



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

1 | Page

SPECIFICATIONS AND CONTRACT DOCUMENTS



PORT OF MOBILE
ALABAMA PORT AUTHORITY

John C. Driscoll, Director & CEO

Kay Ivey, Governor of Alabama

ISSUED BY

Engineering Services Department



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

2 | Page

TABLE OF CONTENTS

DIVISION I BID DOCUMENTS

DIVISION II CONTRACT DOCUMENTS

DIVISION III SPECIAL PROVISIONS

DIVISION IV GENERAL PROVISIONS

DIVISION V CONSTRUCTION SPECIFICATIONS

APPENDIX A GEOTECHNICAL REPORT

APPENDIX B SURVEY

APPENDIX C TURBIDITY CURTAIN

APPENDIX D PERMIT

APPENDIX E EXISTING DRAWINGS

APPENDIX F.....HUD GRANT CONTRACT PROVISIONS



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

3 | Page

BID DOCUMENTS

**DIVISION I
INDEX**

INVITATION FOR BIDS	I-1
INSTRUCTIONS TO BIDDERS	I-2
PROPOSAL.	I-3
BID BOND	I-8
AFFIDAVIT & CERTIFICATE OF COMPLIANCE.....	I-10



Alabama State Port Authority Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

1 | Page

INVITATION TO BID

Sealed bid proposals will be received via courier to the Alabama State Port Authority, 1400 Alabama State Docks Blvd, Room 216, Administration Building, Mobile, AL 36602 by 1:30 PM, on Thursday, August 28, 2025. Faxed or electronic submitted bids will not be accepted. Sealed bid proposals can also be hand delivered from 1:45 PM to 2:00 PM, on Thursday, August 28, 2025 to the Alabama State Port Authority in the International Trade Center Building, 250 North Water Street, 1st Floor Killian Room, Mobile AL.

ALABAMA STATE PORT AUTHORITY PIER B SOUTH REPLACEMENT MOBILE, ALABAMA

The work consists of providing bonds, labor, materials, equipment, and supervision necessary for the pier replacement and relieving platform upgrade work at Pier B South. The major components of the **Base Bid** work include demolition and legal disposal of the existing pier (to Bent 74), fender system, relieving platform concrete slab-on-grade, asphalt and railroad tracks, disconnection of active existing utilities and reconnection after new pier is installed, installation of new concrete cap on existing steel sheet pile wall, installation of structural fill in voids underneath the relieving platform, repairs to existing warehouse concrete, installation of new augercast piles for new concrete slab-on-grade relieving platform, new restroom and traffic bollards, new pile-supported concrete pier with fenders, mooring bollards and utility vaults, and a single-rail elevated track, landside rail that ties into the existing rail line and associated approach slab and asphalt.

Major components of the **Bid Additive** work include the demolition and legal disposal of existing elevated concrete pier (to Bent 101), installation of a new pile-supported concrete pier with fenders, mooring bollards and utility vaults, modification of the existing Pier B North fender system.

Specifications, proposal forms, bid and performance bond forms, and plans are available on the Alabama Port Authority website at www.alports.com. For additional project contractual information, please contact APA Project Manager, Matt Thomas at (251) 441-7242 (email at matthew.thomas@alports.com).

A Pre-Bid Meeting is scheduled for Wednesday, August 6, 2025 at 10:00 A.M. in the International Trade Center Building, 250 North Water Street, **1st Floor Killian Room**, Mobile AL with a site visit to follow. **Bidder attendance to meeting and site visit is MANDATORY.** The site visit is within the TWIC restricted boundary and all participants must have valid Port Access credentials or will require escort. **All bidders not possessing proper access credentials must contact Matt Thomas at least 24 hours in advance to arrange an adequate number of escorts to accommodate the non-credentialed participants.** Each contractor is only allowed two escorted personnel for the site visit.

A Guarantee will be required with each bid as follows: At least five (5%) percent of the amount bid, but in no event more than Ten Thousand (\$10,000) Dollars, shall be furnished in the form of a certified check or bid bond payable to the Alabama State Port Authority.

A Performance Bond in an amount not less than the sum bid will be required at the signing of the contract and, in addition, a bond in an amount not less than One Hundred (100%) percent of the contract price, insuring payment of all labor and material.



Alabama State Port Authority

Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

2 | Page

No bid will be considered unless the bidder, whether resident or non-resident of Alabama, is properly qualified to submit a proposal for this work in accordance with all applicable laws of the State of Alabama. This shall include evidence of holding a current license from the State Licensing Board for General Contractors, Montgomery, Alabama with the classification of (H/RR) – Heavy/Railroad. Also, non-residents of the State must show evidence of having qualified with the Secretary of State to do business in AL.

Bids will be publicly opened at 2:00 P.M., Thursday, August 28, 2025 in the International Trade Center building, 250 North Water Street, 1st Floor – Killian Room, Mobile, AL. The right is reserved, as the interest of the Alabama State Port Authority may require, to reject any and all bids and to waive informalities in bids received.

IMPORTANT NOTICE TO BIDDERS REGARDING ACCESS TO ASPA RESTRICTED FACILITIES:

The Alabama State Port Authority's Access Policy is provided on the ASPA website and in the links below:

<https://www.alports.com/port-access/>

ALL persons working on this project are REQUIRED to have valid access credentials to include: 1) A TWIC Card 2) ASPA Badge 3) ASPA Vehicle Decal.

IMPORTANT NOTICE TO BIDDERS REGARDING EMPLOYMENT PRACTICES:

Effective October 1, 2011, the Beason-Hammon Alabama Taxpayer and Citizen Protection Act ("the Act") requires that any business entity contracting with or providing any grant or incentives to the state, including the Alabama State Port Authority, certify compliance with the Act. All Bidders must certify such compliance by executing the enclosed Certificate of Compliance and returning it to the Alabama State Port Authority with your bid package along with proof of the contractor's enrollment in the e-verify program. The following E-Verify website link is provided for convenience:

http://www.dhs.gov/files/programs/gc_1185221678150.shtm.



Alabama State Port Authority ***Specification Booklet***

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

3 | Page

INSTRUCTIONS TO BIDDERS

1.0 ADDENDA AND INTERPRETATIONS

All questions about the meaning or intent of the Contract Documents shall be submitted in writing to the Mott MacDonald Project Manager, Lowry Denty, at lowry.denty@mottmac.com, on or before Wednesday, August 20, 2025. Replies will be issued by Addenda emailed to all parties recorded as having received the bidding documents. All addenda issued shall become part of the Contract Documents. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

2.0 PREQUALIFICATION OF BIDDERS

No proposal will be considered from any Contractor unless he is licensed to do work in the State of Alabama and has complied with the requirements of Paragraph SP-04 of the DIVISION III Special Provisions.

3.0 SUBMISSION OF PROPOSALS

Before submitting his proposal, the Contractor shall comply with the following:

- a) The Proposals shall be filled in ink on the form provided herein and all blank spaces in the form shall be fully filled. The signature shall be in long hand and the complete form shall be without interlineations, alteration or erasure.
- b) If the Bidder is a corporation organized in a state other than Alabama, attach to the Proposal a certificate from the Secretary of State showing that the Corporation is qualified to transact business in Alabama.
- c) Attach a certified check or Bid Bond in the amount of 5% of the Proposal, but not more than \$10,000 made payable to the Alabama State Port Authority.
- d) Non-resident (out of state) Contractors shall attach all items included by SP-6.
- e) Attach a copy of the State Contractor's License to Proposal.
- f) Certificate of Compliance with the Beason-Hammon Alabama Taxpayer and Citizen Protection Act (see page 1-10)

One copy of Item (a) through (f) should be placed in a sealed envelope with the bidder's name, Contractor's license number, the project, and the time and date of bid opening shown on the outside.



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

4 | Page

Proposal of:

Address:

Date:

To: STATE OF ALABAMA, Alabama State Port Authority, Mobile, Alabama

Gentlemen:

The undersigned, as Bidder, hereby declares that he has examined the site of the work and informed himself fully in regard to all conditions pertaining to the place where the work is to be done; that he has examined the plans and specifications for the work and contractual documents relative thereto, and has read all Special Provisions and Specifications furnished; and that he has satisfied himself relative to all aspects of the work to be performed and especially to those factors affecting cost, progress, or performance.

The Bidder proposes and agrees, if this bid is accepted, to contract with the Owner in the form of contract specified, to furnish all necessary materials, equipment, tools, apparatus, means of transportation, labor and incidentals to perform in a satisfactory manner, the work described in the Contract Specifications and Drawings for the Alabama State Port Authority, for the prices listed below to complete:

PIER B SOUTH REPLACEMENT
MOBILE, ALABAMA

In full and complete accordance with the shown, noted, described and reasonable intended requirements of the plans, specifications and contract documents to the full and entire satisfaction of the Owner with a definite understanding that no money will be allowed for extra work except as set forth in the attached contract documents.

It is agreed that the description under each item, being briefly stated, implies, although it does not mention, all incidentals and that the prices stated are intended to cover all such work materials and incidentals as constitute Bidder's obligation as described in the specifications and any details not specifically mentioned, but evidently included in the contract shall be compensated for the item which most logically includes it.

Bidder agrees that he will commence the work within the time allotted by the Contract Documents with an adequate force, plant, and equipment and that the work will be completed within time schedules outlined in Special Provisions Article SP-3.

Bidder accepts the provisions of the Contract Documents as to liquidated damages in the event of failure to complete the work on time.

The Bidder further agrees that, in case of failure on his part to execute the Contract and required bonds within ten (10) calendar days from the date written notice of award if mailed or otherwise delivered to the Bidder, the certified check or bid bond accompanying this bid and the monies payable thereon shall be paid into the funds of the Owner not as penalty, but as a liquidation of a reasonable portion of the damages incurred by the Owner due to the Bidder's failure to execute the Contract.

Each of the following items within the Schedule of Prices shall be completed in accordance with the Referenced Drawings and Specifications Booklet.



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

5 | Page

BASE BID SCHEDULE OF PRICES

Description	Est. Quantity	Unit	Unit Price	Value
1. Project bonds and insurance & port credentials	1	LS	\$	\$
2. Mobilization/demobilization	1	LS	\$	\$
3. Environmental protection measures	1	LS	\$	\$
4. Pre- & post-construction survey (above water)	1	LS	\$	\$
5. Testing and monitoring (Include cathodic protection ready testing)	1	LS	\$	\$
6. Construction MOT/barriers/fencing	1	LS	\$	\$
7. Demolition and removal of existing pier and fender system	1	LS	\$	\$
8. 24" sq. prestressed concrete piling (straight)	86048	LF	\$	\$
9. 24" sq. prestressed concrete piling (battered)	19596	LF	\$	\$
10. CIP concrete pile caps	2591	CY	\$	\$
11. CIP concrete beams	3953	CY	\$	\$
12. CIP concrete deck	7120	CY	\$	\$
13. CIP concrete bull rail	46	CY	\$	\$
14. Cone fenders	20	EA	\$	\$
15. UMHW fender strips	30	EA	\$	\$
16. Mooring bollards	23	EA	\$	\$
17. Utility vaults (power supply not included)	5	EA	\$	\$
18. Water vaults (water supply not included)	3	EA	\$	\$
19. Utilities to vaults (1 power/ 3 fire+water)	1	LS	\$	\$
20. Elevated rail	1460	LF	\$	\$
21. Removable slab (Include stem wall)	60	CY	\$	\$
22. Striping & stenciling for removable slab	1	LS	\$	\$
23. Demolition and removal of existing relieving platform slab	1	LS	\$	\$
24. Concrete cap on existing sheet pile wall	132	CY	\$	\$



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

6 | Page

25. Select fill for voids under relieving platform	2908	CY	\$	\$
26. 14" dia. augercast piles	90084	LF	\$	\$
27. CIP concrete slab	2622	CY	\$	\$
28. Existing warehouse concrete repairs (see S-03)	1	LS	\$	\$
29. Restroom building	560	SF	\$	\$
30. Utilities to restroom (plumbing and electrical)	1	LS	\$	\$
31. Flashing at existing MCC building & warehouse	48	LF	\$	\$
32. Traffic protection bollards	31	EA	\$	\$
33. Demolition of existing landside rail, asphalt and selective demolition of cap/sheet piles at Bent 1	1	LS	\$	\$
34. Excavation/fill behind existing sheet pile wall	264	CY	\$	\$
35. Approach slab	48	CY	\$	\$
36. Landside rail with tie-in to existing rail	230	LF	\$	\$
37. Asphalt pavement	800	SY	\$	\$
Total Base Bid				\$

ADD ALTERNATE SCHEDULE OF PRICES

1. Pre- & post-construction survey (below water)	1	LS	\$	\$
Total Add Alternate				\$

_____ Dollars
(In Words)



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

7 | Page

BID ADDITIVE SCHEDULE OF PRICES

Description	Est. Quantity	Unit	Unit Price	Value
1. Additional project bonds and insurance	1	LS	\$	\$
2. Additional mobilization/demobilization	1	LS	\$	\$
3. Additional Environmental protection measures	1	LS	\$	\$
4. Pre- and post-construction survey (above water)	1	LS	\$	\$
5. Additional testing and monitoring (include cathodic protection ready testing)	1	LS	\$	\$
6. Additional construction MOT/barriers/fencing	1	LS	\$	\$
7. Demolition and removal of existing pier and fender system	1	LS	\$	\$
8. 24" sq. prestressed concrete piling (straight)	30878	LF	\$	\$
9. 24" sq. prestressed concrete piling (battered)	4996	LF	\$	\$
10. CIP concrete pile caps	688	CY	\$	\$
11. CIP concrete beams	734	CY	\$	\$
12. CIP concrete deck	2361	CY	\$	\$
13. CIP concrete bull rail	18	CY	\$	\$
14. Cone fenders	10	EA	\$	\$
15. Mooring bollards	9	EA	\$	\$
16. Utility vaults (power supply not included)	1	EA	\$	\$
17. Water vaults (water supply not included)	1	EA	\$	\$
18. Utilities to vault (1 fire+water)	1	LS	\$	\$
19. Pier B North fender modifications	21	MB	\$	\$
Total Bid Additive				\$

ADD ALTERNATE SCHEDULE OF PRICES

1. Pre- and post-construction survey (below water)	1	LS	\$	\$
Total Add Alternate				\$

Dollars

(In Words)



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

8 | Page

I, the undersigned bidder, hereby acknowledge receipt of the following addenda:

ADDENDUM NO. _____

ADDENDUM NO. _____

ADDENDUM NO. _____

ADDENDUM NO. _____

Contractor's Signature:

Contractor

Company _____

Name

Title

Date



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

9 | Page

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, undersigned, _____

_____ as Principal, and _____ as Surety, are hereby held and bound unto The Alabama State Port Authority as **OWNER** in the Penal sum of _____ for the payment of which will and truly be made, we hereby jointly and severally bind ourselves, successors and assigns. Signed, the _____ day of _____, 20____.

The Condition of the above obligation is such that whereas the Principal has submitted to the Alabama State Port Authority a certain BID, attached hereto and hereby made a part hereof to enter into a contract in writing, for the ASPA Pier B South Replacement in Mobile, Alabama, Project No.: 11283 Task 02.

NOW, THEREFORE,

(a) If said BID shall be rejected, or

(b) If said BID shall be accepted and the Principal shall execute and deliver a contract in the form of Contract attached hereto (Properly completed in accordance with said BID) and shall furnish a BOND for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the panel amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its **BOND** shall in no way be impaired or affected by any extension of time within which the **OWNER** may accept such BID; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

Principal	
By	
Surety	
By	



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

10 | Page

State of _____

County of _____

CERTIFICATE OF COMPLIANCE WITH THE BEASON-HAMMON ALABAMA TAXPAYER AND CITIZEN PROTECTION ACT (ACT 2011-535, as amended by Act 2012-491)

DATE: _____

RE Contract/Grant/Incentive (describe by number or subject):

_____ by and between
_____ (Contractor/Grantee) and
_____ (State Agency, Department or Public Entity)

The undersigned hereby certifies to the State of Alabama as follows:

1. The undersigned holds the position of _____ with the Contractor/Grantee named above, and is authorized to provide representations set out in this Certificate as the official and binding act of that entity, and has knowledge of the provisions of THE BEASON-HAMMON ALABAMA TAXPAYER AND CITIZEN PROTECTION ACT (ACT 2011-535 of the Alabama Legislature, as amended by Act 2012-491) which is described herein as "the Act".
2. Using the following definitions from Section 3 of the Act, select and initial either (a) or (b), below, to describe the Contractor/Grantee's business structure.

BUSINESS ENTITY. Any person or group of persons employing one or more persons performing or engaging in any activity, enterprise, profession, or occupation for gain, benefit, advantage, or livelihood, whether for profit or not for profit. "Business entity" shall include, but not be limited to the following:

a. Self-employed individuals, business entities filing articles of incorporation, partnerships, limited partnerships, limited liability companies, foreign corporations, foreign limited partnerships, foreign limited liability companies authorized to transact business in this state, business trusts, and any business entity that registers with the Secretary of State.

b. Any business entity that possesses a business license, permit, certificate, approval, registration, charter, or similar form of authorization issued by the state, any business entity that is exempt by law from obtaining such a business license and any business entity that is operating unlawfully without a business license.

EMPLOYER. Any person, firm, corporation, partnership, joint stock association, agent, manager, representative, foreman, or other person having control or custody of any employment, place of employment, or of any employee, including any person or entity employing any person for hire within the State of Alabama, including a public employer. This term shall not include the occupant of a household contracting with another person to perform casual domestic labor within the household.

____ (a) The Contractor/Grantee is a business entity or employer as those terms are defined in Section 3 of the Act.

____ (b) The Contractor/Grantee is not a business entity or employer as those terms are defined in Section 3 of the Act.



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

11 | Page

3. As of the date of this Certificate, Contractor/Grantee does not knowingly employ an unauthorized alien within the State of Alabama and hereafter it will not knowingly employ, hire for employment, or continue to employ an unauthorized alien within the State of Alabama;
4. Contractor/Grantee is enrolled in E-Verify unless it is not eligible to enroll because of the rules of that program or other factors beyond its control.

Certified this _____ day of _____ 20 _____

Name of Contractor/Grantee/Recipient

By: _____

Its _____

The above Certification was signed in my presence by the person whose name appears above, on

this _____ day of _____ 20 _____.

WITNESS:

Printed Name of Witness



U.S Department of Housing and Urban Development

FY2022 Community Project Funding

Grant Forms

**CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER
RESPONSIBILITY MATTERS--PRIMARY COVERED TRANSACTIONS**

- (1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:
- (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded 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 (1)(b) of this certification;
 - (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.
- (2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Signature / Authorized Certifying Official

Typed Name & Title

Applicant / Organization

Date Signed

49 CFR PART 20--CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements

(To be submitted with each bid or offer exceeding \$100,000)

The undersigned [Contractor] certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form--LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions [as amended by "Government wide Guidance for New Restrictions on Lobbying," 61 Fed. Reg. 1413 (1/19/96). Note: Language in paragraph (2) herein has been modified in accordance with Section 10 of the Lobbying Disclosure Act of 1995 (P.L. 104-65, to be codified at 2 U.S.C. 1601, et seq.)]

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31, U.S.C. § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

[Note: Pursuant to 31 U.S.C. § 1352(c)(1)-(2)(A), any person who makes a prohibited expenditure or fails to file or amend a required certification or disclosure form shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such expenditure or failure.]

The Contractor, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. A 3801, et seq., apply to this certification and disclosure, if any.

_____ Signature of Contractor's Authorized Official

_____ Name and Title of Contractor's Authorized Official

_____ Date

AFFIDAVIT AND CERTIFICATE OF COMPLIANCE

FORM FOR SECTIONS 9 (a) and (b) BEASON-HAMMON ALABAMA TAXPAYER AND CITIZEN PROTECTION ACT; CODE OF ALABAMA, SECTIONS 31-13-9 (a) and (b) AFFIDAVIT FOR BUSINESS ENTITY/EMPLOYER /CONTRACTOR

(To be completed as a condition for the award of any contract, grant, or incentive by the State of Alabama, any political subdivision thereof, or any state-funded entity to a business entity or employer that employs one or more employees)

State of _____

County of _____

Before me, a notary public, personally appeared _____ (print name)
who, being duly sworn, says as follows:

As a condition for the award of any contract, grant, or incentive by the State of Alabama, any political subdivision thereof, or any state-funded entity to a business entity or employer that employs one or more employees, I hereby attest that in my capacity as

_____ (state position) for _____ (state business entity/employer/contractor name) that said business entity/employer/contractor shall not knowingly employ, hire for employment, or continue to employ an unauthorized alien.

I further attest that said business entity/employer/contractor is enrolled in the E-Verify program.

(ATTACH DOCUMENTATION ESTABLISHING THAT BUSINESS

ENTITY/EMPLOYER/CONTRACTOR IS ENROLLED IN THE E-VERIFY PROGRAM)

_____.Signature of Affiant

Sworn to and subscribed before me this ____ day of _____, _____.

I certify that the affiant is known (or made known) to me to be the identical party he or she claims to be.

_____.Signature and Seal of Notary Public



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

1 | Page

CONTRACT DOCUMENTS

DIVISION II
INDEX

PERFORMANCE BOND	II-1
LABOR AND MATERIAL BOND	II-3
ACKNOWLEDGMENT FOR CHANGE ORDERS	II-5
CONTRACT	II-6



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

2 | Page

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

That: _____
(Name of Contractor)

(Address of Contractor)

(City, State, Zip)

I, a(n) _____ corporation, hereinafter called Principal, and
(state of domicile)

(Name of Surety)

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto the Alabama State Port Authority hereinafter called OWNER, in the penal sum of _____ DOLLARS, (\$ _____) (100% of the Contract Amount) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, 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 OWNER, dated the _____ day of _____, 20 __, a copy of which is hereto attached and made a part hereof for the construction of:

**PIER B SOUTH REPLACEMENT
MOBILE, ALABAMA**

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term thereof, and any extensions thereof which may be granted by the OWNER, with or without notice to the Surety and during the guaranty period, and if he shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless the OWNER from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all outlay and expense which the OWNER may insure in making good any default, then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED FURTHER, that the said Surety, for value received hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the contract of the WORK to be performed thereunder or the SPECIFICATIONS accompanying the same shall in any way affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the contract or to the WORK or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

3 | Page

IN WITNESS WHEREOF, this instrument is executed this _____ day of _____, 20____.

ATTEST:

_____	_____
(Principal) Secretary	Principal
(SEAL)	_____ (s)
_____	_____
(Witness as to Principal)	(Address)
_____	_____
	Surety

ATTEST:

(Surety) Secretary	
(SEAL)	
_____	BY: _____
Witness as to Surety	Attorney-in-fact
_____	_____
(Address)	(Address)
_____	_____

NOTE: Date of BOND must not be prior to date of CONTRACT.
If CONTRACTOR is Partnership, all partners should execute BOND.



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

4 | Page

LABOR AND MATERIAL BOND

KNOW ALL MEN BY THESE PRESENTS:

That: _____
(Name of Contractor)

(Address of Contractor)

(City, State, Zip)

I, a(n) _____ corporation, hereinafter called Principal, and
(state of domicile)

(Name of Surety)

(Address of Surety)

(City, State, Zip)

hereinafter called Surety, are held and firmly bound unto the Alabama State Port Authority hereinafter called OWNER, in the penal sum of _____ DOLLARS, (\$ _____) (100% of the Contract Amount) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that, the Principal entered into a certain contract with the OWNER, dated the _____ day of _____, 20 __, a copy of which is hereto attached and made a part hereof for the construction of:

**PIER B SOUTH REPLACEMENT
MOBILE, ALABAMA**

NOW, THEREFORE, if the Principal shall promptly make payments to all persons, firms, SUBCONTRACTORS, and corporations furnishing materials or performing labor in the prosecution of the WORK provided for in such contract, and any authorized extension or modification thereof, including all amounts due for materials, lubricants, fuel, repairs on machinery, equipment and tools, consumer or used in connection with the construction of such WORK, and all insurance premiums on said WORK, and for all labor performed in such WORK whether by SUBCONTRACTOR or otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED FURTHER, that the said Surety, for value received hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the contract of the WORK to be performed thereunder or the SPECIFICATIONS accompanying the same shall in any way affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the contract or to the WORK or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

5 | Page

IN WITNESS WHEREOF, this instrument is executed this _____ day of _____, 20____.

ATTEST:

(Principal) Secretary
(SEAL)

Witness as to Surety Principal

(Address)

ATTEST:

Witness as to Surety

(Address)

Principal

BY: _____(s)

(Address)

Surety

BY: _____
Attorney-In-Fact

(Address)

***NOTE: Date of BOND must not be prior to date of CONTRACT.
If CONTRACTOR is Partnership, all partners should execute BOND.***



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

6 | Page

ACKNOWLEDGEMENT FOR CHANGE ORDERS

TO: ALABAMA STATE PORT AUTHORITY

RE: Pier B South Replacement. Mobile, AL

Gentlemen:

In order to avoid the necessity of extensive amendment to the referenced Contract, the undersigned hereby acknowledges that the following conditions are those for which change orders are allowed under the Bid law:

1. Unusual and difficult circumstances which arise during the course of the execution of the Contract which could not have been reasonably foreseen.
2. Where competitive bidding for the new work will be to the serious detriment of the Owner.
3. Emergencies arising during the course of work.
4. Changes or alterations provided for in the original bid and original Contract.
5. The Contractor also acknowledges that he has read paragraph 50-04 (EXTRA WORK) and 60-17 of the (CLAIMS FOR ADJUSTMENT AND DISPUTES) of the General Provisions and agrees that "If for any reason the Contractor deems that additional compensation is due him for work or materials not clearly provided in the Contract, plans, or specifications or previously authorized as extra work, he shall notify the Engineer in writing of his intention to claim such additional compensation before he begins the work on which he bases his claim."

CONTRACTOR

DATE

BY: _____

TITLE



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

7 | Page

CONTRACT

THIS AGREEMENT, made and executed on this _____ day of the month of _____, Two Thousand and _____ (20____), by and between The Alabama State Port Authority, and _____ (contractor name) Contractor, domiciled in the state of _____, Party of the Second Part, and hereinafter designated as "CONTRACTOR," WITNESSETH, that in consideration of the covenants and agreements herein contained, to be performed by the parties hereto and of the payments hereinafter agreed to be made, it is mutually agreed as follows:

The CONTRACTOR shall and will provide and furnish all equipment and labor, and perform the work required to build, construct, and complete in a thorough and workmanlike manner, to the satisfaction of the Alabama State Port Authority:

Project Name Pier B South Replacement

Project # 11283 **Task #** 02

Hereinafter called the project, for the base Contract price of _____ DOLLARS, (\$_____) and all extra work in connection therewith, and in accordance with plans, specifications, and Proposal, which are made a part thereof as fully as is set out herein, and hereby becomes a part of this Contract.

It is agreed and understood that the Alabama State Port Authority shall pay, and the Contractor shall receive, the full compensation for the work performed in accordance with the Specifications.

The project shall commence and will be completed in accordance with Paragraph SP-03 of the Special Provisions.

This contract shall become effective immediately upon, and as of the date all necessary parties hereto have approached and signed the same.

By signing this contract, the contracting parties affirm, for the duration of the agreement, that they will not violate federal immigration law or knowingly employ, hire for employment, or continue to employ an unauthorized alien within the State of Alabama. Furthermore, a contracting party found to be in violation of this provision shall be deemed in breach of the agreement and shall be responsible for all damages resulting therefrom.

IN WITNESS WHEREOF, the parties of these presents have executed this Agreement in the year and day first above written.

WITNESS:

WITNESS:

BY: _____
Alabama State Port Authority

BY: _____
Contractor Party of the Second Part



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

1 | Page

SPECIAL PROVISIONS

DIVISION III
INDEX

SP-01 – DESCRIPTION OF WORK.....	III-1
SP-02 – OWNER PURCHASE OF MATERIALS.....	III-1
SP-03 – COMMENCEMENT AND COMPLETION.....	III-1
SP-04 – QUALIFICATION OF BIDDERS.....	III-1
SP-05 – ACCEPTANCE OR REJECTION OF BIDS.....	III-1
SP-06 – NON-RESIDENT (OUT-OF-STATE) CONTRACTORS.....	III-1
SP-07– INDEMNIFICATION.....	III-2
SP-08 – SUPERVISION AND OFFICE TRAILER.....	III-2
SP-9 – CONTRACTOR’S REPRESENTATIVE.....	III-3
SP-10 – METHOD OF PAYMENT.....	III-3
SP-11 – INSURANCE.....	III-3
SP-12 – TAXPAYER AND CITIZEN PROTECTION ACT.....	III-3
SP-13 – GUARANTEE.....	III-3
SP-14 – CPM PROJECT SCHEDULE.....	III-3
SP-15 – ACCESS TO ASPA RESTRICTED FACILITIES.....	III-3
SP-16 – TEMPORARY WATER AND ELECTRICAL POWER	III-4
SP-17 – INTENT OF PLANS AND SPECIFICATIONS.....	III-4

SP-01 DESCRIPTION OF WORK

The work consists of providing bonds, labor, materials, equipment, and supervision necessary for the pier replacement work at Pier B South. The major components of the **Base Bid** work include demolition and legal disposal of the existing pier (to Bent 74), fender system, relieving platform concrete slab-on-grade, asphalt and railroad tracks, disconnection of active existing utilities and reconnection after new pier is installed, installation of new concrete cap on existing steel sheet pile wall, installation of structural fill in voids underneath the relieving platform, repairs to existing warehouse concrete, installation of new augercast piles for new concrete slab-on-grade relieving platform, new restroom and traffic bollards, new pile-supported concrete pier with fenders, mooring bollards and utility vaults, and a single-rail elevated track, landside rail that ties into the existing rail line and associated approach slab and asphalt. Installation of piles using vibration will not be permitted.

Major components of the **Bid Additive** work include the demolition and legal disposal of existing elevated concrete pier (to Bent 101), installation of a new pile-supported concrete pier with fenders, mooring bollards and utility vaults, modification of the existing Pier B North fender system.

SP-02 OWNER PURCHASE OF MATERIALS

The Alabama State Port Authority will utilize its sales tax exemption status on this project.

SP-03 COMMENCEMENT AND COMPLETION

The Contractor will be required to commence work under this contract in accordance with DIVISION IV GENERAL PROVISIONS Article 90-02 (NOTICE TO PROCEED), to prosecute said work with faithfulness and energy, and to complete the entire project within 730 calendar days after receipt of Notice to Proceed. The time stated for final completion shall include final clean-up of the premises. Failure to complete work on schedule shall initiate liquidated damages, which will be assessed in accordance with the provisions of Paragraph 20-13 (LIQUIDATED DAMAGES) of DIVISION IV, GENERAL PROVISIONS.

SP-04 QUALIFICATION OF BIDDERS

In addition to the requirements of Article 20-01 and 20-03 of Division IV, GENERAL PROVISIONS, the Owner may make such investigations as he deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein. Conditional bids will not be accepted.

SP-05 ACCEPTANCE OR REJECTION OF BIDS

The Authority reserves the right to accept or reject any or all bids and to waive informalities. All bidders must be licensed to operate as contractors in the State of Alabama. Attention of bidders is directed to Chapter 8 of Title 23 of the Code of Alabama, 1975, and Amendments thereto, relating to the licensing of General Contractors. No bid will be accepted from anyone except a qualified Contractor, licensed by the State Licensing Board for General Contractors with the

classification of (H/RR) – Heavy/Railroad. In addition, non-residents of the State must show evidence of having qualified with the Secretary of State to do business in Alabama.

SP-06 NON-RESIDENT (OUT-OF-STATE) CONTRACTORS

Preference shall be given to resident contractors, and non-resident bidders domiciled in a state having laws granting preference to local contractors shall be awarded Alabama public contracts the same as Alabama contractors bidding under similar circumstances; and resident contractors in Alabama are to be granted preference over non-residents in awarding of contracts in the same manner and to the same extent as provided by the laws of the state of domicile of the non-resident. Non-resident bidders must accompany any written bid documents with a written opinion of any attorney at law licensed to practice law in such non-resident bidders' state of domicile, as to the preferences, if any or none, granted by the law of that state to its own business entities whose principal places of business are in that State in the letting of any or all public contracts.

SP-07 INDEMNIFICATION

To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, the Engineer, and their agents and employees from and against all claims, damages, losses, and expenses, including, but not limited to, attorney's fees arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss, or expense (1) is attributed to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom, and (2) is caused in whole or in part by any negligent act or omission of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity that would otherwise exist as to any party or person described in this Paragraph SP-07.

In any and all claims against the Owner, the Engineer or any of their agents or employees by any employee of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification under this Paragraph SP-07, shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any subcontractor under workers' or workmen's compensation acts, or other employee benefits acts.

SP-8 SUPERVISION AND OFFICE TRAILER

The Contractor shall place a competent superintendent on the Project who shall have experience in the type of work being performed under this Contract. A resume of the superintendent's experience shall be submitted for review prior to the placement of the named person on the project. The Contractor shall also submit an organizational chart, which shall clearly show the Contractor's personnel assigned to the Project and the position that they hold. The chart shall also define the persons of contact with the Owner and the Engineer.

The Owner reserves the right to request changes in supervision for incompetent actions or other reasons of due cause. Once the Contractor is notified in writing of a request to replace the superintendent, he shall do so within five (5) calendar days of such request.

The Contractor's assigned superintendent shall have responsibility for the day-to-day operations of the work and shall be the on-site safety officer responsible for implementation of the Contractor's safety program unless another named person is so assigned.

The assigned superintendent shall remain on the Project site while work under the Contract is being performed. In the superintendent's absence from the site, another named person shall be responsible for all aspects of the work. Notification of the name of the individual shall be filed with the Owner and Engineer. The Contractor shall not reassign a superintendent without the acknowledgement and approval of the Owner.

The Contractor is to provide an onsite trailer for its personnel and site documentation storage, whereas the trailer is to include an office space for the Owner's Engineering Representative.

SP-9 CONTRACTOR'S REPRESENTATIVE

A representative of the Contractor shall be on the site at all times work is being conducted as required by paragraph 90-01 (SUBLETTING OF CONTRACT) of DIVISION IV. A telephone number should be given to the Engineer where he might contact the Representative after working hours in case of an emergency.

SP-10 METHOD OF PAYMENT

N/A

SP-11 INSURANCE

Insurance requirements are provided in Section 40 (Indemnification and Insurance Requirements) of Division IV General Provisions. The following shall apply to Section 40 (Indemnification and Insurance Requirements) of Division IV General Provisions:

- 1) 40-08 Railroad Protective Liability – Delete in its entirety
- 2) 40-10 Professional Liability Coverage – Delete in its entirety

SP-12 TAXPAYER AND CITIZEN PROTECTION ACT

Effective October 1, 2011, the Beason-Hammon Alabama Taxpayer and Citizen Protection Act ("the Act") requires that any business entity contracting with or providing any grant or incentives to the state, including the Alabama State Port Authority, certify compliance with the Act. All Bidders must certify such compliance by executing the enclosed Certificate of Compliance and returning it to the Alabama State Port Authority along with proof of the bidding company's enrollment in the e-verify program with your bid package. The following E-Verify website link is provided for convenience: http://www.dhs.gov/files/programs/qc_1185221678150.shtm.

SP-13 GUARANTEE

The Contractor shall furnish to the Alabama State Port Authority a two (2) year written guarantee issued from the date of final acceptance. This guarantee shall cover any defective material or workmanship on the entire project.

SP-14 CPM PROJECT SCHEDULE

The Contractor shall prepare a CPM Project Schedule using Microsoft Project and the schedule shall show all items of work necessary to bring the project to completion. The Contractor shall submit electronic copies of his Progress Schedule updated monthly to reflect the status of the work. These updates shall be submitted in conjunction with the monthly progress Payment Request and shall be a requisite for the payment request to be processed.

SP-15 ACCESS TO ASPA RESTRICTED FACILITIES

IMPORTANT NOTICE TO BIDDERS REGARDING ACCESS TO ASPA RESTRICTED FACILITIES:

<https://www.alports.com/port-access/>

<https://alabama.port.training/>

All persons working on this project are REQUIRED to have valid credentials to include: 1) A TWIC Card 2) ASPA Badge 3) ASPA Vehicle Decal. In addition, the successful Contractor will be required to familiarize itself and conform to all Port safety requirements and procedures.

SP-16 TEMPORARY WATER AND ELECTRICAL POWER

The responsibility shall be upon the Contractor to provide and maintain at his own expense an adequate supply of water of a quality suitable for his use for construction and domestic consumption. At his own expense, he shall install and maintain any necessary water supply connections and piping. However, he shall do so only at locations and in such workmanship manner as may be authorized by the Owner. Before final acceptance, temporary connections and piping installations by the Contractor shall be removed in a workmanship manner to the satisfaction of the Owner.

All electrical current required by the Contractor shall be furnished by the Contractor at his own expense. All temporary connections for electricity shall be subject to the approval of the Engineer. The Contractor shall at his own expense, install a meter to determine the amount of current used by him/her and will pay for such electricity at prevailing rates.

SP-17 INTENT OF PLANS AND SPECS

The following is in addition to Article 60-03 of Division IV, General Provision:

Any detail which may be incomplete or lacking in the plans and specifications shall not constitute claim for extra compensation. Such detail shall be supplied by the Contractor and submitted to the Engineer in advance of its requirement on the job. The true intent of the plans and specifications is to produce a complete working facility and incomplete detail will not abrogate this intent.



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 02

July 2025

1 | Page

**GENERAL PROVISIONS, CLAUSES, REQUIREMENTS
AND COVENANTS**

**DIVISION IV
INDEX**

SUBSECTION	PAGE
SECTION 10 DEFINITIONS OF TERMS.....	IV-1
20-01 PREQUALIFICATION OF BIDDERS.....	IV-5
20-02 CONTENTS OF PROPOSAL FORMS.....	IV-5
20-03 ISSUANCE OF PROPOSAL FORMS.....	IV-5
20-04 INTERPRETATION OF ESTIMATED PROPOSAL QUANTITIES.....	IV-5
20-05 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE.....	IV-5
20-06 PREPARATION OF PROPOSAL.....	IV-6
20-07 IRREGULAR PROPOSALS	IV-6
20-08 PROPOSAL GUARANTY	IV-6
20-09 DELIVERY OF PROPOSAL.....	IV-6
20-10 WITHDRAWAL OR REVISION OF PROPOSALS	IV-7
20-11 PUBLIC OPENING OF PROPOSALS.....	IV-7
20-12 DISQUALIFICATION OF BIDDERS	IV-7
20-13 LIQUIDATED DAMAGES	IV-7
20-14 OWNER PURCHASE OF MATERIALS	IV-8
SECTION 30 AWARD AND EXECUTION OF CONTRACT.....	IV-12
30-01 CONSIDERATION OF PROPOSALS	IV-12
30-02 AWARD OF CONTRACT	IV-12
30-03 CANCELLATION OF AWARD.....	IV-12
30-04 RETURN OF PROPOSAL GUARANTY	IV-12
30-05 REQUIREMENTS OF CONTRACT BONDS.....	IV-12

30-06 EXECUTION OF CONTRACT	IV-13
30-07 APPROVAL OF CONTRACT.....	IV-13
30-08 FAILURE TO EXECUTE CONTRACT	IV-13
SECTION 40 INDEMNIFICATION AND INSURANCE REQUIREMENTS.....	IV-14
40-01 INDEMNIFICATION.....	IV-14
40-02 CONTRACTOR COVERAGE	IV-14
40-03 COMMERCIAL GENERAL LIABILITY.....	IV-14
40-04 OWNER'S AND CONTRACTOR'S PROTECTIVE LIABILITY	IV-14
40-05 BUSINESS AUTOMOBILE LIABILITY	IV-14
40-06 WORKERS COMPENSATION.....	IV-14
40-07 OCEAN MARINE COVERAGE.....	IV-15
40-08 RAILROAD PROTECTIVE LIABILITY	IV-15
40-09 BUILDER'S RISK or INSTALLATION FLOATER (to be determined per project).....	IV-15
40-10 PROFESSIONAL LIABILITY INSURANCE	IV-15
40-11 PROOF OF CARRIAGE OF INSURANCE	IV-15
SECTION 50 SCOPE OF WORK	IV-16
50-01 INTENT OF CONTRACT	IV-16
50-02 ALTERATION OF WORK AND QUANTITIES	IV-16
50-03 OMITTED ITEMS.....	IV-16
50-04 EXTRA WORK	IV-16
50-05 MAINTENANCE OF COMMERCE.....	IV-17
50-06 REMOVAL OF EXISTING STRUCTURES	IV-17
50-07 RIGHTS IN AND USE OF MATERIALS FOUND IN THE WORK.....	IV-18
50-08 FINAL CLEANING UP.....	IV-18
SECTION 60 CONTROL OF WORK.....	IV-19
60-01 AUTHORITY OF THE ENGINEER	IV-19
60-02 CONFORMITY WITH PLANS AND SPECIFICATIONS.....	IV-19
60-03 COORDINATION OF CONTRACT, PLANS AND SPECIFICATIONS	IV-19
60-04 COOPERATION OF THE CONTRACTOR.....	IV-20
60-05 COOPERATION BETWEEN CONTRACTORS.....	IV-20
60-06 CONSTRUCTION LAYOUT AND STAKES	IV-20
60-07 AUTOMATICALLY CONTROLLED EQUIPMENT.....	IV-21

60-08 AUTHORITY AND DUTIES OF INSPECTORS	IV-21
60-09 INSPECTION OF THE WORK	IV-21
60-10 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK.....	IV-21
60-11 LOAD RESTRICTIONS	IV-22
60-12 MAINTENANCE DURING CONSTRUCTION.....	IV-22
60-13 FAILURE TO MAINTAIN THE WORK.....	IV-22
60-14 PARTIAL ACCEPTANCE	IV-22
60-15 FINAL CONSTRUCTION INSPECTION	IV-23
60-16 FINAL ACCEPTANCE	IV-23
60-17 CLAIMS FOR ADJUSTMENT AND DISPUTES	IV-23
SECTION 70 CONTROL OF MATERIALS.....	IV-24
70-01 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS.....	IV-24
70-02 SAMPLES, TESTS, AND CITED SPECIFICATIONS	IV-24
70-03 CERTIFICATION OF COMPLIANCE	IV-24
70-04 PLANT INSPECTION.....	IV-25
70-05 ENGINEER'S FIELD OFFICE AND LABORATORY	IV-25
70-06 STORAGE OF MATERIALS	IV-25
70-07 UNACCEPTABLE MATERIALS	IV-25
70-08 OWNER-FURNISHED MATERIAL	IV-26
70-09 RECEIVING MATERIALS AND EQUIPMENT	IV-26
SECTION 80 LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC	IV-27
80-01 LAWS TO BE OBSERVED.....	IV-27
80-02 PERMITS, LICENSES, AND TAXES.....	IV-27
80-03 PATENTED DEVICES, MATERIALS AND PROCESSES	IV-27
80-04 RESTORATION OF SURFACES DISTURBED BY OTHERS.....	IV-27
80-05 SANITARY, HEALTH, AND SAFETY PROVISIONS	IV-27
80-06 PUBLIC CONVENIENCE AND SAFETY	IV-28
80-07 BARRICADES, WARNING SIGNS, AND HAZARD MARKINGS.....	IV-28
80-08 USE OF EXPLOSIVES	IV-28
80-09 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE	IV-28
80-10 RESPONSIBILITY FOR DAMAGE CLAIMS	IV-29
80-11 THIRD PARTY BENEFICIARY CLAUSE.....	IV-29
80-12 OPENING SECTIONS OF THE WORK FOR OCCUPANCY	IV-29

80-13 CONTRACTOR'S RESPONSIBILITY FOR WORK.....	IV-30
80-14 CONTRACTOR'S RESPONSIBILITY FOR UTILITY SERVICE AND FACILITIES OF OTHERS.....	IV-30
80-15 FURNISHING RIGHTS-OF-WAY	IV-31
80-16 PERSONAL LIABILITY OF PUBLIC OFFICIALS	IV-31
80-17 NO WAIVER OF LEGAL RIGHTS	IV-31
80-18 ENVIRONMENTAL PROTECTION	IV-31
80-19 ARCHAEOLOGICAL AND HISTORICAL FINDINGS	IV-32
SECTION 90 PROSECUTION AND PROGRESS	IV-33
90-01 SUBLETTING OF CONTRACT	IV-33
90-02 NOTICE TO PROCEED	IV-33
90-03 PROSECUTION AND PROGRESS.....	IV-33
90-04 LIMITATION OF OPERATIONS.....	IV-33
90-05 CHARACTER OF WORKERS, METHODS AND EQUIPMENT	IV-33
90-06 TEMPORARY SUSPENSION OF THE WORK	IV-34
90-07 DETERMINATION AND EXTENSION OF CONTRACT TIME.....	IV-35
90-08 FAILURE TO COMPLETE ON TIME.....	IV-36
90-09 CONTRACT DEFAULT.....	IV-36
90-10 CONTRACT TERMINATION	IV-37
SECTION 100 MEASUREMENT AND PAYMENT.....	IV-38
100-01 MEASUREMENT OF QUANTITIES	IV-38
100-02 SCOPE OF PAYMENT	IV-40
100-03 COMPENSATION FOR ALTERED QUANTITIES	IV-40
100-04 PAYMENT FOR OMITTED ITEMS.....	IV-40
100-05 PAYMENT FOR EXTRA AND FORCE ACCOUNT WORK.....	IV-40
100-06 PARTIAL PAYMENT	IV-42
100-07 PAYMENT FOR MATERIALS ON HAND.....	IV-42
100-08 CONTRACT CLOSE-OUT	IV-43
100-09 WITHHOLDING FOR CLAIMS AND LITIGATION	IV-43
100-10 FINAL PAYMENT	IV-43
100-11 RIGHT OF AUDIT.....	IV-44

SECTION 10

DEFINITIONS OF TERMS

Whenever the following terms are used in these specifications, in the Contract, in any documents or other instruments pertaining to construction where these specifications govern, the intent and meaning shall be interpreted as follows:

10-01 AASHTO. The American Association of State Highway and Transportation Officials, the successor association of AASHO.

10-02 ACCESS ROAD. The right-of-way, the roadway and all improvements constructed thereon connecting the site of work to a public highway.

10-03 ADVERTISEMENT. A public announcement, as required by local law, inviting bids for work to be performed and materials to be furnished.

10-04 ALDOT SPECS. The State of Alabama Department of Transportation Standard Specifications for Roads and Bridges, latest edition.

10-05 AISC. The American Institute of Steel Construction.

10-06 AREA. American Railway Engineering Association.

10-07 ASA. American Standards Association.

10-08 ASTM. The American Society for Testing and Materials.

10-09 AWARD. The acceptance, by the OWNER, of the successful bidder's proposal.

10-10 AWPI. American Wood Preservers Institute.

10-11 BIDDER. Any individual, partnership, firm or corporation, acting directly or through a duly authorized representative, who submits a proposal for the work contemplated.

10-12 CALENDAR DAY. Every day shown on the calendar.

10-13 CHANGE ORDER. A written order to the Contractor covering changes in the plans, specifications, or proposal quantities and establishing the basis of payment and Contract time adjustment, if any, for the work affected by such changes. The work, covered by a change order, shall be within the scope of the Contract.

10-14 COMMERCE. The prime business of the OWNER, consisting of the transshipping and storage of goods and materials by highway, rail, barge, and ship.

10-15 CONSTRUCTION MANAGER. The individual, partnership, firm or corporation duly authorized by the OWNER to be responsible for construction management supervision of the Contract work and acting directly or through an authorized representative.

10-16 CONTRACT. The written agreement covering the work to be performed. The awarded Contract shall include, but is not limited to: The Advertisement; The Contract Form; The Proposal; The Performance Bond; The Payment Bond; any required insurance certificates; The Specifications; The Plans; Change Orders and any addenda issued to bidders.

10-17 CONTRACT ITEM (PAY ITEM). A specific unit of work for which a price is provided in the Contract.

10-18 CONTRACT TIME. The number of calendar days or working days, stated in the special provisions, allowed for completion of the Contract, including authorized time extensions. If a calendar date of completion is stated in the proposal, in lieu of a number of calendar or working days, the Contract shall be completed by that date.

10-19 CONTRACTOR. The individual, partnership, firm or corporation primarily liable for the acceptable performance of the work Contracted and for the payment of all legal debts pertaining to the work who acts directly or through lawful agents or employees to complete the Contract work.

10-20 DEPARTMENT. The Alabama State Port Authority.

10-21 DIRECTOR. The Director of the Alabama State Port Authority, as constituted under the laws of Alabama.

10-22 ENGINEER. The individual, partnership, firm or corporation duly authorized by the OWNER to be responsible for Engineering supervision of the Contract work and acting directly or through an authorized representative.

10-23 EQUIPMENT. All machinery, together with the necessary supplies for upkeep and maintenance, and also all tools and apparatus necessary for the proper construction and acceptable completion of the work.

10-24 EXTRA WORK. An item of work not provided for in the awarded Contract is previously modified by change order or supplemental agreement, but which is found by the Engineer to be necessary to complete the work within the intended scope of the Contract as previously modified.

10-25 FEDERAL SPECIFICATIONS. The Federal Specifications and Standards, and supplements, amendments and indices thereto are prepared and issued by the General Services Administration of the Federal Government. They may be obtained from the Specifications Activity, Printed Materials Supply Division, Building 197, Naval Weapons Plant, Washington D.C. 20407.

10-26 FORCE ACCOUNT. The term used to describe a method of accounting which may be employed as a basis of payment to the Contractor for Extra Work.

10-27 INSPECTOR. An authorized representative of the Engineer assigned to make all necessary reviews of the work performed or being performed, or of the materials furnished or being furnished by the Contractor.

10-28 INTENTION OF TERMS. Whenever, in these specifications or on the plans, the words "directed", "required", "permitted", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer is intended; and similarly, the words "approved", "acceptable" "satisfactory", or words of like import, shall mean approved by, or acceptable to, or satisfactory to the Engineer, subject to each case to the final determination of the OWNER.

Any reference to a specific requirement of a numbered paragraph of the Contract specifications or a cited standard shall be interpreted to include all general requirements of the entire section, specification item, or cited standard that may be pertinent to such specific reference.

10-29 LABORATORY. The official testing laboratories of the OWNER or such other laboratories as may be designated by the Engineer.

10-30 MAJOR AND MINOR CONTRACT ITEMS. A major Contract item shall be any item that is listed in the proposal, the total cost of which is equal to or greater than 10 percent of the total amount of the awarded Contract. All other items shall be considered minor Contract items.

10-31 MATERIALS. Any substance specified for use in the construction of the Contract work.

10-32 NOTICE TO PROCEED. A written notice to the Contractor to begin the actual work on a previously agreed to date. If applicable, the Notice to Proceed shall state the date on which the Contract time begins.

10-33 OWNER. The term OWNER shall mean the State of Alabama acting by and through the Alabama State Port Authority.

10-34 PAYMENT BOND. The approved form of security furnished by the Contractor and his surety as a guaranty that he will pay in full all bills and accounts for materials and labor used in the construction of the work.

10-35 PERFORMANCE BOND. The approved form of security furnished by the Contractor and his surety as a guaranty that the Contractor will complete the work in accordance with the terms of the Contract.

10-36 PLANS. The official drawings or exact reproductions, approved by the Engineer, which show the location, character, dimensions and details of the work to be done and which are to be considered as a part of the Contract, supplementary to the specifications.

10-37 PROJECT. The agreed scope of work for accomplishing specific development.

10-38 PROPOSAL. The written offer of the bidder (when submitted on the approved proposal form) to perform the contemplated work and furnish the necessary materials in accordance with the provisions of the plans and specifications.

10-39 PROPOSAL FORM. The approved, prepared form on which the OWNER requires that formal bids be submitted for the work contemplated.

10-40 PROPOSAL GUARANTY. The security furnished with a proposal to guarantee that the bidder will enter into a Contract if his proposal is accepted by the OWNER.

10-41 SPECIAL PROVISIONS. Specific directions and provisions additional to these GENERAL PROVISIONS and to any CONSTRUCTION SPECIFICATIONS setting forth conditions or requirements of construction which are not satisfactorily covered by these GENERAL PROVISIONS or the CONSTRUCTION SPECIFICATIONS. SPECIAL PROVISIONS shall prevail over the GENERAL PROVISIONS and CONSTRUCTION SPECIFICATIONS because they set forth the final Contractual intent as to the matter involved.

10-42 SPECIFICATIONS. A part of the Contract containing the written directions and requirements for completing the Contract work. Standards for specifying materials or testing which are cited in the Contract specifications by reference shall have the same force and effect as if included in the Contract physically.

10-43 STATE. The State of Alabama, the Party of the First Part to the Contract, acting by and through the Alabama State Port Authority.

10-44 STRUCTURES. Port facilities such as wharves, piers, dolphins, bridges, culverts, catch basins, inlets, retaining walls, cribbing, storm and sanitary sewer lines, water lines, under drains, electrical ducts, manholes, handholes, lighting fixtures and bases, transformers, flexible and rigid pavements, buildings, vaults, and other man-made features of the port that may be encountered in the work and not otherwise classified herein.

10-45 SUBCONTRACTOR. Any properly qualified individual undertaking the performance of any part of the work under the terms of the Contract, by virtue of an agreement between himself and the Contractor, with the approval of the OWNER.

10-46 SUBGRADE. The soil which forms the pavement foundation.

10-47 SUPERINTENDENT. The Contractor's executive representative who is present on the work site during progress, authorized to receive and fulfill instructions from the Engineer, and who shall supervise and direct the construction.

10-48 SUPPLEMENTAL AGREEMENT. A written agreement between the Contractor and the OWNER covering: (1) work that would increase or decrease the total amount of the awarded Contract by not more than 10 percent; or any major Contract item, by more than 25 percent, such increased or decreased work being within the scope of the originally awarded Contract, or (2) work that is not within the scope of the originally awarded Contract.

10-49 SURETY. The corporate body, licensed under the laws of Alabama, bound with and for the Contractor for the acceptable performance of the Contract and also for the payment of all claims recoverable under the Contract Bonds.

10-50 WORK. The furnishing of all labor, materials, tools, equipment and incidentals necessary or convenient to the Contractor's performance of all duties and obligations imposed by the Contract, plans and specifications.

10-51 WORKING DAY. A working day shall be any day other than a national legal holiday, Saturday, or Sunday, on which the normal working forces of the Contractor may proceed with regular work for at least 6 hours toward completion of the Contract. Unless work is suspended for causes beyond the Contractor's control, Saturdays, Sundays and national holidays on which the Contractor's forces engage in regular work, requiring the presence of an inspector, will be considered as working days.

SECTION 20 PROPOSAL REQUIREMENTS AND CONDITIONS

20-01 PREQUALIFICATION OF BIDDERS

Proposal forms will be issued only to prospective Bidders who are licensed under the terms of the existing State laws. If the applicant is a corporation organized in a state other than Alabama, it shall furnish a certificate from the Secretary of State showing that it is qualified to transact business in Alabama.

20-02 CONTENTS OF PROPOSAL FORMS

The OWNER shall furnish bidders with proposal forms. All papers bound with or attached to the proposal forms are necessary parts and must not be detached.

The plans, specifications, and other documents designated in the proposal form shall be considered a part of the proposal whether attached or not.

20-03 ISSUANCE OF PROPOSAL FORMS

The OWNER reserves the right to refuse to issue a proposal form to a prospective bidder should such bidder be in default for any of the following reasons:

- (a) Failure to pay, or satisfactorily settle, all bills due for labor and materials on former Contracts in force with the OWNER.
- (b) Contractor default under previous Contracts with the OWNER.
- (c) Proposal withdrawal or Bid Bond forfeiture on previous project with the OWNER.
- (d) Unsatisfactory work on previous Contract with the OWNER.
- (e) Performance failure of manufacturer's product or materials.

20-04 INTERPRETATION OF ESTIMATED PROPOSAL QUANTITIES

An estimate of quantities of work to be done and materials to be furnished under these specifications is given in the proposal. It is the result of careful calculations and is believed to be correct. It is given only as a basis for comparison of proposals and the award of the Contract. The OWNER does not expressly, or by implication, agree that the actual quantities involved will correspond exactly therewith; nor shall the bidder plead misunderstanding or deception because of such estimates of quantities, or of the character, location or other conditions pertaining to the work. Payment to the Contractor will be made only for the actual quantities of work performed or materials furnished in accordance with the plans and specifications. It is understood that the quantities may be increased or decreased as hereinafter provided in the subsection titled 50-02 ALTERATION OF WORK AND QUANTITIES of Division IV, without in any way invalidating the unit bid prices.

20-05 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE

The bidder is expected to carefully examine the site of the proposed work, the proposal, plans, specifications, and Contract forms. He shall satisfy himself as to the character, quality, and quantities of work to be performed, materials to be furnished, and as to the requirements of the proposed Contract. The submission of a proposal shall be prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the proposed Contract, plans, and specifications.

Boring logs and other records of subsurface investigations and tests are available for inspection of bidders. It is understood and agreed that such subsurface information, whether included in the plans, specifications, or otherwise made available to the bidder, was obtained and is intended for the OWNER's design and estimating purposes only. Such information has been made available for the convenience of all bidders. It is further understood and agreed that each bidder is solely

responsible for all assumptions, deductions, or conclusions which he may make or obtain from his examination of the boring logs and other records of subsurface investigations and tests that are furnished by the OWNER.

20-06 PREPARATION OF PROPOSAL

The bidder shall submit his proposal on the forms furnished by the OWNER. All blank spaces in the proposal forms must be correctly filled in where indicated for each and every item for which a quantity is given. The bidder shall state the price (written in ink or typed) both in words and numerals for which he proposed to do each pay item furnished in the proposal. The Department will check the gross sum given in the proposal and in case of error or discrepancy, the gross sum obtained by adding the products of the unit prices and the various estimated quantities listed in the proposal shall prevail and this shall be the Contract Bid Price. In case of conflict between words and numerals, the words, unless obviously incorrect, shall govern.

The bidder shall sign his proposal correctly and in ink. If the proposal is made by an individual, his name and post office address must be shown. If made by a partnership, the name and post office address of each member of the partnership must be shown. If made by a corporation the person signing the proposal shall give the name of the State under the laws of which the corporation was chartered and the name, titles, and business address of the president, secretary, and the treasurer. Anyone signing a proposal as an agent shall file evidence of his authority to do so and that the signature is binding upon the firm or corporation.

20-07 IRREGULAR PROPOSALS

Proposals shall be considered irregular for the following reasons:

- (a) If the proposal is on a form other than that furnished by the OWNER, if the OWNER's form is altered, or if any part of the proposal form is detached.
- (b) If there are unauthorized additions, conditional or alternate pay items, or irregularities of any kind which make the proposal incomplete, indefinite, or otherwise ambiguous.
- (c) If the proposal does not contain a unit price for each pay item listed in the proposal, except in the case of authorized alternate pay items, for which the bidder is not required to furnish a unit price.
- (d) If the proposal contains unit prices that are obviously unbalanced.
- (e) If the proposal is not accompanied by the bid bond specified by the OWNER.

The OWNER reserves the right to reject any irregular proposal and the right to waive technicalities if such waiver is in the best interest of the OWNER and conforms to laws and ordinances pertaining to the letting of construction Contracts.

20-08 PROPOSAL GUARANTY

Each separate proposal shall be accompanied by a certified check, or other specified acceptable collateral, in the amount of 5% of the bid price, but not more than \$10,000. Such check, or collateral, shall be made payable to the Alabama State Port Authority.

20-09 DELIVERY OF PROPOSAL

Each proposal submitted shall be placed in a sealed envelope plainly marked on the outside with the project description, Bidder's name and address, Contractor's License number, Contractor's Classification of License, and the time and date of bid opening. When sent by mail, preferably registered, the sealed proposal, marked as indicated above, should be enclosed in an additional envelope. No proposal will be considered unless received at the place specified in the advertisement before the time specified for opening all bids.

Proposals received after the bid opening time shall be returned to the bidder unopened.

20-10 WITHDRAWAL OR REVISION OF PROPOSALS

A bidder may withdraw or revise (by withdrawal of one proposal and submission of another) a proposal provided that the bidder's request for withdrawal is received by the OWNER in writing or by telegram before the time specified for opening bids. Revised proposals must be received at the place specified in the advertisement before the time specified for opening all bids.

20-11 PUBLIC OPENING OF PROPOSALS

Proposals shall be opened, and read, publicly at the time and place specified in the advertisement. Bidders, their authorized agents, and other interested persons are invited to attend.

Proposals that have been withdrawn (by written or telegraphic request) or received after the time specified for opening bids shall be returned to the bidder unopened.

20-12 DISQUALIFICATION OF BIDDERS

A bidder shall be considered disqualified for any of the following reasons:

- (a) Submitting more than one proposal from the same partnership, firm or corporation under the same or different name.
- (b) Evidence of collusion among bidders. Bidders participating in such collusion shall be disqualified as bidders for any future work of the OWNER.
- (c) If the bidder is considered to be in "default" for any reason specified in the paragraph titled ISSUANCE OF PROPOSAL FORMS of this subsection.
- (d) If the bidder has not complied with the provisions of the Laws of the State of Alabama concerning licensing of Contractors.
- (e) If an out-of-state bidder has not qualified with the Secretary of State to do business in Alabama.

20-13 LIQUIDATED DAMAGES

Time is an essential element in the Contract. As the prosecution of the Work will inconvenience the public, obstruct traffic, and interfere with business, it is important that the work be pressed vigorously to completion. Also, the cost to the Department of the administration of the Contract, supervision, inspection, engineering, and in some cases maintenance of detours around or over the work under construction will be increased or decreased as the time occupied in the Work is lengthened or shortened. Therefore, exclusive of Sundays, national holidays, and other exceptions and extensions as detailed elsewhere in these Specifications for each day that the Work remains incomplete after the time specified in the Contract, or additional time that may be allowed by the Engineer for the completion of the work when extra or additional work is ordered by the Engineer, the amount specified in the following schedule shall be paid by the Contractor to the Department as liquidated damages for the loss sustained by the State because of failure of the Contractor to complete the work within the specified time.

SCHEDULE OF LIQUIDATED DAMAGES

Contract Bid Price	Amount of Liquidated Damages per Day
\$100,000 and less	\$100.00
More than \$100,000 and less than \$250,000	150.00
\$250,000 and less than \$600,000	200.00
\$600,000 or more	0.033% of Contract amount

20-14 OWNER PURCHASE OF MATERIALS

20-14.1 In accordance with the State of Alabama Statutes for **Sales Tax exemptions for a State Agency**, it is the intent of this Contract for the Alabama State Port Authority (Owner) to reduce sales tax.

20-14.1.1 The Owner reserves the right to purchase all of the required materials or equipment to be used on this project which will become part of the realty.

20-14.1.2 The cost of the Materials and Equipment which will become part of the realty is to be included in the Bid Price. Sales taxes, which will become part of the realty in accordance with the Alabama Statutes, are not to be included.

20-14.1.3 In order to achieve sales tax exemption and avoid jeopardizing immunity from sales taxes it is essential that the following procedures be followed.

20-14.2 Purchase of Materials or Equipment

20-14.2.1 All purchase orders must be executed on the Owner's Purchase Order Letterhead/Form.

20-14.2.2 The purchase order form format is to be designed at the Owner's discretion with the Owner reserving approval rights concerning terms and conditions boilerplate.

20-14.2.3 The Contractor's organization will be designated as an agent of the Owner for Material and Equipment purchases and will provide the names of two individuals in the Organization who will be authorized to purchase on the behalf of the Owner.

20-14.2.4 Purchase Orders are to be numerically sequenced with two executed copies furnished to the Construction Manager, one copy of which will be forwarded to the Owner by the Construction Manager. If a Construction Manager is not assigned to the project, the copies should go directly to the Owner's Project Manager within the Engineering Services Division.

20-14.2.5 Owner Purchase Orders are invalid for gross amounts less than \$2,000.00. Any materials purchased directly by the Contractor for the project shall be subject to Sales Tax and paid by the Contractor.

20-14.3 Payment of Materials or Equipment

20-14.3.1 All payments in connection with the purchase orders generated by Owner's Contractor/Agent will be in the form of a check from the Alabama State Port Authority to the appropriate vendors or suppliers.

20-14.3.2 Check Request Form will be furnished to the Contractor by the Owner. The Check Request Form will be numerically sequenced and accounted for.

20-14.3.3 The Contractor is responsible for preparing the Check Request Form for the Owner's signature.

20-14.3.4 An Invoice Transmittal Form is to be designed by the Contractor with the Owner reserving the right of approval of the Invoice Transmittal Form design. It is a primary requirement that the Invoice Transmittal Form indicate that the Owner is the sole payer for materials or equipment. The Invoice Transmittal Form will be numerically sequenced and accounted for.

20-14.3.5 All Contractor requests for payment for materials and equipment purchased under the provisions of this Article will be forwarded to the Construction Manager under cover of the Invoice Transmittal Form, submitted in duplicate, with one copy retained by the Construction Manager and one copy retained by the Owner. The Invoice Transmittal shall be backed-up with signed receiving or delivery tickets, invoices and

prepared Check Request Form plus one (1) additional copy of the Check Request Form which will be kept by the Construction Manager.

20-14.3.6 Upon signature by the Owner of the Check Request Form, a check from the Alabama State Port Authority will be issued directly to the vendor or supplier.

20-14.4 Accounting Procedures

20-14.4.1 The Contractor's Schedule of Values shall be broken down into three categories, if requested by Owner, showing Material, Equipment and with the remaining category containing labor, fee, rentals, overhead and other costs on a line item basis.

20-14.4.2 Check Request Forms generated by the Contractor/Agent for the Owner shall be collated on a monthly basis and assembled into a credit amount showing amounts to be deducted from the current Payment Application and Contract Sum.

20-14.4.3 The Contractor's Payment Application will be adjusted on a monthly basis in accordance with the preceding monthly accumulated credit amounts for Owner purchases.

20-14.4.4 Discounts which accrue from Owner payments for prompt payment will accrue as 50% to the Owner and 50% to the Contractor.

20-14.4.5 Retainage will not be withheld on Owner purchased Materials or Equipment.

20-14.5 Procedures

The Contractor shall follow the procedures set forth below, but nothing herein shall be construed to reduce, limit or change the Contractor's overall responsibility for the quality, scheduling, coordination, warranty, overhead, profit or retainage, except as provided in subparagraph 20-14.4.5 of the complete Contract scope of work in accordance with all provisions of the Contract Documents.

20-14.5.1 Procurement of Material Selected by Contractor.

With respect to any materials, equipment or product to be purchased by the Owner, the following procedures shall be followed:

1. Immediately upon notice to proceed or award of Contract, the Contractor in conjunction with the Construction Manager shall develop a list of items to be purchased by the Owner for incorporation into the work.
2. When the type, quantity, and price of each lot of materials, equipment or product to be purchased on a single purchase order have been determined by the Contractor, Contractor shall complete the Owner Purchase Order Form and shall sign the form to certify that the material, equipment or product described on the form complies with the requirements of the Contract Documents. The Owner Purchase Order Form, signed by the Contractor shall be forwarded to the vendor by the Contractor. The total monetary value listed on the Purchase Order Form is the cost limitation established for the Purchase Order.
3. Simultaneously, with the Contractor/Agent's issuance of a purchase order form for major items the Contractor shall then incorporate into his expediting schedule his activities showing purchase time, shop drawing time, submittal approval time, integrated into the updated project schedule and then tied into the activity requiring the purchase material.
4. The supplier shall deliver the material, equipment or product to the Contractor in accordance with the provisions of the purchase order, and as required by the Contract Documents. Upon receipt of the materials the

Contractor shall inspect the materials, equipment or product as necessary to verify conformity of the material, equipment or product received with the Owner Purchase Order and with the shipping documents. The Contractor shall provide to the Vendor written certification of receipt, or signed delivery ticket, of Each delivery of material, equipment or product which certification shall fully describe any shortages, defects, damage or non-compliance to the supplier within five days or receipt of Each delivery and shall arrange for the return and replacement of defective, damaged or non-conforming material, equipment or product on behalf of the Owner, in accordance with the provisions of the Contract Documents.

5. The supplier shall submit each invoice along with aforementioned proof of delivery for material, equipment or product procured pursuant to the provisions hereof to the Owner in care of the Contractor/Consignee. The Contractor/Consignee shall verify and certify to the Owner the accuracy and completeness of each invoice submitted by the supplier. Each certified invoice shall be submitted with appropriate Check Request Form no later than the Contractor's next monthly Application for Payment to the Owner.
6. After the Contractor's Application for Payment, along with Check Request Forms including certified supplier invoices and delivery tickets, has been approved for payment in accordance with the provisions of the General Conditions, the Owner shall make direct payments to the supplier, and the amount of each such payment, shall be deducted from the then-unpaid balance of the Contractor's Contract Sum. The amount deducted shall be in accordance with subparagraph 20-14.4.2.

20-14.5.2 Owner-Purchased Materials

Materials used on the Project which are purchased by the Owner will be available at the location specified in the Purchase Order and in accordance with the periodically adjusted project schedule. The Contractor shall review the updated and adjusted project schedule and will be responsible for coordinating the deliveries with the progress of the work. The Contractor's costs for storing, transporting, handling, protecting and installing Owner purchased material shall be included in the Contract Sum and paid for **when such material is installed**. The Contractor shall be responsible for material furnished to it, and shall pay for storage charges incurred as a result of its failure to take delivery of Owner material on the assigned date.

The Contractor shall be liable to the Owner for the cost of replacing or repairing material lost or damaged from any cause whatsoever after receipt by the Contractor or after the Contractor has failed to take delivery after the assigned date. The costs will be deducted from any monies due or to become due to the Contractor, except those amounts covered under any claims payments made under insurance policies furnished by the Owner. In cases where lost or damaged material was not evident at the time such materials were received by the Contractor, the Contractor will be afforded the same protection by the Owner as the Owner has received from the original shipper and manufacturer. The Owner, in addition, agrees to provide the Contractor with all necessary assistance in communicating with the manufacturer of any materials which fail to function properly once installed.

The Contractor is responsible for providing and performance of warranty work in connection with the Owner purchased materials, for the time periods as required by the Contract Documents.

20-14.6 Materials and Equipment Responsibility

20-14.6.1 The General Contractor shall retain as part of his Bid and Fee the following responsibilities for care, custody and control of the Owner purchased Materials and Equipment.

1. Insure that all Materials and Equipment purchased by the Owner are in complete accordance with the plans and specifications.
2. Shop drawings and submittals.
3. Scheduling.
4. Shipment, receipt, unloading, inspection, storage and handling.
5. Return of damaged Materials and Equipment.
6. Filing of freight claims.
7. Installation as required.
8. Startup and testing as required per specifications.
9. Warranty and maintenance as required per specifications.
10. Training as required per specifications.
11. Spare parts. Special tools and additional stock as required by the specifications.
12. In the event the Contractor orders non-specified, wrong size or dimensioned Material or Equipment it will be his responsibility to replace such at no cost to the Owner.

20-14.7 Project Close-Out

The Contractor shall return to the Owner all blank Purchase Order Forms issued, but not used on the project.

SECTION 30**AWARD AND EXECUTION OF CONTRACT****30-01 CONSIDERATION OF PROPOSALS**

After the proposals are publicly opened and read, they will be compared on the basis of the summation of the products obtained by multiplying the estimated quantities shown in the proposal by the unit bid prices. If a bidder's proposal contains a discrepancy between unit bid prices written in words and unit bid prices written in numbers, the unit price written in words shall govern.

Until the award of the Contract is made, the OWNER reserves the right to reject a bidder's proposal for any of the following reasons:

- a) If the proposal is irregular as specified in the subsection titled IRREGULAR PROPOSALS of Subsection 20.
- b) If the bidder is disqualified for any of the reasons specified in the subsection titled DISQUALIFICATION OF BIDDERS of Subsection 20.

In addition, until the award of a Contract is made, the OWNER reserves the right to reject any or all proposals; waive technicalities, if such waiver is in the best interest of the OWNER and is in conformance with applicable laws or regulations pertaining to the letting of construction Contracts; advertise for new proposals; or proceed with the work otherwise. All such actions shall promote the OWNER's best interests.

30-02 AWARD OF CONTRACT

The award of a Contract, if it is to be awarded, shall be made within 60 calendar days of the date specified for publicly opening proposals.

Award of the Contract shall be made by the OWNER to the lowest qualified bidder whose proposal conforms to the cited requirements of the OWNER.

30-03 CANCELLATION OF AWARD

The OWNER reserves the right to cancel the award without liability to the bidder, except return of proposal guaranty, at any time before a Contract has been fully executed by all parties and is approved by the OWNER in accordance with the paragraph titled APPROVAL OF CONTRACT of this subsection.

30-04 RETURN OF PROPOSAL GUARANTY

All proposal guaranties, except those of the three lowest bidders, will be returned immediately after the OWNER has made a comparison of bids as hereinbefore specified in the paragraph titled CONSIDERATION OF PROPOSALS of this subsection. Proposal guaranties of the two lowest bidders will be retained by the OWNER until such time as an award is made, at which time, the unsuccessful bidders' proposal guaranty will be returned. The successful bidder's proposal guaranty will be returned as soon as the OWNER receives the contract bonds as specified in the paragraph titled "REQUIREMENTS OF CONTRACT BONDS" of the subsection.

30-05 REQUIREMENTS OF CONTRACT BONDS

In order to insure the faithful performance of each and every condition, stipulation, and requirement of the Contract and to indemnify and save harmless the OWNER from any and all damages, either directly or indirectly, (arising out of any failure to perform same), the successful Bidder to whom the Contract is awarded shall, within ten (10) days from the date of award, furnish at his expense and file with the OWNER an acceptable Surety Bond in an amount equal to one hundred percent (100%) of the Contract Bid Price of the Contract as awarded. Said Bond shall be made on the approved bond form, shall be furnished by a reputable surety company authorized

to do business in the State of Alabama, shall be counter-signed by an authorized agent resident in the State who is qualified for the execution of such instruments, and shall be attached thereto power of attorney of the signing agent.

In case of default on the part of the Contractor, all expenses incident to ascertaining and collecting losses suffered by the OWNER under the Bond, including both Engineering and legal services, shall lie against the Contract Bond for Performance of the Work.

In addition thereto, the successful Bidder to whom the Contract is awarded shall, within ten (10) days, furnish at his expense and file with the OWNER an acceptable Surety Bond for Payment of Labor, Materials, and Supplies payable to the OWNER in an amount not less than one hundred percent (100%) of the Contract price with the obligation that the Contractor shall promptly make payment to all persons furnishing him or them with labor, materials, foodstuffs, or supplies for, or in, prosecution of the work including the payment of reasonable attorney's fees, incurred by successful claimants or plaintiffs in suits on said bond.

No surety bonds from any insurance company or bonding company which has a lower rating, in the Best Key Rating Guide, than A will be accepted.

30-06 EXECUTION OF CONTRACT

The successful bidder shall sign (execute) the necessary agreements for entering into the Contract and return such signed Contract to the OWNER, along with the fully executed surety bond or bonds specified in the paragraph titled REQUIREMENT OF CONTRACT BONDS of this subsection, within 10 calendar days from the date mailed or otherwise delivered to the successful bidder.

30-07 APPROVAL OF CONTRACT

Upon receipt of the Contract and Contract bond or bonds that have been executed by the successful bidder, the OWNER shall complete the execution of the Contract and return the fully executed Contract to the Contractor. Delivery of the fully executed Contract to the Contractor shall constitute the OWNER's approval to be bound by the successful bidder's proposal and the terms of the Contract.

30-08 FAILURE TO EXECUTE CONTRACT

Failure of the successful bidder to execute the Contract and furnish an acceptable surety bond or bonds within the 10 calendar day period specified in the paragraph titled "REQUIREMENTS OF CONTRACT BONDS" of this subsection shall be just cause for cancellation of the award and forfeiture of the proposal guaranty, not as a penalty, but as liquidation of damages to the OWNER. Award may then be made to the next lowest qualified Bidder or the work may be re-advertised, or otherwise contracted as the Director may decide.

SECTION 40 INDEMNIFICATION AND INSURANCE REQUIREMENTS

40-01 INDEMNIFICATION

The Contractor shall assume all liability for and shall indemnify and save harmless the State of Alabama, the Alabama State Port Authority and its officers and employees, and Engineer from all damages and liability for injury to any person or persons, and injury to or destruction of property, including the loss of use thereof, by reason of an accident or occurrence arising from operations under the Contract, whether such operations are performed by himself or by any subcontractor or by anyone directly or indirectly employed by either of them, occurring on or about the premises, or the ways and means adjacent, during the term of the Contract, or any extension thereof, and shall also assume the liability for injury and/or damages to adjacent or neighboring property by reason of work done under the Contract.

40-02 CONTRACTOR COVERAGE

The Contractor shall not commence work under the Contract until he has obtained all insurance required under the following paragraphs and until such insurance has been approved by the Owner, nor shall the Contractor allow any subcontractor to commence work on his subcontract until all similar applicable insurance required of the subcontractor has been obtained and approved. If the subcontractor does not take out insurance in his own name, then the principal Contractor shall provide such insurance protection for subcontractor and his employees by endorsement to the Contractor's policies or by taking out separate policies in the name of the subcontractor.

40-03 COMMERCIAL GENERAL LIABILITY

The Contractor shall take out and maintain during the life of the Contract Commercial General Liability insurance, including Blanket Contractual and Completed Operations coverage, in an amount not less than \$5,000,000 for any one occurrence for bodily injury, including death, and property damage liability. Policy shall include endorsement identifying the Owner and Engineer as Primary and Non-contributory Additional Insureds as respects the Contractor's work for the Owner, to the extent required by written Contract, including a waiver of all rights of subrogation.

40-04 OWNER'S AND CONTRACTOR'S PROTECTIVE LIABILITY

The Contractor shall take out and maintain during the life of the Contract a separate Owner's and Contractor's Protective Liability policy in the names of the Owner and Engineer in an amount not less than \$2,000,000. Policy shall be delivered to the Owner.

40-05 BUSINESS AUTOMOBILE LIABILITY

The Contractor shall take out and maintain during the life of the Contract Business Automobile Liability insurance covering owned, non-owned and hired vehicles in an amount not less than \$1,000,000 for any one occurrence for bodily injury, including death, and property damage liability. The Owner and Engineer shall be identified as Additional Insureds, to the extent required by written Contract.

40-06 WORKERS COMPENSATION

The Contractor shall take out and maintain during the life of the Contract Workers Compensation and Employers Liability insurance providing coverage under the Alabama Workers Compensation Act in an amount not less than that required by Alabama Law.

Where applicable, Contractor shall take out and maintain during the life of the Contract insurance providing coverage as required by Federal statute, including but not limited to U.S. Longshoremen and Harbor Workers Act (USL&H), Jones Act, and Railroad Federal Employers Liability Act (FELA).

40-07 OCEAN MARINE COVERAGE

In the event work involves the use of watercraft in the completion of the Contract, the Contractor shall provide Protection and Indemnity coverage, including crew, in an amount not less than \$2,000,000 for each loss.

Only the Contractor and/or Subcontractor using watercraft in the completion of its work shall be required to provide evidence of this coverage. In the event the Contractor subcontracts for this portion of the work, the Contractor shall not allow the subcontractor to commence work until such coverage has first been obtained by the subcontractor and approved by the Owner.

40-08 RAILROAD PROTECTIVE LIABILITY

In any case where the Contract involves work within 50 feet of an operating railroad track, the Contractor shall provide a Railroad Protective Liability policy in the name of the railroad whose right of way is involved. The limits of the policy shall be not less than \$2,000,000 per occurrence with \$6,000,000 aggregate.

NOTE #1: With the written approval of the Owner, in lieu of the Railroad Protective Liability policy, the Contractor may cause to be attached to its Commercial General Liability policy standard ISO endorsement, "Contractual Liability – Railroads" (CG 24 17). The railroad must be identified as an Additional Insured.

NOTE #2: *Only the Contractor and/or Subcontractor performing the work within 50 feet of the railroad track shall be required to provide evidence of this coverage. In the event the Contractor subcontracts for this portion of the work, the Contractor shall not allow the subcontractor to commence work until such coverage has first been obtained by the subcontractor and approved by the Owner.*

40-09 BUILDER'S RISK or INSTALLATION FLOATER (to be determined per project)

The Contractor shall take out and maintain during the life of the Contract Builder's Risk insurance or Installation Floater, written on an "All Risk" basis, insuring the work included in the Contract against all physical loss. The amount of insurance shall at all times be at least equal to the amount of the Contract. The policy shall be in the names of the Owner, Engineer, Contractor, and "all Subcontractors," as their interests appear. Policy shall be provided to the Owner prior to commencement of work.

When changes in scope of work by written Change Order or aggregate Change Orders equal 15 percent of the total Contract, the amount of coverage provided in the Builder's Risk/Installation Floater policy shall be increased accordingly and evidence of increased coverage delivered to the Owner.

40-10 PROFESSIONAL LIABILITY INSURANCE

The Contractor shall take out and maintain during the life of the contract Professional Liability insurance including design with limits not less than \$2,000,000 per occurrence.

40-11 PROOF OF CARRIAGE OF INSURANCE

The Contractor shall furnish to the Owner, in triplicate, Certificates of Insurance, signed by the licensed agent, evidencing the required coverage, along with letter of transmittal giving date of delivery. A copy of this letter shall also be delivered to the Engineer. The Owner reserves the right to require certified copies of any and all policies.

All coverage and bonds shall be provided by companies acceptable to the Owner. Each policy of insurance shall provide, either in body of the policy or by endorsement, that such policy cannot be substantially altered or cancelled without thirty (30) days' written notice to the Owner and insured.

(Rev. 1/26/06)

SECTION 50

SCOPE OF WORK

50-01 INTENT OF CONTRACT

The intent of the Contract is to provide for construction and completion, in every detail, of the work described. It is further intended that the Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work in accordance with the plans, drawings, specifications, and terms of the Contract.

50-02 ALTERATION OF WORK AND QUANTITIES

The OWNER reserves and shall have the right to make such alterations in the work as may be necessary or desirable to complete the work originally intended in an acceptable manner. Unless otherwise specified herein, the Engineer shall be and is hereby authorized to make such alterations in the work as may increase or decrease the originally awarded Contract quantities, provided that the aggregate of such alterations does not change the total Contract cost by more than 10% or the total cost of any major Contract item by more than 25 percent (total cost being based on the unit prices and estimated quantities in the awarded Contract). Alterations which do not exceed the 25 percent limitation shall not invalidate the Contract nor release the surety, and the Contractor agrees to accept payment for such alteration as if the altered work had been a part of the original Contract. These alterations, which are for work within the general scope of the Contract shall be covered by "Change Orders" issued by the Engineer. Change orders for altered work shall include extensions of Contract time where, in the Engineer's opinion, such extensions are commensurate with the amount and difficulty of added work.

Should the aggregate amount of altered work exceed the 25 percent limitation hereinbefore specified, such excess altered work shall be covered by supplemental agreement. If the OWNER and the Contractor are unable to agree on a unit adjustment for any Contract item that requires a supplemental agreement, the OWNER reserves the right to terminate the Contract with respect to the item and make other arrangement for its completion.

All supplemental agreements shall require consent of the Contractor's surety and separate performance and payment bonds.

50-03 OMITTED ITEMS

The Engineer may, in the OWNER's best interest, omit from the work any Contract item, except major Contract items. Major Contract items may be omitted by a supplemental agreement. Such omission of Contract items shall not invalidate any other Contract provision or requirement.

Should a Contract item be omitted or otherwise ordered to be non-performed, the Contractor shall be paid for all work performed toward completion of such item prior to the date of the order to omit such item. Payment for work performed shall be in accordance with the paragraph titled PAYMENT FOR OMITTED ITEMS of Subsection 100.

50-04 EXTRA WORK

Should acceptable completion of the Contract require the Contractor to perform an item of work for which no basis of payment has been provided in the original Contract or previously issued change orders or supplemental agreements, the same shall be called Extra Work. Extra work that is within the general scope of the Contract shall contain agreed unit prices for performing the change order work in accordance with the requirements specified in the order, and shall contain any adjustment to the Contract time that, in the Engineer's opinion, is necessary for completion of such extra work.

When determined by the Engineer to be in the OWNER's best interest, he may order the Contractor to proceed with extra work by force account as provided in the paragraph titled PAYMENT FOR EXTRA AND FORCE ACCOUNT WORK of Subsection 100.

Extra work that is necessary for acceptable completion of the project, but is not within the general scope of the work covered by the original Contract shall be covered by a Supplemental Agreement as hereinbefore defined in the paragraph titled SUPPLEMENTAL AGREEMENT of Subsection 10.

Any claim for payment of extra work that is not covered by written agreement (change order or supplemental agreement) shall be rejected by the OWNER.

50-05 MAINTENANCE OF COMMERCE

It is the explicit intention of the Contract that the safety of workers and vessels, as well as the Contractor's equipment and personnel, is the most important consideration.

It is understood and agreed that the Contractor shall provide for the free and unobstructed movement of vessels in the waterfront areas of the port with respect to his own operations and the operations of all his Subcontractors as specified in the paragraph titled LIMITATION OF OPERATIONS of Subsection 90.

With respect to his own operations and the operations of all his Subcontractors, the Contractor shall provide marking, lighting, and other acceptable means of identifying: personnel; equipment; vehicles; storage areas; and any work area or condition that may be hazardous to the operation of fire rescue equipment, or maintenance vehicles at the port.

When the Contract requires the maintenance of vehicular traffic on an existing road, street, or highway during the Contractor's performance of work that is otherwise provided for in the Contract, plans, and specifications, the Contractor shall keep such road, street, or highway open to all traffic and shall provide such maintenance as may be required to accommodate traffic. The Contractor shall furnish, erect, and maintain barricades, warning signs, flagmen, and other traffic control devices in reasonable conformity with the manual of Uniform Traffic Control Devices for Streets and Highway (published by the United States Government Printing Office), unless otherwise specified herein. The Contractor shall also construct and maintain in a safe condition any temporary connections necessary for ingress to and egress from abutting property or intersecting roads, streets or highways.

The Contractor shall make his own estimate of all labor, materials, equipment, and incidentals necessary for providing the maintenance of commerce and vehicular traffic as specified in this subsection.

The cost of maintaining the commerce and vehicular traffic specified in this subsection shall not be measured or paid for directly, but shall be included in the various Contract items.

50-06 REMOVAL OF EXISTING STRUCTURES

All existing structures encountered within the established lines, grades, or grading sections shall be removed by the Contractor, unless such existing structures are otherwise specified to be relocated, adjusted up or down, salvaged, abandoned in place, reused in the work or to remain in place. The cost of removing such existing structures shall not be measured or paid for directly but shall be included in the various Contract items.

Should the Contractor encounter an existing structure (above or below ground) in the work for which the disposition is not indicated on the plan, the Engineer shall be notified prior to disturbing such structure. The disposition of existing structures so encountered shall be immediately determined by the Engineer in accordance with the provisions of the Contract.

Except as provided in the subsection titled RIGHTS IN AND USE OF MATERIALS FOUND IN THE WORK of this subsection, it is intended that all existing materials or structures that may be encountered (within the lines, grades, or grading sections established for completion of the work) shall be utilized in the work as otherwise provided for in the Contract and shall remain the property of the OWNER when so utilized in the work.

50-07 RIGHTS IN AND USE OF MATERIALS FOUND IN THE WORK

Should the Contractor encounter any material such as (but not restricted to) sand, stone, gravel, slag, or concrete slabs within the established lines, grades, or grading sections, the use of which is intended by the terms of the Contract to be either embankment or waste, he may at his option either:

- (a) Use such material in another Contract item, providing such use is approved by the OWNER and Engineer and is in conformance with the Contract specifications applicable to such use; or
- (b) Remove such material from the site, upon written approval of the Engineer; or
- (c) Use such material for his own temporary construction on site; or
- (d) Use such material as intended by the terms of the Contract.

Should the Engineer approve the Contractor's wish to exercise option (a), (b), or (c), the Contractor shall be paid for the excavation or removal of such material at the applicable Contract price. The Contractor shall replace, at his own expense, such removed or excavated material with an agreed equal volume of material that is acceptable for use in constructing embankment, backfills, or otherwise to the extent that such replacement material is needed to complete the Contract work. The Contractor shall not be charged for his use of such material so used in the work or removed from the site.

Should the Engineer approve the Contractor's exercise of option (a), the Contractor shall be paid, at the applicable contract price, for furnishing and installing such material in accordance with requirements of the Contract item in which the material is used.

It is understood and agreed that the Contractor shall make no claim for delays by reason of his exercise of option (a), (b), or (c).

The Contractor shall not excavate, remove, or otherwise disturb any material, structure, or part of a structure which is located outside the lines, grades, or grading sections established for the work, except where such excavation or removal is provided for in the Contract, plans, or specifications.

50-08 FINAL CLEANING UP

Upon completion of the work and before acceptance and final payment will be made, the Contractor shall remove from the site all machinery, equipment, surplus and discarded materials, rubbish, temporary structures, and stumps or portions of trees. He shall cut all brush and woods within the limits indicated and shall leave the site in a neat and presentable condition. Material cleared from the site and deposited on adjacent property will not be considered as having been disposed of satisfactorily, unless the Contractor has obtained the written permission of such property OWNER.

SECTION 60

CONTROL OF WORK

60-01 AUTHORITY OF THE ENGINEER

The Engineer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished, work performed, and as to the manner of performance and rate of progress of the work. He shall decide all questions which may arise as to the interpretation of the specifications or plans relating to the work, the fulfillment of the Contract on the part of the Contractor, and the rights of different Contractors on the project. The Engineer shall determine the amount and quality of the several kinds of work performed and materials furnished which are to be paid for under the Contract.

60-02 CONFORMITY WITH PLANS AND SPECIFICATIONS

All work and all materials furnished shall be in reasonably close conformity with the lines, grades, grading sections, cross sections, dimensions, material requirements, and testing requirements that are specified (including specified tolerances) in the Contract, plans, or specifications.

If the Engineer finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the plans and specifications but that the portion of the work affected will, in his opinion, result in a finished product having a level of economy, durability, and workmanship acceptable to the OWNER, he will advise the OWNER of his determination that the affected work be accepted and remain in place.

In this event, the Engineer will document his determination and recommend to the OWNER a basis of acceptance which will provide for an adjustment in the Contract price for the affected portion of the work. The Engineer's determination and recommended Contract price adjustments will be based on good Engineering judgment and such tests or retests of the affected work as are, in his opinion, needed. Changes in the Contract price shall be covered by Contract modifications (change order or supplemental agreement) as applicable.

If the Engineer finds the materials furnished, work performed, or the finished product are not in reasonably close conformity with the plans and specifications and have resulted in an unacceptable finished product, the affected work or materials shall be removed and replaced or otherwise corrected by any at the expense of the Contractor in accordance with the Engineer's written orders.

For the purpose of this subsection, the term "reasonably close conformity" shall not be construed as waiving the Contractor's responsibility to complete the work in accordance with the Contract, plans and specifications. The term shall not be construed as waiving the Engineer's right to insist on strict compliance with the requirements of the Contract, plans, and specifications during the Contractor's prosecution of the work, when, in the Engineer's opinion, such compliance is essential to provide an acceptable finished portion of the work.

For the purpose of this subsection, the term "reasonably close conformity" is also intended to provide the Engineer with the authority to use good Engineering judgment in his determinations as to acceptance of work that is not in strict conformity but will provide a finished product equal to or better than that intended by the requirements of the Contract, plans and specifications.

60-03 COORDINATION OF CONTRACT, PLANS AND SPECIFICATIONS

The Contract, plans, specifications, and all referenced standards cited are essential parts of the Contract requirements. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions will govern over scaled dimensions; special provisions shall govern over plans, Contract construction specifications, Contract general provisions, cited specifications, and cited testing standards; plans shall govern over Contract construction

specifications, Contract general provisions, and cited testing standards; Contract construction specification shall govern over Contract general provisions, and cited testing standards; Contract general provisions shall govern over cited testing standards. The Contractor shall not take advantage of any apparent error or omission on the plans or specifications. In the event the Contractor discovers any apparent error or discrepancy, he shall immediately call upon the Engineer for his interpretation and decision, and such decision shall be final.

60-04 COOPERATION OF THE CONTRACTOR

The Contractor will be supplied with five (5) copies each of the plans and specifications. He shall have available on the work at all times, one copy each of the plans and specifications. Additional copies of plans and specifications may be obtained by the Contractor for the cost of reproduction.

The Contractor will give constant attention to the work to facilitate the progress thereof, and he shall cooperate with the Engineer and his inspectors and with other Contractors in every way possible. The Engineer shall allocate the work and designate the sequence of construction in case of controversy between Contractors. The Contractor shall have a competent superintendent on the work at all times who is fully authorized as his agent on the work. The superintendent shall be capable of reading and thoroughly understanding the plans and specifications and shall receive and fulfill instructions from the Engineer or his authorized representative.

60-05 COOPERATION BETWEEN CONTRACTORS

The OWNER reserves the right to Contract for and perform other or additional work on or near the work covered by this Contract.

When separate Contracts are let within the limits of any one project, Each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his Contract and shall protect and save harmless the OWNER from any and all damages or claims that may arise because of inconvenience, delays, or loss experienced by him because of the presence and operations or other Contractors working within the limits of the same project.

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. He shall join his work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

60-06 CONSTRUCTION LAYOUT AND STAKES

The Engineer will establish horizontal and vertical control only and the Contractor must furnish all additional stakes for the layout and construction of the work. The Engineer will also furnish any additional information, upon request of the Contractor, needed to layout and construct the work. The Contractor shall satisfy himself as to the accuracy of all measurements before constructing any permanent structure and shall not take advantage of any errors which may have been made in laying out the work. Such stakes and markings as the Engineer may set for either his own or the Contractor's guidance shall be scrupulously preserved by the Contractor. In case of negligence on the part of the Contractor, or his employees, resulting in the destruction of such stakes or markings, an amount equal to the cost of replacing the same may be deducted from subsequent estimates due to the Contractor at the discretion of the OWNER.

60-07 AUTOMATICALLY CONTROLLED EQUIPMENT

Whenever batching or mixing plant equipment is required to be operated automatically under the Contract and a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually or by other methods for a period of 48 hours following the breakdown or malfunction, provided this method of operations will produce results which conform to all other requirements of the Contract.

60-08 AUTHORITY AND DUTIES OF INSPECTORS

Inspectors employed by the OWNER shall be authorized to inspect work done and all 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. Inspectors are not authorized to revoke, alter, or waive any provision of the Contract. Inspectors are not authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

Inspectors employed by the OWNER are authorized to notify the Contractor or his representatives of any failure of the work or materials to conform to the requirements of the Contract, plans, or specifications and to reject such nonconforming materials in question until such issues can be referred to the Engineer for his decision.

60-09 INSPECTION OF THE WORK

All materials and each part or detail of the work shall be subject to review by the Engineer. The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

If the Engineer requests it, the Contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed.

After examination, the Contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as extra work; but should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be at the Contractor's expense.

Any work done or materials used without supervision or inspection by an authorized representative of the OWNER may be ordered removed and replaced at the Contractor's expense unless the OWNER's representative failed to inspect after having been given reasonable notice in writing that the work was to be performed.

Should the Contract work include relocation, adjustment, or any other modification to existing facilities, not the property of the (Contract) OWNER, authorized representatives of the owners of such facilities shall have the right to inspect such work. Such inspection shall in no sense make any facility owner a party to the Contract, and shall in no way interfere with the rights of the parties to this Contract.

60-10 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK

All work which does not conform to the requirements of the Contract, plans, and specifications will be considered unacceptable, unless otherwise determined acceptable by the OWNER as provided in the paragraph titled CONFORMITY WITH PLANS AND SPECIFICATIONS of this subsection.

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner in accordance with the provisions of the paragraph titled CONTRACTOR'S RESPONSIBILITY FOR WORK of Subsection 80.

No work shall be done without lines and grades having been established by the Contractor and subsequently approved by the Engineer. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans or as given, except as herein specified, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the Contract. Work so done may be ordered removed or replaced at the Contractor's expense.

Upon failure on the part of the Contractor to comply forthwith with any order of the Engineer made under the provisions of this subsection, the Engineer will have authority to cause unacceptable work to be remedied, or removed and replaced, and unauthorized work to be removed, and to deduct the costs (incurred by the OWNER) from any monies due or to become due the Contractor.

60-11 LOAD RESTRICTIONS

The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads beyond the limits of the work. A special permit will not relieve the Contractor of liability for damage which may result from the moving of material or equipment.

The operation of equipment of such weight or so loaded as to cause damage to structures or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed. No loads will be permitted on a concrete pavement, base, or structure before the expiration of the curing period. The Contractor shall be responsible for all damage done by his hauling equipment and shall correct such damage at his own expense.

60-12 MAINTENANCE DURING CONSTRUCTION

The Contractor shall maintain the work during construction and until the work is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces so that the work is maintained in satisfactory condition at all times.

All costs of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various Contract items, and the Contractor will not be paid an additional amount for such work.

60-13 FAILURE TO MAINTAIN THE WORK

Should the Contractor at any time fail to maintain the work as provided in the paragraph titled MAINTENANCE DURING CONSTRUCTION of this subsection, the Engineer shall immediately notify the Contractor of such noncompliance. Such notification shall specify a reasonable time within which the Contractor shall be required to remedy such unsatisfactory maintenance condition. The time specified will give due consideration to the urgency that exists.

Should the Contractor fail to respond to the OWNER's notification, the OWNER may suspend any work necessary for the OWNER to correct such unsatisfactory maintenance condition, depending on the urgency that exists. Any maintenance cost incurred by the OWNER, shall be deducted from monies due or to become due the Contractor.

60-14 PARTIAL ACCEPTANCE

If at any time during the prosecution of the project the Contractor substantially completes a usable unit or portion of the work, the occupancy of which will benefit the OWNER, he may request the

Engineer to make final inspection of that unit. If the Engineer finds upon inspection that the unit has been satisfactorily completed in compliance with the Contract, he may accept it as being completed, and the Contractor may be relieved of further responsibility for that unit. Such partial acceptance and beneficial occupancy by the OWNER shall not void or alter any provision of the Contract or warranty.

60-15 FINAL CONSTRUCTION INSPECTION

Whenever the Engineer considers the work provided and contemplated by the Contract is nearing completion, or within ten (10) days after being notified by the Contractor that the work is completed, the Engineer will inspect all the work included in the Contract. If the Engineer finds that the work has not been satisfactorily completed at the time of such inspection, he shall inform the Contractor in writing as to the work to be done or the particular defects to be remedied to place the work in condition satisfactory for Final Construction Inspection. After the work has been satisfactorily completed the Engineer shall make the Final Construction Inspection.

60-16 FINAL ACCEPTANCE

Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer and OWNER will make an inspection. If all construction provided for and contemplated by the Contract is found to be completed in accordance with the Contract, plans and specifications, such inspection shall constitute the final inspection. The Engineer shall notify the Contractor in writing of final acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection, provided the work has been satisfactorily completed. In such event, the OWNER will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of final inspection.

60-17 CLAIMS FOR ADJUSTMENT AND DISPUTES

If for any reason the Contractor deems that additional compensation is due him for work or materials not clearly provided for in the Contract, plans, or specifications or previously authorized as extra work, he shall notify the Engineer in writing of his intention to claim such additional compensation before he begins the work on which he bases the claim. If such notification is not given or the Engineer is not afforded proper opportunity by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby agrees to waive any claim for such additional compensation. Such notice by the Contractor and the fact that the OWNER has kept account of the cost of the work shall not in any way be construed as proving or substantiating the validity of the claim. When the work on which the claim for additional compensation is based has been completed, the Contractor shall, within 10 calendar days, submit his written claim to the Engineer, who will present it to the OWNER for consideration.

Nothing in this subsection shall be construed as a waiver of the Contractor's right to dispute the final payment based on differences in measurements or computations.

SECTION 70

CONTROL OF MATERIALS

70-01 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS

The materials used on the work shall conform to the requirements of the Contract, plans, and specifications. Unless otherwise specified, such materials that are manufactured or processed shall be new (as compared to used or reprocessed).

In order to expedite the inspection and testing of materials, the Contractor shall furnish complete statements to the OWNER as to the origin, composition, and manufacture of all materials to be used in the work. Such statements shall be furnished promptly after execution of the Contract, but, in all cases, prior to delivery of such materials.

At the OWNER's option, materials may be approved at the source of supply before delivery is started. If it is found after trial sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other sources.

70-02 SAMPLES, TESTS, AND CITED SPECIFICATIONS

All materials used in the work shall be inspected, tested, and approved by the Engineer before incorporation in the work. Any work in which untested materials are used without approval or written permission of the Engineer shall be performed at the Contractor's risk. Materials found to be unacceptable and unauthorized will not be paid for and, if directed by the Engineer, shall be removed at the Contractor's expense. Unless otherwise designated, tests in accordance with the cited standard methods of AASHTO or ASTM which are current on the date of advertisement for bids will be made by and at the expense of the OWNER. Samples will be taken by a qualified representative of the OWNER. All materials being used are subject to inspection, test, or rejection at any time prior to or during incorporation into the work. Copies of all tests will be furnished to the Contractor's representative at his request.

70-03 CERTIFICATION OF COMPLIANCE

The Engineer may permit the use, prior to sampling and testing, of certain materials or assemblies when accompanied by manufacturer's certificates of compliance stating that such materials or assemblies fully comply with the requirements of the Contract. The certificate shall be signed by the manufacturer. Each lot of such materials or assemblies delivered to the work must be accompanied by a certificate of compliance in which the lot is clearly identified.

Materials or assemblies used on the basis of certificates of compliance may be sampled and tested at any time and if found not to be in conformity with Contract requirements will be subject to rejection whether in place or not.

The form and distribution of certificates of compliance shall be as approved by the Engineer.

When a material or assembly is specified by "brand name or equal" and the Contractor elects to furnish the specified "brand name", the Contractor shall be required to furnish the manufacturer's certificate of compliance for each lot of such material or assembly delivered to the work. Such certificate of compliance shall clearly identify Each lot delivered and shall certify as to:

- (a) Conformance to the specified performance, testing, quality or dimensional requirements; and
- (b) Suitability of the material or assembly for the use intended in the Contract work.

Should the Contractor propose to furnish an "or equal" material or assembly, he shall furnish the manufacturer's certificates of compliance as hereinbefore described for the specified brand name material or assembly. However, the Engineer shall be the sole judge as to whether the proposed "or equal" is suitable for use in the work.

70-04 PLANT INSPECTION

The Engineer or his authorized representative may inspect, at its source, any specified material or assembly to be used in the work. Manufacturing plants may be inspected from time to time for the purpose of determining compliance with specified manufacturing methods or materials to be used in the work and to obtain samples required for his acceptance of the material or assembly.

Should the Engineer conduct plant inspections, the following conditions shall exist:

- (a) The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has contracted the materials.
- (b) The Engineer shall have full entry at all reasonable times to such parts of the plant that concern the manufacture or production of the materials being furnished.
- (c) If required by the Engineer, the Contractor shall arrange for adequate office or working space that may be reasonably needed for conducting plant inspections. Office or working space should be conveniently located with respect to the plant.

It is understood and agreed that the OWNER shall have the right to retest any material which has been tested and approved at the source of supply after it has been delivered to the site. The Engineer shall have the right to reject only material which, when retested, does not meet the requirements of the Contract, plans, or specifications.

70-05 ENGINEER'S FIELD OFFICE AND LABORATORY

When specified and provided for as a Contract item, the Contractor shall furnish a building for the exclusive use of the Engineer as a field office and field testing laboratory. The building shall be furnished and maintained by the Contractor, as specified herein, and shall become property of the Contractor when the Contract work is completed.

70-06 STORAGE OF MATERIALS

Materials shall be stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be located so as to facilitate their prompt inspection. The Contractor shall coordinate the storage of all materials with the Engineer. Materials to be stored on OWNER's property shall not create an obstruction to commerce nor shall they interfere with the free and unobstructed movement of traffic. Unless otherwise shown on the plans, the storage of materials and the location of the Contractor's plant and parked equipment or vehicles shall be as directed by the Engineer. Private property shall not be used for storage purposes without written permission of the owner or lessee of such property. The Contractor shall make all arrangements and bear all expenses for the storage of materials on private property. Upon request, the Contractor shall furnish the Engineer a copy of the property owner's permission.

All storage sites on private or owner's property shall be restored to their original condition by the Contractor at his entire expense, except as otherwise agreed to (in writing) by the owner or lessee of the property.

70-07 UNACCEPTABLE MATERIALS

Any material or assembly that does not conform to the requirements of the Contract, plans, or specifications shall be considered unacceptable and shall be rejected. The Contractor shall remove any rejected material or assembly from the site of the work, unless otherwise instructed by the Engineer.

No rejected material or assembly, the defects of which have been corrected by the Contractor, shall be returned to the site of the work until such time as the Engineer has approved its use in the work.

70-08 OWNER-FURNISHED MATERIAL

The Contractor shall furnish all materials required to complete the work, except those specified herein (if any) to be furnished by the OWNER. OWNER-furnished materials shall be made available to the Contractor at the location specified herein.

All cost of handling, transportation from the specified location to the site of work, storage, and installing OWNER-furnished materials shall be included in the unit price bid for the Contract item in which such OWNER-furnished material is used.

After any OWNER-furnished material has been delivered to the location specified, the Contractor shall be responsible for any demurrage, damage, loss, or other deficiencies which may occur during the Contractor's handling, storage, or use of such OWNER-furnished material. The OWNER will deduct from any monies due or to become due the Contractor any cost incurred by the OWNER in making good such loss due to the Contractor's handling, storage, or use of OWNER-furnished materials.

70-09 RECEIVING MATERIALS AND EQUIPMENT

The Contractor shall be responsible for clerical salaries, office space and equipment rental, incidentals to receiving incoming shipments and deliveries of all materials and equipment. All material which must be protected from the elements will be properly and orderly stored in shelters provided by the Contractor. All goods and materials stored out of doors will be properly and orderly supported. The Contractor will be responsible for safeguarding all such goods and materials against loss due to damage and theft.

SECTION 80 LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

80-01 LAWS TO BE OBSERVED

The Contractor shall keep fully informed of all Federal and State laws, and local ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. He shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the OWNER and all his officers, agents, or servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by himself or his employees.

80-02 PERMITS, LICENSES, AND TAXES

The Contractor shall procure all permits and licenses, pay all charges, fees and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work.

80-03 PATENTED DEVICES, MATERIALS AND PROCESSES

If the Contractor is required or desires to use any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner, or a third party, from any and all claims for infringement by reason of the use of any such patented design, device, materials or process, or any trademark or copyright, and shall indemnify the OWNER for such costs, expenses, and damages which it may be obliged to pay by reason of an infringement, at any time during the prosecution or after the completion of the work.

80-04 RESTORATION OF SURFACES DISTURBED BY OTHERS

The OWNER reserves the right to authorize the construction, reconstruction, or maintenance of any public or private utility service, or a utility service of another government agency at any time during the process of the work. To the extent that such construction, reconstruction, or maintenance has been coordinated with the OWNER, such authorized work (by others) is noted in the plans.

Except as noted on the plans, the Contractor shall not permit any individual, firm, or corporation to excavate or otherwise disturb such utility services or facilities located within the limits of the work without the written permission of the Engineer.

Should the owner of public or private utility service, or a utility service of another government agency be authorized to construct, reconstruct, or maintain such utility service or facility during the process of the work, the Contractor shall cooperate with such owners by arranging and performing the work in this Contract so as to facilitate such construction, reconstruction or maintenance by others whether or not such work by others is noted on the plans. When ordered as extra work by the Engineer, the Contractor shall make all necessary repairs to the work which are due to such authorized work by others, unless otherwise provided for in the Contract, plans, or specifications. It is understood and agreed that the Contractor shall not be entitled to make any claim for damages due to such authorized work by others or for any delay to the work resulting from such authorized work.

80-05 SANITARY, HEALTH, AND SAFETY PROVISIONS

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements of the State and Local Board of Health, or of other bodies or tribunals having jurisdiction.

Attention is directed to Federal, State, and local laws, rules and regulations concerning construction safety and health standards. The Contractor shall not require any worker to work in surroundings or under conditions which are unsanitary, hazardous, or dangerous to his health or safety.

80-06 PUBLIC CONVENIENCE AND SAFETY

The Contractor shall control his operations and those of his Subcontractors and all suppliers, to assure the least inconvenience to the public. Under all circumstances, safety shall be the most important consideration.

The Contractor shall maintain the free and unobstructed movement of commerce and vehicular traffic with respect to his own operations and those of his Subcontractors and all suppliers in accordance with the paragraph titled MAINTENANCE OF COMMERCE of subsection 50, hereinbefore specified and shall limit such operations for the convenience and safety of the public, as specified in the paragraph titled LIMITATION OF OPERATIONS of subsection 90, hereinafter.

80-07 BARRICADES, WARNING SIGNS, AND HAZARD MARKINGS

The Contractor shall furnish, erect, and maintain all barricades, warning signs, and markings for hazards necessary to protect the public and the work. When used during periods of darkness, such barricades, warning signs and hazard markings shall be suitably illuminated.

For vehicular and pedestrian traffic, the Contractor shall furnish, erect, and maintain barricades, warning signs, lights and other traffic control devices in reasonable conformity with the Manual of Uniform Traffic Control Devices for Streets and Highways (published by the United States Government Printing Office).

The Contractor shall furnish, erect, and maintain markings and associated lighting of open trenches, excavations, temporary stockpiles, and his parked construction equipment that may be hazardous to the operation of emergency fire rescue or maintenance vehicles.

The Contractor shall furnish and erect all barricades, warning signs, and markings for hazards prior to commencing work which requires such erection and shall maintain the barricades, warning signs, and markings for hazards until their dismantling is directed by the Engineer.

Open-flame type lights shall not be permitted.

80-08 USE OF EXPLOSIVES

When the use of explosives is necessary for the prosecution of the work, the Contractor shall exercise the utmost care not to endanger life or property, including new work. The Contractor shall be responsible for all damage resulting from the use of explosives.

All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the Engineer and, in general, not closer than 1,000 feet from the work or from any building, road, or other place of human occupancy.

The Contractor shall notify Each property owner and public utility company having structures or facilities in proximity to the site of the work of his intention to use explosives. Such notice shall be given sufficiently in advance to enable them to take such steps as they may deem necessary to protect their property from injury.

80-09 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE

The Contractor shall be responsible for the preservation of all public and private property, and shall protect carefully from disturbance or damage all land monuments and property marks until

the Engineer has witnessed or otherwise referenced their location and shall not move them until directed.

The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the work, or at any time due to defective work or materials, and said responsibility will not be released until the project shall have been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work or in consequence of the nonexecution thereof by the Contractor, he shall restore, at his own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or he shall make good such damage or injury in any acceptable manner.

80-10 RESPONSIBILITY FOR DAMAGE CLAIMS

The Contractor shall indemnify and save harmless the Engineer and the OWNER and their officers, and employees from all suits, actions, or claims of any character brought because of any injuries or damage received or sustained by any person, persons, or property on account of the operations of the Contractor; or on account of or in consequence of any neglect in safeguarding the work; or because of any act or through use of unacceptable materials in constructing the work; or because of any claims or amount recovered from any infringements of patent, trademark, or copyright; or from any claims or amount arising or recovered under the "Workman's Compensation Act" or any other law, ordinance, order or decree.

Money due the Contractor under and by virtue of his Contract as may be considered necessary by the OWNER for such purpose may be retained for the use of the OWNER or, in case no money is due, his surety may be held until such suit or suits, action or actions, claim or claims for injuries or damages as aforesaid shall have been settled and suitable evidence to that effect furnished to the OWNER, except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that he is adequately protected by public liability and property damage insurance.

80-11 THIRD PARTY BENEFICIARY CLAUSE

It is specifically agreed between the parties executing the Contract that it is not intended by any of the provisions of any part of the Contract to create the public or any member thereof a third party beneficiary or to authorize anyone not a party to the Contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the Contract.

80-12 OPENING SECTIONS OF THE WORK FOR OCCUPANCY

Should it be necessary for the Contractor to complete portions of the Contract work for the beneficial occupancy of the OWNER prior to completion of the entire Contract, such "phasing" of the work shall be as specified herein, and indicated on the plans. When so specified, the Contractor shall complete such portions of the work on or before the date specified or as otherwise specified. The Contractor shall make his own estimate of the difficulties involved in arranging his work to permit such beneficial occupancy by the OWNER as described elsewhere in these specifications.

Upon completion of any portion of the work so described, such portion shall be accepted by the OWNER in accordance with the paragraph titled PARTIAL ACCEPTANCE of Subsection 60.

No portion of the work may be opened by the Contractor for use until ordered by the Engineer in writing. Should it become necessary to open a portion of the work to Docks traffic on a temporary or intermittent basis, such openings shall be made when, in the opinion of the Engineer, such

portion of the work is in an acceptable condition to support the intended traffic. Temporary or intermittent openings are considered to be inherent in the work and shall not constitute either acceptance of the portion of the work so opened or a waiver of any provision of the Contract. Any damage to the portion of the work so opened that is not attributable to traffic which is permitted by the OWNER shall be repaired by the Contractor at his expense.

The Contractor shall make his own estimate of the inherent difficulties involved in completing the work under the conditions herein described and shall not claim any added compensation by reason of delay or increased cost due to opening a portion of the Contract work.

80-13 CONTRACTOR'S RESPONSIBILITY FOR WORK

Until the Engineer's final written acceptance of the entire completed work excepting only those portions of the work accepted in accordance with the paragraph titled PARTIAL ACCEPTANCE of Subsection 60, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part due to the action of the elements or from any other cause, whether arising from the execution or from the nonexecution of the work. The Contractor shall rebuild, repair, store, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof.

If the work is suspended for any cause whatever, the Contractor shall be responsible for the work and shall take such precautions necessary to prevent damage to the work. The Contractor shall provide for normal drainage and shall erect necessary temporary structures, signs, or other facilities at his expense. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established planting, seeding, and sodding, furnished under his Contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

80-14 CONTRACTOR'S RESPONSIBILITY FOR UTILITY SERVICE AND FACILITIES OF OTHERS

As provided in the paragraph titled RESTORATION OF SURFACES DISTURBED BY OTHERS of this subsection, the Contractor shall cooperate with the owner of any public or private utility service, or a utility service of another government agency that may be authorized by the OWNER to construct, reconstruct or maintain such utility services or facilities during the progress of the work. In addition, the Contractor shall control his operations to prevent the unscheduled interruption of such utility services and facilities.

To the extent that such public or private utility services, or utility services of another governmental agency are known to exist within the limits of the Contract work, the approximate locations have been indicated on the plans.

It is understood and agreed that the OWNER does not guarantee the accuracy or the completeness of the location information relating to existing utility services, facilities, or structures that may be shown on the plans or encountered in the work. Any inaccuracy or omission in such information shall not relieve the Contractor of his responsibility to protect such existing features from damage or unscheduled interruption of service.

It is further understood and agreed that the Contractor shall, upon execution of the Contract, notify the owners of all utility services or other facilities of his plan of operations. Such notification shall be in writing. In addition to the general written notifications hereinbefore provided, it shall be the responsibility of the Contractor to keep such individual owners advised of changes in his plan of operations that would affect such owners.

Prior to commencing the work in the general vicinity of an existing utility service or facility, the Contractor shall again notify Each such owner of his plan or operation. If, in the Contractor's

opinion, the owner's assistance is needed to locate the utility service or facility or the presence of a representative of the owner is desirable to observe the work, such advice should be included in the notification. Such notification shall be given by the most expeditious means to reach the utility owner no later than two normal business days prior to the Contractor's commencement of operations in such general vicinity. The Contractor shall furnish a written summary of the notification to the Engineer.

The Contractor's failure to give the two days' notice hereinabove provided shall be cause for the Engineer to suspend the Contractor's operations in the general vicinity of a utility service or facility.

Where the outside limits of an underground utility service have been located and staked on the ground, the Contractor shall be required to use excavation methods acceptable to the Engineer within three (3) feet of such outside limits at such points as may be required to insure protection from damage due to the Contractor's operations.

Should the Contractor damage or interrupt the operations of a utility service or facility by accident or otherwise, he shall immediately notify the proper authority and the Engineer and shall take all reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall cooperate with the utility service or facility owner and the Engineer continuously until such damage has been repaired and service restored to the satisfaction of the utility or facility owner.

The Contractor shall bear all costs of damage and restoration of service to any utility service or facility due to his operations whether or not due to negligence or accident. The OWNER reserves the right to deduct such costs from any monies due or which may become due the Contractor, or his surety.

80-15 FURNISHING RIGHTS-OF-WAY

The OWNER will be responsible for furnishing all rights-of-ways upon which the work is to be constructed in advance of the Contractor's operations.

80-16 PERSONAL LIABILITY OF PUBLIC OFFICIALS

In carrying out any of the Contract provisions or in exercising any power or authority granted to him by this Contract, there shall be no liability upon the Engineer, his authorized representatives, or any official of the OWNER either personally or as an official of the OWNER. It is understood that in such manner they act solely as agents and representatives of the OWNER.

80-17 NO WAIVER OF LEGAL RIGHTS

Upon completion of the work, the OWNER will expeditiously make final inspection and notify the Contractor of final acceptance. Such final acceptance, however, shall not preclude or stop the OWNER from correcting any measurement, estimate or certificate made before or after completion of the work, nor shall the OWNER be precluded or stopped from recovering from the Contractor or his surety, or both, such overpayment as may be sustained, or by failure on the part of the Contractor to fulfill his obligations under the Contract. A waiver on the part of the OWNER of any breach of any part of the Contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the Contract, shall be liable to the OWNER for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the OWNER's rights under any warranty or guaranty.

80-18 ENVIRONMENTAL PROTECTION

The Contractor shall comply with all Federal, State and local laws and regulations controlling pollution of the environment. He shall take necessary precautions to prevent pollution of streams,

lakes, ponds, and reservoirs with silt runoff, fuels, oils, bitumens, chemicals, or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter.

80-19 ARCHAEOLOGICAL AND HISTORICAL FINDINGS

Unless otherwise specified in this subsection, the Contractor is advised that the site of the work is not within any property, district, or site, and does not contain any building, structure, or object listed in the current National Register of Historic Places published by the United States Department of Interior.

Should the Contractor encounter, during his operations, any building, part of a building, structure, or object which is incongruous with its surroundings, he shall immediately cease operations in that location and notify the Engineer. The Engineer will immediately investigate the Contractor's finding and will direct the Contractor to either resume his operations or to suspend operations as directed.

Should the Engineer order suspension of the Contractor's operations in order to protect an archaeological or historical finding, or order the Contractor to perform extra work, such shall be covered by an appropriate Contract modification (change order or supplemental agreement) as provided in the paragraph titled EXTRA WORK AND FORCE ACCOUNT WORK of Subsection 100. If appropriate, the Contract modification shall include an extension of Contract time in accordance with the paragraph titled DETERMINATION AND EXTENSION OF CONTRACT TIME of Subsection 90.

SECTION 90 PROSECUTION AND PROGRESS

90-01 SUBLETTING OF CONTRACT

The OWNER will not recognize any Subcontractor on the work. The Contractor shall at all times when work is in progress be represented either in person, by a qualified superintendent, or by other designated, qualified representative who is duly authorized to receive and execute orders of the Engineer.

Should the Contractor elect to assign his Contract, said assignment shall be concurred in by the surety, shall be presented for the consideration and approval of the OWNER. In case of approval, the Contractor shall file copies of all Subcontractors with the Engineer.

90-02 NOTICE TO PROCEED

The notice to proceed shall state the date on which it is expected the Contractor will begin the construction and from which date Contract time will be charged. If no such date is stated in the notice to proceed, Contract time will start on the date the notice to proceed is issued. The Contractor shall begin the work to be performed under the Contract within ten (10) days of the date set by the Engineer in the written notice to proceed, but in any event the Contractor shall notify the Engineer at least 24 hours in advance of the time actual construction operations will begin.

90-03 PROSECUTION AND PROGRESS

Unless otherwise specified, the Contractor shall submit his progress schedule for the Engineer's approval within 10 days after the effective day of the notice to proceed. The Contractor's progress schedule, when approved by the Engineer, may be used to establish major construction operations and to check on the progress of the work. The Contractor shall provide sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the plans and specifications within the time set forth in the contract.

If the Contractor falls significantly behind the submitted schedule, the Contractor shall, upon the Engineer's request, submit a revised schedule for completion of the work within the Contract time and modify his operations to provide such additional materials, equipment, and labor necessary to meet the revised schedule. Should the prosecution of the work be discontinued for any reason, the Contractor shall notify the Engineer at least 24 hours in advance of resuming operations.

90-04 LIMITATION OF OPERATIONS

The Contractor shall control his operations and the operations of his Subcontractors and all suppliers so as to provide for the free and unobstructed movement of commerce in those areas adjacent to the work.

90-05 CHARACTER OF WORKERS, METHODS AND EQUIPMENT

The Contractor shall, at all times, employ sufficient labor and equipment for prosecuting the work to full completion in the manner and time required by the Contract, plans, and specifications.

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform the work satisfactorily.

Any persons employed by the Contractor or by any Subcontractor who, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed forthwith by the Contractor or Subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the Engineer.

Should the Contractor fail to remove such person or persons or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until compliance with such orders is ascertained.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet the requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the work shall be such that no injury to previously completed work, adjacent property, or existing facilities will result from its use.

When the methods and equipment to be used by the Contractor in accomplishing the work are not prescribed in the Contract, the Contractor is free to use any methods or equipment that will accomplish the work in conformity with the requirements of the Contract, plans and specifications.

When the Contract specifies the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than specified in the Contract, he may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed and of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing the work in conformity with Contract requirements. If, after trial use on the substituted methods or equipment, the Engineer determines that the work produced does not meet Contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining work with the specified methods and equipment. The Contractor shall remove any deficient work and replace it with work of specified quality or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the Contract items involved or in Contract time as a result of authorizing a change in methods or equipment under this subsection.

90-06 TEMPORARY SUSPENSION OF THE WORK

The Engineer shall have the authority to suspend the work wholly, or in part, for such period or periods as he may deem necessary, due to unsuitable weather, or such other conditions as are considered unfavorable for the prosecution of the work, or for such time as is necessary due to the failure on the part of the Contractor to carry out orders given or perform any or all provisions of the Contract.

In the event that the Contractor is ordered by the Engineer, in writing, to suspend work for some unforeseen cause not otherwise provided for in the Contract and over which the Contractor has no control, the Contractor may be reimbursed for actual money expended on the work during the period of shutdown. No allowance will be made for anticipated profits. The period of shutdown shall be computed from the effective date of the Engineer's order to suspend work to the effective date of the Engineer's order to resume the work. Claims for such compensation shall be filed with the Engineer within the time period stated in the Engineer's order to resume work. The Contractor shall submit with his claim information substantiating the amount shown on the claim. The Engineer will forward the Contractor's claim to the OWNER for consideration. No provision of this article shall be construed as entitling the Contractor to compensation for delays due to inclement weather, for suspensions made at the request of the Contractor, or for any other delay provided for in the Contract, plans, or specifications.

If it should become necessary to suspend work for an indefinite period, the Contractor shall store all materials in such manner that they will not become an obstruction nor become damaged in any way. He shall take every precaution to prevent damage or deterioration of the work performed and provide for normal drainage of the work. The Contractor shall erect temporary structures where necessary to provide for traffic on, to, or from the site.

90-07 DETERMINATION AND EXTENSION OF CONTRACT TIME

The number of calendar or working days allowed for completion of the work shall be stated in the proposal and Contract and shall be known as the CONTRACT TIME.

Should the CONTRACT TIME require extension for reasons beyond the Contractor's control, it shall be adjusted as follows:

- (a) CONTRACT TIME based on WORKING DAYS shall be calculated weekly by the Engineer. The Engineer will furnish the Contractor a copy of his weekly statement of the number of working days charged against the CONTRACT TIME during the week and the number of working days currently specified for completion of the Contract (the original CONTRACT TIME plus the number of working days, if any, that have been included in approved CHANGE ORDERS, or SUPPLEMENTAL AGREEMENTS covering EXTRA WORK).

The Engineer shall base his weekly statement of CONTRACT TIME charges on the following considerations:

- (1) No time shall be charged for days on which the Contractor is unable to proceed with the principal item of work under construction at the time for at least 6 hours with the normal work force employed on such principal item. Should the normal work force be on a triple shift, 18 hours shall apply. Conditions beyond the Contractor's control such as strikes, lockouts, unusual delays in transportation, temporary suspension of the principal item of work under construction or temporary suspension of the entire work which have been ordered by the Engineer for reasons not the fault of the Contractor, shall not be charged against the CONTRACT TIME.
 - (2) The Engineer will not make charges against the CONTRACT TIME prior to the effective date of the notice to proceed.
 - (3) The Engineer will begin charges against the CONTRACT TIME on the first working day after the effective date of the notice to proceed.
 - (4) The Engineer will not make charges against the CONTRACT TIME after the date of final acceptance as defined in the paragraph titled FINAL ACCEPTANCE of Subsection 60.
 - (5) The Contractor will be allowed one week in which to file a written protest setting forth his objections to the Engineer's weekly statement. If no objection is filed within such specified time, the weekly statement shall be considered as acceptable to the Contractor.
 - (6) The CONTRACT TIME (state in the proposal) is based on the originally estimated quantities as described in the paragraph titled INTERPRETATION OF ESTIMATED PROPOSAL QUANTITIES of Subsection 20. Should the satisfactory completion of the Contract require performance of work in greater quantities than those estimated in the proposal, the CONTRACT TIME shall be increased in the same proportion as the cost of the actually completed quantities bears to the cost of the originally estimated quantities in the proposal. Such increase in CONTRACT TIME shall not consider either the cost of work or the extension of CONTRACT TIME that has been covered by change order or supplemental agreement and shall be made at the time of final payment.
- (b) CONTRACT TIME based on CALENDAR DAYS shall consist of the number of calendar days stated in the Contract counting from the effective date of the notice to proceed and including all Saturdays, Sundays, holidays, and no work days. All calendar days elapsing between the effective dates of the Engineer's orders to suspend and resume all work, due to causes not the fault of the Contract, shall be excluded.

At the time of final payment, the CONTRACT TIME shall be increased in the same proportion as the cost that the actually completed quantities bear to the cost of the originally estimated quantities in the proposal. Such increase in the CONTRACT TIME shall not consider either

the cost of work of the extension of CONTRACT TIME that has been covered by a change order or supplemental agreement. Charges against the CONTRACT TIME will cease as of the date of final agreement.

- (c) When the CONTRACT TIME is a specified completion date, it shall be the date on which all Contract work shall be substantially completed.

If the Contractor finds it impossible for reasons beyond his control to complete the work within the Contract time as specified, or as extended in accordance with the provisions of this subsection, he may, at any time prior to the expiration of the CONTRACT TIME as extended, make a written request to the Engineer for an extension of time setting forth the reasons which he believes will justify the granting of his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect, the same as though it were the original time for completion.

90-08 FAILURE TO COMPLETE ON TIME

For Each calendar day or working day, as specified in the Contract, that any work remains incomplete after the CONTRACT TIME (including all extensions and adjustments as provided in the paragraph titled DETERMINATION AND EXTENSION OF CONTRACT TIME of this Subsection) the sum specified in the Contract and proposal as liquidated damages will be deducted from any money due or to become due the Contractor or his surety. Such deducted sums shall not be deducted as a penalty but shall be considered as liquidation of a reasonable portion of damages that will be incurred by the OWNER should the Contractor fail to complete the work in the time provided in his Contract.

The Contractor will not be charged with liquidated damages when delay in completion of the work is due to acts of the public enemy, acts of the OWNER, acts of another Contractor in the performance of a Contract with the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, or freight embargoes.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a waiver on the part of the OWNER of any rights under the Contract.

90-09 CONTRACT DEFAULT

The Contractor shall be considered in default of his Contract and such default will be considered as cause for the OWNER to terminate the Contract for any of the following reasons if the Contractor:

- (a) Fails to begin the work under the Contract within the time specified in the "Notice to Proceed"; or
- (b) Fails to perform the work or fails to provide sufficient workers, equipment or materials to assure completion of work in accordance with the terms of the Contract; or
- (c) Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable; or
- (d) Discontinues the prosecution of the work; or
- (e) Fails to resume work which has been discontinued within a reasonable time after notice to do so; or
- (f) Becomes insolvent or is declared bankrupt, or commits an act of bankruptcy or insolvency; or

- (g) Allows any final judgment to stand against him unsatisfied for a period of 10 days; or
- (h) Makes an assignment for the benefit of creditors; or
- (i) For any other cause whatsoever, fails to carry on the work in an acceptable manner.

Should the Engineer consider the Contractor in default of the Contract for any reason hereinbefore, he shall immediately give written notice to the Contractor and the Contractor's surety as to the reasons for considering the construction in default and the OWNER's intentions to terminate the Contract.

If the Contractor or surety, within a period of 10 days after such notice, does not proceed in accordance therewith, then the OWNER will, upon written notification from the Engineer of the facts of such delay, neglect, or default and the Contractor's failure to comply with such notice, have full power and authority without violating the Contract, to take the prosecution of the work out of the hands of the Contractor. The OWNER may appropriate or use any or all materials and equipment that have been mobilized for use in the work and are acceptable and may enter into an agreement for the completion of said Contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of said Contract in an acceptable manner.

All costs and charges incurred by the OWNER, together with the cost of completing the work under Contract, will be deducted from any monies due or which may become due the Contractor. If such expense exceeds the sum which would have been payable under the Contract, then the Contractor and the surety shall be liable and shall pay to the OWNER the amount of such excess.

90-10 CONTRACT TERMINATION

The Owner may terminate the Contract, or any portion hereof, for just cause by written notice to the Contractor.

When the Contract, or any portion thereof, is terminated before completion of all items of work in the Contract, payment will be made for the actual number of units or items of work completed or started. No claims for loss of anticipated profits shall be considered.

Acceptable materials both in quantity and quality obtained or ordered by the Contractor that are not incorporated into the work shall, at the option of the Contractor, be purchased by the Owner at actual cost as shown by receipted bills and actual cost records. Delivery of the materials will be performed as designated by the Engineer.

Termination of the Contract, or a portion thereof, shall neither relieve the Contractor of his responsibilities for the completed work nor relieve his surety of its obligation for and concerning any just claim arising out of the work performed.

The costs incurred by the Contractor for mobilization, if applicable, shall be itemized and presented to the Owner. Rebates and refunds that are applicable shall be itemized, and the amount paid the Contractor shall be adjusted to reflect actual cost as shown by receipted bills and actual cost records.

The cost of demobilization of Contractor's equipment and other items pertaining to the expense of moving off the job site shall be itemized and supported by actual cost records and presented for payment. Demobilization as a percentage of the Contract amount, or portion thereof, shall not be paid.

Reimbursement for organization of the work and overhead expenses (when not otherwise included in the Contract) will be considered, the intent being that an equitable settlement will be made with the Contractor.

All of the above are subject to audit as specified by the Right to Audit, Paragraph 100-11.

SECTION 100 MEASUREMENT AND PAYMENT

100-01 MEASUREMENT OF QUANTITIES

All work completed under the Contract will be measured by the Engineer, or his authorized representatives, using United States Customary Units of Measurement.

The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the Contract will be those methods generally recognized as conforming to good Engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and no deductions will be made for individual fixtures (or leave-outs) having an area of 9 square feet or less. Unless otherwise specified, transverse measurements for area computations will be the near dimensions shown on the plans or ordered in writing by the Engineer.

Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

Unless otherwise specified, all Contract items which are measured by the Linear Foot such as electrical ducts, conduits, pipe culverts, underdrains, and similar items shall be measured parallel to the base or foundation upon which such items are placed.

In computing volumes of excavation, the average end area method or other acceptable methods will be used. Acceptability of another method will be decided by the Engineer.

The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing will be specified and measured in decimal fractions of inches.

The term "ton" will mean the short ton consisting of 2,000 pounds avoirdupois. All materials which are measured or proportioned by weights shall be weighed on accurate, approved scales by competent, qualified personnel at locations designated by the Engineer. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material is paid for. However, car weights will not be acceptable for materials to be passed through mixing plants. Trucks used to haul materials being paid for by weight shall be weighed empty daily at such times as the Engineer directs, and each truck shall bear the plainly legible identification mark.

Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles shall be loaded to at least their water level capacity and all loads shall be leveled when the vehicles arrive at the point of delivery.

When requested by the Contractor and approved by the OWNER in writing, material specified to be measured by the Cubic Yard may be weighed and such weights will be converted to Cubic Yards for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the Engineer and shall be agreed to by the Contractor before such method of measurement of pay quantities is used.

Bituminous materials will be measured by the gallon or ton. When measured by volume, such volumes will be measured at 60 degrees F, or will be corrected to the volume at 60 degrees F using ASTM D 1250 for asphalt or ASTM D 633 for tars.

Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when bituminous material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work.

When bituminous materials are shipped by truck or transport, net certified weights by volume, subject to correction for loss or foaming, may be used for computing quantities.

Lumber will be measured by the thousand feet board measure (M.F.B.M.) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term "Lump Sum" when used as an item of payment will mean complete payment for the work described in the Contract.

When a complete structure or structural unit (in effect, "Lump Sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

Rental of equipment will be measured by time in hours of actual working time and necessary traveling time of the equipment within the limits of the work. Special equipment ordered by the Engineer in connection with force account work will be measured as agreed in the change order or supplemental agreement authorizing such force account work as provided in the paragraph titled PAYMENT FOR EXTRA AND FORCE ACCOUNT WORK of this section.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

Scales for weighing materials which are required to be proportioned or measured and paid for by weight shall be furnished, erected, and maintained by the Contractor, or by certified permanently installed commercial scales.

Scales shall be accurate within one-half percent of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the inspector before beginning work and at such other times as requested. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and shall not exceed one tenth of one percent of the nominal rated capacity of the scale, but not less than one pound. The use of spring balances will not be permitted.

Beams, dials, platforms, and other scale equipment shall be so arranged that the operator and inspector can safely and conveniently view them.

Scale installation shall have available, ten standard fifty pound weights for testing the weighing equipment or suitable weights and devices for other approved equipment.

Scales must be tested for accuracy and serviced before use at a new site. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end.

Scales "overweighing" (indicating more than correct weight) will not be permitted to operate, and all materials received subsequent to the last previous correct weighing-accuracy-test will be reduced by the percentage of error in excess of one-half of one percent.

In the event inspection reveals the scales have been "underweighing" (indicating less than correct weight) they shall be adjusted and no additional payment to the Contractor will be allowed for materials previously weighed and recorded.

All costs in connection with furnishing, installing, certifying, testing, and maintaining scales; for furnishing check weights and scale house; and for all other items specified in this subsection, for the weighing of materials for proportioning, or payment, shall be included in the unit Contract prices for the various items of the project.

When the estimated quantities for a specific portion of the work are designated as the pay quantities in the Contract, they shall be the final quantities for which payment for such specific

portion of the work will be made, unless the dimensions of said portion of the work shown on the plans are revised by the Engineer. If revised dimensions result in an increase or decrease in the quantities of such work, the final quantities for payment will be revised in the amount represented by the authorized changes in the dimensions.

100-02 SCOPE OF PAYMENT

The Contractor shall receive and accept compensation provided for in the Contract as full payment for furnishing all materials, for performing all work under the Contract in a complete and acceptable manner, and for all risk, loss, damage, or expense of whatever character arising out of the nature of the work or the prosecution thereof, subject to the provisions of the paragraph titled NO WAIVER OF LEGAL RIGHTS of Subsection 80.

When the "basis of payment" subsection of a technical specification requires that the Contract price (price bid) include compensation for certain work or material essential to the item, this same work or material will not also be measured for payment under any other Contract item which may appear elsewhere in the Contract, plans, or specifications.

100-03 COMPENSATION FOR ALTERED QUANTITIES

When the accepted quantities of work vary from the quantities in the proposal, the Contractor shall accept as payment in full, so far as Contract items are concerned, payment at the original Contract price for the accepted quantities of work actually completed and accepted. No allowance, except as provided for in the paragraph titled ALTERATION OF WORK AND QUANTITIES of Subsection 50 will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor which results directly from such alterations or indirectly from his unbalanced allocation of overhead and profit among the Contract items, or from any other cause.

100-04 PAYMENT FOR OMITTED ITEMS

As specified in the paragraph titled OMITTED ITEMS of Subsection 50, the Engineer shall have the right to omit from the work (order nonperformance) any Contract item, except major Contract items, in the best interest of the OWNER.

Should the Engineer omit or order nonperformance of a Contract item or portion of such item from the work, the Contractor shall accept payment in full at the Contract prices for any work actually completed and acceptable prior to the Engineer's order to omit or not perform such Contract item.

Acceptable materials ordered by the Contractor or delivered on the work prior to the date of the OWNER's order will be paid for at the actual cost to the Contractor and shall thereupon become the property of the OWNER.

In addition to the reimbursement hereinbefore provided, the Contractor shall be reimbursed for all actual costs incurred for the purpose of performing the omitted Contract item prior to the date of the Engineer's order. Such additional costs incurred by the Contractor must be directly related to the deleted Contract item and shall be supported by certified statements by the Contractor as to the nature and amount of such costs.

100-05 PAYMENT FOR EXTRA AND FORCE ACCOUNT WORK

Extra work, performed in accordance with the paragraph titled EXTRA WORK of Subsection 50, will be paid for at the Contract prices or agreed prices specified in the change order or supplemental agreement authorizing such extra work. When the change order or supplemental agreement authorizing the extra work requires that it be done by force account, such force account shall be measured and paid for as follows:

- (a) Labor: For all labor (skilled and unskilled) and foremen in direct charge of a specific force account item, the Contractor shall receive the rate of wage (or scale) for every hour that such laborer or foreman is actually engaged in the specified force account work. Such wage (or scale) shall be agreed upon in writing before beginning the work.

The Contractor shall receive the actual costs paid to, or in behalf of, workers by reason of subsistence and travel allowances, health and welfare benefits, pension funds benefits or other benefits, when such amounts are required by collective bargaining agreement or other employment Contract generally applicable to the classes of labor employed on the work.

An amount equal to fifteen percent (15%) of the sum of the above items will also be paid the Contractor.

- (b) Insurance and Taxes: For property damage, liability, and workmen's compensation insurance premiums, unemployment insurance contributions, and social security taxes on the force account work, the Contractor shall receive the actual cost, and to this cost (sum) 5 percent will be added. The Contractor shall furnish satisfactory evidence of the rate or rates paid for such insurance and taxes.
- (c) Materials: For materials accepted by the Engineer and used, the Contractor shall receive the actual cost of such materials delivered on the work, including transportation charges paid by him (exclusive of machinery rentals as hereinafter set forth), to which cost (sum) 10 percent will be added.
- (d) Equipment: For any machinery or special equipment (other than small tools) including fuel and lubricants, plus transportation costs, the use of which has been authorized by the Engineer, the Contractor shall receive the rental rates agreed upon in writing before such work is begun for the actual time that such equipment is committed to the work.
- (e) Miscellaneous: No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.
- (f) Comparison of Records: The Contractor and the Engineer shall compare records of the cost of force account work at the end of each day. Agreement shall be indicated by signature of the Contractor and Engineer or their duly authorized representatives.
- (g) Statements: No payment will be made for work performing on a force account basis until the Contractor has furnished the Engineer with the duplicate itemized statements of the cost of such force account work detailed as follows:
- (1) Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.
 - (2) Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.
 - (3) Quantities of materials, prices, and extensions.
 - (4) Transportation of materials.
 - (5) Cost of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions, and social security tax.

Statements shall be accompanied and supported by receipted invoice for all materials used and transportation charges. However, if materials used on the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then in lieu of the invoices the Contractor shall furnish an affidavit certifying that such materials were taken from his stock, that the quantity claimed, was actually used, and that the price and transportation claimed represent the actual cost provided above shall constitute full compensation for such work.

100-06 PARTIAL PAYMENT

Partial payments will be made once each month as the work progresses. Said payments will be based upon estimates prepared by the Engineer of the value of the work performed and materials complete in place in accordance with the Contract, plans, and specifications. Such partial payments may also include the delivered actual cost of those materials stockpiled and stored in accordance with the subsection titled PAYMENT FOR MATERIALS ON HAND of this subsection.

No partial payment will be made when the amount due the Contractor since the last estimate is less than five hundred dollars.

Retainage withheld by Owner shall not exceed 10% of an approved payment, and after 50% project completion, no further retainage shall be withheld.

When not less than 95% of the work has been completed the Engineer may, at his discretion and without the consent of the surety, prepare an estimate from which will be retained an amount not less than twice the Contract value or estimated cost, whichever is greater, of the work remaining to be done. The remainder, less all previous payments and deductions, will then be certified for payment to the Contractor.

It is understood and agreed that the Contractor shall not be entitled to demand or receive partial payment based on quantities or work in excess of those provided in the proposal or covered by approved change orders or supplemental agreements, except when such excess quantities have been determined by the Engineer to be a part of the final quantity for the item of work in question.

No partial payment shall bind the OWNER to the acceptance of any materials or work in place as to quality or quantity. All partial payments are subject to correction at the time of final payment as provided in the paragraph titled FINAL PAYMENT of this subsection.

100-07 PAYMENT FOR MATERIALS ON HAND

Partial payments, for projects which do not utilize the OWNER'S tax exempt status, may be made to the extent of the delivered cost of materials to be incorporated in the work, provided that such materials meet the requirements of the Contract, plans, and specifications and are delivered to acceptable sites on the OWNER's property or at other sites in the vicinity that are acceptable to the OWNER. Such delivered costs of stored or stockpiled materials may be included in the next partial payment after the following conditions are met:

- (a) The material has been stored or stockpiled in a manner acceptable to the Engineer at or on an approved site.
- (b) The Contractor has furnished the Engineer with acceptable evidence of the quantity and quality of such stored or stockpiled materials.
- (c) The Contractor has furnished the Engineer with satisfactory evidence that the material and transportation costs have been paid.
- (d) The Contractor has furnished the OWNER legal title (free of liens or encumbrances of any kind) to the material so stored or stockpiled.
- (e) The Contractor has furnished the OWNER evidence that the material so stored or stockpiled is insured against loss by damage to or disappearance of such materials at any time prior to use in the work.

It is understood and agreed that the transfer of title and the OWNER's payment for such stored or stockpiled materials shall in no way relieve the Contractor of his responsibility for furnishing and placing such materials in accordance with the requirements of the Contract, plans, and specifications.

In no case will the amount of partial payments for materials on hand exceed the Contract price for such materials or the Contract price for the Contract item in which the material is intended to be used.

No partial payment will be made for stored or stockpiled living or perishable plant materials.

The Contractor shall bear all costs associated with the partial payment of stored or stockpiled materials in accordance with the provisions of this subsection.

100-08 CONTRACT CLOSE-OUT

Subsequent to the final acceptance of this project by the Engineer, the following requirements must be satisfied by the Contractor before final payment can be made.

- (a) The Contractor must publicly advertise the NOTICE OF COMPLETION furnished by the Engineer in accordance with Title 39, Code of Alabama, 1975.
- (b) The Contractor must execute copies of CONTRACTOR'S AFFIDAVIT OF PAYMENT OF CLAIMS AND DEBTS on the form furnished by the Engineer.
- (c) The Contractor must have his surety execute copies of CONSENT OF SURETY TO FINAL PAYMENT on the form furnished by the Engineer.
- (d) The Contractor must furnish a letter on his letterhead acknowledging that acceptance of final payment by the Contractor constitutes a waiver of all claims, present or future, in connection with this project.
- (e) The Contractor must furnish a written guarantee on his letterhead covering all defects in material and workmanship for a period of one (1) year commencing on the date of final acceptance.
- (f) If any purchased items have been incorporated in the work, the Contractor must furnish a letter on his letterhead assigning those warranties to the OWNER. Copies of said warranties shall be bound in one binder and submitted along with the letter assignment.
- (g) The Contractor must keep track of "as built" information and at the contract closeout provide one complete set of reproducible "as built" covering all earthwork, utility routing, structural, mechanical, and electrical aspects of the work, including wiring schematics.

100-09 WITHHOLDING FOR CLAIMS AND LITIGATION

If at the time of Contract close-out, the project is subject to a claim or the Contractor is involved in litigation concerning the project, the OWNER reserves the right to:

- (a) Refuse to close out the Contract retaining all monies unpaid until such time as all claims are dropped and litigation is resolved, or
- (b) Refuse to close out the Contract, retaining enough money to cover the total of all outstanding claims and amounts claimed by litigation until such time as all claims are dropped and litigation is resolved, or
- (c) Require the Contractor to post a letter of credit to each individual claimant or litigant and satisfactory to the claimant or litigant. Once such letters of credit have been posted and the OWNER is in receipt of written agreement from each individual claimant or litigant, the OWNER will proceed with Contract close-out and release of retainage in the normal manner.

100-10 FINAL PAYMENT

When the Contract work has been accepted in accordance with the requirements of the paragraph titled FINAL ACCEPTANCE of Subsection 60, and the paragraph titled Contract CLOSE-OUT above, the Engineer will prepare the final estimate of the items of work actually performed. The

Contractor shall approve the Engineer's final estimate or advise the Engineer of his objections to the final estimate, which are based on disputes in measurements or computations of the final quantities to be paid under the Contract, as amended by change order or supplemental agreement. The Contractor and Engineer shall resolve all disputes (if any) in the measurement and computation of final quantities to be paid within 30 calendar days of the Contractor's receipt of the Engineer's final estimate. If, after such 30-day period, a dispute still exists, the Contractor may approve the Engineer's estimate under protest of the quantities in dispute and such disputed quantities shall be considered by the OWNER as a claim in accordance with the paragraph titled CLAIMS FOR ADJUSTMENT AND DISPUTES of Subsection 60.

After the Contractor has approved, or approved under protest, the Engineer's final estimate, final payment will be processed based on the entire sum, or the undisputed sum in case of approval under protest, determined to be due the Contractor less all previous payments and all amounts to be deducted under the provisions of the Contract.

If the Contractor has filed a claim for additional compensation under the provisions of the paragraph titled CLAIMS FOR ADJUSTMENTS AND DISPUTES of Subsection 60 or under the provisions of this subsection, such claims will be considered by the OWNER in accordance with State laws or ordinances. Upon final adjudication of such claims, any additional payment determined to be due the Contractor will be paid pursuant to a supplemental final estimate.

100-11 RIGHT OF AUDIT

Contractor's records which shall include but not be limited to accounting records (hard copy, as well as computer readable data if it can be made available), written policies and procedures; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, etc.); original estimates; estimating work sheets; correspondence; change order files (including documentation covering negotiated settlements); back charge logs and supporting documentation; general ledger entries detailing cash and trade discounts earned, insurance policies, rebates and dividends; and any other supporting evidence deemed necessary by the Owner to substantiate charges related to this Contract (all foregoing hereinafter referred to as "records") shall be open to inspection and subject to audit and/or reproduction by Owner's agent or its authorized representative to the extent necessary to adequately permit evaluation and verification of (a) Contractor compliance with Contract requirements, (b) compliance with Owner's business ethics policies, and (c) compliance with provisions for pricing change orders, payment or claims submitted by the Contractor or any of their payees.

Such audits may require inspection and copying from time to time and at reasonable times and places of any and all information, materials and data of every kind and character, including without limitation, records, books, papers, documents, subscriptions, recordings, agreements, purchase orders, leases, Contracts, commitments, arrangements, notes, daily diaries, superintendent reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may in Owner's judgment have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Contract Document. Such records subject to audit shall also include, but not be limited to, those records necessary to evaluate and verify direct and indirect costs, (including overhead allocations) as they may apply to costs associated with this Contract.

The Owner or its designee shall be afforded access to all of the Contractor's records, and shall be allowed to interview any of the Contractor's employees, pursuant to the provisions of this article throughout the term of this Contract and for a period of three (3) years after final payment or longer if required by law.

Contractor shall require all subcontractors, insurance agents, and material suppliers (payees) to comply with the provisions of this article by insertion of the requirements hereof in a written Contract agreement between Contractor and payee. Such requirements will also apply to

Subcontractors and Sub-Subcontractors, etc. Contractor will cooperate fully and will cause all Related Parties and all of Contractor's subcontractors (including those entering into Lump Sum subcontracts) to cooperate fully in furnishing or in making available to Owner from time to time, whenever requested, in an expeditious manner, any and all such information, materials and data.

Owner's agent or its authorized representative shall have access to the Contractor's facilities, shall have access to the Subcontractor's facilities, shall have access to all necessary records, and shall be provided adequate and appropriate work space, in order to conduct audits in compliance with this article.

If an audit inspection or examination in accordance with this article, discloses overcharges (of any nature) by the Contractor to the Owner in excess of one percent (1%) of the total Contract billings, the actual cost of the Owner's audit shall be reimbursed to the Owner by the Contractor. Any adjustments and/or payments which must be made as a result of any such audit or inspection of the Contractor's invoices and/or records shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of Owner's findings to Contractor.

Division V Specifications

PIER B SOUTH REPLACEMENT MOBILE, ALABAMA

ASPA PROJECT NO: 11283 – TASK 01

PREPARED FOR



**Issued for Bid
Not for Construction**

July 2025

PREPARED BY:

M
M
**MOTT
MACDONALD**

**107 St. Francis Street, Suite 2900
Mobile, AL 36602**

502397324-001



Alabama State Port Authority
Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 01

July 2025

1 | Page

Issued for Bid

**DIVISION V
INDEX**

DIVISION 01 – GENERAL REQUIREMENTS

01 00 00 – GENERAL PROVISIONS
01 25 00 – SUBSTITUTION PROCEDURES
01 31 13 – PROJECT COORDINATION
01 33 00 – SUBMITTALS
01 52 00 – CONSTRUCTION FACILITIES
01 55 00 – VEHICULAR ACCESS
01 57 20 – PROTECTION OF ENVIRONMENT
01 71 13 – MOBILIZATION AND DEMOBILIZATION
01 71 23 – CONSTRUCTION SURVEYING

DIVISION 02 – EXISTING CONDITIONS

02 41 00 – DEMOLITION

DIVISION 03 - CONCRETE

03 10 00 – CONCRETE FORMWORK
03 15 00 – CONCRETE ACCESSORIES
03 20 00 – CONCRETE REINFORCEMENT
03 30 00 – CAST-IN-PLACE CONCRETE
03 62 13 – NON-METALLIC NON-SHRINK GROUTING

DIVISION 05 – METALS

05 12 53 – WELDING
05 50 00 – METAL FABRICATIONS

DIVISION 06 – WOODS, PLASTICS, AND COMPOSITES

06 10 00 – ROUGH CARPENTRY

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 19 16 – SILANE WATER REPELLANT
07 54 23 – THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING
07 62 00 – SHEET METAL FLASHING AND TRIM
07 92 00 – JOINT SEALANTS



Alabama State Port Authority

Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283

Task # 01

July 2025

2 | Page

DIVISION 08 – OPENINGS

08 31 13 – ACCESS DOORS AND FRAMES

08 90 00 – LOUVERS AND VENTS

DIVISION 09 – FINISHES

09 97 13 – MARINE COATINGS

DIVISION 10 – SPECIALITES

10 21 13 – PLASTIC TOILET COMPARTMENTS

10 28 00 – TOILET, BATH, AND LAUNDRY ACCESSORIES

DIVISION 22 – PLUMBING

22 00 00 – PLUMBING, GENERAL PURPOSE

22 07 19 – PLUMBING PIPING INSULATION

DIVISION 26 – ELECTRICAL

26 05 00 – BASIC ELECTRICAL REQUIREMENTS

26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

26 05 26 – GROUNDING AND BONDING

26 05 29 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

26 05 33 – RACEWAYS AND BOXES

26 05 36 – CABLE TRAYS FOR ELECTRICAL SYSTEMS

26 05 44 – SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

26 05 48.16 – SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

26 22 00 – LOW-VOLTAGE TRANSFORMERS

26 24 16 – PANELBOARDS

26 43 13 – LOW-VOLTAGE SURGE PROTECTION

26 51 19 – LED INTERIOR LIGHTING

DIVISION 31 – EARTHWORK

31 23 33 – EXCAVATION BACKFILL AND COMPACTION

31 62 13 – PRESTRESSED CONCRETE PILES

31 63 16 – AUGER CAST-IN-PLACE PILES

DIVISION 33 – UTILITIES

33 05 04 – SELECTIVE DEMOLITION



Alabama State Port Authority

Specification Booklet

Project Name Pier B South Replacement

Location Mobile, AL

Project # 11283 **Task #** 01

July 2025

3 | Page

33 05 05 – BURIED PIPE INSTALLATION
33 05 19 – PIPING VALVES AND APPURTENANCES
33 14 16 – SITE WATER UTILITY DISTRIBUTION PIPING

DIVISION 34 – TRANSPORTATION

34 11 00 – RAILROAD TRACK AND ACCESSORIES

DIVISION 35 – WATERWAY AND MARINE CONSTRUCTION

35 20 20 – MISPLACED MATERIAL
35 59 13 – ELASTOMERIC FENDER SYSTEM
35 59 33 – MOORING BOLLARDS

APPENDICES (REFER TO SEPARATE PDF FOR APPENDICES)

APPENDIX A – GEOTECHNICAL REPORT
APPENDIX B – SURVEY
APPENDIX C – TURBIDITY CURTAIN
APPENDIX D – USACE NATIONWIDE PERMIT
APPENDIX E – EXISTING DRAWINGS
APPENDIX F – HUD GRANT CONTRACT PROVISIONS

END OF TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01 00 00

GENERAL PROVISIONS

PART 1– GENERAL

1. The following detail specifications, taken in conjunction with the drawings and the general provisions and applicable material specifications describe the work to be performed by the contractor. They amplify and explain most items in connection with the work, but do not alter the scope of same as described in the general conditions of the specifications and contract form.
2. All materials used in the work, which are not described specifically, shall be of the best quality that it is customary to employ in construction of the character involved. The following details are not necessarily complete in the description of all items entering into the work but are intended to furnish a basis for acceptance of the more important items. Other details shall be consistent with them.
3. Any detail which may be incomplete or lacking in the plans and specifications shall not constitute claim for extra compensation. Such detail shall be supplied by the contractor and submitted to the engineer in advance of its requirement on the job. The true intent of the plans and specifications is to produce a complete working facility, and incomplete detail will not abrogate this intent.
4. It is the intent to follow the drawings and specifications closely in all details, elevations, dimensions, etc., but it is understood that alterations may be required to conform to local conditions and that such alterations must be of the same character of construction as that specified. Workmanship shall be of the best quality in each class of work.
5. Current (latest) editions of all codes and standards specified shall apply.
6. Permit and fees: ASPA has obtained a department of army nationwide permit, file number SAM-2018-01099-GAC dated September 06, 2023, for this project. Refer to Appendix D of the Division V Specifications for copy of permit. Contractor shall comply with all permit conditions included. Contractor shall also obtain all other necessary permits, licenses, meters, and inspections required for his work and pay all fees and charges required for execution of this contract. Provide certificates of approval to engineer and owner.
7. Verification of owner's data: prior to commencing any excavation or removal of existing work, the contractor shall satisfy itself as to the accuracy of all data indicated on the drawings and/or provided by the owner. Should the contractor discover any inaccuracies, errors, or omissions in the data, he shall immediately notify the engineer. Commencement by the contractor of any removal of existing work, excavation or upgrading shall be held as an acceptance of the data by it after which time the contractor has no claim against the owner resulting from alleged errors, omissions, or inaccuracies of the said data.
8. Delivery and storage of materials: materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. All material shall be stored to provide protection from the weather and accidental damage. Any damage to material shall be the responsibility of the contractor to coordinate with the supplier for replacement and/or repair.

9. Extent of work is indicated in the drawings, schedules, and specifications. Singular references shall not be construed as requiring only on device if multiple devices are shown on the drawings or are required for proper system operation.

10. This project is being performed at a working port facility at a production dock and as such the contractor shall coordinate its activities with ASPA operations so as not to interfere with them.

11. Definitions:

- 1) Provide: furnish install, and test, complete and ready for intended use.
- 2) Furnish: supply and deliver to project site, ready for subsequent requirements.
- 3) Install: operations at project site, including providing, unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.
- 4) Approved: approved and accepted for construction by the engineer. Any exceptions shall be noted in writing.
- 5) Approved equal: approved as equivalent in quality and workmanship and will perform satisfactorily according to their intended purpose. The engineer shall approve in writing all such substitutions in materials or equipment.

12. Request for substitution:

- 1) Where a particular system, product or material is specified by name, consider it as standard basis for bidding, and base proposal on the particular product or material specified. Other systems, products, equipment or materials may be accepted only if in the opinion of the engineer, they are equivalent in quality and workmanship and will perform satisfactorily according to their intended purpose. The engineer shall approve all such substitutions in materials or equipment in writing.
- 2) In making request for substitution, the contractor shall list the particular product, equipment or material it wishes to substitute and at bid time the contractor shall state the amount it will add or deduct from its base (or additive) bid if the substitution is approved by the engineer. If the contractor allows no deduction or addition to the base (or additive) bid for such substitution, it shall be so stated on the request.
- 3) Requests by contractor for substitution will be considered only when reasonable, timely, fully documented, and qualifying under one or more of the following circumstances.
 - a) Required product cannot be supplied in time for compliance with contract time requirements.
 - b) Required product is not acceptable to governing authority, or determined to be non-compatible, or cannot be properly coordinated, warranted or insured, or has other recognized disability as certified by contractor.
 - c) Substantial cost advantage is offered owner after deducting offsetting disadvantages including delays, additional compensation for redesign, investigation, evaluation and other necessary services and similar considerations.
- 4) All request for substitution shall contain a "comparison schedule" and clearly and specifically indicate any and all differences or omissions between the product specified as the basis of design and the product proposed for substitution. Differences shall include but shall not be limited to data as follows for both the specified and substituted products:
 - a) Principle of operation.
 - b) Materials of construction or finishes.
 - c) Thickness of materials.
 - d) Weight of item.
 - e) Deleted features or items.

- f) Added features or items.
 - g) Changes in other work caused by the substitution.
 - h) Performance and rating data.
- 5) If the approved substitution contains differences or omissions not specifically called to the attention of the engineer, the owner reserves the right to require equal or similar features to be added to the substituted products at the contractor's expense.
13. Prior approval: where the terms "approved equal" is used in the drawings or the specifications, submit all requests for engineer's written approval of the alternate manufacturer's products. Approval will be in the form of an addendum to the specifications and drawings. Clearly indicate all differences between the specified and proposed product following the guidelines for substitution herein. This requirement may be waived if, by the opinion of the engineer, it is for the best interest of the owner.

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance.
- B. Product options.
- C. Product substitution procedures.

1.2 QUALITY ASSURANCE

- A. Contract is based on products and standards established in Contract Documents without consideration of proposed substitutions.
- B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.
- C. Substitution Proposals: Permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by Engineer and Owner.

1.3 PRODUCT SUBSTITUTION PROCEDURES

- A. Engineer will consider requests for substitutions only within 30 days after date established in Notice to Proceed.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:
 - 1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.
 - 2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
 - 3. Reference to Article and Paragraph numbers in Specification Section.
 - 4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
 - 5. Changes required in other Work.
 - 6. Availability of maintenance service and source of replacement parts as applicable.
 - 7. Certified test data to show compliance with performance characteristics specified.

8. Samples when applicable or requested.
9. Other information as necessary to assist Architect/Engineer's evaluation.

D. A request constitutes a representation that Contractor:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
2. Will provide same warranty for substitution as for specified product.
3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension that may subsequently become apparent.
5. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.
6. Will reimburse Owner and Engineer for review or redesign services associated with reapproval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals without separate written request or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:

1. Submit requests for substitutions on CSI Form 13.1A Substitution Request or similar form .
2. Submit electronic files of Request for Substitution for consideration. Limit each request to one proposed substitution.
3. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
4. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

1.4 INSTALLER SUBSTITUTION PROCEDURES

A. Document each request with:

1. Installer's qualifications.
2. Installer's experience in work similar to that specified.
3. Other information as necessary to assist Architect/Engineer's evaluation.

B. Substitution Submittal Procedure:

1. Submit electronic files to Project website of Request for Substitution for consideration. Limit each request to one proposed substitution.
2. Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 31 13

PROJECT COORDINATION

PART 1 - GENERAL

1.01 SUMMARY

- A. This section specifies administrative and supervisory requirements necessary for project coordination including, but not necessarily limited to:
 - 1. Coordination.
 - 2. Administrative and supervisory personnel.
 - 3. General installation provisions.
- B. Mandatory bi-weekly Owner/Engineer/Contractor (OEC) meetings are required that will convene at the engineering offices of the ASPA. The purpose of the meeting is to discuss progress of construction. The Contractor shall provide an agenda for each meeting to include attendees, safety share, progress update, general business, new business, request for information, submittals, schedule, change orders, and payment status. The Contractor shall also submit monthly progress reports with each pay application.
- C. Requirements for construction schedules are included in Section 01 33 00, "Submittals."

1.02 COORDINATION

- A. Coordination: Coordinate construction activities (as defined in the various sections of the Contract Documents) to assure efficient and orderly installation of each part of the work. Coordinate construction operations (as defined in the different sections of the Contract Documents) that are dependent upon each other for proper installation, connection, and operation. Contractor shall ensure all personnel (including, but not limited to, contractor, truck/delivery drivers, etc.) requiring access to ASPA property must have an active TWIC card and have ASPA port access. No delays will be considered for the time to acquire TWIC cards and/or ASPA port access. At the contractor's expense, all field staff and subcontractors shall acquire a TWIC card and APSA port access.
 - 1. Where installation of one part of the work is dependent upon installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
 - 2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.
 4. Prepare memoranda for distribution to each involved party outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progression of the work. Such administrative activities include, but are not limited to, the following:
1. Preparation of schedules.
 2. Installation and removal of temporary facilities.
 3. Delivery and processing of submittals.
 4. Progress meetings.
 5. Project closeout activities.

1.03 SUBMITTAL

Within 10 days of the Notice to Proceed, the Contractor will submit a list of the Contractor's principal staff assignments including the superintendent and other personnel in attendance at the site; provide a proposed organizational chart that identifies individuals, their duties and responsibilities; and list the proposed staff's contact information (email, phone, etc.).

1.04 GENERAL INSTALLATION PROVISIONS

- A. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations if those instructions and recommendations are more explicit or stringent than requirements contained in the Contract Documents.
- B. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
- C. Recheck measurements and dimensions before starting installation procedure.
- D. Install each component during weather conditions and at the point in the project sequence that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- E. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

1.05 CLEANING AND PROTECTION

- A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration until Final Acceptance.
- B. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
 - 1. Excessive static or dynamic loading.
 - 2. Excessive internal or external pressures.
 - 3. Heavy traffic.
 - 4. Vibration from adjacent activity.
 - 5. Erosion.
 - 6. Prop wash.
 - 7. Damage by contact with construction equipment.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01 33 00

SUBMITTALS

PART 1 – GENERAL

1.01 DESCRIPTION

This Section specifies administrative and procedural requirements for submittals requisite to the performance of the work, including, but not limited to:

- A. Contractor's partial payment and construction schedule for the entire project.
- B. Submittal schedule.
- C. Shop drawings.
- D. Product data and mill certificates.

1.02 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment, or method of work shall be as described in the submittal.
- B. The Contractor shall verify that the material and equipment described in each submittal conform to the requirements of the specifications and Contract Drawings. If the information shows deviations from the specifications or Contract Drawings, the Contractor shall, by written statement accompanying the information, clearly identifying the deviations and state the reason, therefore.
- C. The Contractor shall ensure that there is no conflict with other submittals and notify the Engineer and Owner in each case where the submittal may affect the work of others.
- D. The Contractor shall be responsible for the coordination of submittals by its Subcontractors.
- E. The Contractor cannot claim delays due to the Engineer's review of the Submittals if they require multiple revisions due to incompleteness as determined by the Engineer. Failure to approve all or part of any such Plan shall not make the Engineer/Owner liable to the Contractor for any Work delays.

1.03 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of Submittals with performance and construction activities. Transmit each Submittal in advance of performance of related construction activities to avoid delay (including time for resubmittals). Materials furnished by the Contractor shall not be incorporated into the construction before review except as specified herein.
- B. All submittals shall be in accordance with the following:
 - 1. All submittals shall be sent electronically to Engineer in (*.pdf) format. All review comments and approvals shall be sent back to the Contractor electronically via

(*pdf) format.

2. Review of submittals by the Engineer is for general compliance with the contract documents. Responsibility for the correctness of dimensions, details, quantities, and safety during fabrication and construction shall remain with the contractor.
 3. Correctness and/or comments made on the shop drawings during review do not imply that all errors and omissions have been corrected, nor does it relieve the contractor from compliance with the contract documents.
 4. No detailed check of quantities or dimensions will be made. Only those shop drawings required by the contract documents to be submitted will be reviewed. All others will be returned without comment.
 5. Shop drawings will not be reviewed unless they are stamped "approved" or "approved as noted" by the general contractor or construction manager, whichever is applicable.
 6. Do not reproduce the contract documents for use as shop drawings.
 7. Shop drawings not meeting the above criteria or submitted after fabrication will not be reviewed.
- C. Submit shop drawings and any other special information necessary for proper fabrication, erection, and placement. Include plans, elevations, and sections. Clearly show anchorages, connections, and accessory items. The detailer must interpret the contract documents and clearly convey this interpretation to the field in the form of placing or erection drawings. Materials shall be submitted for review in the manner specified herein and under the applicable technical specification sections. The methods of review may include submission of samples, shop drawings (including stock prints), catalogs (including cuts and descriptive literature), schedules, certificates, or field inspection. All materials for which no specific method of review is specified shall be subject to field inspection and review.
- D. Each Submittal shall be accompanied by a transmittal letter from the Contractor stating that the items of material submitted are the Contractor's selection for construction under the Contract and requesting review. The Contractor shall include one (1) transmittal letter per one (1) copy of the submittal data.
- E. The Contractor shall present all materials for each submittal at the same time as one (1) submittal. Incomplete submittals, multiple submittals submitted under the same transmittal letter, and submittals with inadequate data will be rejected.
- F. Review Time: All requests for material review shall be submitted in sufficient time so as not to delay the progress of the Work, allowing ten (10) working days after receipt by the Engineer for review. Work performed by the Contractor without accepted submittals related to such work shall be considered as having been performed by the Contractor at his own risk. If related submittals are found not acceptable, the Contractor shall correct work related to such unacceptable submittals, to the satisfaction of the Engineer and Owner.
- G. Address all correspondence to the Engineer and Alabama State Port Authority Project Management team. Specific contact details will be supplied at the Pre-Construction Conference.

1.04 SUBMITTAL PREPARATION

Contractor shall place a permanent label or title block on each submittal transmittal letter for identification. Indicate the name of the entity that prepared each submittal. Contractor's review comments shall be in green or blue. The Engineer's review comments will be in red.

- A. Provide a space approximately 4" x 5" on the transmittal letter to record the Engineer's review and approval markings and action taken.
- B. Include the following information on the label for processing and recording action taken: Project name, date, name of Engineer, name of Contractor, name of applicable subcontractor, name of applicable supplier, name of applicable manufacturer, number and title of the reference technical specification section, drawing number and detail references as appropriate.

1.05 CONSTRUCTION SCHEDULE

- A. The Contractor shall prepare a Progress or Work Schedule for the entire Project, using CPM, showing the order in which, the Contractor proposes to carry on his work and salient features, including submissions of shop drawings, samples, review time, and procurement of materials to meet date of completion. The Baseline schedule shall be submitted at the scheduled Pre-Construction Meeting.
- B. The Contractor shall secure time commitments for performing critical elements of the work from parties involved. Coordinate each element on the schedule with other construction activities including minor elements involved in the sequence of the Work. Show each activity in proper sequence. Graphically indicate sequences necessary for completion of related portions of the Work.
- C. Prepare the Construction Schedule with the schedule of values, list of subcontractors, submittal schedule, progress reports, schedule of anticipated monthly partial payment requests, and all other schedules.
- D. The Construction Schedule shall include anticipated dates for Substantial and Final Completion inspections.
- E. In addition to the schedule described above, the Contractor shall submit a list of shop drawings he proposes to submit for review which shall include the following:
 - 1. Specification Section Number
 - a. Description of all items within section.
 - b. Approximate date of each submittal.
 - 2. Contract Drawing Number
 - a. Description of all items on each Contract Drawing, if not previously covered by the Specifications.
 - b. Approximate date of each submittal.

1.06 SCHEDULE OF SUBMITTALS

The Contractor shall submit a Schedule of Submittals, in writing, to the Engineer, at the Pre-Construction Conference for review and approval. The Schedule of Submittals shall be reviewed by the Engineer prior to initiating any Work. This document shall include, but is not limited to, a

schedule of required submittals listed in the Contract Documents (including required notifications), the reference technical specification section, the time requirements for Contractor's expected delivery, Engineer's review of the submittals, and the performance of related construction activities.

1.07 CONTRACTORS DAILY REPORTS.

On a weekly basis, the Contractor will submit to the Engineer daily reports that include, but is not limited to the following minimum information.

- A. Number of Contractor and subcontractor employees working on site (itemized by trade).
- B. Equipment on site.
- C. Ongoing construction activities.
- D. Progress made (i.e., quantity of material installed, or work completed).
- E. Delays or problems encountered.
- F. Direction received from the Engineer.
- G. Visitors on site.
- H. General comments.
- I. Field superintendent's signature

1.08 PROPOSED PRODUCT LIST

- A. In those instances where the specified technical specification sections cite a brand name product, the Contractor shall advise the Engineer in writing that the specified brand name product will be used.
- B. Materials which are specified by reference to an industry standard or specification which is also stamped or otherwise shown on the material itself and is readily identified in the field, do not require submittal of the material for review; however, the Contractor shall advise the Engineer in writing that the product will be used.

1.09 SHOP DRAWINGS

- A. Submit newly prepared information, drawn to accurate scale. Highlight, encircles, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis for shop drawings. Standard information prepared without specific reference to the Project will not be considered shop drawings. Reproductions of the Contract Documents will be rejected and require resubmittal.
- B. Shop drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings. All shop drawings shall include the following information:
 - 1. Dimensions.
 - 2. Identification of products and materials included.

3. Compliance with specified standards.
 4. Notation of coordination requirements.
 5. Notation of dimensions established by field measurements.
- C. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit shop drawings on sheets at least 8 ½" x 11", but no larger than 24" x 36" in PDF format.

1.10 PRODUCT DATA

- A. Brand names: The Contractor may propose an "or equal" item or material and shall include a submittal with sufficient technical documentation to readily demonstrate the material proposed is, in fact, equal to the brand name(s) specified. Submittals will be rejected if the Contractor fails to submit such documentation or such documentation fails to demonstrate the equality of the item.
- B. Collect product data into each specified submittal. Product data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves. Where product data must be specifically prepared because standard printed data is not suitable for use, submit as shop drawings (Paragraph 1.09).

1.11 MANUFACTURER INSTALLATION INSTRUCTIONS

- A. When specified by a specific technical specification section, submit printed instructions for delivery, storage, assembly, installation, adjusting, and finishing to the Engineer.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.12 MANUFACTURER CERTIFICATES

- A. Submit certificates covering conformity to requirements of referenced technical specification sections or standard test results as follows:
- B. Certificates of conformity to referenced technical specification sections shall consist of a statement on the manufacturer's letterhead that the materials listed conform to the requirements of the referenced technical specification section referred to by number.
- C. Certificates of standard test results shall consist of statements on the test laboratory's letterhead of the tests made and the tests results. The tests shall have been performed within one (1) year of submittal of the report for approval. Test reports shall be accompanied by certificates from the manufacturer certifying that the material and equipment proposed to be supplied is of the same, type, quality, manufacture, and make as that tested.

1.13 PRE-CONSTRUCTION PHOTOGRAPHS

- A. Submit pre-construction photographs of areas which may be accessed by the Contractor to complete the Work, including but not limited, to the Project Site, staging area(s), and adjacent areas. Any concerns with adjacent underwater components to remain shall also be documented.
- B. Photographs should provide documentation of pre-construction site conditions, including conditions for public and private property including but not limited to roadways, sidewalks,

bulkheads and breakwaters, utilities, landscaping, etc.

1.14 ENGINEER'S ACTION

- A. Except for Submittals for record, information of similar purposes where action and return is required or requested, the Engineer will review each submittal, mark to indicate action taken, and returned to the Contractor in the allotted time noted in this specification.
- B. Compliance with specified characteristics is the Contractor's responsibility. Submittal will be rejected for non-compliance of required characteristics.
- C. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked to indicate the action taken. Submittal review will be made by returning PDF appropriately stamped. "Reviewed" or "Reviewed as Noted" shall be considered adequate to incorporate into the construction. If the submittal is stamped "Revise and Resubmit", the submittal is considered incomplete and shall require resubmission. Work performed by the Contractor without reviewed submittals related to such work shall be considered as having been performed by the Contractor at their own risk

1.15 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS

Review of any Submittal including drawings, information regarding materials or equipment the Contractor proposes to provide shall not relieve Contractor of his responsibility for errors therein and for failure to comply with the Contract Documents, and shall not be regarded as an assumption of risks or liability by the Owner, or by any officer, employee or consultant of the Owner. The Contractor shall have no claim under the Contract because of the failure, or partial failure, of the method of work, material, or equipment so reviewed.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION

SECTION 01 52 00

CONSTRUCTION FACILITIES

PART 1 – GENERAL

1.01 DESCRIPTION

This Section covers the following:

1. Construction Facilities
2. Construction Aids and Safety Precautions
3. Special Controls
4. Sanitary Facilities and Domestic Water Supply
5. Traffic Control at Project Site
6. Telephone Services and Communications Systems
7. Navigation
8. Signal Lights
9. Temporary Power
10. Temporary Buildings
11. Use of Project Site
12. Protection of Property

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

3.01 CONSTRUCTION FACILITIES

- A. Temporary Facilities Supplied by Contractor: Contractor shall supply temporary services and facilities required for the execution of the Work, such as electrical power distribution as may be required, compressed air, fuel, temporary lighting, sanitary facilities, field office, fencing, barricades, barges, turbidity curtains, Maintenance of Traffic (MOT) and other facilities required.
- B. Contractor use areas required outside the Project Site shown on the Contract Drawings are not provided by the Owner. The Contractor will be responsible for obtaining any additional approvals, agreements, or easements for additional construction facilities and Contractor Use Areas and must provide documentation of approvals, agreements, or easements to the Owner/Engineer prior to mobilization of facilities and equipment.
- C. The Contractor shall coordinate the location of their proposed field office, if needed, laydown areas, etc. with the Engineer and Owner.

3.02 CONSTRUCTION AIDS AND SAFETY PRECAUTIONS

- A. The Contractor shall comply with applicable laws, OSHA, ordinances, rules, regulations and orders pertaining to personnel, construction machinery and equipment, hoists, cranes, staging,

materials handling facilities, tools, appliances and other construction aids. The Contractor shall provide first aid facilities where required.

- B. The Contractor shall provide barriers and shall post “No Trespassing”, other construction safety signs and MOT signage as necessary to protect the public. Appropriate barriers should be erected around all open excavations.
- C. At areas that require safety precautionary measures for ASPA staff or other port workers at the port, the Contractor shall install construction fencing such as U.S. Netting Safety Fence SFS series (1.800.331.2973) or equivalent. The fence shall be 6.0 feet minimum height, high-visibility, high-density mesh with rigid-material warning signs.
- D. The Contractor shall limit access within the Project Site for the protection of the non-contractor employees and subcontractors. Any stockpile areas shall also be adequately protected with construction as necessary to isolate the work area from public access. The Contractor shall be responsible for public safety around any stockpile areas and at the construction site. All temporary safety fencing, barricades, warning lights, signs, MOT signage and flagmen shall be provided and maintained by Contractor as needed. The Contractor shall maintain security of the construction site. The Contractor is permitted to exclude ASPA staff and other port workers from his Work Area as necessary to perform the Work.
- E. The contractor shall remove safety fencing upon completion of the work immediately prior to demobilizing from the project site.

3.03 SPECIAL CONTROLS

- A. Water Control: The Contractor shall maintain site drainage.
- B. Archeological and Historic Preservation Control: If during the course of construction, the Contractor discovers any archaeological or historic properties, all land-disturbing activities in the vicinity of the properties shall be halted and the Contractor shall notify the Owner immediately. The Owner will consult with the proper authorities and will obtain permission to proceed. The Contractor will be entitled to time extensions equal to the time the Work is suspended but will not be entitled to additional compensation.

3.04 SANITARY FACILITIES AND DOMESTIC WATER SUPPLY

The Contractor shall provide sanitary and drinking water facilities to accommodate its employees to comply with the applicable requirements and regulations. Facilities shall be located within the immediate Project Site and readily accessible.

3.05 TELEPHONE SERVICES AND COMMUNICATION SYSTEMS

Telephone service is not currently available at the site. The Contractor will be responsible for making their own arrangements for telephone service.

3.06 NAVIGATION

- A. Vessel traffic through the channels near the Project Site will occur throughout the duration of the project. The Contractor shall not prevent Channel traffic from passing the Project Site. The contractor is required to coordinate with the Harbormaster and ASPA Engineering as necessary.
- B. Obstruction of Channel: The Owner shall not be responsible for keeping channels free from vessels or other obstructions. The Contractor shall conduct the Work in such a manner as to not endanger commercial navigation. The Contractor will be required to conduct the Work in such a manner as to preclude any obstruction to navigation. In case the Contractor's equipment so obstructs the channel or harbor as to make difficult or endanger the passage of vessels, the Contractor shall notify the Harbormaster and the said equipment shall be promptly moved on the approach of any vessel to such extent as may be necessary to afford a practicable passage. Upon completion of the Work, the Contractor shall promptly remove his equipment, including ranges, buoys, piles, and other marks placed by him under the Contract in navigable waters or on shore.
- C. The Contractor shall anticipate vessel traffic in the slip at the pier and vessel berthing/mooring operations at the pier across the slip. Support tug traffic is to be expected during construction. Support tugs will regularly operate at the pier west end for refueling/overnight mooring operations. Construction sequencing and all work at the west end of the Pier shall be coordinated with the Owner and tug operators.

3.07 SIGNAL LIGHTS

The Contractor shall display signal lights and conduct his operation in accordance with the General Regulations of the Department of the Army and of the Coast Guard governing lights and day signals to be displayed by towing vessels with tows on which no signal can be displayed; vessels working on, dredges, and vessels engaged in laying cables or pipe or in submarine or bank protection operations and day signals to be displayed by vessels of more than 65 feet in length moored or anchored in a fairway or channel, and the passing by other vessels of floating plant working in navigable channels, as set forth in Commandant U.S. Coast Guard Instruction MI6672.2 Navigation Rules: International Inland (COMDTINST M16672.2) or 33 C.F.R. 81 Appendix A (International) and 33 C.F.R. 84 and 33 C.F.R. 84 through 89 (Inland) as applicable.

3.08 TEMPORARY POWER

The Contractor will be responsible for providing their own temporary power if required. Upon completion of the Work, temporary power shall be removed from the site.

3.09 TEMPORARY BUILDINGS

- A. General: The Contractor may install temporary field trailers within the Project Site, and if so elected, must allow space for Owner's Resident Engineer. Proposed location shall be submitted to Engineer for review and approval prior to mobilization.
- B. Camp: Camp for employees at the Project Site will not be allowed. The Contractor and its employees shall make their own arrangements for lodging.

3.10 USE OF PROJECT SITE

- A. Staging on the Pier is limited on site. No Staging on the Pier outside of the Reliving Platform is allowed. Construction access to the site shall be limited by barge or laydown areas agreed for

- use by Owner. The adjacent warehouse doors must be accessible. Coordinate with ASPA operations on which doors must maintain accessibility and which doors may be temporarily obstructed.
- B. The Contractor will not have exclusive or unrestricted use of the Project Site for storage and its operations due to ongoing projects by Others near and in close proximity to the Project Site. The Contractor shall recognize and take into account during its planning and execution of the Work that the Engineer or Owner may require access to and use of certain areas or spaces during certain periods. The Contractor will need to coordinate access with ASPA Engineering and warehouse operators as necessary including but not limited to staging areas and vehicular access route(s).
 - C. The Contractor shall perform all work within the boundaries defined on the Contract Drawings. If other areas are required for construction, the Contractor shall secure any necessary agreement or construction easement documentation with the private landowners at no additional expense to the Owner. The actual selected location shall be coordinated with and approved by the Owner.
 - D. Work will be conducted within the Project Site limits during the duration of the Contract.
 - E. The Owner assumes no responsibility for the condition or maintenance of any road or structure thereon that may be used by the Contractor in performing the Work under these specifications or in traveling to and from the Project Site of the Work. The Contractor is responsible for constructing, maintaining, and removing any additional access that they deem necessary to the site of the work. No payment will be made to the Contractor by the Owner for any work done in improving, repairing, or maintaining any road or structure thereon for use in the performance of the Work under these specifications.
 - F. The Contractor shall be responsible for restoring the Contractor Use Areas, Contractor Site Access Areas, Project Site, and other impacted areas to their original condition as directed by the Owner/Engineer.

3.11 PROTECTION OF PROPERTY

- A. The Contractor shall not enter upon private property for any purpose without first obtaining permission from the private property owner or his duly authorized representative and providing documentation of that permission to the Owner. The Contractor shall be responsible for the preservation of all public and private property along and adjacent to work completed under the Contract and shall use every precaution necessary to prevent damage or injury thereto. He shall exercise due care in preventing and shall be responsible for damages to structures of all kinds, whether owned by the Owner or privately, and shall protect from disturbance or damage all land monuments until they have been properly referenced by the Engineer.
- B. The Contractor is also responsible for the protection of and repair of any damages to the existing roadways and facilities used during the course of construction at no additional expense to the Owner.
- C. If a staging area is utilized during construction, the Contractor is responsible for obtaining and abiding by any site use agreements with specific requirements pertaining to site restoration and improvements. The Contractor is responsible for all staging area cleanup and restoration work required at no additional expense to the Owner. f

- D. The Contractor shall protect private or public property on or in the vicinity of the Project Site. The Contractor shall ensure that it is not removed, damaged, destroyed, or prevented from being used unless the contract so specifies. Property includes land, utilities, trees, landscaping, improvements legally on the right-of-way, markers, monuments, building, structures, pipe, conduit, sewer or water lines, signs, and other property of all description whether shown on the Contract Drawings or not.
- E. If the Owner requests in writing, or if otherwise necessary, the Contractor shall install protection, acceptable to the Owner, for property such as that listed herein. The Contractor is responsible for locating all property that is subject to damage by the construction operation.
- F. If the Contractor (or agents/employees of the Contractor) damage, destroy, or interfere with the use of such property, the Contractor shall restore it to original condition. The Contractor shall also halt any interference with the property's use. If the Contractor refuses or does not respond immediately, the Owner may have such property restored by other means and subtract the cost from money that will be or is due the Contractor.
- G. Navigation Aids may be located adjacent to the Project Site. If present, construction activities shall proceed so that the Navigation Aids are not damaged. Any damage to the Navigation Aid shall be immediately reported to the Owner. Repair of damage to Navigation Aids and any necessary reinstallation shall be the responsibility of the Contractor at no additional expense to the Owner.

END OF SECTION

SECTION 01 55 00

VEHICULAR ACCESS

PART 1 – GENERAL

1.01 DESCRIPTION

This Section discusses the limitations, regulations, and submittals related to any vehicular access to the project site.

1.02 RELATED SECTIONS

The provisions and intent of the Contract, including the General Conditions, Supplementary Conditions, and General Requirements, apply to this Work as if specified in this section. Related Sections include the following:

- A. Section 01 33 00, “Submittals”
- B. Section 01 52 00, “Construction Facilities”

1.03 SUBMITTALS

All Submittals shall be made in accordance with Section 01 33 00, “Submittals”. Submittals for this Section shall include the following:

- A. Construction Access Plan (Paragraph 1.04)
- B. Traffic Control Plan (Paragraph 1.06)

1.04 CONSTRUCTION ACCESS PLAN

The Contractor shall submit a Construction Access Plan and Construction Access Restoration Plan or Maintenance of Traffic (MOT) Plan, in writing, to the Engineer and Owner, at the Pre-Construction Conference for review and approval. The Plan shall be reviewed by the Engineer and Owner before accessing the Work Area. The Plan shall include, but not be limited to, the following:

- A. Planned access route for mobilization and demobilization as well as servicing of the project with supplies, personnel, and fuel.
- B. Location of staging area including fuel storage/refueling location, equipment storage.
- C. Upland Staging Area Plan that describes the equipment, procedures, and spill prevention methods for handling materials within the site(s).
- D. Types of equipment the Contractor proposes to use for construction and delivering construction materials, supplies, and personnel to the project site and on the construction site to transport materials, personnel, etc.

- E. If applicable, plan for coordinating with the Owner and other contractors working in the area in order to gain access to locked gates within the Owner's Property or other work areas where access is controlled by other contractors, as necessary.

1.05 TRAFFIC CONTROL AT THE SITE

- A. All required and necessary traffic control throughout the Work Area and adjacent roadways including all signs, barricades, signals, and flaggers shall be provided by the Contractor.
- B. All work around and involving roadways, lane closures or truck crossings shall be coordinated with ASPA 72 hours prior and will be conducted in accordance with the ALDOT Traffic Signal Design Guide & Timing Manual, and ALDOT Standard Specifications for Highway Construction. The Contractor shall provide and ensure that appropriate "Roadwork Ahead", "Trucks Entering Roadway", "Truck Crossing" signs are established and maintained as required per ALDOT Standard Specification and Standard Traffic Signal Design Guide.
- C. The Contractor shall maintain and protect traffic on all affected roadways during the construction period. Measures for the protection and diversion of traffic, including provisions for flaggers, placing lights on or around equipment, and the erection and maintenance of adequate warning, danger and direction signs shall be as required by state (ALDOT) and local entities having jurisdiction. It is the Contractor's responsibility to contact each of the local jurisdictions to determine their requirements and to incorporate those requirements into his Traffic Control Plan.
- D. The Contractor shall be aware of regular traffic activity in the project vicinity. Warehouse access via the south side doors and eastern door must be maintained. Coordinate with warehouse operators as required.

1.06 TRAFFIC CONTROL PLAN

The Contractor shall submit a Traffic Control Plan, in writing, to the Engineer and Owner, at the Pre-Construction Conference for review and approval. The Plan shall be reviewed by the Engineer and Owner before transporting any materials to the Project Site. The Plan shall include, but not be limited to, the following:

- A. Traffic control provisions for any state highways used.
- B. Traffic control provisions for Contractor use areas.
- C. Traffic control provisions for any other required traffic control in the vicinity of the project site.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

3.01 CONSTRUCTION ACCESS

- A. Construction access to the site shall be limited by barge until the new relieving platform is constructed.
- B. The Contractor is responsible for fully investigating the project area and existing conditions to ensure suitability of equipment for the Work described herein relative to access restrictions. The Contractor will be responsible for developing a Construction Access Plan (Paragraph 1.04), taking into account the access and any access restrictions. Review of this Plan regarding materials or equipment the Contractor proposes to use shall not relieve Contractor of his responsibility for errors therein and for failure of equipment to completely access the site and complete the work in a safe, sufficient manner acceptable to the Owner. Approval of the Construction Access Plan by the Owner shall not be regarded as an assumption of risks or liability by the Owner, or by any officer, employee or consultant of the Owner. The Contractor shall have no claim under the Contract because of the failure, or partial failure, of the method of work or equipment so reviewed as a result of access.
- C. At the conclusion of the project site construction activities, the Construction Access roads shall be restored to the original grade and condition as necessary subject to the approval of the Engineer and Owner.
- D. The Contractor will not have exclusive use of the Pier or adjacent roads during the execution of the Work. The Contractor will be responsible for the coordination of their proposed work activities with the Owner.

3.02 PUBLIC ROADWAY TRUCK ROUTES AND STAGING

- A. Haul route from the staging and/or storage areas shall be limited to the Relieving Platform. Staging on the Pier shall be limited to the Relieving Platform only. No Staging on the Pier outside of the Reliving Platform is allowed.
- B. Barge loading and offloading facility to the Work Area Limits shall be determined by the Contractor unless otherwise noted in the Contract Drawings or these Specifications. However, the Contractor must obey all State and Local laws governing truck traffic along the routes. If the Contractor chooses to deliver the materials via overland routes, he is subject to the provisions specified herein.
- C. The Contactor shall coordinate with and obtain approval (regarding load restrictions and traffic control requirements) from applicable State and Local organizations for use of Public Roads along the Contractors proposed haul route, when applicable.

*Alabama Department of Transportation Operations Division (ALDOT)
Mobile County Engineering & Public Works*

- D. *Alabama State Port Authority (ASPA)* The Owner assumes no responsibility for the condition or maintenance of any road or structure thereon that may be used by the Contractor in performing the Work under these Specifications or in traveling to and from the site of the Work. The Contractor is responsible for constructing, maintaining, and removing any additional access allowed in the Contract Documents that he deems necessary to the site of the Work. Any damage to the existing roadways that are used for access purposes shall be repaired by the Contractor and shall be restored to its original condition.
- E. Should the Contractor, during the progress of the Work misplace any material, plant, equipment, or other materials along Public Roadways, the Contractor shall recover and remove the same with the utmost dispatch. The Contractor shall give immediate notice, with description and location of such misplaced Materials to the Owner and Engineer.

END OF SECTION

SECTION 01 57 20

PROTECTION OF ENVIRONMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. The work specified in this Section consists of providing, maintaining and removing temporary and permanent erosion and sedimentation controls. All the work for the project shall conform in full with ALDOT Standard Specification for Highway Construction (2022), and Related Sections:
 - 1. Section 107 Legal Relations and Responsibility to the Public
 - 2. Alabama Handbook for Erosion Control, Sediment Control, and Stormwater Management on Construction Sites and Urban Areas, Volume 1. 2022.
 - 3. Alabama Department of Environmental Management (ADEM)
 - 4. US Army Corps of Engineers Nation Wide Permit along with Mitigation Measures and Conditions (CFR 1505.2 (c) from the National Environmental Policy Act which are both located in Appendix D of the Division V specifications.
- B. Land disturbance activity requiring a Development Order will not commence until the order is approved.
- C. Basic Principles
 - 1. Conduct the earthwork and excavation activities in such a manner to fit the topography, soil type and conditions.
 - 2. Minimize the disturbed area and duration of exposure to erosion elements.
 - 3. Stabilize disturbed areas immediately.
 - 4. Safely convey run-off from the site to an outlet such that erosion will not be increased off site.
 - 5. Retain sediment on site that was generated on site.
 - 6. Minimize encroachment upon watercourses.
- D. Temporary Erosion and Sedimentation Control; In general, temporary erosion and sedimentation control procedures shall be directed toward:
 - 1. Preventing soil erosion at the source.
 - 2. Preventing silt and sediment from entering any waterway if soil erosion cannot be prevented.
- E. Preventing silt and sediment from migrating downstream in the event it cannot be prevented from entering the waterway.

Permanent Erosion Control: Permanent erosion control measures shall be implemented to prevent sedimentation of the waterways and to prevent erosion of the Project site.

1.02 REFERENCES

The publications listed below form a part of this Technical Specification to the extent referenced. Publications are referred to in the text by basic designation only.

- A. Alabama Handbook for Erosion Control, Sediment Control, and Stormwater Management on Construction Sites and Urban Areas, Volume 1. 2022.

PART 2– PRODUCTS

- A. The Contractor is responsible for the selection and adequacy of all materials and equipment used for compliance with the Owner and Contractor supplied permits.
- B. A floating turbidity barrier shall be employed as part of the BMP's. Unless specified in the Contract Drawings, the turbidity barrier class shall be Type II per the Alabama Handbook for Erosion Control July 2022. The floating turbidity barrier shall extend down 12 feet (minimum) at Mean Low Water. The turbidity barrier materials and installation methods shall be consistent with the Handbook for Erosion Control. Contractor shall coordinate with Engineer and ADEM for the turbidity barrier permit and turbidity barrier footprint. Refer to Appendix C for additional details on turbidity curtain requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. All debris or deleterious material resulting from construction shall be removed from the Project Site and prevented from entering waters of the State.
- B. All work operations shall be conducted in a manner that causes little or no adverse environmental impact to adjacent areas. If at any time, as a result of project activities, water quality problems develop (including equipment leaks or spills), operations associated with the problems shall cease, the Contractor shall immediately correct the problem, and contact the appropriate authorities. The Engineer and Owner should be notified of the problem as soon as possible but is not the first responder.

3.02 PROTECTION OF ENVIRONMENTAL RESOURCES

The environmental resources within the project boundaries and those affected outside the limits of permanent work under this Contract shall be protected during the entire period of this Contract. The Contractor shall confine his activities to areas defined by the Contract Documents. Environmental protection shall be as stated in the following paragraphs.

3.03 PROTECTION OF LAND RESOURCES

Prior to the beginning of any construction, the Contractor shall identify all land resources to be impacted by construction for approval by the Owner. The Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without special permission from the Owner. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. Where such special emergency

use is permitted, the Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs.

3.04 PROTECTION OF WATER RESOURCES

The Contractor shall keep construction activities under surveillance, management and control to avoid pollution of surface and ground waters. As soon as possible the Contractor shall clear all waterways of temporary embankments, temporary bridges, matting, falsework, debris, or other obstructions placed during construction operations that are not part of the finished work. The Contractor is responsible for maintaining area drainage during construction.

3.05 PROTECTION OF FISH AND WILDLIFE RESOURCES

The Contractor shall keep construction activities under surveillance, management and control to minimize interference with, disturbance to and damage of fish and wildlife. Species that require specific attention along with measures for their protection will be listed by the Contractor prior to beginning of construction operations.

3.06 CONSTRUCTION DEBRIS

The Contractor shall collect and properly dispose all trash and construction debris in accordance with all local and state solid waste management regulations and practices. No construction waste material shall be allowed to fall into the water or buried on the Project Site. The Contractor shall store all waste materials in approved metal dumpsters, or other containers approved by the Engineer. The dumpster shall be emptied as necessary or as required by local and state regulation, and the contents hauled away for proper disposal.

3.07 EQUIPMENT MAINTENANCE

The Contractor's equipment used in excavation and filling operations shall be inspected, cleaned, and maintained to prevent loss of petroleum products.

3.08 EROSION AND SEDIMENT MAINTENANCE

- A. Best Management Practices (BMPs): Contractor should employ BMPs to minimize environmental impacts. The Contractor can find a list of BMPs recommended by the Alabama Handbook for Erosion Control, Sediment Control, and Stormwater Management on Construction Sites and Urban Areas, Volume 1. 2022.
<https://www.dot.state.al.us/publications/Design/pdf/Stormwater/AlabamaHandbookforErosionControl.pdf>
- B. Excavation: All excavation shall be conducted in a manner that will minimize turbidity and sedimentation and that will comply with all local/state regulations.
- C. The Corp of Engineers permit procured by the Engineer and Owner is included in Appendix D of the Project Manual. The Contractor shall be responsible for complying with all the requirements of the permit at all times.

END OF SECTION

SECTION 01 71 13

MOBILIZATION AND DEMOBILIZATION

PART 1 – GENERAL

1.01 SUMMARY

Mobilization consists of preparatory work and operations, including those necessary for movement of personnel, equipment, supplies and incidentals to and within the Work Area; the establishment of offices, buildings, and other facilities necessary for the Work on the project; the cost of bonds and any required insurance; and other pre-construction expenses necessary for start of the Work. All equipment transported to the Site by barge must be floating at all times during the transit to and from the Site of Work, i.e., no grounding of equipment will be permitted during transit.

1.02 ARBITRARY MOBILIZATION BY CONTRACTOR

The Owner will pay for Mobilization and Demobilization only once. Should the Contractor demobilize prior to completing the project, such demobilization and subsequent remobilization shall be at no additional cost to the Owner.

1.03 JUSTIFICATION OF MOBILIZATION COSTS

In the event that the Owner considers the amount in this item, sixty percent (60%) and forty percent (40%) which represents mobilization and demobilization respectively does not bear a reasonable relation to the cost of the Work in this Contract, the Owner may require the Contractor to produce cost data to justify this portion of the Bid. Failure to justify such price to the satisfaction of the Owner will result in payment of actual mobilization costs, as determined by the Owner at the completion of mobilization, and actual demobilization costs at the completion of demobilization, and payment of the remainder of this item in the final payment under this Contract. The determination of the Owner is not subject to appeal.

1.04 PERMITS

The Contractor shall obtain, and pay for, all required building permits and other county or city construction and road use permits and comply with applicable laws and regulations regarding mobilization, transport of equipment, personnel and supplies, and the construction and maintenance of temporary facilities including but not limited to: structures, storage sites, laydown areas, and construction utilities.

1.05 EASEMENTS AND LAND USE AGREEMENTS

The Contractor is responsible for obtaining any easements or land use agreements for areas outside of the defined project area, at no additional expense to the Owner.

PART 1– PRODUCTS

(Not Used)

PART 2 – EXECUTION

(Not Used)

END OF SECTION

SECTION 01 71 23

CONSTRUCTION SURVEYING

PART 1 – GENERAL

1.01 QUALITY CONTROL

- A. The Contractor shall establish and maintain control for all work performed to assure compliance with the Specifications.
- B. All work performed shall be in conformity with the lines, grades, slopes, cross sections, and dimensions shown in the Contract Drawings. If the Contract Drawings, special provisions, or these Specifications state specific tolerances, the work shall be performed to meet or exceed those limits. The Contractor shall not deviate from the approved Contract Drawings unless the Engineer approves in writing.
- C. At the Engineer's request, the Contractor shall provide copies of any quality control records requested.
- D. Scope: Work covered by this section consists of furnishing all labor, materials, and equipment for performing construction surveying.

1.02 REFERENCES

- A. US ARMY CORPS OF ENGINEERS:
 - 1. EM 1110-1-1005 (Jan 2007) Topographic Surveying Manual

1.03 SUBMITTALS

All Submittals shall be made in accordance with Section 01 33 00, "Submittals":

- A. Construction Surveys

1.04 DATUMS

All surveys shall reference the North American Vertical Datum of 1988 (NAVD88) in U.S. Survey Feet.

1.05 QUALIFICATIONS OF SURVEYORS

All surveying, and temporary benchmark establishment work shall be conducted in responsible charge of a licensed professional land surveyor. The surveyor shall have a minimum 2 years of documented experience using the equipment proposed for use on this project.

1.06 TOPOGRAPHIC SURVEY EQUIPMENT

The Contractor shall employ a suitable method to locate and control horizontal positions that will meet or exceed the tolerance specified.

PART 2– PRODUCTS

(Not Used)

PART 3 – EXECUTION

3.01 CONSTRUCTION SURVEYS

A. General

1. The benchmarks located near the Project Site shown on Contract Drawings shall be used for horizontal and vertical control. The Contractor shall notify the Engineer if any discrepancies or errors are identified for benchmarks provided in order to resolve any benchmark issues in coordination with the Contractor and the Contractor's Surveyor. Contractor shall protect benchmarks before construction operations commence and throughout the duration of construction. If the benchmarks are disturbed and/or destroyed by the Contractor during the Work, the Engineer may require the benchmarks to be reinstalled by a professional, licensed surveyor at no expense to the Owner.
2. Construction surveys shall be conducted utilizing surveying procedures and methodology that meet or exceed accuracy tolerances of +/- 0.05 feet in vertical and +/- 0.05 feet horizontal.
3. All construction surveys shall be performed and recorded to the nearest 0.01 feet.
4. Surveys will be of sufficient frequency and accuracy during construction so that the Engineer can determine that all construction is being performed within the tolerances of the Specifications. From time to time, Engineer can require additional surveys and/or spot checks during construction.

B. CONSTRUCTION STAKING

1. The Contractor shall perform all construction staking required to layout and set any construction stakes, baselines and marks which are needed to establish the lines, grade, slopes, cross sections, etc. A baseline offset from the Project Site shall be established, utilizing benchmarks and monuments provided on the Contract Drawings, at a location that shall not be disturbed by construction activities and located close to the work so that it provides alignment and location reference. In addition, the Contractor shall perform surveys during construction to ensure that the materials are being placed within the tolerance specified. The Engineer shall be allowed to review any surveying data prior to the start of Work.

A. AS-BUILT SURVEY

1. The Contractor shall perform a final post-construction survey (As-Built) within two (2) business days after completion of all construction. As-Built Survey shall include a full topographic dataset which provides coordinates and geometry of all newly installed elements, including but not limited to utilities, concrete construction, piling, and any critical construction points and spot elevations.

2. Survey drawings required by these Specifications shall be submitted in AutoCAD 2022 (or compatible format) and shall be signed and sealed by a registered professional land surveyor and submitted to the Engineer.
3. Point files shall contain point number, station, Northing and Easting (referenced to the datum specified in Paragraph 1.04), Elevation (referenced to the datum specified in Paragraph 1.04 and reported to the nearest 0.01 feet), and point description in electronic format.

END OF SECTION

SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

The demolition work includes the requirements for the removal, whole or partial, and satisfactory disposal and/or salvage of all structures, debris, and other obstructions that are designated to be demolished on the drawings or within these specifications.

1.02 WORK SCOPE

The Contractor is responsible for, but not limited to, the demolition of the following:

- A. Selective demolition and disposal of a portion of the concrete relieving platform slab, restrooms, bollards, elevated concrete pier slab, concrete beams, concrete walls, concrete piles caps, concrete piles, bollards, timber fender system, utilities, asphalt, railroads tracks, and any ancillary items needed to complete new construction as noted on the demolition drawings for both Base Bid and Bid Additive.
- B. Refer to the drawings for items to be salvaged.

1.03 RELATED SECTIONS

The provisions and intent of the Contract, including the General Conditions, Special Conditions and General Requirements, and other Division V Construction Specifications apply to this work as if specified in this section. Work related to this section is described in:

- 1. Section 01 33 00 "Submittals"
- 2. Section 01 57 20 "Protection of the Environment"
- 3. Appendix E – "Existing Drawings"

1.04 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- 1. American National Standards Institute (ANSI)
- 2. ANSI A10.6 – "Safety Requirements for Demolition Operations"
- 3. Code of Federal Regulations (CFR)
- 4. 40 CFR 261 Identification and Listing of Hazardous Waste
- 5. 30 TAC 335 Industrial Solid Waste and Municipal Hazardous Waste
- 6. Guidelines for the Classification and Coding of Industrial and Hazardous Wastes (RG – 022)

1.05 JOB CONDITIONS

- A. It is the Contractor's responsibility to visit the site and perform any inspection the Contractor deems appropriate, and to examine the drawings and specifications to become familiar with the quantity and character of all materials to be demolished prior to the deadline for submission of bids. The Contractor assumes full responsibility for the proper disposal of all demolition materials in an approved facility and in accordance with all applicable local, state and federal regulatory requirements.
- B. Demolition Notations on Drawings are schematic and general in nature and do not attempt to show the exact scope or detail of all required demolition. Refer to Appendix E for reference to existing drawings showing specific details and materials of the existing components to demolish.
- C. If existing unidentified utilities, structures, or services are discovered that affect the work in any way, Contractor must submit information in writing to the Owner for resolution prior to proceeding.
- D. If any demolition material is suspected to contain hazardous substances, the Contractor shall submit information in writing to the Owner and Engineer for resolution prior to proceeding.

1.06 SUBMITTALS

The following items shall be submitted to the Engineer for review in accordance with Section 01 33 00 – "Submittals"

- A. Demolition Work Plan to also include items to be salvaged and stored for turning over to Owner.

1.07 DEMOLITION WORK PLAN:

- A. A demolition work plan shall be submitted to the Engineer for review and approval. The demolition work plan shall be submitted prior to commencing the demolition work.
- B. The plan shall include a summary of the procedures proposed for the accomplishment of the demolition work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The plan shall include the location of all offsite disposal sites and transportation methods. The plan shall also include all proposed locations for stockpiling materials to be salvaged.
- C. The plan shall include a detailed description for how the Contractor will remove, transport, and dispose of hazardous material as detailed in Paragraph 3.07. The plan shall also include detailed information regarding the landfill used including, but not limited to, certification that the landfill meets the liner and leachate standards of the Minimum Functional Standards, Chapter 335 TAC.
- D. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with U.S. Army Corps of Engineers Engineering Manual EM 385-1-1.

- E. Within the Demolition Work Plan, the Contractor shall include best management practices to conduct the demolition in a manner to contain floatable materials, disturbed sediments, spills, blowing debris, storm water pollution and any other affect resulting from the Contractor's demolition activities.

1.08 COORDINATION

- A. The Contractor shall fully coordinate all demolition work with the Engineer and Owner, and shall file and obtain adequate approval from the Alabama Department of Environmental Management (ADEM) for all demolition work, and shall be in conformance with ALDOT Section 205 – Removal and Relocation of Structures.
- B. Demolition of any existing electrical components, including light poles, light fixtures, transformers, etc. shall be coordinated with Alabama Power.
- C. All demolition work shall proceed in an orderly and careful manner with due consideration for any existing structures, including any portions of the surrounding structure, which are to remain.

1.09 CONTRACTOR ACCESS

- A. The Contractor shall include all anticipated access by barge for equipment delivery and for disposal of debris and materials off site.

1.10 DEMOLISH AND DISPOSE

- A. Demolish or remove and dispose of concrete debris indicated on the Contract Drawings and as further required to properly implement the new work of the Contract.
- B. Demolition and disposal shall be in accordance with all federal, state, and local laws and regulations. Contractor shall obtain any necessary permits.

1.11 REMOVAL

- A. Remove and dispose of all broken up pieces and other obstructions that lie wholly or partially within the specified demolition work.

1.12 DISPOSAL

- A. All demolished materials not designated to be salvaged shall become the property of the Contractor. Remove from site and dispose of legally. Prior to disposal, the Contractor shall provide the Engineer with the locations of all disposal sites to be used and copies of applicable permits and approvals for each site.
- B. Burning shall not be allowed at the project site.

1.13 PROTECTION

- A. Protection of Personnel

1. During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.
 2. Provide protection of persons and existing adjacent property.
- B. Protection of Existing Property
1. The Contractor shall take necessary precautions to avoid damage to the existing structures to remain in place including those underwater. Any damaged items shall be repaired or replaced to the satisfaction of the Owner. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural support or adding new supports as may be required as a result of any cutting, removal, or demolition work perform under this contract.
 2. Avoid any encroachment on adjacent properties unless prior permission is obtained from the Owner. Repair and make good any damage to adjoining properties or improvements caused by operations under this Contract.
- C. Protection of the Environment
1. Any demolition work that disturbs sediment and frees contaminants shall adhere to the US Army Corps of Engineers permit for water quality.
 2. Locations and amounts of hazardous materials are not specifically noted on these drawings. If the contractor uncovers materials in areas that have not been abated or tested, they are obligated to contact the Engineer and Owner for additional testing and must stop work in the affected area(s). This excludes creosote materials as all creosote materials shall be disposed of per Paragraph 3.07.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 GENERAL DEMOLITION

- A. The Contractor shall keep the Engineer and Owner aware of the timing and duration of project activities. Any changes or delays from the information provided to the Engineer and Owner shall be communicated as soon as it is known.
- B. The Contractor shall confirm all structures to be demolished with the Engineer and Owner prior to starting work.

3.02 SEQUENCING

- A. Refer to Contract Drawings for sequencing.

3.03 UTILITY SERVICES

- A. The Contractor shall demolish existing utility piping where interferes with the Base Bid or Bid Additive activities. Refer to the utility drawings for the connections between the new utility piping and the existing piping.)

3.04 DEMOLITION OF STRUCTURES

- A. Completely remove and dispose of designated structures and other obstructions, unless specified to be salvaged. Adjacent materials designated to remain that are damaged by the Contractor as a result of their operations shall be replaced at no additional cost to the Owner.
- B. Execute all required demolition in an orderly and careful manner.
- C. All structures, materials, debris and rubble obtained from the demolition work (unless specified to be salvaged) shall be removed from the premises promptly and disposed of at Contractor's expense at a commercially operating upland facility.
- D. Particular care shall be taken at boundaries of demolition work to provide for smooth and properly finished merging of new work with existing structures or site features to remain.
- E. All damage to existing surfaces or site components to remain, resulting from demolition work, shall be filled, patched, or refinished as required for proper completion and appearance of the finished Work.
- F. Demolition work shall be scheduled and conducted in such a manner as not to destabilize the work area during the time period between completion of demolition and completion of new work within the demolition areas. The Contractor is responsible for protections and maintenance of work area until final completion.
- G. Perform work in accordance with ANSI A10.6 and regulatory requirements.

3.05 PROTECTION:

- A. The Contractor shall be solely responsible for safety, adequacy and satisfactory performance of methods and means employed for demolition.
- B. Protection of Personnel: During the demolition work, the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of any structural elements will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.
- C. Protection of Structures: Structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Engineer and Owner. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.
- D. Protection of Existing Property: The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Owner; any damaged items shall be repaired or replaced to the satisfaction of the Owner. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for

increasing structural support or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

3.06 DEMOLITION OF CONCRETE

- A. Before removal of existing concrete or other supporting members, provide shoring as required and in a manner suitable to the work sequence.

3.07 DISPOSAL

- A. All materials, except those indicated as salvage, and except those materials containing substances classified as hazardous or potentially hazardous by regulating local, state or federal controlling agencies, shall upon their demolition or removal become the property of the Contractor. All such material, including those containing hazardous or potentially hazardous substances shall be removed and promptly disposed of in a legal manner, away from the site and in a local disposal facility, except as otherwise provided herein.
- B. No material shall be disposed of offshore or in adjoining waterways.
- C. Dispose of any ammoniacal copper zinc arsenate (ACZA), chromated copper arsenate (CCA), and creosote treated timber materials as required by state and federal regulations and approved by the Engineer and Owner.

State Regulations: ADEM

3.08 CLEANUP

- A. Remove tools, equipment, and demolished materials from the site. Remove protections, barricades and temporary work. Remove and transport debris and rubbish in a manner that will prevent spillage into waters, onto streets or adjacent area. Restore work site to a condition comparable or better than originally encountered prior to demolition.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMWORK

PART 1 - SCOPE OF WORK

1.01 GENERAL

- A. The contractor is to furnish all labor, equipment and material required to comply with the intent of the Contract Drawings pertaining to concrete formwork and shall comply with the requirements of Section 501 of the ALDOT Standard Specifications for Highway Construction.
- B. The design and engineering of the formwork (removeable and/or stay-in-place), as well as its construction, are to be the responsibility of the Contractor. All forms are to be tight, adequately constructed, and securely held in place. All forms are to withstand, without deformation, the load of the fresh concrete, reinforcing, construction personnel and the effects of the vibrating process, as well as prevent the leakage of mortar. The alignment of forms is to be carefully undertaken to ensure that the forms are secured to the lines and elevations required. Forms are to be clean and are to be recleaned and repaired for each use. Form surfaces against which concrete is to be placed are to be coated with a non-staining material to prevent the adhesion of the concrete.
- C. Proper safe shoring, reshoring, and time of stripping of forms, plus number, adequacy, size and location of these shores, re-shores and forms shall be in accordance with ALDOT Section 501 and shall be so designed and constructed that all local Codes are adhered to. It shall be the sole responsibility of the Contractor to provide a safe structure at all times, and to provide safety to human life and property.
- D. All corners, edges and arises are to be constructed with a minimum 1" chamfer, or as shown on the Contract Drawings. Larger bevels and bull-nose shall be constructed as shown. The Contractor is to review the Contract Drawings to determine what other special concrete configurations may be required.
- E. Form design, tolerances of finished lines, and camber to compensate for deflections due to the weight of the fresh concrete, reinforcing, and construction personnel shall conform to ALDOT Section 501, or as otherwise required.
- F. The Contractor shall provide all chamfers, bevels, "V" scores, construction and expansion joints, waterstops, recesses, notches, reveals, keyways, reglets, inserts, anchors, depressions, ledges, knock-out panels, and temporary cleanout openings of suitably shaped materials in order to produce the cast-in-place concrete work as indicated on the Contract Drawings and in accordance with ALDOT Section 501.
- G. The Contractor shall build into the formwork all plates including sliding plates, slab drains, sleeves, frames, anchors, anchor bolts, shelf angles, hangers, recesses, necessary ties, or other special items.
- H. All forms shall be arranged with joints either vertical or horizontal and having a uniform spacing. All panel faces shall be as large as possible to reduce the number of

form joints. Form ties shall be uniformly spaced. Joints and form ties shall be arranged in a geometric pattern acceptable to the Owner.

1.02 RELATED SECTIONS

- A. 01 33 00 – “Submittals”
- B. 03 15 00 – “Concrete Accessories”
- C. 03 20 00 – “Concrete Reinforcement”
- D. 03 30 00 – “Cast-in-Place Concrete”

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings for fabrication and erection of formwork for specific finished concrete surfaces. Shop drawings shall show the general construction of forms including jointing, special formed joints or reveals, location and pattern of form tie placement, and other items which affect the exposed concrete visually.
- B. Shop drawing review shall be for the general applications and features only. The design of formwork for structural stability and sufficiency shall be the Contractor's responsibility. The submission of shop drawings shall be in accordance with ALDOT Section 105 – Control of Work and project specification 01 33 00- “Submittals”.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 03 15 00

CONCRETE ACCESSORIES

PART 1 – SCOPE OF WORK

1.01 GENERAL

- A. This Section of the Specification covers the furnishing and installation of all accessories for concrete construction, exclusive of reinforcing steel. These accessories include, but are not necessarily limited to: construction joints, water stops, epoxy anchors, dovetail anchors, embedded items to support, brace or carry equipment or the work of others, expansion anchors, anchor bolts, elastomeric bearing pads, electrical conduit, and other items to be placed in the concrete work.
- B. These items may in some instances be specified in other Sections of these Specifications but their inclusion in the concrete work is covered under this Section.
- C. All accessories associated with the support of reinforcing steel shall be as specified in another Section of the Specifications.
- D. The Contractor is to install expansion joints and construction joints as specified in this and/or other Sections of the Specifications. Refer to Contract Drawings for locations.
- E. Insert or embedded items are to include supports, anchorages, base plates, pipe sleeves, electrical conduit, and other such items which may not necessarily be related to concrete construction but are required in order to accommodate the work of others. All such items are to be securely installed to prevent movement when the concrete is placed. Concrete shall not be placed until all insert items have been placed and the Engineer has observed their location.
- F. The Contractor is to arrange to furnish and install all insert items, of the material necessary within the formwork, prior to the placing of concrete.
- G. Materials and methods of construction not specifically covered in the Plans and Specifications shall conform to ALDOT Standard Specification for Highway Construction (2022).

1.02 RELATED SECTIONS

- A. 01 33 00 – “Submittals”
- B. 03 10 00 – “Concrete Formwork”
- C. 03 20 00 – “Concrete Reinforcement”
- D. 03 30 00 – “Cast-in-Place Concrete”

1.03 SUBMITTALS

- A. The Contractor is to furnish to the Engineer any samples which might be required to determine the type of materials to be placed in the work. Any shop drawings required to detail such work are to be submitted at that time.
- B. Submittals are to be made in accordance with requirements stated in Specification Section 01 33 00 – Submittals.

PART 2 - PRODUCTS

2.01 WATERSTOPS

- A. The Contractor is to furnish and install waterstops in the locations indicated on the Contract Drawings.
- B. Dumbbell waterstops shall be of extruded polyvinyl chloride which is dimensionally stable, dense, homogeneous, and non-porous. The waterstops shall be capable of effectively sealing construction joints in concrete against the infiltration or leakage of water.
- C. Polyvinyl-chloride waterstops are to be as manufactured by Greenstreak (Sika) or equal. Waterstops shall be minimum 9” wide dumbbell and dumbbell center bulb type meeting U.S. Army Corps of Engineers CRD C 572 74 Specifications, unless otherwise noted on Contract Drawings.
- D. Dumbbell waterstops are to be of the following style or equal:
 - 1. Greenstreak: 709
- E. Bentonite waterstops are to be “Volclay Waterstop – Rx 101” as manufactured by Minerals Technologies Inc or equal.
- F. “Waterstop – Rx” is a formulated joint sealant comprised of Volclay bentonite/butyl rubber and supplied in coil form.
- G. Bentonite waterstops are to be used where acceptable to the Engineer, or as shown on the Contract Drawings.

2.02 EMBEDDED ELECTRICAL CONDUIT

- A. All conduit encased in concrete shall conform to standard schedule 80-PVC pipe.

2.03 OTHER EMBEDDED AND INSERT ITEMS

- A. Anchor bolts are to be as indicated and/or detailed on the Contract Drawings and as specified elsewhere in the Contract Documents, in case of conflicts the Contractor shall immediately notify the Engineer in writing for discussion and resolution.
- B. Expansion anchors are to be Type 316 stainless steel wedge type, such as “Kwik Bolt 3 316 Stainless Steel” as manufactured by Hilti, or equal.
- C. Anchor bolts cast in concrete for attachment of aluminum and stainless-steel work are to be Type 316 stainless steel hooked bolts, with stainless steel nuts and washers.

Anchor bolts, for attachment of structural steel work, shall conform to F1554 Gr. 55, unless otherwise indicated on the Contract Drawings.

- D. Epoxy anchors shall be stainless steel type 316 threaded rod stud unless otherwise noted in the drawings. Reinforcing dowels shall match material used for the slabs or beams. Epoxy shall be a two component, low deflection ceramic filled epoxy. The epoxy material shall be "HIT-RE 500" as manufactured by Hilti, or equal. The adhesive shall contain no solvents or styrene. A carbide bit shall be used for the drilling of holes for use with epoxy, in no way shall a diamond-tipped core bit be used for this application unless allowed by the manufacturer where the capacity of the anchor is not reduced.

PART 3 – EXECUTION

3.01 WATERSTOPS

- A. The Contractor is to ensure steel reinforcing bars do not interfere with proper position of waterstops. The joints shall be cleaned of dirt and construction debris prior to second placement of concrete.
- B. Field jointing of the dumbbell waterstops shall be made by welded butt splices. At intersections, dumbbell waterstops shall be spliced to preformed type joints which have been fabricated at the Manufacturer's plant. Splices are to be located a sufficient distance away from corners and elsewhere to permit adequate working room and are to be formed by means of electric tools designed specifically for this purpose, or by other acceptable methods. Splices shall be neatly made and the resulting joint is to have continuity and be in true alignment with the unspliced portions of the embedded water stops. The splices shall have a tensile strength of not less than 80% of the tensile strength of the unspliced material. The procedure for making splices in the field, and the description of the equipment required for properly making such splices, is to be presented for review at the time of the submission of the certified copies of the test reports and the samples of the waterstops. The initial splices are to be made under the supervision of a qualified representative of the Manufacturer of the waterstops.
- C. Where directed by the Engineer, splices shall be electrically tested, by an instrument recommended by the waterstop Manufacturer and supplied by the Contractor for unwelded portions, pinholes, openings, or any other imperfections in the weld, which would affect its water tightness. The Contractor shall test the welded joint in the presence of the Engineer and any joint not passing the test, as determined by the Engineer, shall be immediately replaced with a new joint and retested. Concrete shall not be placed against welded waterstops until they have been accepted.
- D. Dumbbell waterstops shall be placed as shown on the Contract Drawings or as ordered, forming a continuous watertight diaphragm in each joint, and be so secured and supported as to prevent displacement during the progress of the work and until the concrete has set. Waterstops are to be held rigidly in place. In no case are the waterstops to be bent over the joint. To ensure their proper embedment in concrete, the waterstops shall be secured in position by means of anchoring rings, 16-gauge tie wire, or other acceptable methods. The placing of concrete in forms is not to be done until the secured waterstops have been inspected.

- E. The bentonite waterstop material shall be confined within a joint, with a minimum 3” concrete cover to the exterior of the joint surface. An exposed length of the waterstop material should not be submerged for extended periods of time. If the waterstop material exhibits considerable swelling prior to confinement in the joint, it must be replaced with new material. Field joining shall be made by butt splice.
- F. The Contractor shall ensure that the bentonite waterstop material will not be displaced during or prior to concrete placement. The Contractor shall use “CETSEAL”, as manufactured by Minerals Technologies Inc or equal, to hold the material in place.

3.02 EMBEDDED ELECTRICAL CONDUIT

- A. The Contractor, and/or the electrical trade Sub-Contractor, shall review with the Engineer the proposed location and method of installation of conduits in concrete construction and shall not proceed with installation of same until arrangement of conduits and openings has been agreed upon.
- B. No conduits shall be so located and installed that will impair the structural integrity of the concrete members.
- C. All conduit cross-overs shall be so located so they do not vertically displace any main reinforcing bars or otherwise impair the structural integrity of the framing system.
- D. No conduit with an outside diameter larger than one-third of the concrete slab thickness will be permitted to be installed in the slab system.
- E. All conduits shall be spaced a minimum of three conduit diameters center to center. Larger spacing of conduit is preferred.

3.03 OTHER EMBEDDED AND INSERT ITEMS

- A. Anchor bolts are to be set in pipe sleeves, where directed by the Engineer. All anchor bolts are to be set in templates and adequately braced to prevent misalignment during the placement of concrete. All bolts are to be of such a length that at least two (2) threads are exposed after tightening.

3.04 EPOXY ANCHOR SYSTEM

- A. Substitution for cast-in-place embedded anchors shall be prohibited without prior written approval from the engineer of record.
- B. Where called for epoxy anchors, bolts, dowels, reinforcing shall use an epoxy adhesive such as Hilti HIT-RE 500 V3 or equal. Follow all the manufacturer’s written instructions for installation.
- C. All post-installed anchors and hardware (nuts and washers) shall be 316 stainless steel. Reinforcing dowels shall match the material of the reinforcing in the slabs or beams.
- D. Diameter of hole shall be as recommended by manufacturer for the particular product specified in the drawings.

- E. All anchored threaded rods and rebars shall be continuously monitored by an independent testing agency retained by the Contractor. Daily monitoring reports shall include that proper holes (diameter and depth), cleaning, and epoxy applications were used and provided to EOR for review and record.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 – SCOPE OF WORK

1.01 GENERAL

- A. This Section of the Specifications covers the furnishing, bending and placement of all reinforcing steel, welded wire reinforcement, supports and fastenings used in the concrete work. This Section also includes furnishing placement (shop) drawings covering the layout and bending of all reinforcing. These placement drawings are to be furnished to the Engineer for review, as per the requirements of Specification Section 01 33 00 – Submittals, prior to cutting, bending, or placing any reinforcement. No work shall be started until the drawings have been reviewed by the Engineer.
- B. All reinforcing is to be kept clean, free of dirt, oil or other substances which might in any way impair the bond between the reinforcing and concrete. The Contractor is to advise the Engineer to his readiness to have the reinforcing inspected after it has been installed. No concrete is to be placed unless the reinforcing, which is in place, has been observed by the Engineer or Authorized Representative.
- C. The contractor is to furnish all labor, equipment and material required to comply with the intent of the Contract Drawings pertaining to concrete work. All the concrete reinforcement work for the project shall conform in full to ALDOT Standard Specifications for Highway Construction (2022), Section 502 – Steel Reinforcement, Section 835 – Steel Reinforcement, and all related sections.

1.02 RELATED SECTIONS

- A. 01 33 00 – “Submittals”
- B. 03 10 00 – “Concrete Formwork”
- C. 03 15 00 – “Concrete Accessories”
- D. 03 30 00 – “Cast-in-Place Concrete”

1.03 SUBMITTALS

- A. The Contractor is to allow proper time for the review of shop drawings. The Contractor is to allow sufficient time for inspection of reinforcing steel, once placed, before ordering and placing of concrete.

- B. The Contractor is to submit rebar shop drawings showing all plans, sections, details, elevations, bar schedules and diagrams of all bars, arrangements and assemblies as required for the fabrication and placement in the concrete formwork. Details are to be included for all special reinforcements at openings, and for all support accessories, which must be adequate in strength to hold applied live and dead loads without excessive or permanent displacement of the reinforcement.

PART 2 – PRODUCTS

- A. Where reinforcing material is properly identified, mill reports will be accepted. The Contractor shall submit certificates of the mill tests. All reinforcing steel shall come from an ALDOT approved steel mill. Approved steel mills are listed in the Department's Materials, Sources and Devices with Special Acceptance Requirements Manual, List I-12, Deformed and Plain Steel Bar Producing Mills.

(Refer to ALDOT Standard Specifications for Highway Construction (2022), Section 835 – Steel Reinforcement, and all related sections.)

PART 3 – EXECUTION

3.01 REINFORCEMENT TESTING

- A. In the event that the Engineer requires additional testing of reinforcing materials which have been delivered to the Project Site, the Contractor is to make such materials available in the sizes, lengths, and quantities necessary for testing, at no additional cost.

3.02 FABRICATION

- A. All reinforcement is to be fabricated to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI "Manual of Standard Practice" MSP-1-97. In case of fabricating errors, the Contractor shall not re bend or straighten reinforcement in a manner that will injure or weaken the material. All reinforcing steel is to be pre-cut and pre-bent off site in an approved fabricating shop by an acceptable subcontractor for reinforcing steel fabrication.

3.03 DELIVERY, HANDLING, AND STORAGE

- A. All concrete reinforcement is to be delivered to the Project Site bundled, tagged, and marked. Metal tags are to be used to indicate bar size, lengths, and other information corresponding to markings shown on the placement diagrams.
- B. All concrete reinforcing materials are to be stored at the Project Site, to prevent damage and accumulation of dirt or excessive rust.

3.04 INSTALLATION

- A. The Contractor is to comply with the previously specified Codes and Standards and Concrete Reinforcing Steel Institute recommended practice described in "Placing Reinforcing Bars",

latest edition, for details and methods of reinforcement placement and supports, and as herein specified.

- B. All reinforcement shall be cleaned prior to installation to remove loose rust and mill scale, earth, ice, and other materials which reduce or destroy the bond with the concrete.
- C. Bar supports shall be provided for reinforcement in foundation elements, slabs on ground, and all framed beams and slabs. Reinforcement shall be positioned, supported, and secured against displacement by formwork, construction, or concrete placement operations. Reinforcement shall be located and supported by metal chairs, runners, bolsters, spacers, and hangers.
- D. Reinforcing steel shall be supported in a manner that will maintain the clear distances between bars and the face of concrete as indicated on the Contract Drawings or mentioned in the Specifications. Supports are to include slab and beam bolsters, low and high chairs, spacers and other devices suitable for the proper spacing, supporting and fastening of reinforcing bars or welded wire reinforcement in place. Consideration is to be given for all loads applied to the reinforcing. Supports for slabs on grade are to include sand plates, laterally welded braces for high chair legs and specially designed steel framed supports for heavy reinforcing.
- E. In no case will the use of masonry, stone, or wood be permitted for bar supports. Plastic protected or non-staining legs are to be provided in the case of bar supports being in contact with the formwork of concrete surfaces exposed to view after completion.
- F. Provide reinforcing steel bar supports manufactured in accordance with all requirements of the CRSI Manual of Standard Practice. Metal supports shall be in accordance with CRSI Manual of Standard practice MSP-1-97 for Class 3 bar supports except that supports which are to be in direct contact with removable forms shall be Class 1 supports. Any premolded Class 1 support tips that do not provide a tight snug fit shall be rejected and removed from the work.
- G. Use chairs and bolsters of adequate strength to withstand loading without permanent deformation or breakage. Ensure that bar supports, both chair and bolster, do not move during concrete placing operations. To prevent movement, tie supports to the reinforcing steel. When using bar supports on corrugated metal stay-in-place forms, use supports specifically designed for the form being used.
- H. The Contractor is to vary the support bar diameters and spacing to suit each specific support requirement and detail them to suit the condition of loading.
- I. The Contractor shall not place reinforcing bars more than two (2) inches beyond the last leg of any continuous bar support. The Contractor shall not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- J. All reinforcement shall be secured against displacement by tying with No. 16 gauge, black soft annealed wire at all intersections, and shall be so supported so as to keep all reinforcement away from the exposed surfaces. Whenever the members are reinforced with two curtains of reinforcement, bar spacers securely tied to both curtains shall be provided.
- K. The Contractor shall set all wire ties so that twisted ends are directed away from exposed concrete surfaces.

- L. Tack welding of reinforcement shall not be permitted.
- M. Reinforcement shall be contact lap spliced where practical, with the location of and minimum lap lengths as called for on the Contract Drawings. Where no lap length is noted on plan or section, the minimum lap shall be as per the typical details for tension lap splices. All adjacent splices shall be progressively staggered at 5' 0" on center. Unless otherwise shown on the plans, bar splices shall be Class B per ACI 318.
- N. Splicing: All laps or splices shall be Class B unless otherwise noted and shall be tied with No. 16 gauge black annealed wire and seized tight at both ends. Reinforcement shall not be spliced at points of maximum stress and, where possible, shall have splice locations staggered, and shall be designed to develop the strength of the steel without exceeding the allowable unit bond strength.
- O. The Contractor shall install welded wire reinforcement in as long lengths as practical. He shall lap adjoining pieces at least one full mesh and lace splices with 16 gauge wire. He shall not make end laps midway between supporting beams, or directly over beams of continuous members. The Contractor shall offset end laps in adjacent widths to prevent continuous laps. If fabric is ordered in rolls, transverse wires are to be on the inside of the rolls. All such fabric is to be unrolled in the direction of the span.
- P. Welding of reinforcing steel is strictly prohibited unless prior approval is provided by the Engineer.
- Q. After the reinforcement has been placed, the Contractor shall notify the Engineer as to his readiness to have the reinforcing inspected. Concrete shall not be placed until the reinforcement placement is complete and has been observed by the Engineer or Authorized Representative.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – SCOPE OF WORK

1.01 GENERAL

- A. This Section of the Specifications covers the furnishing and installation of all cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. The contractor is to furnish all labor, equipment and material required to comply with the intent of the Contract Drawings pertaining to cast-in-place concrete work. All the cast-in-place concrete work for the project shall conform in full to ALDOT Standard Specifications for Highway Construction (2022), Section 501 and 510, and all referenced sections.

1.02 RELATED SECTIONS

- A. 01 33 00 – “Submittal”
- B. 03 10 00 – “Concrete Formwork”
- C. 03 15 00 – “Concrete Accessories”
- D. 03 20 00 – “Concrete Reinforcement”

1.03 SUBMITTALS

- A. Batching Plants: Batching plant supplying concrete shall be on List I-7, “Portland Cement Concrete Producer”, of the Materials, Sources and Devices with Special Acceptance Requirements Manual (MSDSAR) of ALDOT. The concrete producer shall submit a valid BMT-75 and proof of NRMCA certification prior to batching concrete.
- B. Product Data: For each type of product indicated.
- C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

Formwork Shop Drawing shall be signed and sealed by a qualified professional engineer registered in the State of Alabama.

- F. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- G. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval by the Engineer.
- H. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Waterstops.
 - 6. Curing compounds.
 - 7. Slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Semirigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.
- I. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates.
- J. The concrete producer shall provide the Contractor with a Certificate of Compliance for each truck load of concrete, which is to be submitted to the Engineer. The Certificate of Compliance shall verify that the delivered concrete complies with the mix design and shall include:
 - 1. Manufacturer Plant (batching facility).
 - 2. Contracting Agency Contract number.
 - 3. Date.
 - 4. Time batched.
 - 5. Truck No.
 - 6. Initial revolution counter reading.
 - 7. Quantity (quantity batched this load).
 - 8. Type of concrete by class and producer design mix number.
 - 9. Cement producer, type, and Mill Certification No.
 - 10. Fly ash or slag brand and Type.
 - 11. Approved aggregate gradation designation.
 - 12. Mix design weight per cubic yard and actual batched weights for:
 - a. Cement.
 - b. Fly ash or slag.

- c. Coarse concrete aggregate and moisture content (each size).
 - d. Fine concrete aggregate and moisture content.
 - e. Water (including free moisture aggregates).
 - f. Admixtures brand and total quantity batched.
 - g. Air-entraining admixtures.
 - h. Water-reducing admixtures.
 - i. Other admixtures.
- K. Floor surface flatness and levelness measurements indicating compliance with specified tolerances as follows:

Deviation from Plumb	$\pm \frac{1}{8}$ in
Horizontal Deviation (Centerline alignment)	$\pm \frac{3}{16}$ in
Length, width, or depth of specified elements	$\pm \frac{3}{16}$ in
Reinforcement Cover (Top, Bottom, and Sides)	$\pm \frac{1}{2}$ in
Slope of formed and unformed surfaces with respect to the specified plane or elevation shall not exceed the following amounts in 10 ft	$\pm \frac{1}{8}$ in
Cast-in-Place concrete at interface with existing concrete	$\pm \frac{1}{16}$ in
Floor Flatness (FF)	35
Floor Levelness (FL)	25

- L. Testing: Concrete sampling and testing plan report(s)
- M. Equipment Summary: Summary of pumping, transport, and vibratory equipment to be used for concrete pouring, and any other equipment to be used for concrete handling and/or placement.

1.04 QUALITY ASSURANCE

- A. Refer to paragraph 3.08, this specification, for testing requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Refer to Section 03 20 00 – Concrete Reinforcement for reinforcement requirements.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants. Refer to Section 03 15 00 – Concrete Accessories for requirements.

PART 2 – PRODUCTS

2.01 FORM FACING MATERIALS

- A. Refer to Section 03 10 00 – Concrete Formwork for Facing Material requirements.

2.02 CONCRETE MATERIALS

- A. All the cast-in-place concrete work for the project shall conform in full to ALDOT Standard Specifications for Highway Construction (2022), Section 501 – Structural Portland Cement Concrete. Concrete specific requirements are summarized in this section.

- B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

Mix Proportion 1:

1. Portland Cement: ASTM C 595, Type IL, 51-79%
2. Fly Ash: Type F, 18-40%
3. Silica Fume: ASTM C 1240, 9%

Mix Proportion 2:

1. Portland Cement: ASTM C 595, Type IL, 36-43%
2. Slag: Type F, 50-55%
3. Silica Fume: ASTM C 1240, 9%

- C. Normal-Weight Aggregates: Coarse Aggregate shall comply with the gradation and material requirements of ALDOT Section 801 – Coarse Aggregate and 802- Fine Aggregate.

- D. Maximum Coarse-Aggregate Size: 3/4-inch (19 mm) nominal.

1. Free of materials with deleterious reactivity to alkali in cement.

- E. Water: ASTM C 94/C 94M.

- F. The minimum concrete compressive strength at 28 days shall be 5500 psi, or as specified on the Contract Drawings. Substitution with a lower strength mixture is not permitted.

2.03 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

- B. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

- C. Proportion normal-weight concrete mixture as follows:

1. Maximum Water-Cementitious Materials Ratio: 0.35 w/cm
2. Maximum Slump: 3 ½ inches ± 1 inch for vibrated concrete, provided the water cement ratio does not exceed the requirements and an approved water reducer is used. Approved Type “F” chemical admixtures may be used to chemically

increase the slump specified to a maximum slump of 6 inches. Tolerance does not apply when Type “F” chemical admixtures are used.

3. Target Air Content: 5%. Approved air entraining admixtures are listed in the MSDSAR manual, List II-1, “Chemical Admixtures for Portland Cement Concrete”.
4. Concrete Temperature: 95 deg. F max.
5. Cementitious Materials: Use fly ash or slag and silica fume to reduce the total amount of Portland cement, which would otherwise be used. Refer to the mix proportion options in Section 2.02.B
6. Permeability: 2,000 coulombs, max

2.04 ADMIXTURES

- A. Concrete admixtures, if added, shall conform to the requirements of ALDOT Technical Specifications for Highway Construction (2022), Section 501.
- B. Admixtures: Use admixtures as directed by the Design Engineer and in strict accordance with manufacturer's written instructions.
 1. Use water-reducing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.05 VAPOR RETARDERS

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

2.06 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

PART 3 – EXECUTION

3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork in accordance with Specification Section 03 10 00 – Concrete Formwork.

3.02 CONCRETE PLACEMENT

- A. Concrete Placement Procedures shall conform to ALDOT Specifications Section 501.
- B. Contractor shall notify the Engineer at least 24 hours before placing concrete. No concrete shall be placed until the Engineer has observed the concrete work to be performed. All special inspections to be performed by Contractor.
- C. No concrete shall be placed until the Engineer has reviewed and approved the concrete mix design.
- D. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- E. Time of hauling: The delivery and placement of ready-mixed concrete shall be completed within the time frames listed in the following table. These times are measured from the time at which water is added to the cement until the time at which placement of the load is completed.

Time limitations for the delivery and placement of concrete		
Temperature of the Concrete	Mixtures without Retarding Admixtures	Mixtures with Retarding Admixtures
Less than 85°F	1 hour	1 hour and 45 Minutes
85°F or More	45 minutes	1 hour and 15 Minutes

- F. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ALDOT Section 501.03.(c)
- In no instance shall the maximum water-cementitious ratio of the mixture design, or the maximum slump be exceeded.
- G. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
- Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- H. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration

to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- I. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture above 50 deg F. If there are indications that there will be temperatures below 40 deg. during the first three days after placement of concrete, concrete shall be protected from cold temperatures by keeping the surface at temperatures above 50 deg F for the first 72 hours after placement and above 32 deg F for an additional 72 hours. However, the protective covering shall be retained in place until the temperature inside the protective covering reaches that of the surrounding atmosphere.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
 4. Hot-Weather Placement: Comply with ACI 305 and as follows:
 - a. In no instance shall the concrete be placed when the temperature of the plastic concrete is above 90 deg F. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - b. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.03 CONCRETE PROTECTING AND CURING

- A. General: Concrete curing shall conform to ALDOT Specifications Section 501. A summary of general criteria is provided in this section.
- B. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305 for hot-weather protection during curing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

1. Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven (7) days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven (7) days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.04 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete. Seal all joints, refer to drawings.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated in the contract drawings and as approved by the Engineer.
- C. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
- D. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades within 8hrs (max) of placing concrete. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.05 CONCRETE SURFACE REPAIRS

- A. After removal of forms, concrete with surface defects and out of alignment or level beyond required tolerances, shall be repaired in accordance with ACI 301.
- B. All tie holes shall be patched.
- C. Curing shall be interrupted for the shortest time and in the smallest area practicable to perform repair.
- D. Methods of making repairs shall be approved by the Engineer.

- E. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- F. Patching Mortar: Mix dry-pack patching mortar, consisting of one-part Portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- G. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by the Engineer.
- H. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding. Maximum grinding depth shall be 3/8 inch.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edge to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
8. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
9. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.06 FINISHING FORMED SURFACES

- A. General: Unless otherwise specified in the drawings, exposed surfaces shall have a textured finish obtained using a burlap or cotton drag, brush, or broom so that a uniform gritty texture is obtained.
- B. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces not exposed to public view. Tolerances in accordance with ACI 347-R14, Class C, Table 5.3.1.
- C. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, and to be covered with a coating or covering material applied directly to concrete. Tolerances in accordance with ACI 347-R14, Class A, Table 5.3.1.

- D. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.07 FIELD QUALITY CONTROL

- A. Testing and Inspecting: The Engineer will review qualified testing and inspecting agency field tests, inspections, and test reports.
- B. Testing and Inspecting: The Contractor shall engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports. The contractor shall coordinate inspections and testing with the Engineer.
- C. Concrete Tests: Concrete Testing Services: Tests shall be performed by qualified concrete technicians and concrete laboratories per ALDOT-405. Mold and cure one set of 5 standard cylinders for each compressive strength test required.
1. Testing Frequency: Obtain at least a composite sample for each 150 cu. yd. of concrete or 5000 s.f. or fraction thereof of each concrete mixture placed each day. Test one specimen at 3 and 7 days, two specimens at 28 days, and save one specimen as spare to test at 56 days if required. Compressive strength from concrete cylinders will be accepted when the average of two consecutive cylinders test results, obtained at the same age, equals or exceeds the specified 28-day compressive strength.
 2. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: T119; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 4. Air Content: T152, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: T309; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Compressive-Strength Tests: T22.
7. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below 5% of the specified compressive strength.
9. Test results shall be reported in writing to the concrete manufacturer and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for 3-, 7- and 28-day tests. Provide 56-day test results if required.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Engineer but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by the Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with T24 or by other methods as directed by the Engineer.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.08 ACCEPTANCE OF CONCRETE

- A. The Engineer will review testing reports and investigate any concrete not meeting the acceptance requirements outlined. Concrete investigations will be used to determine the suitability of potentially substandard concrete according to ALDOT Section 501 and may include any and all the procedures outlined in ALDOT-170.
- B. Fresh Concrete will be accepted on the basis of slump, total air content, and temperature meeting the outlined requirements.

- C. Hardened concrete shall be accepted on the basis of compressive strength meeting the requirements specified.
- D. If the investigation results show that the concrete fails to meet the contract requirements, the Contractor shall be responsible for the cost of the investigation including but not limited to, per-diem, travel expenses, and sampling and testing.
- E. All unsatisfactory concrete shall be removed or repaired as directed by the Engineer. No additional compensation to the Contractor will be allowed for compliance with the outlined requirements.

END OF SECTION

SECTION 03 62 13

NON-METALLIC NON-SHRINK GROUTING

PART 1 – SCOPE OF WORK

1.01 SUMMARY

- A. This Section covers the requirements for non-metallic, non-shrink, cement-based grouting.
- B. Materials and methods of construction not specifically covered in the Contract Drawings and Specifications shall conform to the ALDOT Standard Specifications for Highway Construction (2022).

1.02 RELATED SECTIONS

- C. Technical Specification Section 01 33 00 – Submittal Procedures
- D. Technical Specifications Section 35 59 33 – Mooring Bollards

1.03 APPLICABLE PUBLICATIONS

- A. All work performed and materials installed by the Contractor, unless otherwise specified herein, are to be in strict accordance with the latest version of the following Codes and Standards. In the event of a conflict between these specifications and the referenced standards, the more stringent requirement shall govern.

American Society of Testing and Materials (ASTM)

C109	Testing Method for Compressive Strength of Hydraulic Cement Mortars
C191	Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle
C827	Test Method for Early Volume Change of Cementitious Mixtures

1.04 SUBMITTALS

- A. The following submittals shall be in accordance with Section 01 33 00 – Submittals
- B. Submit manufacturer's product data sheet, instructions and methods for handling, storage, mixing, and placing of the grout, for approval.
- C. Testing Reports

1.05 QUALITY CONTROL

- A. Quality Control under this Section shall be performed as determined necessary by the Contractor to ensure the in progress and completed work meets the requirements of the plans and specifications.

1.06 QUALITY ASSURANCE

- A. Quality Assurance shall be the contractor's responsibility. Quality Assurance testing and observation include, but are not limited to, the following:
 - 1. By the Contractor:
 - a. Sample Testing
- B. Manufacturer Representative: The contractor shall request instruction on proper grout installation from the manufacturer. The manufacturer shall provide a representative to observe and instruct the contractor during installation of the product. After installation is complete, the Manufacturer's Representative shall submit documentation stating that the product was satisfactorily installed per manufacturer's recommendations.

PART 2 – PRODUCTS

2.01 MATERIAL

- A. Grout shall have a minimum 28-day compressive strength of 6,500 psi based on fluid consistency. Extend with aggregate as required for thicker applications.
- B. Grout consistency shall be selected by the contractor, as necessary for the application, in coordination with manufacturer's recommendations.
- C. Gout shall be premeasured and prepackaged by the manufacturer, requiring only addition of potable water for mixing.
- D. Gout products shall be one of the following or an approved equal:
 - 1. "NS Grout" – manufactured by Euclid Chemical
 - 2. "Five Star Fluid Grout 100" – manufactured by Five Star Products, Inc.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Areas to be grouted as shown on the Contract Drawings shall be cleaned of all foreign materials, to the satisfaction of the Engineer, and as required by the manufacturer's instructions.

3.02 MIXING AND PLACING

- A. Use only experienced and/or qualified personnel trained by the manufacturer's representative, as required by the manufacturer and the Contract Documents.
- B. Mix and place the grout in accordance with manufacturer's methods.
- C. Placement shall be continuous to avoid cold joints and voids. For consistencies that aren't pourable, grout shall be rodded or spaded to prevent the formation for air pockets.

3.03 FIELD TESTS

- A. The contractor shall take, and test samples of the grout being placed in accordance with ASTM C109, C191, C827, (once per day of production, witnessed by Engineer).
- B. In the event that test of the grout placed reveal any failure to meet requirements of this Section, the contractor shall require removal and replacement of all portions of grout from the batch from which the sample was taken and direct the contractor to discontinue grouting until the contractor has demonstrated to the satisfaction of the engineer that the causes of failure have been corrected.

END OF SECTION

SECTION 05 12 53

WELDING

PART 1 – SCOPE OF WORK

1.01 SUMMARY

- A. This Section specifies the requirements for furnishing all equipment, materials, labor, and contractor provided inspections and testing to provide structural welded connections and underwater welded connections. The contractor shall be responsible for testing of all welded connections through the services of a third-party Certified Welding Inspector (CWI).
- B. Materials and methods of construction not specifically covered in the Contract Drawings and Specifications shall conform to the ALDOT Standard Specifications for Highway Construction (2022).

1.02 RELATED SECTIONS

- A. Technical Specification Section 05 50 00 – Metal Fabrications

1.03 APPLICABLE PUBLICATIONS

- A. All work performed and materials installed by the contractor, unless otherwise specified herein, are to be in strict accordance with the latest version of the following Codes and Standards. In the event of a conflict between these specifications and the referenced standards, the more stringent requirement shall govern.

American Society of Nondestructive Testing (ASNT): SNT-TC-IA
American Welding Society (AWS):

- B2.1 Standard for Welding Procedure and Performance Qualification
- D1.1 Structural Welding Code- Steel
- D1.6 Structural Welding Code- Stainless Steel
- D3.6M Underwater Welding Code
- QC-1 Standard for AWS Certification of Welding Inspectors

American Society of Mechanical Engineers (ASME):

- BPVC SEC V Standard for Welding Procedure and Performance Qualification
- BPVC SEC IX Welding and Brazing Qualifications

1.04 SUBMITTALS

- A. The following submittals shall be in accordance with Section 01 33 00 – Submittals
 - 1. Welding Procedure Specification (WPS): Submit shop and field welding procedures including the type of equipment to be used, electrode selection, preheat requirements, base materials, and joint details.
 - 2. Procedure Qualification Records (PQRs).
 - 3. Welding Documentation: Submit on appropriate forms in referenced welding codes.
 - 4. Nondestructive testing procedure specifications prepared in accordance with ASME BPVC SEC V.
- B. Qualifications
 - 1. Welding Operator: Prior to welding, the contractor will submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

1.05 QUALITY ASSURANCE

- A. Company specializing in performing the work of this Section shall have at least five (5) years minimum experience.
- B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- C. The contractor shall be responsible for testing of all shop and field welded connections through the services of a third-party Certified Welding Inspector (CWI). The engineer will perform additional visual welding inspection. The contractor shall make reasonable accommodation to the engineer to perform said inspections.
- D. The contractor shall submit test results and reports to the engineer for record and conformance with Contract Documents.

1.06 QUALIFICATIONS

- A. Welding Procedure Specifications: In accordance with AWS D1.1, D1.6 and D3.6M as appropriate, or AWS B2.1 (App. A) or ASME BPVC SEC LX (Forms QW-482 and QW-483).
- B. Welder/ Welding Operator: In accordance with AWS D1.1, AWS D1.6 and/or D3.6M as applicable, AWS B2.1 or ASME BPVC SEC IX (Form QW-484).
- C. Welding Inspector: Certified in accordance with AWS QC1 and having prior experience with the welding codes specified.
- D. Testing Agency: Personnel performing tests shall be NDT Level II Certified in

accordance with ASNT SNT-TC-1A.

1.07 SEQUENCING AND SCHEDULING

- A. All submittals required in this Section shall be submitted and approved prior to commencement of welding operations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 NON-DESTRUCTIVE WELD TESTING REQUIREMENTS

- A. Perform all non-destructive testing in accordance with AWS D1.1, D1.6 or D3.6M, as appropriate.
- B. Visual Inspection: All welds shall be 100 percent visually inspected unless otherwise stated. Contractor to obtain photos of underwater anode plate-to-pile welds for CWI review.

3.02 SOURCE/ FIELD QUALITY CONTROL

- A. The contractor's CWI shall be present whenever shop or field welding is performed and shall:
 - 1. Verify conformance of specified job material and proper storage.
 - 2. Monitor conformance with approved welding procedure specifications (WPSs).
 - 3. Monitor conformance of welder/welding operator qualification (WPQs).
 - 4. Provide 100 percent visual inspection of all welds.
 - 5. Supervise nondestructive testing personnel and evaluate test results.
 - 6. Maintain records and prepare report confirming results of inspection and testing.

3.03 CORRECTIONS AND REPAIRS

- A. If contractor inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder. Conduct corrections in accordance with the requirements of AWS D1.1, D1.6 or D3.6M, as appropriate, and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds must meet the inspection requirements for the original welds.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 – SCOPE OF WORK

1.01 GENERAL

- A. This Technical Specification section covers the detailing, supply, fabrication and installation of metal components including all miscellaneous metal fabrication and connection components required to complete the work as required by the Contract Drawings and Specifications. Components covered under this specification include:
 - 1. Miscellaneous fabricated metal items
 - 2. Miscellaneous structural steel
 - 3. Bolts and nuts (if not specified elsewhere)
 - 4. Welding Specifications
- B. Materials and methods of construction not specifically covered in the Contract Drawings and Specifications shall conform to the ALDOT Standard Specifications for Highway Construction (2018).
- C. The design, manufacture, and installation of all items under this section shall be performed by experienced personnel meeting the minimum qualifications as defined in this specification as applicable.
- D. The work specified in this section may be considered as individual bid items or incidental to bid item work and costs as defined in the contract. All fastening materials and installation of such shall be considered incidental to applicable bid item work and are not to be paid for separately.

1.02 RELATED SECTIONS

- A. 01 33 00 – “Submittals”
- B. 09 96 26 – “Marine Coatings”

1.03 REFERENCES

- A. All work performed and materials installed by the Contractor are to be in strict accordance with the most recent revisions of the following Codes and Standards:
- B. The publications listed below form a part of this specification to the extent referenced. Latest editions apply.
 - 1. American Welding Society (AWS)
D1.1 Structural Welding Code – Steel

2. American Society of Testing and Materials (ASTM)

A500 Gr B	Structural Steel
A572	Structural Steel
F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
F594	Standard Specification for Stainless Steel Nuts
A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A563	Carbon and Alloy Steel Nuts
A780	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
A992	Structural Steel Shapes
316	Stainless Steel
F1554 Gr 55	Anchor Bolts

1.04 GENERAL

- A. Miscellaneous metals material specification requirements shall apply to all metal items unless otherwise identified or noted on the Contract Drawings.
- B. Temporary construction. The Contractor is responsible for temporary bracing and support of all structures during construction and shall protect all exposed partially complete work against damage. The Contractor shall take precautions to assure that the structure is adequately braced to avoid damage from wave, wake or other force action during construction. Any structural component damaged during construction shall be replaced by the Contractor at no cost to the Owner. The Contractor's proposed methods for providing temporary protection shall be included in the work plan as approved by the Engineer.

1.05 QUALITY ASSURANCE

- A. Fabricate and install structural steel in accordance with AISC Code of Standard Practice.
- B. Field Measurements. The Contractor is responsible for performing all necessary field measurements prior to ordering and fabrication of the miscellaneous metals.
- C. Fabricator qualifications: The Contractor shall engage an experienced fabricator who has completed metal fabrication work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.
- D. Qualification of Welders and Welding Operators. Welders and welding operators shall be qualified for shop and field welding in accordance with AWS D1.1, Section 5, Parts C and D for steel welding.

1.06 MATERIAL TESTS

- A. Miscellaneous metals and appurtenant materials shall be tested and certified by the manufacturer to meet the specified chemical, mechanical, and section property

requirements prior to delivery to the site. Testing of miscellaneous metals for mechanical properties shall be performed after the completion of all rolling and forming operations. Testing of miscellaneous metals shall meet the requirement of ASTM A6.

1.07 SUBMITTALS

- A. The following items shall be submitted to the Engineer for review per technical specification Section 01 33 00 - Submittals:
 - 1. Shop Drawings, including complete bills of material for metal fabrications, frame connection fabrications, attachments, and any other miscellaneous metal fabrications, and all fabricated assemblies.
 - 2. Signed & Sealed Design drawings with supporting calculations shall be developed for fabrication items designed by the fabricator or manufacturer and such design documentation shall be submitted for review and approval by the Engineer and Owner prior to fabrication.
 - 3. Submit manufacturers' mill certificates and certificates of compliance for the following materials as applicable:
 - a. Steel
 - b. Fasteners
 - c. Cast Iron
 - d. Stainless Steel
- B. Placement drawings, showing location in the Project of all fabrications, cross referenced to the shop drawings.
- C. Work plan for new fabrications and installations, and rehabilitation of existing structures; including proposed schedule and procedures shall be submitted to the Engineer.
- D. Manufacturer's literature and data for products used that demonstrates compliance with the applicable materials specifications.
- E. Certificates: Contractor to provide a copy of the Materials Safety Data Sheets (MSDS) and Consumer Information Safety (CIS) sheets to the Owner's Representative.
- F. Company Data: The Contractor shall submit the proposed metal fabricator and/or galvanizing sub-Contractors' name, address, contact name, phone number and company information, verifying that the company is in compliance with the specifications, to the Engineer for review.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. The Contractor shall supply miscellaneous metal connectors, and other metal items required to fabricate and install new structural items and perform repairs, rehabilitations to existing structures and associated components, as applicable. Metal fastener compatibility shall be as required by AISC 360 to avoid increasing the corrosion of the base metal. Miscellaneous structural steel materials shall be new, free from defects and imperfections, and shall unless otherwise indicated, conform to the following:
 - 1. Steel Shapes: ASTM 572 Gr. 50 or Better, unless noted on the Drawings, herein, or otherwise approved by the Engineer.
 - 2. High Strength Bolts: ASTM F3125, Gr. A325 T1 (Galvanized, U.O.N.)
 - 3. Nuts: ASTM A563 (Galvanized, U.O.N.)
 - 4. Plates/Bars ASTM A572, Gr.50 (Galvanized, U.O.N.)
 - 5. Structural Shapes: ASTM A992 (Galvanized, U.O.N.)

2.02 REQUIREMENTS FOR FASTENERS, HARDWARE, AND WELDMENTS

- A. Bolt, anchor bolt, washer, and nut requirements vary depending on the materials being fastened.
- B. Bare steel to coated steel hardware:
 - 1. Regular hot-dip galvanized hexagon head type bolts shall be used in accordance with ASTM F3125, Gr A325 T1, with threads excluded from the shear plane unless otherwise noted. Hardened washers conforming to ASTM F436 shall be used under all nuts and bolt heads unless otherwise noted. Nuts shall be heavy hex nuts conforming to ASTM A563 and shall be lubricated. Lock nuts conforming to ASTM A563 shall be used if shown on the Contract Drawings
- C. All joints between dissimilar materials which react electrolytically are to be separated with appropriate insulators, such as micarta strips, or protected with zinc chromate primer, as directed.

2.03 METAL FABRICATION

- A. General
 - 1. Items shall be shop fabricated to the extent practicable for transportation and handling. No splicing is allowed. If having no splices becomes impractical, splices shall be designed and detailed by the Contractor and submitted to the Engineer for review and approval.
 - 2. Parts shall be match-marked to ensure accurate installation.

- B. Tolerances. Items shall be fabricated to the tolerances indicated herein or on the Drawings, or if not specified, to accepted industry standards.

2.04 STEEL FABRICATION COATING METAL GALVANIZING

- A. Fabricated and/or steel items specified or specifically required to be galvanized steel shall be galvanized in accordance with ASTM. Hot dip galvanization process shall be completed after fabrication.
- B. Repair of Zinc-Coated Surfaces. Repair all galvanized surfaces removed or damaged during welding, or shipping in accordance with ASTM A780. Repair material shall be a zinc-based alloy solder (zinc rod). Application shall be in accordance with ASTM A780 and rod manufacturer's recommendations. Minimum applied thickness shall be the minimum original galvanizing thickness required for the component in accordance with ASTM galvanizing requirements, or 12 mils, whichever is greater. After cooling, apply two coats of zinc rich paint. The Contractor shall submit repair material and methods of repair to the Engineer for review and approval.

2.05 FABRICATION MARKING

- A. Marking the Weight. Mark the weight on sub-assemblies and individual members weighing over 200 pounds.
- B. Marking Piece Marks and Directional Arrows. Mark piece marks and directional arrows on all members and sub-assemblies to be assembled at the job site. Use the piece marks assigned on the shop detail drawings or erection drawings.
- C. Method of Marking. Make all markings plainly visible with waterproof paint after shop painting.
- D. Marking Materials to be Galvanized. Stamp piece marks or match marks in material to be galvanized with metal dies so that the marks are clearly legible after galvanizing.
- E. Fabrications. All fabrications shall be marked to correspond to the fabricators placing drawings.

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

- A. All joints between dissimilar materials which react electrolytically are to be separated with appropriate insulators, such as micarta strips, or protected with zinc chromate primer, as directed.
- B. All metal fastenings are to be installed in conformance with the manufacturer's recommendations and with the best practices in the construction industry.

3.02 GENERAL METAL FABRICATION AND INSTALLATION

- A. Materials Delivery and Storage. Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. Steel fabrications shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage. Storage of metal materials and/or fabrications should also facilitate required inspection activities.
- B. Field Measurements. The Contractor shall obtain all field measurements required for proper and adequate fabrication and installation of the work. Exact field measurements are the Contractor's responsibility.
- C. Fabrication:
 - 1. Structural Fabrication: Materials must be straight before being laid off or worked. If straightening is necessary, it shall be done by methods that will not impair the metal. Sharp kinks or bends shall be cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated or otherwise approved. Bends shall be made by approved dies, press brakes or bending rolls. Where heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in a manner that will not impair the original properties of the metal. Proposed flame cutting of material other than structural steel shall be subject to approval and shall be indicated on detail drawings. Shearing shall be accurate, and all portions of the work shall be neatly finished. Corners shall be square and true unless otherwise shown. Exposed edges and corners shall be chamfered to a $\frac{3}{4}$ inch radius. Finished members shall be free of twists, bends and open joints. Bolts, nuts and screws shall be tight.
 - 2. Metal Fabrication: Metal may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a surface that is smooth and free from cracks and notches is obtained. Surfaces and edges to be welded shall be prepared in accordance with AWS. Where structural steel is not to be welded, chipping or grinding will not be required except as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Hand-guided cuts that are to be exposed or visible shall be chipped, ground or machined to sound metal.
 - 3. Shop Assembly: Structural unit furnished shall be assembled in the shop to determine the correctness of the fabrication and matching of the component parts unless otherwise specified. Tolerances shall not exceed those shown. Each unit assembled shall be closely checked to ensure that all necessary clearances have been provided. Assembly in the shop shall be in the same position as final installation in the field unless otherwise specified. Errors or defects disclosed shall be immediately remedied by the Contractor without cost to the Owner. Before disassembly for shipment each piece of a structural unit shall be match-marked to facilitate erection in the field. The location of match-marks shall be indicated by circling with a ring of white paint after the shop coat of paint has been applied or as otherwise directed.

4. Metal fabrications shall be placed accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.
5. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

3.03 GENERAL WELDING REQUIREMENTS

- A. Welding shall be done in accordance with AWS procedures, including procedures for repair of defective welds.
- B. All welds shall be visually inspected by a Contractor provided independent testing company. The components shall be inspected as statically loaded, non-tubular and tubular connections in accordance with AWS requirements.
- C. All welds and edges that may be encountered by the public after construction shall be ground to remove all burrs and weld splatter to the satisfaction of the Engineer.
- D. The Contractor shall engage a qualified testing agency to test all field welds in accordance with AWS criteria. Acceptance criteria shall be for non-cyclic loading. Welds failing shall be repaired at the Contractor's expense, which will also include all costs for retesting to achieve a passing inspection test.

3.04 STEEL WELDING

- A. Qualifications. Steel welding shall be performed by welders certified as being qualified in accordance with AWS D1.1, Section 5, Parts C and D. Welders shall be qualified to perform the type of weld being performed in all positions of the relevant type (plate, tube, etc.), using the procedures, materials, and equipment of the type required for the work. All welding shall conform to AWS D1.1. All welds shall be visually inspected by a Contractor provided independent testing company.
- B. Weld filler metal. Weld filler metal shall meet Charpy requirements of 20 foot-pounds at -20 degrees Fahrenheit and shall have chemistry similar to the base metal. Filler metals shall only be used in welding positions recommended by the filler metal manufacturer, and any welds not conforming to manufacturer's recommendations shall be removed and replaced by the Contractor at the Contractor's expense. Welding consumables shall be stored in accordance with the manufacturer's recommendations and in accordance with AWS requirements and recommendations. Overmatching weld filler metals shall be avoided.
- C. Electrodes shall be selected to match the base metal as follows:
 1. Use E70XX electrodes with steels that have a yield strength $\leq$ 60 ksi
 2. Use E80XX electrodes with steels that have a yield strength $>$ 60 ksi

- D. Preheat. Preheat shall be based on material grade and thickness in accordance with AWS D1.1 Annex I.
- E. Inspection timeline. Prior to galvanizing, all required weld inspections and required repairs shall be performed.
- F. Welding galvanized/metalized components. All welding shall be done prior to galvanizing if possible, unless otherwise required for field-assembly. Galvanizing/metalizing within one inch of the finished weld location shall be removed prior to welding.
- G. Fillet weld soundness Test. Fillet weld procedures shall be qualified by a fillet soundness test in accordance with AWS requirements.

3.05 MISCELLANEOUS METALS INSTALLATION

- A. All parts to be installed shall be thoroughly cleaned. Packing compounds, rust, dirt, grit and other foreign matter shall be removed. Holes and grooves for lubrication shall be cleaned. Enclosed chambers or passages shall be examined to make sure that they are free from damaging materials. Where units or items are shipped as assemblies they will be inspected prior to installation. Disassembly, cleaning and lubrication will not be required except where necessary to place the assembly in a clean and properly lubricated condition. Pipe wrenches, cold chisels or other tools likely to cause damage to the surfaces of rods, nuts or other parts shall not be used for assembling and tightening parts. Bolts and screws shall be tightened firmly and uniformly but care shall be taken not to overstress the threads. When a half nut is used for locking a full nut, the half nut shall be placed first and followed by the full nut. Threads of all bolts, rods, nuts and screws shall be lubricated with an approved lubricant before assembly. Threads of corrosion-resisting steel bolts and nuts shall be coated with an approved anti-galling compound. Driving and drifting bolts or keys will not be permitted.
- B. Alignment and Settings. Each structural unit shall be accurately aligned by the use of steel shims or other approved methods so that no binding in any moving parts or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required.

3.06 ANCHORAGE, FASTENINGS, AND CONNECTIONS

- A. Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated machine and carriage bolts for steel; through bolts. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.
- B. All bolts shall be installed at the proper location and set straight and square with connecting members. Bolt installation shall conform to the requirements of AISC 303 specifications for structural joints.

- C. Bolt holes shall be provided where required or specified and at the proper location or position. Holes in metals members shall be shop punched or drilled. Field cutting or drilling of holes shall not be allowed. Unless otherwise indicated or specified, all holes for items that are to be inserted through metal members shall be standard size and not more than 1/16 inch larger than the diameter of the item being installed.

3.07 TEMPORARY CONSTRUCTION

- A. The Contractor is responsible for temporary bracing and support of all structures during construction and shall protect all exposed partially complete work against damage. The Contractor shall take precautions to ensure that structures are adequately braced to avoid damage during construction. Any structural component damaged during construction shall be replaced by the Contractor at no cost to the Owner. The Contractor's proposed methods for providing temporary protection shall be included in the work plan as approved by the Engineer.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roofing nailers.
- B. Preservative treated wood materials.
- C. Fire retardant treated wood materials.
- D. Miscellaneous framing and sheathing.
- E. Communications and electrical room mounting boards.
- F. Concealed wood blocking, nailers, and supports.

1.2 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other sections and not exposed, unless otherwise specified.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NLGA: National Lumber Grades Authority.
 - 2. SPIB: The Southern Pine Inspection Bureau.

1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood Protection Association; 2012.
- E. PS 1 - Structural Plywood; 2009.
- F. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology, Department of Commerce; 2010.
- G. SPIB (GR) - Grading Rules; Southern Pine Inspection Bureau, Inc.; 2014.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials and application instructions.
- C. Product Data for the following products:

1. Fasteners for attachment of wood fascia to roof framing.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
 1. Stack lumber flat with spacers beneath and between each bundle to provide air circulation.
 2. Protect lumber from weather by covering with waterproof sheeting, securely anchored and keep dry.
 3. Provide for air circulation around stacks and under coverings.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 1. Species: Southern Pine, unless otherwise indicated.
 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 4. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 5. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
- B. Lumber fabricated from old growth timber is not permitted.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Southern Pine Inspection Bureau, Inc. (SPIB).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
 1. Maximum Moisture Content of Lumber: 19 percent maximum moisture content at time of dressing for all dimensional lumber or less, unless otherwise indicated.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:

1. Lumber: S4S, No. 2 or Standard Grade.
2. Boards: Standard or No. 3.

2.3 CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.4 ACCESSORIES

- A. Fasteners and Anchors:
 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 3. Anchors: Toggle bolt type for anchorage to hollow masonry.

2.5 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWP A U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWP A standards.
 3. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2, Use Category UC3b for exterior construction not in contact with the ground.
 - a. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Fire Retardant Treatment:
 1. Manufacturers:
 - a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
 - b. Hoover Treated Wood Products, Inc: www.frtw.com.
 - c. Substitutions: See Section 016000 - Product Requirements.
 2. Exterior Type: AWP A U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat all exterior rough carpentry items.
 - c. Do not use treated wood in direct contact with the ground.
 3. Interior Type A: AWP A U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion

when test is extended for an additional 20 minutes.

- a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
- b. Treat rough carpentry items as indicated.
- c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Treatment:

1. Manufacturers:

- a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
- b. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com.
- c. Viance, LLC: www.treatedwood.com.
- d. Substitutions: See Section 016000 - Product Requirements.

D. Preservative Pressure Treatment of Lumber Above Grade: AWP A U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.40 lb/cu ft retention.

1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
2. Treat lumber exposed to weather.
3. Treat lumber in contact with roofing, flashing, or waterproofing.
4. Treat lumber in contact with masonry or concrete.
5. Treat lumber less than 18 inches above grade.

6. Preservative Pressure Treatment of Plywood Above Grade: AWP A U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative to 0.40 lb/cu ft retention.

- a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
- b. Treat plywood in contact with roofing, flashing, or waterproofing.
- c. Treat plywood in contact with masonry or concrete.
- d. Treat plywood less than 18 inches above grade.

2.6 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including nailers, blocking, furring, stripping and similar members.
- B. Grade: For dimensional lumber and board sizes, provide Southern Pine No. 2 per SPIB, Douglas Fir-Larch No. 2 per WWP/WCLIB/NLGA or better.

2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Carbon steel, aluminum and electroplated galvanized steel fasteners and connectors shall NOT be used in contact with treated wood.
- B. Nails: Common wire nails conforming to FS FF-N-105, hot-dip galvanized complying with ASTM A 153 or Type 304/316 stainless steel.
 1. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view, will receive finish materials or opposite side substrate materials will not permit proper penetration for countersinking of head.

- C. Wood Screws: Course head screws, hot-dip galvanized complying with ASTM A 153 or Type 304/316 stainless steel.
 - 1. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view, will receive finish materials or opposite side substrate materials will not permit proper penetration for countersinking of head.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.
- D. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- F. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- G. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.
- I. Make tight connections between members. Install fasteners without splitting wood; pre-drill as required.
- J. Stagger joints in wood nailers and blocking from joints in underlying wood nailers and blocking.

3.3 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

3.4 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.5 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on

center on all edges and into studs in field of board.

1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.
4. Size: 48 by 96 inches, installed horizontally at ceiling height.

3.6 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.7 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.8 CLEANING

- A. Waste Disposal: Comply with the requirements of Section 017419 - Construction Waste Management and Disposal.
 1. Comply with applicable regulations.
 2. Do not burn scrap on project site.
 3. Do not burn scraps that have been pressure treated.
 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

3.9 PROTECTION.

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 07 19 16

SILANE WATER REPELLANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Application of clear, water repellent sealer for concrete and masonry surfaces.

1.02 RELATED SECTIONS

- A. Section 03 05 00 - Common Work Results for Concrete.
- B. Section 03 30 00 - Cast-in-Place Concrete.

1.03 SUBMITTALS

- A. Comply with Section 01 33 00 - Submittal Procedures.
- B. Submit manufacturer's product data and application instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean, dry area in accordance with manufacturer's instructions.
- C. Keep product from freezing.
- D. Avoid direct contact with this product as it may cause mild to moderate irritation of the eyes and/or skin.
- E. Protect materials during handling and application to prevent damage or contamination.
- F. Do not mix any compound containing solvent.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply product when surface temperatures are expected to be below 40° F (4° C) or above 90° F (32° C) during or within eight hours of expected application.
- B. Do not apply to frozen concrete.
- C. Do not apply to surfaces that are to receive caulks or sealants.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. W. R. MEADOWS®, INC., PO Box 338, Hampshire, Illinois 60140-0338. (800) 342-5976. (847) 683-4500. Fax: (847) 683-4544. Website: www.wrmeadows.com.
- B. Approved Equals

2.02 MATERIALS

- A. PENTREAT 244-100 Water Repellent Penetrating Sealer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive water repellent sealer. Notify architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.
- B. Perform a test application on each type of surface prior to full-scale application to determine suitability and final appearance.
- C. Test using the recommended application instructions.
- D. Let area dry thoroughly before inspection.

3.02 SURFACE PREPARATION

- A. Protect adjacent surfaces not designated to receive water repellent.
- B. Wait a minimum of 14 days before applying the water repellent to new concrete.
- C. Clean and prepare surfaces to receive water repellent in accordance with manufacturer's instructions, ensuring that all stains, oil, grease, form release agents, dust and dirt are removed prior to application.
- D. Ensure surface is clean and thoroughly dry. The residual moisture must not exceed 4% and the surface temperature should be 5.5° F (3° C) above the dew point.
- E. Apply water repellent on substrate and observe the rate of penetration. If it does not absorbed by the surface immediately, then additional cleaning of surface is required.

3.03 APPLICATION

- A. Apply with low-pressure sprayer (<50 psi) using a 0.1 gallon/minute (0.379 L/minute) spray rate, allowing the water repellent to totally saturate the surface.
- B. Horizontal Application Instructions
 1. Saturate in a single application at a coverage rate of 200 ft.²/gal. (4.91 m²/L).
 2. Use enough to keep surface wet for 3-5 minutes.
 3. Broom out puddles until they soak in.
- C. Vertical Applications Instructions
 1. Apply to a visibly dry and absorbent surface.
 2. Saturate from the bottom up, creating a 4" - 8" (10 - 20 cm) rundown below the spray contact point.

3. Let the first application penetrate for 3 – 5 minutes.
4. Re-saturate while surface is still wet.

3.04 PROTECTION

- A. Protect treated surfaces from rain for a minimum of six hours.
- B. Restrict foot traffic for a minimum of four hours at 68° F (20° C). This time may need to be extended based on air and surface temperatures.

END OF SECTION

SECTION 07 54 23

THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Roof insulation.
4. Insulation accessories and cover board.
5. Walkways.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counter flashings.

3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

- ###### A. Roofing Terminology:
- Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference:

Conduct conference at Project site.

1. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
2. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
4. Review structural loading limitations of roof deck during and after roofing.
5. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
6. Review governing regulations and requirements for insurance and certificates if applicable.

7. Review temporary protection requirements for roofing system during and after installation.
8. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Substrate board.
4. Roof insulation.
5. Insulation accessories and cover board.

B. Sustainable Design Submittals:

1. Product Test Reports: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirements.
2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

D. Samples for Verification: For the following products:

1. Roof membrane and flashings, of color required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of compliance with performance requirements.
2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.
- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer for the roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight,

moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, and other components of roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.
 - 1. Accelerated Weathering: Roof to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
- B. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
 - 1. Zone 1 (Roof Area Field): As indicated on Drawings.
 - 2. Zone 2 (Roof Area Perimeter): As indicated on Drawings.
 - 3. Zone 3 (Roof Area Corners): As indicated on Drawings.
- D. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 64 or initial SRI not less than 82 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- E. Energy Star Listing: Roofing system to be listed on the DOE's Energy Star "Roof Products Qualified Product List" for low -slope roof products.
- F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

- A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, fabric-backed TPO sheet.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Syntec Systems.
 - b. Elevate (Formerly Firestone Building Products)
 - c. GAF.
 - d. Approved Equals
 - 2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
 - 3. Thickness: 60 mils (1.5 mm), nominal.
 - 4. Exposed Face Color: White.

2.3 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 - 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants shall comply with the following limits for VOC content:
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesives: 80 g/L.
 - f. PVC Welding Compounds: 510 g/L.
 - g. Other Adhesives: 250 g/L.
 - h. Single-Ply Roof Membrane Sealants: 450 g/L.
 - i. Nonmembrane Roof Sealants: 300 g/L.
 - j. Sealant Primers for Nonporous Substrates: 250 g/L.
 - k. Sealant Primers for Porous Substrates: 775 g/L.
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as TPO sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Bonding Adhesive: Manufacturer's standard.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at

- penetrations and terminations and that nailers match thicknesses of insulation.
- 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.
- C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

3.4 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

- H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.5 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests:
 - 1. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
 - 2. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
 - 3. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.7 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.8 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner:
 - 2. Owner Address:
 - 3. Building Name/Type:
 - 4. Building Address:
 - 5. Area of Work:
 - 6. Acceptance Date:
 - 7. Warranty Period: **20 year.**
 - 8. Expiration Date:
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 - 1. Specifically excluded from this Warranty are damages to work and other parts of the

building, and to building contents, caused by:

- a. lightning;
 - b. peak gust wind speed exceeding 120 mph (53.6 m/sec);
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.

2. Name:_____.
3. Title:_____.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

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. Formed roof-drainage systems.
 - 2. Formed wall opening flashings.
 - 3. Roof edge drainage fabrications.
- B. Related Sections:
 - 1. Section 07 71 00 "Roof Specialties" for manufactured fasciae, copings, gravel stops, and counterflashings.
 - 2. Section 07 92 00 "Joint Sealants" for field-applied sealants between flashings and adjacent materials.

1.3 PREINSTALLATION MEETINGS

- B. Preinstallation Conference: Conduct conference at Project site, to ensure coordination with siding, storefront and door installations, and with manufactured specialty items,

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Distinguish between shop- and field-assembled work.
 - 3. Include identification of finish for each item.
 - 4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.
- C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

- 1. Design Pressure: As indicated on Drawings

- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

- 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

- 1. Exposed Coil-Coated Finish:

- a) Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoats. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- b) Color: As selected by Architect from manufacturer's full range to match colors indicated on the drawings.

2.3 UNDERLAYMENT MATERIALS

- A. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F; and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.

2.4 General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a) Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b) Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane, polysulfide or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

2.2 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Obtain field measurements for accurate fit before shop fabrication.
 - 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- F. Seams: At visible locations in running lengths of sheetmetal trim, fabricate nonmoving seams with flat-lock seams and concealed cleats. Form seams and seal with elastomeric sealant or epoxy seam sealer, unless otherwise recommended by sealant manufacturer for intended use.
 - 1. Nonvisible seam locations may utilize lap seams with sealant or seam sealer.

2.6 WALL SHEET METAL FABRICATIONS

- A. Roof Edge Flashings: Fabricate edge flashings to configurations shown on the drawings. Fabricate from aluminum, 0.032 inch thick, with Two-Coat Fluoropolymer finish.
 - 1. Colors: As selected by Architect from manufacturer's full range of colors to match colors indicated on the drawings.
- B. Miscellaneous Wall Flashings: Fabricate flashings to configurations shown on the drawings. Fabricate from aluminum, 0.032 inch thick, with Two-Coat Fluoropolymer finish.
 - 1. Colors: As selected by Architect from manufacturer's full range of colors to match colors indicated on the drawings.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

- A. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim in accordance with SMACNA's "Architectural Sheet Metal Manual" requirements, including recommended dimensions for laps and roof- to-wall transitions.
 - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
 - 3. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 4. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 5. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 6. Torch cutting of sheet metal flashing and trim is not permitted.
 - 7. Flat-lock seam locations in clear anodized aluminum trim above and below storefront unit openings shall align with each storefront mullion location.
 - a. Trim pieces shall be installed without changing the directional grain of the metal.
 - b. Seam locations shall be reviewed and approved in the field with the Architect prior to fabrication and installation.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

3.4 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated.
1. Coordinate installation of wall flashing with installation of wall-opening components, including windows, doors, and louvers.
 2. Configuration of wall flashings shall be as indicated on the drawings.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 04 22 00 "Concrete Unit Masonry."

3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION

SECTION 07 92 00
JOINT SEALERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. The sealing of joints indicated on schedule at the end of this Section.
 - 2. The sealing of other joints indicated on drawings.
- B. Joints of a nature similar to that of joints indicated on the schedule shall be sealed with same sealer, whether indicated on drawings to be sealed or not.

1.02 DEFINITIONS

- A. Substrates:
 - 1. M-type substrates: Concrete, concrete masonry units, brick, mortar, natural stone. The term "masonry" means brick, stone, and concrete masonry work.
 - 2. G-type substrates: Glass and transparent plastic glazing sheets.
 - 3. A-type substrates: Metals, porcelain, glazed tile, and smooth plastics.
 - 4. O-type substrates: Wood, unglazed tile; substrates not included under other categories.

1.03 SUBMITTALS

- A. Provide all submittals in accordance with Section 01 33 00.
- B. Product Data
- C. Samples for Color Selection: (Products exposed to view only.)
- D. Certified Product Test Reports
- E. Manufacturer's Certificates

1.04 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install sealers if any of the following conditions exist:
 - 1. Air or substrate temperature exceeds the range recommended by sealer manufacturers.
 - 2. Substrate is wet, damp, or covered with snow, ice, or frost.
- B. Dimensional Limitations: Do not install sealers if joint dimensions are less than or greater than that recommended by sealer manufacturer; notify the engineer and get sealer manufacturer's recommendations for alternative procedures.

1.05 WARRANTY

- A. Submit written warranty signed by contractor and installer guaranteeing to correct failures in sealer work that occur within 5 years after substantial completion, without reducing or

otherwise limiting any other rights to correction which the owner may have under the contract documents. Failure is defined as failure to remain weather tight due to faulty materials or workmanship. Correction is limited to replacement of sealers.

PART 2 - PRODUCTS

2.01 MATERIALS - GENERAL

- A. General: Provide only products which are recommended and approved by their manufacturer for the specific use to which they are put and which comply with all requirements of the contract documents.
 - 1. Provide only materials which are compatible with each other and with joint substrates.
 - 2. Colors of exposed sealers: As selected by the engineer from manufacturer's standard colors.
- B. Manufacturers: Products of the manufacturers listed, provided they comply with requirements of the contract documents will be among those considered acceptable.
 - 1. Silicone sealants:
 - a. Dow Corning Corporation
 - b. Pecora Corporation
 - c. Tremco, Inc
 - d. GE Silicones
 - 2. Acrylic solvent-release sealants:
 - a. Pecora Corporation
 - b. Koch Protective Treatments, Inc.
 - c. Tremco, Inc.
 - 3. Acrylic-latex emulsion sealant:
 - a. Bostik Inc.
 - b. Pecora Corporation
 - c. Sonneborn Building Products Division/Chemrex, Inc.

2.02 ELASTOMERIC SEALANTS

- A. Elastomeric Sealants - General: Chemically curing elastomeric sealants of types indicated, complying with ASTM C 920, including specific Type, Grade, Class, and Uses indicated, as well as all other requirements specified.
 - 1. Where movement capability exceeding that measured by ASTM C 920 is specified, sealant shall withstand the total movement indicated while remaining in compliance with the other requirements specified, when tested in accord with ASTM C 719, with base joint width measured at the time of application.
 - 2. For M-type substrates: Comply with requirements for Use M.
 - 3. For G-type substrates: Comply with requirements for Use G.
 - 4. For A-type substrates: Comply with requirements for Use A.
 - 5. For O-type substrates: Comply with requirements for Use M (minimum) and Use O for the particular substrate.
- B. High Movement Silicone Sealant: One- or two-part non-acid-curing, Grade NS, Class 25, Use NT, plus movement capability of more than 50 percent in both extension and compression.
- C. High Strength Silicone Sealant: One- part acid-curing or non-acid curing, Type S, Grade NS,

Class 25, Use NT, with not over plus or minus 30 percent in movement capability.

2.03 SOLVENT-RELEASE-CURING SEALANTS

- A. Acrylic Sealant: Nonsag, one-part, solvent-release-curing; complying with ASTM C 920, Type S, Grade NS, use NT, with the following exceptions.
 - 1. Weight loss: 15 percent, maximum.
 - 2. Movement capability: 7 2 percent in both extension and compression, minimum.

2.04 LATEX SEALANTS

- A. Acrylic-latex emulsion sealant: One-part, non-sag, mildew-resistant, paintable; complying with ASTM C 834.

2.05 NONCURING SEALERS

- A. Butyl polyisobutylene sealant: Non-curing, nondrying, solvent-release; complying with 809.2, as described in AAMA 800.

2.06 SEALANT BACKERS

- A. Backers - General: Non-staining; recommended or approved by sealant manufacturer for specific use.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Do not begin joint sealer work until unsatisfactory conditions have been corrected.
- B. Masking Tape: Use masking tape to keep primers and sealers off of adjacent surfaces which would be damaged by contact or by cleanup. Remove tape as soon as practical.

3.02 INSTALLATION

- A. Comply with sealer manufacturers' installation instructions and recommendations, except where more restrictive requirements are specified.

3.03 SCHEDULE OF JOINT SEALERS

- A. Exterior Joints for Which No Other Sealer Is Indicated:
 - 1. Use one of the following sealants:
 - a. High movement silicone sealant.
 - 2. Backer: Backer rod.
 - 3. Joint shape: Concave joint configuration.

- B. Interior Joints for Which No Other Sealer Is Indicated:
 - 1. Use one of the following sealants:
 - a. Acrylic-emulsion latex sealant.
 - 2. Backer: Backer rod.
 - 3. Joint shape: Concave joint configuration.
- C. Exterior Joints Well Protected from weather and not subject to movement:
 - 1. Use one of the following sealants:
 - a. Acrylic sealant.
 - 2. Backer: Backer rod.
- D. Joints around pipes, ducts, and conduit penetrating exterior walls and roofs:
 - 1. Use one of the following sealants:
 - a. Same as used for adjacent substrates.
- E. All exterior flashing:
 - 1. Use one of the following sealants:
 - a. High strength silicone sealant.
- F. Butyl polyisobutylene sealant.
 - 1. Use bond-breaker tape.
 - 2. Joint shape: Concave joint configuration.

END OF SECTION 07 92 00

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.

1.3 ALLOWANCES

- A. Access doors and frames are part of an access door and frame allowance.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Product Schedule: For access doors and frames: See Drawings

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Nystrom
9300 73rd Avenue North
Minneapolis, MN 55428
Phone: 800.547.2635
Web: www.nystrom.com

- B. Approved Equal

2.2 ACCESS DOORS AND FRAMES

- A. Flush Access Doors (Model: NT Architectural) with Exposed Flanges (Non-Rated General-Purpose Access Door).
 - 1. Description: Face of door flush with frame, with 1-inch exposed flange and concealed, removable, button hinge.
 - 2. Locations: Wall.

3. Door Size: Refer to drawings.
1. Stainless-Steel Sheet:
 - a. Door Material: Nominal 0.063 inch, 16 gauge.
 - b. Frame Material: Nominal 0.063 inch, 16 gauge.
 - c. Finish: Type 304, stainless-steel, No. 4 finish.
2. Hinges: Concealed spring, button type, to allow for door removal.
3. Latch and Lock: Cam latch, key operated with interior release.
4. Options: Gasketing

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

SECTION 08 90 00

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded-aluminum louvers and screens.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axis of the blades are horizontal.
- C. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without structural failure of louver components, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Louvers shall structurally perform to the windloads described on the structural drawings and the Large Missile Impact Requirements of the 2018 IBC, Section 1603.1.4, Wind design data, and ASCE 7-16.
- B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For type of metal finish required.
- E. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- D. Fasteners: Use sizes to suit unit installation conditions.

1. For all fastening, use 300 series stainless-steel fasteners.
 2. For color-finished louvers, use fasteners with heads that match color of louvers.
- E. Post installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
1. Frame Type: Channel unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Join frame members to each other and to fixed louver blades with welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal Storm-Resistant Louver:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product by Ruskin ELF6375DXD, or comparable product by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. Arrow United Industries; a division of Mestek, Inc.
 - f. Greenheck Fan Corporation.
 - g. Industrial Louvers, Inc.
 - h. Reliable Products, Inc.
 - i. Ruskin Company; Tomkins PLC.
 2. Louver Depth: 6 inches.
 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch for blades and 0.080 inch for frames.
 4. Louver Performance Ratings:

- a. Free Area: equal or greater than 57%
 - b. Air Performance: Not more than 0.10-inch wg static pressure drop at 600-fpm free-area exhaust or intake velocity.
 - c. Wind-Driven Rain Performance: Not more than .01 oz/ SF at 1000 FPM free area velocity.
- 5. Blade Profile: per manufacturer.
 - 6. Blade Spacing: per manufacturer.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver indicated.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Flattened aluminum bird screening in removable frame.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
 - 2. Finish: Same finish as louver frames to which louver screens are attached.
 - 3. Type: Rewirable frames with a driven spline for insert screens.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.6 ALUMINUM FINISHES

- A. High-Performance Organic Finish: 4-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

- C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

SECTION 09 97 13

MARINE COATINGS

PART 1 – SCOPE OF WORK

1.01 SUMMARY

- A. The work under this section shall consist of all labor, materials, tools and equipment necessary to coat new structural steel, including preparing the surface, furnishing and applying a coating system intended for immersion in the marine environment, in-shop, and performing field repairs as necessary on all structural steel as follows:
 - 1. Any elements called out on the plans to receive marine coating.
- B. The work to be performed as part of this specification is considered incidental to work and the cost shall be included as part of other associated bid items.
- C. Materials and methods of construction not specifically covered in the Contract Drawings and Specifications shall conform to the ALDOT Standard Specifications for Highway Construction (2018).

1.02 RELATED SECTIONS

- A. Technical Specification Section 05 50 00 – Metal Fabrications

1.03 APPLICABLE PUBLICATIONS

- A. All work performed and materials installed by the contractor, unless otherwise specified herein, are to be in strict accordance with the latest version of the following Codes and Standards. In the event of a conflict between these specifications and the referenced standards, the more stringent requirement shall govern.

American Society of Testing and Materials (ASTM)

- A 1652 Standard Test Methods for Epoxy Content of Epoxy Resins
- D 522 Standard Test Method for Mandrel Bend Test of Attached Organic Coatings
- D 562 Consistency of Paints Using the Stormer Viscometer
- D 1475 Density of Liquid Coatings, Inks, and Related Products
- D 1640 Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
- D 1652 Standard test methods for Epoxy Content of Epoxy resins
- D 2196 Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational Viscometer

D 4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
D 4752	Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
D 5162	Standard Practice for Discontinuity (Holiday) testing of Nonconductive Protective Coating on Metallic Substrates
D 7091	Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.

National Bureau of Standards (NBS)

Certified Coating Thickness Calibration Standards

Cod of Federal Regulations (CFR)

CFR 1910	Occupational Safety and Health Standards
CFR 1926	Safety and Health Regulations for Construction

National Association of Corrosion Engineers (NACE)

RP0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape
SP0188	Standard Practice, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

Steel Structures Painting Council (SSPC) Specifications

SP 12	Surface Preparation of Cleaning of Steel and Other Hard Materials by High and Ultrahigh Pressure Water Jetting Prior to Coating
SP 11	Bare Metal Power Tool Cleaning
SP 10	Near White Blast Cleaning
SP 7	Brush-off Blast Cleaning
SP 6	Commercial Blast Cleaning
SP 5	White Metal Blast Cleaning
SP 3	Power Tool Cleaning
SP 2	Hand Tool Cleaning
SP 1	Solvent Cleaning

AB 1	Mineral and Slab Abrasives
PA 1	Shop, Field, and Maintenance Painting
PA 2	Measurement of Dry Paint Thickness with Magnetic Gadgets Guide 6 Containing Debris Generated During Paint Removal Operations, 2015 Edition
Guide 6	Guide for Containing Surface Preparation Debris
SPCOM	Surface Preparation Commentary
Vol. 1	Shop, Field, and Maintenance Painting of Steel
Vol. 2	Measurement of Dry Paint Thickness with Magnetic Gauges

1.04 DEFINITIONS

- A. Coating Applicator: Company specializing in the metal preparation and application of shop and field coating (paint). Coating Applicator is a company contracted with the contractor or steel Manufacturer to apply coating to the new steel fabrications. Coating Applicator shall be approved by the engineer prior to the start of metal preparation for coating application.
- B. Paint: The term “paint” or “coat” as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, and other coatings, organic or inorganic, whether they be used as prime, intermediate, or finish coats. This definition does not include troweled or sprayed-metal coating.
- C. Shop painting: The term “shop painting” or “shop coating” as referred to herein covers surface preparation and painting or coating operations conducted in a shop, mill, or plant, before shipment of paint-receiving items to the project site.
- D. Holiday: A void, crack, thin spot, foreign inclusion, or contamination in the coating film that significantly lowers the dielectric strength of the coating. This may also be identified as a holiday or pinhole.
- E. Exposed Exterior Surface: Surface which is exposed to weather but not necessarily exposed to view as well as surface exposed to view. Exterior surfaces are considered corrosive environment.
- F. Independent Inspector: NACE Level III certified coating inspector (or AMPP Equivalent) to oversee and certify the correct surface preparation, coating application, DFT, and repairs.

1.05 SUBMITTALS

- A. The following submittals shall be in accordance with Section 01 33 00 – Submittals
- B. Coating Work Plan: A coating work plan shall be submitted to the engineer for review and approval fifteen (15) days prior to the start of any coating work. The

Work Plan shall include:

1. Proposed Applicator's name, address, contact name, phone number and qualifications, verifying that the company is in compliance with the specifications.
2. The contractor shall submit a notarized letter signed by a principal officer certifying the Applicator fully complies with the State (State where the coating process is to be completed) Safety Regulations and the Federal Code of Regulations pertaining to the scope of this project, as well as any other applicable Local orders, codes, ordinances, or laws.
3. Proposed coating product data and information providing the manufacturer's name, address, and phone number, and the coating manufacturer's recommended application procedures for each coating system.
4. Contractor to provide a copy of the Materials Safety Data Sheets (MSDS) and Consumer Information Safety (CIS) sheets to comply with OSHA's hazard Communication Standard, and Technical Data sheets for each coating system to the engineer with fifteen (15) days after the notice to proceed. Certificate of Qualifications shall also be included for the contractor(s) performing the work.
5. A detailed description of coating preparation work including cleaning, scraping, blasting of steel surfaces; containment of solvents, alkali and emulsions, if used; and containment of paint flakes, loose material, dust and other materials removed by power cleaning.
6. Written notification that the surface area to receive coatings has been prepared in accordance with the manufacturer's recommendations for that coating and the requirements of this specification.
7. Written notification that the coatings have been mixed in accordance with the recommendations of the coating manufacturer and the requirements of this specification.
8. Written notification that the coatings have been cured in accordance with the conditions required by the coating manufacturer and the requirements of this specification.

C. Product Data

1. Acknowledgement that the products submitted meet the requirements of the specification, and notification that the coating corresponds to the manufacturer's intended use for that coating.
2. Manufacturer's surface preparation and application instructions
3. Curing time required before holiday testing, and curing time required before immersion
4. Acceptable temperatures at the time of application and curing
5. Maximum and minimum re-coat times for the anticipated coating conditions
6. Weight in pounds/gallon – ASTM D2196
7. Percent solids by volume - ASTM D2369

8. Percent solids by weight – ASTM D2369
 9. Air cure dry time to recoat – ASTM D1640
 10. Adhesion to steel substrate - ASTM D4541
 11. Minimum adhesion value of full system – ASTM D4541
 12. Manufacturer's batch numbers and dates of manufacture and expiration for materials to be furnished as part of this project.
- D. Product Handling and Installation Instructions
1. Storage – including maximum and minimum storage temperatures.
 2. Coating Repair
 3. Application Equipment
- E. Qualifications
1. Applicator Qualifications
 2. Certified Coating Inspector Qualifications
- F. Disposal Plan
1. Submit Disposal Plan certifying that spent abrasive blast media, removed coating materials, and other waste, whether hazardous or non-hazardous, will be disposed of per all applicable requirements of the Federal Resource Conservation and Recovery Act, Title 40 code Parts 260-273; and all applicable regulations of all local, state, and federal agencies having jurisdiction.

1.06 QUALITY CONTROL

- A. Quality control under this section shall be performed as determined necessary by the CONTRACTOR to ensure the in progress and completed work meets the requirements of the plans and specifications.

1.07 QUALITY ASSURANCE

- A. Coating Manufacturer
1. Coating manufacturer's authorized representative shall provide written statement attesting that Applicator has been instructed on proper predation, mixing, and application procedures for coating system.
 2. Coating materials shall be labeled and used in accordance with SSPC-PA 1, Paragraphs 5.1.1 thru 5.1.5, except all coating system materials without a stated shelf life shall be delivered and used within six months of the date of manufacture. Certification, from any source, that the coating system materials are still suitable for use beyond the stated shelf life or beyond the six-month period specified above will not be accepted.
- B. Coating Applicator
1. Unless otherwise approved by the Port, the Coating Applicator's shop shall be located in the United States and shall be easily accessible by

Manufacture's Representative(s).

2. The Coating Applicator shall be regularly engaged in the application of similar coatings and structures for at least five years immediately prior to this work. Applicator shall identify and furnish references for five (5) similar projects involving coating of steel piling via the methods proposed for the work of this Section.
3. Foreman and workers in the shop and the project site shall be experienced and knowledgeable in preparation for and application of high-performance industrial coatings.
4. Workmanship shall conform to standards and recommendations of Society of Protective Coatings SSPC Vol. 1.
5. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
6. Mock-Up: Not used.

C. Contractor

1. The contractor shall retain the services of an Independent Coating Inspector to oversee and certify the correct surface preparation, coating, application, DFT, and repairs were done with respect to coating of the pile system per this specification. The contractor's coating inspector will be responsible for overseeing all executional items outlines in this specification. The services of coating inspector shall be obtained from an inspector having a minimum of five years of documented experience in the field of coating application and inspection for marine structures.
2. Quality control activities performed by the contractor shall be recorded and submitted to the engineer for record and conformance with Contract Documents.

D. Manufacturer's Representative

1. At contractor's expense, a qualified technical representative from the coating manufacturer shall be made available to provide on-site technical assistance. The representative is to evaluate the prepared surface and periodically throughout the coating process as required to ensure that the product has been applied satisfactorily, and to resolve problems related to the coating system or the application of the system. Prior to the application of coating, the manufacturer shall provide written approval that the surface preparation meets their requirements. During the periodic site visits, the representative shall submit a report to the engineer with their observations and conclusions.

E. Miscellaneous

1. Coating products which will be used on this project shall be provided from a single paint manufacturer.
2. Coating products which will be used on this project for touch-up repairs to the primary coating shall be provided from the same manufacturer.

3. Any deviation will require prior approval from the engineer; appropriate warranties will be required.
4. Deviation from specified Dry Film Thickness or product type is not allowed without written authorization of Engineer.

1.08 DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Deliver coating system materials in original, unopened containers with seals unbroken and labels intact. Labels shall identify the following:
 - a. Name or type number of materials.
 - b. Manufacturer's name and item stock number.
 - c. Manufacturer's name, batch number, specification number.
 - d. Contents, by volume, of major constituents.
 - e. Warning labels.
 - f. Application instructions
 - g. Color name and number
 - h. Date of manufacture and expiration date

B. Storage

1. Store materials in a single, approved location. Keep storage location clean, neat, and free of fire hazards. All compressors and fuel storage tanks shall be placed in a temporary fenced enclosure within the project site.
2. All containers shall be handled and stored in such a manner as to prevent damage or loss of labels or containers. All painting materials shall be stored in an enclosed, dry, well-ventilated place, protected from sparks, flame, direct rays of the sun, or from excessive heat. The contractor shall be solely responsible for the protection of the materials stored at the shop coating facility and project job site. Maintain temperature inside the structure within the temperature range recommended by the manufacturer.
3. The contractor shall comply with the requirements of all pertinent codes and local fire regulations. Proper containers shall be provided by the contractor and used for painting wastes. No plumbing fixtures shall be used for this purpose. Empty coating cans shall be neatly stacked and removed from the job site as required by applicable codes.

C. Handling

1. Do not spill thinners, solvents, paint products or other materials that contain toxic substances.
2. Remove discarded thinners, solvents, and paint products from the job site daily. Used rags shall be removed from the job site daily, and every

precaution taken against spontaneous combustion.

1.09 SAFETY

- A. Contractor shall comply with all Federal, State, and Local applicable safety regulations and requirements.
- B. Ventilation – Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof and of industrial design. Household-type venting equipment will not be acceptable.
- C. Head and Face Protection and Respiratory Devices - Equipment shall include protective helmets, which shall be worn by all persons while in the vicinity of the work. During cleaning operations, nozzle men shall wear U.S. Bureau of Mines approved air-supplied helmets; other persons who are exposed to blasting dust shall wear approved filter-type respirators and safety goggles. When paints are applied in confined areas, all persons exposed to toxic vapors shall wear approved air supplied masks. Barrier creams shall be used on any exposed areas of skin.
- D. Grounding - Spray and air hoses shall be grounded to prevent accumulation of charges of static electricity
- E. Illumination - Spark-proof artificial lighting shall be provided for all work in contained spaces. Light bulbs shall be guarded to prevent breakage. Lighting fixtures and flexible cords shall comply with the requirements of NFPA 70 "National Electric Code" for the atmosphere in which they will be used. Whenever required engineer, the contractor shall provide additional illumination and necessary supports to cover all areas to be observed. The level of illumination for inspection purposes shall be determined by the engineer.
- F. Toxicity and Explosiveness – The solvents used with specified protective coatings are explosive at low concentrations and are highly toxic. Because of toxicity, the maximum allowable concentration of vapor shall be kept below the maximum safe concentration for an eight-hour exposure, plus Lower Explosive Limit (LEL) must be strictly adhered to. If coatings or paints contain lead or other hazardous materials, all regulations related to safety of personnel and handling of such materials shall be strictly adhered to.
- G. Protective Clothing - Paint materials may be irritating to the skin and eyes. When handling and mixing paints, workmen shall wear gloves and eye shields.
- H. Fire – During mixing and application of all materials, all flames, welding, and smoking shall be prohibited in the vicinity. Appropriate type fire abatement devices shall be provided by contractor and be readily available at the job site during all operations.
- I. Sound Levels- Whenever the occupational noise exposure exceeds the maximum allowable sound levels, the contractor shall provide and require the use of approved ear protective devices.
- J. General sound levels for the project shall be those which will not affect routine facility or neighborhood activities. Whenever levels are objectionable, they shall be adjusted as directed by the contractor.

- K. Warranty inspections of remedial work shall be at the expense of the contractor.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The following is a list of engineer pre-approved coating systems. All products used in the coating system are to be provided by the same manufacturer. The coating system shall use the coatings from one supplier only and all coating materials shall be compatible. The coating used shall be applicable for the intended use in splash zone and immersed conditions to cope with tidal movements and surges. Materials for marine coating shall conform to the following manufacturers, or approved equivalent, and minimum finished dry film thickness.
- B. The following products are acceptable:

Coating System I	DuraPlate 6000 Sherwin-Williams Ph. 954-868-4953
Coating System II	Interzone 954 Interbay Coatings Ph. 727-373-8783
Coating System III	Carboguard 1209 Carboline Ph. 561-400-8915

- C. Coatings shall be applied at the total Dry Film Thickness (DFT) specified for each of the elements to be marine coated.
- D. Tolerance for Coating Thickness:
1. Minimum: As Specified
 2. Maximum: Unrestricted
- E. Primary coating color to be GRAY or as approved by Port.
- F. Provide materials that are lead and chromium free.
- G. No primers shall be used with the specified coating material.
- H. For unspecified materials, provide manufacturer's recommended products.
- I. Abrasive Blasting Media
1. Blasting media shall be sized (graded) to achieve the profile and level of cleanliness as recommended by the coating manufacturer.
 2. Blasting media shall be new, clean and free of contaminants, and containing no hazardous materials.

2.02 MATERIALS FOR TOUCHUP AND UNDERWATER COATING SYSTEMS

- A. The field coating system shall be compatible with the shop coating system in accordance with the shop coating manufacturer's recommendations.
- B. All field coatings shall match the type and color of the shop applied coating system.

Touch-Up Coating System I	DuraPlate 6000
Touch-Up Coating System II	Interzone 954
Touch-Up Coating System III	Carboguard 1209

PART 3 - EXECUTION

3.01 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 50°F for 24 hours before, during, and 48 hours after application of finishes, unless otherwise required by manufacturer's instructions.
- B. Do not apply coatings when relative humidity is above 85%, unless otherwise required by manufacturer's instructions.
- C. The Independent Inspector will examine surfaces after blast cleaning to verify that deposits of contaminants have been removed.
- D. No coating shall be applied if the substrate/steel is wet or damp, or if the temperature is less than 5°F above the dew point.

3.02 COATING OF STEEL COMPONENTS

- A. All steel components shall be coated as specified in this section and in accordance with the specified coating manufacturers' instructions.
- B. Where there is a discrepancy between the manufacturer's requirements for shop applied coating system and the requirements in this specification, the contractor shall notify the engineer prior to proceeding. The most conservative shall govern unless otherwise directed by the engineer.
- C. Coat thicknesses specified in this Specification indicate minimum requirements. Contractor shall apply coating with the specified maximum wet thickness per layer to meet manufacturer's recommendations.
- D. Follow manufacturer's instructions for proportioning, mixing, and storing. Apply mixed products within stated pot life for each product. Do not thin or modify coatings unless written authorization is provided by the coating manufacturer's representative and approved by the engineer.
- E. Discard all catalyzed coatings at the end of each working day or at the end of manufacturer's recommended pot life, whichever is first.

3.03 GENERAL PREPARATION

- A. Applicator shall measure air temperature, humidity, relative humidity, and metal surface temperature, and determine dew point prior to blasting or painting each day. Repeat measurements and determination of dew point as often as the Inspector

deems necessary, but not less often than every 4 hours.

1. Maintain a written record of measurements and dew points, and time that measurements were taken. Make record available to engineer on a weekly basis, at a minimum, and immediately on request.

3.04 SURFACE PREPARATION

- A. Surfaces to be coated shall be clean and free of oil, grease, dust, weld splatter (including existing weld splatter), steel slivers, and other contaminants before applying paint or surface treatments. Cleaning of surfaces to be painted shall be conducted in strict accordance with the coating manufacturer's recommendations. The removal of oil and grease shall, in general, be accomplished in accordance with SSPC SP 1. Cleaning and painting shall be so programmed that dust or other contaminants from the cleaning process do not fall on wet, newly painted surfaces. Surfaces not intended to be painted, such as side seals, stainless steel, and wearing surfaces shall be suitably protected from the effects of cleaning and painting operations. Welding of, or in the vicinity of, previously painted surfaces shall be conducted in a manner to prevent weld spatter from striking the paint and to otherwise reduce coating damage to a minimum. Paint damaged by welding operations shall be restored to the specified condition.
- B. All abrasive-blasted ferrous metal surfaces shall be inspected and approved by the Independent Inspector immediately prior to application of paint coatings.
 1. Inspection shall be performed to determine cleanliness and profile depth of blasted surfaces and to certify that surface has been prepared in accordance with these Specifications.
- C. All edges of items to be painted shall be rounded or chamfered a minimum of 1/16 of an inch.
- D. All damaged surfaces shall be prepared to a level acceptable to the coating manufacturer and in accordance with (SSPC-SP11) Power Tool Cleaning to Bare Metal with a minimum Surface profile of 1.5 mils, or (SSPC-SP10) Near White Metal Blast.

3.05 SHOP APPLICATION

- A. Application of coating system shall be conducted in strict accordance with coating manufacturer's recommendations, including atmospheric conditions, method and time of coat applications, drying time, mixing, safety, and all other manufacturer application recommendations for conformance with manufacturer's warranty.
- B. The finished coating shall be within the specified limits for holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, unnecessary brush marks, and variations in color, texture, and gloss. All paint coats shall be applied in such manner as to produce an even, continuous film of uniform thickness. Edges, corners, crevices, seams, joints, welds, rivets, bolts, and other surface irregularities shall receive special attention to ensure that they receive the specified thickness of paint by hand stripping with a stiff bristled brush. Spray equipment shall be equipped with traps and separators and where appropriate, mechanical agitators, pressure gages, pressure regulators, and screens or filters. Air caps, nozzles, and needles shall be as

recommended by the spray equipment manufacturer for the material being applied.

- C. Applicator shall obtain Independent Inspector's evaluation and approval of steel surface preparation immediately prior to application. Applicator shall perform surface preparation requirements as necessary to obtain Independent Inspector's approval.
- D. Applicator will coat a "test area" on the first day of coating as per the coating manufacturer's specifications, and the Inspector will evaluate. Applicator shall obtain Independent Inspector's approval before commencing coating operations.
- E. Provide notification to the engineer and applicator if any repairs on the coating or additional surface preparation is required to meet the requirements of this specification and/or manufacturer recommendations.
- F. Apply each coat so that finished surfaces are free from runs, sags, brush marks, or variations in color. Upon completion of shop applied coating, all coated surfaces shall be holiday tested.
- G. Repairs to the coating shall be made in accordance with materials and procedures as recommended by the coating manufacturer, and as indicated on the submitted technical data sheets.
- H. Unless otherwise specified by the coating manufacturer's recommendations, do not allow drying time between coats to exceed 72 hours.
- I. Coating shall be allowed to cure prior to handling, transportation, immersion, and installation. Curing time shall in be accordance with the manufacturers written recommendations. Unless otherwise specified by the coating manufacturer's recommendations, allow a period of at least 72 hours to pass following final coat before placing in immersion service.
- J. Painters: Painters shall be versed in the application of paint systems similar to or equal to that specified to be applied. Certification of all painters is required for each type of paint and each type of spray gun application that will be used.
- K. Repair detected breaks, thin areas, and exposed areas damaged prior to or during installation by surface treatment and application of additional coating or by manufacturers' recommendations.

3.06 FIELD TOUCHUP

- A. Coordinate the coating repair work with the work by others. Field coating on items as needed to repair any transportation or installation damages according to the following instructions. In addition, repair observed coating holidays and thin areas. Provide surface preparation in accordance with SSPC SP 11 in the presence of the Inspector. When practical, and when not in conflict with the manufacturer's instructions, apply field repairs using the same coating system applied in the shop. Apply all field coatings with a brush or roller. Spray painting shall not be allowed in the field.
- B. All properly prepared bare steel surfaces shall receive the number of coats as required by the manufacturer recommendations, applied by brush in multiple passes

to achieve the required minimum dry film thickness. Care shall be exercised to ensure that the coating is not over worked with the brush during application.

- C. A smooth transition shall be achieved between sound existing coating and spot prepared substrate in accordance with SSPC good painting practices in preparation for spot touchup.
- D. The proposed field coating product shall be compatible with the proposed shop coating product.
- E. All underwater coating repairs shall be performed using an approved product in accordance with manufacturer recommendations.

3.07 INSPECTION

- A. The Independent Coatings Inspector, retained by contractor, shall be onsite during all phases of shop coating operations and all field coating touchup operations, from surface preparation to final clean-up.
 - 1. Inspector shall maintain and provide the following information for each coat applied:
 - a. Date, starting time, end time, and all breaks taken by painters.
 - b. Weather Condition
 - c. Air temperature.
 - d. Relative humidity
 - e. Wind speed and direction
 - f. Moisture content of substrate prior to each coat
 - g. Measure surface temperature of items to be painted with surface temperature gage specifically designed for such.
 - h. Measure substrate humidity with humidity gage specifically designed for such.
 - i. Provisions utilized to maintain work area within manufacturers recommended application parameters.
 - j. Provisions utilized to maintain work area within manufacturers recommended application parameters.
 - k. Provisions utilized to maintain safety within the work area
 - 2. Inspector will evaluate cleanliness of coated surface immediately prior to application of a subsequent coat(s) and determine if surface meets the manufacturer's requirements for additional coats.
 - 3. Inspector will evaluate a coat "test area" on the first day of coating as per

the coating manufacturer's specifications and determine if coating operations can proceed.

4. Each coat is to be visually inspected and should be free of pinholes, holidays, dry spray, sags, runs, wrinkles and other excessive film build characteristics and surface defects.
5. Measure coating dry film thickness in accordance with SSPC PA-2 using Mikrotest gage or equivalent calibrated against National Bureau of Standards "Certified Coating Thickness Calibration Standards."
6. 5. Measure wet coating with wet film thickness gages.
7. Perform discontinuity testing, of coated piles prior to driving/installation in accordance with NACE SPO188 requirements.
8. Provide notification to the engineer and Applicator if any repairs on the coating or additional surface preparation is required to meet the requirements of this specification and/or manufacturer recommendations.
9. Re-test as required until surface area and coating pass evaluation.

3.08 CLEANUP AND PROTECTION

- A. During the course of the work, remove from site discarded paint materials, rubbish, cans and rags at the end of each workday.
- B. Clean paint spattered surfaces. Use proper cleaning agents and methods and use care not to damage finished surfaces.
- C. Remove surplus materials, scaffolding, and debris.
- D. Protection:
 1. Protect the work of other trades, whether to be painted or not, against damage by painting and finishing the work.
 2. Protect surrounding off-site property from damage and over spray.

END OF SECTION

SECTION 10 21 13
PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for blocking.
2. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 COORDINATION

- A. Coordinate requirements for blocking, reinforcing, and other supports concealed within wall.**

1.3 ACTION SUBMITTALS

A. Product Data:

1. Solid-plastic toilet compartments:
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings: For solid-plastic toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.

C. Samples for Verification: Actual sample of finished products for each type of toilet compartment indicated.

1. Size: 6-inch- (152-mm-) square, of same thickness indicated for Work.
2. Include each type of hardware and accessory.

D. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost.

1.4 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.
- B. Regional Materials: Products shall be manufactured within 500 miles (800 km) of Project site.
- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Department of Justice "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.
 1. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.
- B. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
- C. Brackets (Fittings):
 1. Full-Height (Continuous) Type: Manufacturer's standard design; extruded aluminum.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories, Standard Duty: Manufacturer's standard operating hardware and accessories.
 1. Material: Clear-anodized aluminum.
 2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door.

3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit, designed for emergency access, and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Aluminum Extrusions: ASTM B221 (ASTM B221M).
- B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PLASTIC TOILET COMPARTMENTS

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
 - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 21 13

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY 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. Public-use washroom accessories.
 - 2. Under lavatory guards.
 - 3. Towel dispenser/ waste
 - 4. Custodial accessories.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE 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.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

Toilet Tissue (Roll) Dispenser: (as scheduled in drawings)

Stainless steel liquid-Soap Dispenser as scheduled in drawings)

A. Grab Bar:

1. Manufacturers: Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A&J Washroom Accessories, Inc.
 - b. American Specialties, Inc.; ASI Group.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4 finish satin.
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings.

B. Mirror Unit with Frame:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A&J Washroom Accessories, Inc.
 - b. American Specialties, Inc.; ASI Group.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.
2. Frame: Stainless-steel angle, 0.05 inch thick Stainless-steel channel Stainless steel, fixed tilt Stainless steel.
 - a. Corners: Welded and ground smooth.

C. Coat Hook:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A&J Washroom Accessories, Inc.
 - b. American Specialties, Inc.; ASI Group.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.

2. Description: Single-prong unit.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

2.3 UNDERLAVATORY GUARDS

A. Under lavatory Guard:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Plumberex Specialty Products, Inc.
 - b. Truebro by IPS Corporation.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.4 TOWEL DISPENSER/ WASTE

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A&J Washroom Accessories, Inc.
 - b. American Specialties, Inc.; ASI Group.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.
2. Description: Surface mounted towel dispenser and waste receptacle combination unit with manual towel dispenser.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

2.5 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder: (As scheduled in drawings, contractor installed)

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A&J Washroom Accessories, Inc.
 - b. American Specialties, Inc.; ASI Group.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.

2. Description: Unit with hooks and holders.
3. Length: 24 inches.
4. Hooks: Three.
5. Mop/Broom Holders: Three.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

2.6 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

END OF SECTION

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4 (2015; R 2020) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2 (2012; R 2017; R 2022) Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)

ASME A112.6.1M (1997; R 2017) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use

ASME A112.6.3 (2019) Standard for Floor and Trench Drains

ASME A112.14.1 (2003; R 2017; R 2022) Backwater Valves

ASME A112.19.3/CSA B45.4 (2017; Errata 2017) Stainless Steel Plumbing Fixtures

ASME A112.19.5 (2017) Flush Valves and Spuds for Water Closets, Urinals, and Tanks

ASME A112.36.2M (1991; R 2017) Cleanouts

ASME B1.20.1 (2013; R 2018) Pipe Threads, General Purpose (Inch)

ASME B16.3 (2021) Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.4 (2021) Gray Iron Threaded Fittings; Classes 125 and 250

ASME B16.5 (2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.12 (2019) Cast Iron Threaded Drainage Fittings

ASME B16.15 (2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250

ASME B16.18 (2021) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2021) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(2022) Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves Classes 150, 300, 600, 900, 1500, and 2500
ASME B16.29	(2017) Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.50	(2021) Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
ASME B16.51	(2013) Copper and Copper Alloy Press-Connect Pressure Fittings
ASME B31.1	(2020) Power Piping
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME CSD-1	(2021) Control and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2021) Performance Requirements for Atmospheric Type Vacuum Breakers
ASSE 1003	(2020) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1010	(2021) Performance Requirements for Water Hammer Arresters
ASSE 1011	(2017) Performance Requirements for Hose Connection Vacuum Breakers

ASSE 1012	(2021) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent
ASSE 1013	(2021) Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies
ASSE 1018	(2001; R 2021) Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002)
ASSE 1019	(2011; R 2016) Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance
ASSE 1020	(2020) Performance Requirements for Pressure Vacuum Breaker Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2018) Hypochlorites
AWWA B301	(2018) Liquid Chlorine
AWWA C203	(2020) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(2015) Grooved and Shouldered Joints
AWWA C651	(2014) Standard for Disinfecting Water Mains
AWWA C652	(2019) Disinfection of Water-Storage Facilities

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS B2.2/B2.2M	(2016) Specification for Brazing Procedure and Performance Qualification

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A74	(2021) Standard Specification for Cast Iron Soil Pipe and Fittings

ASTM A105/A105M	(2021) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A515/A515M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A518/A518M	(1999; R 2018) Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A733	(2016) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A888	(2021a) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B42	(2020) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B43	(2020) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B152/B152M	(2019) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar

ASTM B306	(2020) Standard Specification for Copper Drainage Tube (DWV)
ASTM B370	(2022) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B584	(2014; R 2022) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B813	(2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B828	(2016) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM C564	(2020a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C1053	(2000; R 2010) Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2235	(2004; R 2016) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2657	(2007; R 2015) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D2661	(2014; E 2018) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40, Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2665	(2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2822/D2822M	(2005; R 2011; E 2011) Standard Specification for Asphalt Roof Cement, Asbestos-Containing
ASTM D2846/D2846M	(2019) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems

ASTM D2855	(2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D2996	(2017) Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D3122	(1995; R 2009) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D3138	(2004; R 2016) Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3311	(2017) Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D4101	(2017) Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
ASTM E1	(2014) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F437	(2021) Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F438	(2017) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F439	(2019) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F441/F441M	(2020) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F442/F442M	(2020) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ASTM F493	(2020) Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F628	(2022) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
ASTM F891	(2016) Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core
ASTM F1290	(2019) Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
ASTM F1760	(2016; R 2020) Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
ASTM F2389	(2021) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2018) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2012) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(2016; 14/17) Copper Tube Handbook

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO PS 117	(2005b) Press Type Or Plain End Rub Gasketed W/ Nail CU & CU Alloy Fittings 4 Install On CU Tubing

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1	(2017) Standard And Commentary Accessible and Usable Buildings and Facilities
ICC IPC	(2018) International Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(2018) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	(2019) Steel Pipeline Flanges
MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	(2017; Errata 1 2017) Butterfly Valves
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-78	(2011) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(2014) Class 3000 Steel Pipe Unions Socket Welding and Threaded
MSS SP-85	(2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends
MSS SP-110	(2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NACE INTERNATIONAL (NACE)

NACE SP0169	(2013) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 372	(2016) Drinking Water System Components - Lead Content
NSF/ANSI 14	(2021) Plastics Piping System Components and Related Materials
NSF/ANSI 61	(2020) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man (2016) Firestopping: Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (2010) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2009) Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SM 9223 (2004) Enzyme Substrate Coliform Test

PL 93-523 (1974; A 1999) Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 141.80 National Primary Drinking Water Regulations; Control of Lead and Copper; General Requirements

UNDERWRITERS LABORATORIES (UL)

UL 499 (2014; Reprint Jun 2022) UL Standard for Safety Electric Heating Appliances

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System;

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details shall be drawn to scale.

SD-03 Product Data

Recycled Content for Steel Pipe

Recycled Content for Cast Iron Pipe

Backflow Prevention Assemblies

WaterSense Label for Lavatory Faucet

Fixtures

List of installed fixtures with manufacturer, model, and flow rate.

Flush Valve Water Closets

WaterSense Label for Flush Valve Water Closet

Flush Valve Urinals

WaterSense Label for Urinal

Wall Hung Lavatories

Water Heaters

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions, and specifications.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing, and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System;

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record.

1.5.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.8 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption and shall be certified in accordance with NSF/ANSI 61, Annex G or NSF 372. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings, and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Couplings for Grooved Pipe: Ductile Iron ASTM A536 (Grade 65-45-12) .

- d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self-centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- e. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.
- f. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.
- g. Solder Material: Solder metal shall conform to ASTM B32.
- h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.
- i. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.
- j. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.
- k. Rubber Gaskets for Grooved Pipe: ASTM D2000, maximum temperature 230 degrees F.
- l. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.
- m. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.
- n. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D3138.
- o. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D2235.
- p. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.
- q. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F493.
- r. Flanged fittings including, but not limited to, flanges, bolts, nuts, and bolt patterns shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.
- s. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D3122.
- t. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of ASME B16.51 and performance criteria of IAPMO PS 117. Sealing elements for copper press fittings shall be EPDM, FKM or HNBR. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.

- u. Copper tubing shall conform to ASTM B88, Type K, L or M.
- v. Heat-fusion joints for polypropylene piping: ASTM F2389.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrestor: PDI WH 201.
- b. Copper, Sheet, and Strip for Building Construction: ASTM B370.
- c. Asphalt Roof Cement: ASTM D2822/D2822M.
- d. Hose Clamps: SAE J1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and vermin proof properties.
- h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.
- i. Hypochlorites: AWWA B300.
- j. Liquid Chlorine: AWWA B301.
- k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.
- l. Thermometers: ASTM E1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 22 07 19 PLUMBING PIPING INSULATION.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4

Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.3 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.4 Yard Hydrants

Yard box or post hydrants shall have valve housings located below frost lines. Water from the casing shall be drained after valve is shut off. Hydrant shall be bronze with cast-iron box or casing guard. "T" handle key shall be provided.

2.4 FIXTURES

Water closet replacements in major renovations may have a flush valve of up to 1.6 GPF to accommodate existing plumbing capacity. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. ASME A112.19.3/CSA B45.4 302 stainless steel. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush valves and flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains shall be copper alloy with all visible surfaces chrome plated.

2.4.1 Flush Valve Water Closets

ASME A112.19.3/CSA B45.4 302 Stainless Steel, siphon jet, elongated bowl, wall mounted, wall outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide solid plastic elongated open-front seat .

Water flushing volume of the water closet and flush valve combination shall not exceed 1.28 gallons per flush. Water closets must meet the EPA WaterSense product definition specified in http://www.epa.gov/watersense/partners/product_program_specs.html and must be EPA WaterSense labeled products. Provide data identifying WaterSense label for flush valve water closet.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, split-ring wall support, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the handrail in ADA stalls.

2.4.2 Flush Valve Urinals

ASME A112.19.3/CSA B45.4 302 stainless steel, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 17 inches above the floor. Provide urinal with the rim 24 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 0.5 gallons per flush. Urinals must meet the specifications of http://www.epa.gov/watersense/partners/product_program_specs.html and must be EPA WaterSense labeled products. Provide data identifying WaterSense label for urinal. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, split-ring wall support, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture.

2.4.3 Wheelchair Flush Valve Type Urinals

ASME A112.19.3/CSA B45.4 302 stainless steel, wall-mounted, wall outlet, blowout action, integral trap, elongated projecting bowl, 20 inches long from wall to front of flare, and ASME A112.19.5 trim. Provide large diaphragm (not less than 2.625 inches upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower chambers), nonhold-open flush valve of chrome plated cast brass conforming to ASTM B584, including vacuum breaker and angle (control-stop) valve with back check, and split-ring wall support. The water flushing volume of the flush valve and urinal combination shall not exceed 0.5 gallon per flush. Urinals must meet the specifications of http://www.epa.gov/watersense/partners/product_program_specs.html and must be EPA WaterSense labeled products. Provide data identifying WaterSense label for wheelchair flush valve urinal. Furnish urinal manufacturer's certification of conformance. Provide ASME A112.6.1M concealed chair carriers. Mount urinal with front rim a maximum of 17 inches above floor and flush valve handle a maximum of 44 inches above floor for use by handicapped on wheelchair.

2.4.4 Wall Hung Lavatories

AASME A112.19.3/CSA B45.4 302 stainless steel, straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide aerator with faucet. Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph

LAVATORIES. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top mounted washerless centerset lavatory faucets.

2.5 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer shall meet ASSE 1018.

2.6.1.1 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.6.2 Floor Sinks

Floor sinks shall be square, with 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, aluminum sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

2.6.3 Pit Drains

Pit drains shall consist of a body, integral seepage pan, and nontilting perforated or slotted grate. Drains shall be of double drainage pattern suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps, unless otherwise indicated.

2.7 TRAPS

Unless otherwise specified, traps shall be copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. The thermal efficiencies and standby heat losses shall conform to TABLE III in PART 3 of this Section for each type of water heater specified.

2.8.1 Electric Instantaneous Water Heaters (Tankless)

UL 499 and UL listed flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory.

2.9 ELECTRICAL WORK

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.10 MISCELLANEOUS PIPING ITEMS

2.10.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.10.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.10.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.10.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.10.3 Pipe Hangers (Supports)

Provide MSS SP-58 Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.10.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the

location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves, and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Mechanical Couplings

Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous, or non-ferrous, domestic hot and cold water systems, in lieu of unions, brazed, soldered, welded, flanged, or threaded joints.

Mechanical couplings are permitted in accessible locations including behind access plates. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to ensure positive rigid clamping of the pipe.

Designs which can only clamp on the bottom of the groove, or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications will not be permitted.

Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer. Segmentally welded elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations.

The Contracting Officer shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.

3.1.2.3 Unions and Flanges

Unions, flanges, and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.4 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.2.5 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.6 Copper Tube and Pipe

- a. Brazed. Brazed joints shall be made in conformance with AWS B2.2/B2.2M, ASME B16.50, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include

the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver, or a silver brazing filler metal.

- b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.
- c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.
- d. Press connection. Copper press connections shall be made in **strict** accordance with the manufacturer's installation instructions for manufactured rated size. The joints shall be pressed using the tool(s) approved by the manufacturer **of that joint**. Minimum distance between fittings shall be in accordance with the manufacturer's requirements.

3.1.2.7 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed) or mated flanged.

3.1.2.8 Glass Pipe

Joints for corrosive waste glass pipe and fittings shall be made with corrosion-resisting steel compression-type couplings with acrylonitrile rubber gaskets lined with polytetrafluoroethylene.

3.1.2.9 Corrosive Waste Plastic Pipe

Joints for polyolefin pipe and fittings shall be made by mechanical joint or electrical fusion coil method in accordance with ASTM D2657 and ASTM F1290. Joints for filament-wound reinforced thermosetting resin pipe shall be made in accordance with manufacturer's instructions. Unions or flanges shall be used where required for disconnection and inspection.

3.1.2.10 Polypropylene Pipe

Joints for polypropylene pipe and fittings shall be made by heat fusion welding socket-type or butt-fusion type fittings and shall comply with ASTM F2389.

3.1.2.11 Other Joint Methods

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding. The cathodic protection system, protective coating system, and joint bonding for cathodically protected pipe shall be in accordance with Section 26 42 13 GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM. Coatings shall be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe shall be cleaned, and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned, and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

- a. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.
- b. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.
- c. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.
- d. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.
- e. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT

SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

- f. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.5.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.5.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 6 inches in diameter.

- b. A tack-welded or banded-metal rain shield around the pipe.

3.1.5.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs FLASHING REQUIREMENTS and WATERPROOFING, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.5.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.6 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.7.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-58 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
 - (1) Be used on insulated pipe less than 4 inches.
 - (2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
 - (3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-58 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
 - (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
 - (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
 - (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.
- m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure, and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

- n. Hangers and supports for plastic pipe shall not compress, distort, cut, or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.7.3 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.8 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed, and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.9 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs, and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat, or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.4.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.4.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.4.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.4.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.3.4.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.5 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

3.3.7 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.

3.5 IDENTIFICATION SYSTEMS

3.5.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.5.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages, and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room.

3.6 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel,

polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.7 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.7.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.7.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.7.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil, and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.
- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

- c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

3.8 TESTS, FLUSHING, AND DISINFECTION

3.8.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with , except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure and reasons for choosing this option in lieu of the smoke test to the Contracting Officer for approval.

- a. Drainage and Vent Systems Test. The final test shall include a smoke test.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.8.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.8.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 1 inch for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.8.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary, and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.8.3 System Flushing

3.8.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.8.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Flow rates on fixtures must not exceed those stated in PART 2 of this Section. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.8.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments,

and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

3.8.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator or inject liquid chlorine into the system through a solution-feed chlorinator.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take additional samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer. Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA SM 9223 .

The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.9 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.10 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 70 degrees F delta T.

SL = Standby loss is maximum (Btu/h) based on a 70 degrees F temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

3.10.1 Electric Instantaneous Water Heaters(Tankless)

UL 499 and UL listed flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory.

3.11 TABLES

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X	X	X	X	X		
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings shall be marked with the CISPI trademark.		X	X	X	X		
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X			
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X		
5	Grooved pipe couplings, ferrous and non-ferrous pipe, ASTM A536 And ASTM A47/A47M	X	X		X	X		
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A536 and ASTM A47/A47M for use with Item 5	X	X		X	X		

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B584, for use with Item 5	X	X		X	X		
8	Wrought copper grooved joint pressure fittings for non-ferrous pipe ASTM B75/B75M C12200, ASTM B152/B152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X					
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X		
10	Steel pipe, seamless galvanized, ASTM A53/A53M, Type S, Grade B	X			X	X		
11	Seamless red brass pipe, ASTM B43				X	X		X
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X		X
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X		X

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
14	Seamless copper pipe, ASTM B42						X	X
15	Cast bronze threaded fittings, ASME B16.15				X	X		
16	Copper drainage tube, (DWV), ASTM B306	X*	X	X*	X	X		X
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X		X
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X		X
19	Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D2661, ASTM F628	X	X	X	X	X	X	
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, ASTM F891, (Sch 40) ASTM F1760	X	X	X	X	X	X	X
21	Process glass pipe and fittings, ASTM C1053						X	
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A518/A518M		X			X	X	

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
23	Polypropylene (PP) waste pipe and fittings, ASTM D4101						X	
24	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D2996						X	
SERVICE: A - Underground Building Soil, Waste and Storm Drain B - Aboveground Soil, Waste, Drain In Buildings C - Underground Vent D - Aboveground Vent E - Interior Rainwater Conductors Aboveground F - Corrosive Waste And Vent Above And Belowground G - Condensate Drain Aboveground * - Hard Temper								

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
1	Malleable-iron threaded fittings:				
	a. Galvanized, ASME B16.3 for use with Item 4a	X	X	X	X
	b. Same as "a" but not galvanized for use with Item 4b			X	
2	Grooved pipe couplings, ferrous pipe ASTM A536 and ASTM A47/A47M, non-ferrous pipe, ASTM A536 and ASTM A47/A47M	X	X	X	

3	Ductile iron grooved joint fittings for ferrous pipe ASTM A536 and ASTM A47/A47M, for use with Item 2	X	X	X	
4	Steel pipe:				
	Seamless, galvanized, ASTM A53/A53M, Type S, Grade B	X	X	X	X
5	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
6	Seamless copper pipe, ASTM B42	X	X		X
7	Seamless copper water tube, ASTM B88, ASTM B88M	X**	X**	X**	X***
8	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X
9	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8	X	X	X	X
10	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8	X	X	X	X
11	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B584, for use with Item 2	X	X	X	
12	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D2846/D2846M	X	X		X
13	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F441/F441M	X	X		X
14	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F442/F442M	X	X		X

15	Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F437, for use with Items 20, and 21	X	X		X
16	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F438 for use with Items 20, 21, and 22	X	X		X
17	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F439 for use with Items 20, 21, and 22	X	X		X
18	Steel pipeline flanges, MSS SP-44	X	X		
19	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B828	X	X		
20	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X	
21	Malleable-iron threaded pipe unions ASME B16.39	X	X		
22	Nipples, pipe threaded ASTM A733	X	X	X	
	SERVICE: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground C - Compressed Air Lubricated D - Cold Water Service Belowground Indicated types are minimum wall thicknesses. ** - Type L - Hard *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors **** - In or under slab floors only brazed joints				

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 GENERAL

Section 22 00 00 PLUMBING, GENERAL PURPOSE applies to work specified in this section.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	(2020a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C195	(2007; R 2013) Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C449	(2007; R 2013) Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C534/C534M	(2020a) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C552	(2022) Standard Specification for Cellular Glass Thermal Insulation
ASTM C592	(2022a) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C647	(2008; R 2013) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C795	(2008; R 2018) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C916	(2020) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants

ASTM C921	(2010; R 2015) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C1136	(2021) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM D579/D579M	(2015) Standard Specification for Greige Woven Glass Fabrics
ASTM D5590	(2000; R 2010; E 2012) Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2022) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 220	(2021) Standard on Types of Building Construction
NFPA 255	(2006; Errata 2006) Standard Method of Test of Surface Burning Characteristics of Building Materials

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS 3779	(2016; Rev B) Tape Adhesive, Pressure Sensitive Thermal Radiation Resistant, Aluminum Foil/Glass Cloth

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-3316	(1987; Rev C; Am 2 1990) Adhesives, Fire-Resistant, Thermal Insulation
MIL-PRF-19565	(1988; Rev C) Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Adhesives

Coatings

Insulating Cement

Insulation Materials

Jacketing

Tape

SD-08 Manufacturer's Instructions

Installation Manual

SD-11 Closeout Submittals

Record Drawings

Adhesives

Coatings

Insulation Materials

Recycled Materials

1.3 QUALITY CONTROL

1.3.1 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section. The minimum recycled material content of the following insulation types are:

- a. Rock Wool - 75 percent slag by weight
- b. Fiberglass - 20-25 percent glass cullet by weight
- c. Plastic Rigid Foam - 9 percent recovered material
- d. Polyisocyanurate/Polyurethane - 9 percent recovered material
- e. Rigid Foam - 9 percent recovered material

Submit recycled materials documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Performance Requirements

Provide noncombustible thermal-insulation system materials, as defined by NFPA 220. Provide adhesives, coatings, sealants, facings, jackets, and thermal-insulation materials, except cellular elastomers, with a flame-spread classification (FSC) of 25 or less, and a smoke-developed classification (SDC) of 50 or less. Determine these maximum values in accordance with NFPA 255. Provide coatings and sealants that are nonflammable in their wet state.

Provide adhesives, coatings, and sealants with published or certified temperature ratings suitable for the entire range of working temperatures normal for the surfaces to which they are to be applied.

2.2 COMPONENTS

2.2.1 Insulation

2.2.1.1 Mineral Fiber Insulation

Provide mineral fiber insulation conforming to ASTM C592 and suitable for surface temperatures up to 370 degrees F. Provide insulation with a density not less than 4-pound per cubic foot and with thermal conductivity not greater than 0.26 Btu-inch per hour per square foot per degree F at 150 degrees F mean.

2.2.1.2 Cellular Elastomer Insulation

Provide cellular elastomer insulation conforming to ASTM C534/C534M. Ensure the water vapor permeability does not exceed 0.30 grain per foot per inch per hour per square foot mercury pressure difference for 1-inch thickness of cellular elastomer.

2.2.1.3 Cellular Glass Insulation

Conform to ASTM C552, Type II, Grade 2, pipe covering for Cellular Glass. Substitutions for this material are not permitted. Ensure minimum thickness is not less than 1-1/2 inches.

2.2.1.4 Flexible Blankets

Provide flexible blankets and felts for use at temperatures up to and including 350 degrees F with a density of 1 pound per cubic foot. Ensure thermal conductivity is no greater than 0.26 Btu per hour per square foot per degree F at 75 degrees F mean.

2.2.2 Adhesives

2.2.2.1 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. To resist mold/mildew, ensure lagging adhesive conforms to ASTM D5590 with 0 growth rating. Provide nonflammable and fire-resistant lagging adhesives with a maximum flame spread index of 25 and a maximum smoke

developed index of 50 when tested in accordance with ASTM E84. Adhesive are MIL-A-3316, Class 1, pigmented white and suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Apply lagging adhesives in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.2.2 Vapor-Barrier Material Adhesives

Ensure adhesives conform to the requirements of ASTM C916, Type I, when attaching fibrous-glass insulation to metal surfaces or attaching insulation to itself, to metal, and to various other substrates.

2.2.2.3 Cellular Elastomer Insulation Adhesive

For cellular elastomer insulation adhesive, provide a solvent cutback chloroprene elastomer conforming to ASTM C916, Type I, and is approved by the manufacturer of the cellular elastomer for the intended use.

2.2.3 Insulating Cement

2.2.3.1 General Purpose Insulating Cement

Provide general purpose insulating cement, mineral fiber, conforming to ASTM C195. Ensure composite is rated for 1800 degrees F service, with a thermal-conductivity maximum of 0.85 Btu per inch per hour per square foot for each degree F temperature differential at 200 degrees F mean temperature for a 1 inch thickness.

2.2.3.2 Finishing Insulating Cement

Provide finishing insulating cement of a mineral-fiber, hydraulic-setting type conforming to ASTM C449.

2.2.4 Caulk

Provide elastomeric joint sealant in accordance with ASTM C920, Type S, Grade NS, Class 25, Use A.

2.2.5 Corner Angles

Provide a nominal 0.016 inch thick aluminum 1 by 1 inch corner angle piping insulation with factory applied kraft backing. Ensure aluminum conforms to ASTM B209, Alloy 3003 .

2.2.6 Jacketing

2.2.6.1 Stainless Steel Jacket

Provide stainless steel jackets conforming to ASTM A240/A240M; Type 304, minimum thickness of 0.010 inch, smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges.

2.2.7 Coatings

2.2.7.1 Outdoor Vapor-Barrier Finishing

Provide a nonasphaltic, hydrocarbon polymer, mastic coating. Ensure the coating conforms to the requirements of ASTM C1136 and ASTM C921.

2.2.7.2 Indoor Vapor-Barrier Finishing

Provide a pigmented resin and solvent compound coatings conforming to ASTM C1136, Type II.

2.2.7.3 Vapor Retarder

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be 0.013 perms or less at 43 mils dry film thickness as determined according to procedure B of ASTM E96/E96M utilizing apparatus described in ASTM E96/E96M. The coating shall be nonflammable, fire resistant type. To resist mold/mildew, coating shall meet ASTM D5590 with 0 growth rating. Coating shall meet MIL-PRF-19565 Type II (if selected for indoor service) and be Qualified Products Database listed. All other application and service properties shall be in accordance with ASTM C647.

2.2.7.4 Cellular-Elastomer Finishing

Provide a polyvinylchloride lacquer coating recommended by the manufacturer of the cellular elastomer finish.

2.2.7.5 Coating Color

Conform to the color code specified for the coating color.

2.2.8 Tape

Provide a knitted elastic cloth glass lagging specifically suitable for continuous spiral wrapping of insulated pipe bends and fittings that produces a smooth, tight, wrinkle-free surface. Conform to requirements of SAE AMS 3779, ASTM D579/D579M, and ASTM C921 for tape, weighing not less than 10 ounces per square yard.

2.3 MATERIALS

Submit manufacturer's catalog data for the following items:

- a. Adhesives
- b. Coatings
- c. Insulating Cement
- d. Insulation Materials
- e. Jacketing

f. Tape

Provide compatible materials that do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state. Meet ASTM C795 requirements for materials to be used on stainless steel surfaces. Provide materials that are asbestos free.

PART 3 EXECUTION

Apply insulation only to the system or component surfaces that have previously been tested and approved by the Contracting Officer.

3.1 PREPARATION

Submit installation drawings for pipe insulation, conforming with the adhesive manufacturer's written instructions for installation. Submit installation manual clearly stating the manufacturer's instructions for insulation materials.

Clean surfaces to remove oil and grease before insulation adhesives or mastics are applied. Provide solvent cleaning required to bring metal surfaces to such condition.

3.2 INSTALLATION OF INSULATION SYSTEMS

Apply materials in conformance with the recommendations of the manufacturer.

Install smooth and continuous contours on exposed work. Smoothly and securely paste down cemented laps, flaps, bands, and tapes. Apply adhesives on a full-coverage basis.

Install insulation lengths tightly butted against each other at joints. Where lengths are cut, provide smooth and square and without breakage of end surfaces. Where insulation terminates, neatly taper, and effectively seal ends, or finish as specified. Direct longitudinal seams of exposed insulation away from normal view.

Use insulation meeting maximum value conductance as tested at any point, do not use an average. Meet or exceed the specified maximum conductance by adding additional insulation thickness.

3.3 APPLICATION

3.3.1 Type T-1, Mineral Fiber with Vapor-Barrier Jacket

Apply factory and field attached vapor barrier jacket to piping insulated with mineral fiber. Maintain vapor seal. Securely cement jackets, jacket laps, flaps, and bands in place with vapor-barrier adhesive. Provide jacket overlaps not less than 1-1/2 inches and jacketing bands for butt joints 3-inches in width.

Insulate exposed-to-view fittings and valve bodies with preformed mineral-fiber of the same thickness as the pipe-barrel insulation. Temporarily secure fitting insulation in place with light cord ties. Apply a 60-mil coating of white indoor vapor-barrier coating and, while still wet, wrap with glass lagging tape with 50 percent overlap, and smoothly blend into the adjacent jacketing. Apply additional coating as needed with rubber-gloved hands to smooth fillets or contour coating. Allow to fully cure before the finish coating is applied. Field fabricate and install insulation for concealed fittings and special configurations. Build up insulation from mineral fiber and a special mastic consisting of a mixture of insulating cement and lagging adhesive diluted with 3 parts water. Where standard vapor-barrier

jacketing cannot be used, make the surfaces vapor tight by using coating and glass lagging cloth or tape as previously specified.

In lieu of materials and methods previously specified, fittings may be wrapped with a twine-secured, mineral-wool blanket to the required thickness and covered with premolded polyvinylchloride jackets. Make seams vapor tight with a double bead of manufacturer's standard vapor-barrier adhesive applied in accordance with the manufacturer's instructions. Hold all jacket ends in place with AISI 300 series corrosion-resistant steel straps, 15-mils thick by 1/2-inch wide.

Set pipe insulation into an outdoor vapor-barrier coating applied intermittently over a minimum length of 6 inches at maximum 12 feet spacing. Seal the ends of the insulation to the jacketing with the same coating material to provide an effective vapor-barrier stop.

Do not use staples as a means to apply insulation. Install continuous vapor-barrier materials over all surfaces, including areas inside pipe sleeves, hangers, and other concealment.

Provide piping insulation at hangers consisting of 13-pounds per cubic foot density; fibrous-glass inserts or expanded, rigid, closed-cell, polyvinylchloride. Where required, seal junctions with vapor-barrier jacket, glass-cloth mesh tape, and vapor-barrier coating.

Expose white-bleached kraft paper side of the jacketing to view.

Finish exposed-to-view insulation with not less than a 6-mil dry-film thickness of nonvapor-barrier coating suitable for painting.

3.3.2 Type T-4, Cellular Glass with Vapor-Barrier Jacket

Apply factory and field attached vapor barrier jacket to piping insulated with cellular glass. Maintain vapor seal. Securely cement jackets, jacket laps, flaps, and bands in place with vapor-barrier adhesive. Provide jacket overlaps not less than 1-1/2 inches. Provide jacket bands for butt joints of not less than 3 inches width. Provide insulation continuous through hangers. Bed insulation in an outdoor vapor-barrier coating applied to all piping surfaces.

Insulate flanges, unions, valves, anchors, and fittings with factory premolded or prefabricated or field fabricated segments of insulation of the same material and thickness as the adjoining pipe insulation. When segments of insulation are used, provide elbows with not less than three segments. For other fittings and valves, cut segments to the required curvature or nesting size.

Secure segments of the insulation in place with twine or copper wire. After the insulation segments are firmly in place, apply a vapor-barrier coating over the insulation in two coats with glass tape imbedded between coats. Vary the tint of the first coat from the expected white color of the second coat to ensure the complete application of the two coats. Apply coatings to a total dry-film thickness of 1/16 inch minimum. Overlap glass tape seams not less than 1 inch and tape ends not less than 4 inches.

In lieu of materials and methods specified above, fittings may be wrapped with 3/8-inch thick, vapor-barrier, adhesive-coated strips of cellular elastomer insulation. Install insulation under tension, compressed to 25 percent of original thickness, and wrapped until overall thickness is equal to adjacent insulation. Secure cellular elastomer in place with twine and sealed with vapor-barrier coating applied to produce not less than 1/16-inch dry-film thickness. Cover fittings with premolded polyvinylchloride jackets. Make seams vapor-tight with a double bead of manufacturer's standard vapor-barrier adhesive

applied in accordance with the manufacturer's instructions. Hold jacket ends in place with AISI 300 series corrosion-resistant steel straps, 15-mils thick by 1/2-inch wide.

To prevent condensation, insulate anchors secured directly to piping for not less than 6 inches from the surface of the pipe insulation.

Install white-bleached kraft paper side of jacket exposed to view.

Finish exposed-to-view insulation with not less than a 6-mil dry-film thickness of nonvapor-barrier coating suitable for painting.

3.4 CLOSEOUT ACTIVITIES

Final acceptance of the performed work is dependent upon providing Record Drawings details to the Contracting Officer. Include construction details, by building area, the insulation material type, amount, and installation method. An illustration or map of the pipe routing locations may serve this purpose.

Provide a cover letter/sheet clearly marked with the system name, date, and the words "Record Drawings Insulation/Material" for the data. Forward to the Owner for inclusion in the Maintenance Database."

End of Section

SECTION 26 05 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Electrical Requirements specifically applicable to Division 26 Sections, in addition to Division 1 General Requirements.

1.2 SCOPE

- A. This scope covers the furnishing, installation, testing, adjusting, and placing in operation all electrical equipment, devices, facilities, materials, and auxiliary items necessary for the complete and successful operation of all electrical equipment as herein described, shown on the plans, or deemed necessary for the completion of the electrical portion of the project. It is the intent of DIVISION 26 to outline the electrical requirements of the contract in order to provide the information necessary for the construction of a fully operational system as shown on the plans and as herein described. A comprehensive electrical scope of work is as follows:
 - 1. High Voltage Electrical
 - 2. Power/Electrical System
 - 3. Generator Systems
 - 4. Lighting System
 - 5. Utility Work
 - 6. Connection of Electrically Powered Mechanical Equipment
 - 7. Temporary Construction Power
 - 8. All Incidentals Necessary for a Complete and Fully Operational Electrical System.

1.3 WORKING CLEARANCES

- A. Working clearances around equipment requiring electrical services shall be verified by Contractor to comply with Code requirements. Should there be apparent violations of clearances; the Contractor shall notify the Engineer before proceeding with connection or placing of equipment.
- B. In the case of panelboards, safety switches and other equipment requiring wire and cable terminations, the Contractor shall ascertain that lug sizes and wiring gutters, or space allowed for proper accommodation and termination of the wires and cables are adequate.

1.4 WORKMANSHIP

- A. Workmanship under this Division shall be accomplished by persons skilled in the performance of the required task. All work shall be done in keeping with conventions of the trade. Work of this Division shall be closely coordinated with work of other trades to avoid conflict and interference.

1.5 PROTECTION OF ELECTRICAL EQUIPMENT

- A. Electrical equipment shall be protected by the weather, especially from water dripping or splashing upon it, always during shipment, storage and after installation. Should any apparatus be subjected to possible injury by water, it shall be thoroughly dried out and put through a dielectric test, at the expense of the contractor, to ascertain the suitability of this apparatus. The results of the test shall be submitted to the Engineer and if the apparatus is found to be unsuitable, the contractor shall replace it without additional cost to the Owner.

1.6 UTILITIES

- A. The electrical contractor shall install a fully operational electrical service as described in the plans.
- B. Arrange with the utility company for the services and install the services in accordance with their requirements, regulations and recommendations.

1.7 GUARANTEE

- A. Contractor shall guarantee all light bulbs. They shall be guaranteed for a period of one (1) year after the building is occupied. Guarantee shall include material and labor for repair.
- B. The Contractor shall guarantee all other electrical systems, materials and workmanship to be free from defects for a period of one (1) year from the date of final acceptance. He shall correct all defects arising within this period upon notification by the Owner or Engineer, without additional compensation.
- C. It is understood that the rights and benefits given the Owner by the guarantees found in the technical specifications are in addition to and not in derogation of any rights or benefits found in the special and general provisions of the contract.

1.8 TEMPORARY POWER AND LIGHTS DURING CONSTRUCTION

- A. It shall always be the responsibility of the Contractor to provide and maintain adequate temporary power and lighting during construction, so that the various other trades can accomplish their work in a flawless manner. Particular attention will be given to power and lighting for masonry, drywall, painting, tile work and any other finish work.

1.9 MATERIAL STANDARDS

- A. Material shall be new and comply with standards of Underwriters' Laboratories, Inc., where standards have been established for the product and the various NEMA, ANSI, ASTM, IEEE, AEIC, IPCEA or other publications referenced.

1.10 TEST EQUIPMENT

- A. The contractor shall provide all test equipment and supplies deemed necessary by the Engineer at no extra cost to the Owner. These supplies shall include but not be limited to the following: volt

meters, amp meters, clamp-on ground rod test meter, light meters, generator load banks & temporary cables, watt meters, harmonic distortion test equipment, thermal image camera, megger tester, high pot test equipment, power quality analyzers, recording power meter, and oscilloscopes.

1.11 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code.
- B. ANSIC2 – National Electrical Safety Code.
- C. NEMA – National Electrical Manufacturer's Assoc.
- D. UL – Underwriters Laboratories
- E. NFPA – National Fire Protection Assoc.
- F. IEEE – The Institute of Electrical and Electronics Engineers
- G. IESNA – The Illuminating Engineering Society of North America
- H. NETA – International Electrical Testing Association
- I. API – American Petroleum Institute
- J. AGA – American Gas Association
- K. Recommended Standards for Water Works and Wastewater Facilities as published by Great Lakes – Upper Mississippi River Board of State Public Health and Environmental Managers.

1.12 SUBMITTAL

- A. Submit under provisions of the General Provisions.
 - 1. The Contractor installing all Electrical work shall review and approve all electrical shop drawings prior to submittal to the Engineer for review. As part of the review, the installer shall certify the following:
 - a. I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is in compliance with the contract drawing and specifications, can be installed in the allocated space, will be stored in accordance with the manufacturer's recommendation, will be installed per NEC, and is submitted for approval.

Certified by: _____ Date: _____

- B. Submit shop drawings and product data grouped to include complete submittal of related systems, products, and accessories in a single submittal. No electrical work may be performed until shop drawings are approved. Submit Shop Drawings on the Following Systems as Grouped Below:
 - 1. High Voltage Distribution System
 - a. Transformers
 - b. Switches
 - c. Distribution Equipment

- d. High Voltage Cable
- e. Equipment Pads
- f. Utility Conduit
- g. Miscellaneous Materials
- h. Utility Work
- 2. Low Voltage Power/Electrical System
 - a. Conduit and Conduit Fittings
 - b. Wire
 - c. Pull Boxes
 - d. Panelboards
 - e. Panelboard Layouts
 - f. Circuit Breakers
 - g. Disconnects
 - h. Fuses
 - i. Conduit Support Systems
 - j. Wiring Devices
 - k. Switchboards
 - l. Motor Control Centers
 - m. Transformers
 - n. Surge Protection Equipment
 - o. Intelligent Motor Control Centers
 - p. Breaker Coordination Study **(NO BREAKERS OR FUSES WILL BE APPROVED WITHOUT AN APPROVED COORDINATION STUDY)**
- 3. Generator Equipment
 - a. Generator
 - b. Fuel System
 - c. Generator Paralleling/ATS Equipment
 - d. Generator Enclosure
 - e. Power Correction Equipment
- 4. Lighting System
 - a. All Light Fixtures
 - 1) Computer Printout of Lighting Layout
 - 2) Sample Fixture (as directed by Engineer)
 - 3) IES Photometric Files
 - b. Poles & Foundations
- 5. Miscellaneous Electrical Equipment
 - a. Miscellaneous Electrical Parts
- 6. Drawings
 - a. Coordination drawing of All Electrical Room
 - b. Conduit layout drawings
 - c. Duct drawings
 - d. As-Built Drawings

C. Mark dimensions and values in units to match those specified.

1.13 REGULATORY REQUIREMENTS

- 1. Conform to applicable sections of the Building Code and all local rules, regulations, and ordinances.
- 2. Electrical: Conform to NFPA 70 & National Electric Safety Code
- 3. Obtain permits, and request inspections from authority having jurisdiction.

4. References listed in Paragraph 1.11, this section.

1.14 FINAL INSPECTION AND TESTING

- A. After the electrical installation is complete, the Contractor shall deliver to the Engineer the following information with his request for final inspection.
 1. One set of contract drawings marked to show all significant changes in equipment ratings and locations, alterations in locations of conduit runs, or of any data differing from the contract drawings. This shall include revised or changed panelboard and switchgear schedules.
 2. Certificates of final inspection from local authority.
 3. A tabulation of all motors listing their respective manufacturer, horsepower, nameplate voltage and current, actual running current after installation and overload heater rating.
- B. The electrical work shall be thoroughly tested to demonstrate that the entire system is in proper working order and in accordance with the plans and specifications. Each motor with its control shall be run as nearly as possible under operating conditions for a sufficient length of time to demonstrate correct alignment, wiring capacity, speed and satisfactory operation. All main switches and circuit breakers shall be operated, but not necessarily at full load. Contractor may be required during final inspection, at the request of the Engineer to furnish test instruments for use during the testing.
- C. All wiring shall be given a megger test using a 1000 Volt megger. This test shall be performed after conductors are pulled, but before final connections are made. The Engineer shall be given two (2) days' written notice of the anticipated test date so that he may witness the test if so desired. In any event, the Contractor shall record the circuit designation and the megger reading on each phase. This written record shall be submitted to the Engineer. The cost of this test or any retest caused by insufficient megger readings shall be the responsibility of the Contractor (All tests shall be done in accordance with NETA Standards).

1.15 STAFFING

- A. The electrical contractor shall provide a "Master Electrician" who has been deemed a "Master Electrician" by exam through the State, or any other Local Permitting Authority as the Electrical Superintendent for the project. The Electrical Superintendent shall be on the project site any time any electrical work is performed by the contractor.
- B. In addition, the contractor shall provide one Journeyman electrician for every four electrical helpers used on the project site.

1.16 AS-BUILT DRAWINGS

- A. The contractor shall provide detailed as-built drawings for the project indicating all power wiring. (All Drawings shall be delivered to the Owner in an AutoCAD Format same version as the CD containing the bid set.)

- B. The As-Built drawings shall include detailed drawings of all duct banks, underground conduit, above ground conduit, motor control centers, PLC control panels, control drawings. These drawings shall indicate exact location of all underground electrical wiring and fiber optic cable.
 - 1. The location shall indicate the following:
 - a. Centerline location
 - b. Width / Cross section
 - c. Depth
- C. The Engineer will provide electronic copies of all drawings in the bid plans set on a CD for use by the contractor.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Division 26

1.3 DEFINITIONS

- A. VFD: Variable frequency drive.

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.
- C. Standard Test Record Sheet/s per NETA ATS Inspection and Test Procedures.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - 1. Alpha Wire.

2. Belden Inc.
 3. Encore Wire Corporation.
 4. General Cable Technologies Corporation.
 5. 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 THHN-2-THWN-2, Type XHHW-2, RHW-2 Low Smoke, SOW and Type SO.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC, Type SO with ground wire.
- E. VFD Cable:
1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
 2. Type TC-ER with oversized crosslinked polyethylene insulation, dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.
 3. Comply with UL requirements for cables in Classes I and II, Division 2 hazardous location applications.
 4. Cable shall be rated for 1000V unless otherwise indicated.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products 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 Barden 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. General Branch Circuits in building for lighting and receptacles: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger, except VFD cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Non- Industrial Facilities
 1. Service Entrance: Type THHN-THWN, single conductors in raceway.
 2. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway Metal-clad cable, Type MC.
 3. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
 4. Feeders in Cable Tray: Type THHN-THWN, single conductors in raceway Metal-clad cable, Type MC.
 5. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway Metal-clad cable, Type MC.
 6. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
 7. Branch Circuits in Cable Tray: Type THHN-THWN, single conductors in raceway Metal-clad cable, Type MC.
 8. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
 9. Class 1 Control Circuits: Type THHN-THWN, in raceway.
 10. Class 2 Control Circuits: Type THHN-THWN, in raceway.
- B. Industrial Facilities (including but not limited to: Water / Wastewater, Aviation Fueling, Roadway Lighting, Airports, etc.)
 1. Service Entrance: Type XHHW-2, single conductors in raceway.
 2. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type XHHW-2, single conductors in raceway.
 3. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
 4. Feeders in Cable Tray: Type XHHW-2, single conductors in raceway
 5. Branch Circuits Concealed in Ceilings, Walls, and Partitions of an air-conditioned space: Type THHN-THWN, single conductors in raceway Metal-clad cable, Type MC.
 6. Branch Circuits Concealed in Ceilings, Walls, and Partitions of non-air-conditioned space: Type XHHW-2, single conductors in raceway.

7. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
8. Branch Circuits in Cable Tray: Type XHHW-2, single conductors in raceway
9. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
10. Class 1 Control Circuits: Type XHHW-2, in raceway.
11. Class 2 Control Circuits: Type XHHW-2, in raceway

C. Road and Rail Tunnels

1. All conductors installed in the Road and Rail Tunnel shall be type Low Smoke Zero Halogen.
2. Service Entrance: Type RHW-2, single conductors in raceway.
3. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type RHW-2, single conductors in raceway.
4. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
5. Feeders in Cable Tray: Type XHHW-2, single conductors in raceway
6. Branch Circuits Concealed in Ceilings, Walls, and Partitions of an air-conditioned space: Type RHW-2, single conductors in raceway Metal-clad cable, Type MC.
7. Branch Circuits Concealed in Ceilings, Walls, and Partitions of non-air-conditioned space: Type RHW-2, single conductors in raceway.
8. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THW-2, single conductors in raceway.
9. Branch Circuits in Cable Tray: Type RHW-2, single conductors in raceway
10. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
11. Branch Circuits: Type RHW-2.
12. Tunnel lighting final tap circuits: Type RHW-2.
13. Class 1 Control Circuits: Type XHHW-2, in raceway.
14. Class 2 Control Circuits: Type XHHW-2, in raceway.

D. VFD Output Circuits: Type TC-ER cable with dual tape shield.

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 Division 26 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. All torque tightening equipment shall be calibrated before use with calibration records available for inspection.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to the project specifications.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Record all results and submit to engineer for approval. Certify compliance with manufacturer's test parameters, in the absence of Manufacturer's

published data, certify compliance with the table listed in NETA Acceptance Testing Specification.

2. All testing must be carried out by competent persons.
3. NETA Acceptance Testing Specification is the minimum level of testing that will be required on all projects with the most relevant inspection and test procedures extracted as listed below. The following list includes additional tests that will be required unless stated otherwise.

Pre-connection:

- a. Visual and Mechanical inspection.
- b. Perform resistance measurements through bolted connections with a low resistance DC Ohmmeter or an insulation resistance test meter.
- c. Continuity of all protective conductors to be recorded using a low resistance DC Ohmmeter or an insulation resistance test meter.
- d. Check continuity of all conductors and verify correct cable connections.
- e. Check polarity of all conductors.
- f. Perform insulation-resistance test on each conductor with respect to ground and all adjacent conductors using an insulation resistance test meter. Each conductor must be tested for 1 minute.
- g. Verify uniform resistance of all parallel conductors.

Post-connection

- h. Test and record the impedance at the supply origin.
 - i. Test and record the Ground fault loop impedance between all live conductors and ground at the furthest extents of each final circuit. This test is to be completed using a Fault Loop Impedance tester and all results must be in compliance with the Circuit Protective Device (CPD) limits from the Manufacturer.
 - j. Test and record the operating trip time of all GFI and GFCI's devices to ensure compliance with NEC and Manufacturer's published data. This test is to be completed using a GFCI test meter.
 - k. Other functional testing may be listed here if required.
4. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. List of testing personnel with Resumes.
3. Submit all test results on the enclosed test form, see Appendix A.

4. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. For definitions of grounding and bonding terms see NFPA 70.

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes.

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. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
- B. 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 "Operation and Maintenance Data," include the following:

- a. Instructions for periodic testing and inspection of grounding features at test wells ground rings grounding connections for separately derived systems based on NETA MTS
 - 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. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. Harger Lightning and Grounding.
 - 4. ILSCO.
 - 5. O-Z/Gedney; A Brand of the EGS Electrical Group.
 - 6. Robbins Lightning, Inc.
 - 7. Siemens Power Transmission & Distribution, Inc
 - 8. Or Engineer approved equal.

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.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) 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.
- D. Grounding & Bonding Conductors
 1. All raceways and equipment shall be provided with an Equipment Grounding Conductor as shown on the drawings. When the Equipment Grounding Conductor is not shown on the drawings, provide an Equipment Grounding Conductor per Table 250.122 of the NEC
 2. All Service Entrance Equipment shall be provided with a Grounding Electrode Conductor between the Service Entrance Ground and the Grounding Electrode System as shown on the drawings. When the Grounding Electrode Conductor is not shown on the drawing, provide a Grounding Electrode Conductor per Table 250.66 of the NEC.
 3. Main Bonding Jumper installed between the Service Entrance Ground and Neutral and shall be sized per Table 250.66 of the NEC.
 4. System Bonding Jumper installed between the Separately Derived System Ground and Neutral and shall be sized per Table 250.66 of the NEC.

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 compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m) min
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
 2. Backfill Material: Electrode manufacturers recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 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 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If

necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, no shrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors' level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Ant frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. 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.
- E. 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.
- F. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- G. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 2. When service grounding is not detailed on the drawings, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange 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.

- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. 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 (18 m) apart.
- H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of area.
 - 1. Install copper conductor not less than No. 2/0 AWG or as shown on the drawing for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet (6.0 m) long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.7 FIELD QUALITY CONTROL

- A. Perform 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.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81 and NETA Standards.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

- D. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: **5ohms**.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: **5 ohms**.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: **3 ohms**.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: **3 ohm(s)**.
 5. Substations and Pad-Mounted Equipment: **5 ohms**.
 6. Manhole Grounds: **10 ohms**.
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. 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: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. 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 mounted electrical with structural and architectural specification and drawings.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Atkore International.
 - g. Wesanco, Inc.
 - h. or Approved Equal

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 4. 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- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) on center, in at least 1 surface.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - e. or Approved Equal
 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 shall be as indicated below:
1. PVC Conduit – PVC, Fiberglass, or Stainless Steel (unless atmosphere is corrosive to Stainless Steel)
 2. RGS Conduit – Galvanized Steel
 3. Aluminum Conduit – Stainless Steel
 4. PVC Coated RGS – Stainless Steel (unless atmosphere is corrosive to Stainless Steel); if atmosphere is corrosive to Stainless Steel then use Fiberglass
 5. EMT – Painted or Galvanized Steel
 - 6.
- E. Cable Tray Supports shall be as indicated below:
1. Galvanized Steel – Galvanized or Stainless Steel
 2. Fiberglass – Stainless Steel or a combination of Fiberglass and Stainless Steel
 3. Aluminum – Stainless Steel
- F. 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.
- G. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

H. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
 - 5) or Approved Equal
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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 6) or Approved Equal
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.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps].

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb. (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements as specified in the contract documents.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Nonmetal wireways and auxiliary gutters.
 - 5. Surface raceways.
 - 6. Boxes, enclosures, and cabinets.
 - 7. Handholes and boxes for exterior underground cabling.

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. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, include those for internal 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.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- C. Source quality-control reports.

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.
 - 13. or Approved Equal.
- 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. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.

- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- K. 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. Carlon Electrical Products.
 - 10. Niedax-Kleinhuis USA, Inc.
 - 11. RACO; Hubbell.
 - 12. Thomas & Betts Corporation.
 - 13. or Approved Equal.
- 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, or EPC-80-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.

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.
 - 5. or Approved Equal.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 for interior or Type 4X stainless steel for exterior 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: Hinged type for NEMA 1 and hinged, flanged-and-gasketed type for NEMA 4X unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Moulded Products, Inc.
 2. Hoffman.
 3. Carlon Electrical Products.
 4. Niedax-Kleinhuis USA, Inc.
 5. or Approved Equal.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: Fiberglass polyester or PVC, extruded and fabricated to required size and shape, and having hinged cover with captive screws.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.5 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.
 - d. or Approved Equal.
- 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.
 - e. or Approved Equal.
- D. Tele-Power Poles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mono-Systems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
 - d. or Approved Equal.
2. Material: Galvanized steel with baked-enamel finish in Architect choice of colors.
3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 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. FSR Inc.
 6. Hoffman.
 7. Hubbell Incorporated.
 8. Kraloy.
 9. Milbank Manufacturing Co.
 10. Mono-Systems, Inc.
 11. O-Z/Gedney.
 12. RACO; Hubbell.
 13. Robroy Industries.
 14. Spring City Electrical Manufacturing Company.
 15. Stahlin Non-Metallic Enclosures.
 16. Thomas & Betts Corporation.
 17. Wiremold / Legrand.
 18. or Approved Equal.
- 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 or aluminum to match raceway type, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
 1. Material: sheet metal.

2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, round.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb. (23 kg) shall be listed and marked for the maximum allowable weight.
- I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb. (32 kg).
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.
- J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover, unless otherwise noted.
- L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep), unless otherwise noted.
- N. Gangable boxes are prohibited, unless specifically noted.
- O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4X Stainless Steel for outdoor locations, Type 12 for indoor locations, 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: Fiberglass.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- P. Cabinets:
1. NEMA 250, Type 4X Stainless Steel for outdoor locations, Type 12 for indoor locations, with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power System, Inc.
 - f. Synertech Moulded Products.
 - g. Or approved equal.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, as required to identify system indicated on the drawings.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of fiberglass unless otherwise noted.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Nordic Fiberglass, Inc.
 - e. Oldcastle Precast, Inc; Christy Concrete Products.
 - f. Quazite: Hubbell Power System, Inc; Hubbell Power Systems.
 - g. Synertech Moulded Products.
 - h. Or Approved Equal.
- 2. Standard: Comply with SCTE 77.
 - 3. Color of Frame and Cover: Gray.
 - 4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 - 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 7. Cover Legend: Molded lettering, as required to identify system indicated on the drawings.
 - 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 9. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC, unless otherwise indicated on drawings.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC when concrete encased, Type EPC-80-PVC when direct buried,

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC unless otherwise indicated on drawings.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X Stainless steel unless otherwise indicated on drawings.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC unless otherwise noted.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X stainless steel in institutional and commercial kitchens and damp or wet locations, unless otherwise noted.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. 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 F (49 deg C) .

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. 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 (300 mm) 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 (300 mm) of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 3 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Engineer for each specific location.
 - 5. Change from ENT to GRC before rising above floor.
- J. 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.
- K. 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.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

- 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 (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install 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 (53-mm) 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 (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- 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 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. Provide expansion joint fitting any time conduit systems cross building expansion joints or structural expansion joints.
 - 2. Provide expansion fittings as recommended by the manufacturer of the conduit.
 - 3. Provide expansion fittings per NFPA 70.
 - 4. 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 (1830 mm) of flexible conduit for recessed and semi-recessed 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.
 - 3. Provide a separate ground for all flex conduits.
- 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 boxes and cover plate or supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set metal floor boxes level and flush with finished floor surface.
- EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit.
 - 2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction per 95% modified proctor density.
 - 3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor. Wrap conduit with 2 coats of 3M Scotch Wrap or Approved Equal.
 - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

- b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
- 4. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 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."

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping." If Section 078413 is not included as part of the project specifications, provide fire rated penetrations based on the fire proofing material being supplied. All penetrations through fire rated walls shall be fire proofed.

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 36

CABLE TRAYS 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. Ladder cable trays.
 - 2. Trough cable trays.
 - 3. Fiberglass cable trays.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- C. Delegated-Design Submittal: For seismic restraints.
 - 1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
 - 2. Design Calculations: Calculate requirements for selecting seismic restraints.
 - 3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays. Detailed fabrication will not be required if standard vendor supplied components are adequate for the calculated seismic forces, including anchorages and attachments to structure and to supported cable trays.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 - 2. Vertical and horizontal offsets and transitions.

3. Clearances for access above and to side of cable trays.
 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Seismic Qualification Certificates: For cable trays, 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.
- B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
 2. Component Importance Factor: 1.5.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
1. Temperature Change: Use the maximum and minimum temperature for the area the cable tray is to be installed for calculating thermal expansion. Gap settings shall be based on cable tray temperature at the time of installation and table 4-2 in NEMA VE-2.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAYS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Chalfant Manufacturing Company.
3. Cooper B-Line, Inc.
4. Mono-Systems, Inc.
5. MP Husky.
6. PW Industries
7. or approved equal.

B. Description:

1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
2. Rung Spacing: 12 inches (300 mm) unless otherwise specified or required for cable support. on center.
3. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) minimum width with radius edges.
5. No portion of the rungs shall protrude below the bottom plane of side rails.
6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
7. Minimum Usable Load Depth: 6 inches (150 mm) unless otherwise noted.
8. Straight Section Lengths: as required to facilitate tray assembly.
9. Width: as indicated on Drawings.
10. Fitting Minimum Radius: Min of 24" or based on cables installed per NEC.
11. Class Designation: Comply with NEMA VE 1, Class 20C unless otherwise specified.
12. Splicing Assemblies: Bolted type using serrated flange locknuts.
13. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316 Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.4 TROUGH CABLE TRAYS (Solid Bottom)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Tube & Conduit.
2. Chalfant Manufacturing Company.
3. Cooper B-Line, Inc.
4. Mono-Systems, Inc.
5. MP Husky.
6. PW Industries

B. Description:

1. Configuration: Two longitudinal members (side rails) with a solid sheet over rungs exposed on the interior of the trough, or corrugated sheet with both edges welded to the side rails.
2. Rung Spacing: Rungs or corrugations shall be spaced a maximum of 6 inches (150 mm) on center. and have a minimum flat bearing surface of 2 inches (50 mm).
3. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
4. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
5. Minimum Usable Load Depth: 6 inches (150 mm).
6. Straight Section Lengths: as required to facilitate tray assembly.
7. Width: as indicated on Drawings.
8. Fitting Minimum Radius: Min of 24" or based on cables installed per NEC.
9. Class Designation: Comply with NEMA VE 1, Class 20C.
10. Splicing Assemblies: Bolted type using serrated flange locknuts.
11. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
12. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316.

2.5 FIBERGLASS CABLE TRAYS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Tube & Conduit.
2. Cooper B-Line, Inc.
3. Mono-Systems, Inc.
4. MP Husky.
5. PW Industries
6. or approved equal.

B. Description:

1. Configuration: Two longitudinal members with rounded edges and smooth surfaces, complying with NEMA FG 1.
2. Materials: Straight section structural elements; side rails, rungs and splice plates shall be constructed from glass-fiber-reinforced polyester or vinyl ester resin as recommended by the manufacturer of the tray based on the environment, complying with NEMA FG 1 and UL 568.

3. Fasteners: Fiberglass-encapsulated, ASTM F 593 and ASTM F 594 stainless steel, Type 316. Design fasteners so that no metal is visible when fully assembled and tightened. Fastener encapsulation shall not be damaged when torqued to manufacturer's recommended value.
4. Minimum Usable Load Depth: 7 inches (175 mm) according to NEMA FG 1.
5. Straight Section Lengths: as required for installation.
6. Width: as indicated on Drawings.
7. Class Designation: Comply with NEMA VE 1, Class 20C.
8. Temperature Rating: Reduce the load rating of tray exposed to temperatures above 75 deg F (24 deg C) according to Table 4-3, "Working Loads," in NEMA FG 1.
9. Fitting Minimum Radius: Min of 24" or based on cables installed per NEC.
10. Splicing Assemblies: Minimum four nuts and bolts per plate. Splice plates shall be furnished with straight sections and fittings (stainless steel plates, bolts, nuts, and washers)
11. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.6 MATERIALS AND FINISHES

A. Steel:

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33
2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
4. Finish: Hot-dip galvanized after fabrication.
 - a. Standard: Comply with ASTM A123/A123 M, Class B2.
 - b. Hardware: Stainless steel, Type 316.

B. Aluminum:

1. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 5052-H32 according to ANSI H35.1/H 35.1M for fabricated parts.
2. Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

C. Stainless Steel:

1. Materials: Low-carbon, stainless steel, Type 304L, ASTM F 593 and ASTM F 594.
2. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.7 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Covers as specified on the Drawings.
- C. Barrier Strips: Same materials and finishes as for cable tray (When indicated on the drawings or required by the NEC).
- D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer and as required by the NEC. (Cable tray is not to be used as the ground conductor.)
- E. Dissimilar metals between cable tray and supports shall have insulating barrier, such as Neoprene.
- F. Provide an expansion joint in the cable system whenever the system crosses an expansion joint or fitting.

2.8 WARNING SIGNS

- A. Lettering: 1 1/2-inch (40-mm-) high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
- B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

2.9 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA FG 1 and NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA FG 1 NEMA VE 2.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.

- E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure and install seismic restraints.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. (90 kg). Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- H. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- I. Support bus assembly to prevent twisting from eccentric loading.
- J. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- K. Locate and install supports according to NEMA FG 1 or NEMA VE 2. Do not install more than one cable tray splice between supports.
- L. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- M. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1 or NEMA VE 2. Space connectors and set gaps according to applicable standard.
- N. Make changes in direction and elevation using manufacturer's recommended fittings.
- O. Make cable tray connections using manufacturer's recommended fittings.
- P. Seal penetrations through fire and smoke barriers in accordance with the building code.
- Q. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- R. Install cable trays with enough workspace to permit access for installing cables.
- S. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- T. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- U. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

- V. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Cable trays with electrical power conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at a minimum of every section and fitting. The grounding conductor shall be sized according to NEC.
- D. Bond cable trays to power source for cables contained within with bonding conductors sized according to NEC.

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 36 inches (450 mm).
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).
- E. Tie MI cables down every 36 inches (900 mm) where required to provide a 2-hour fire rating and every 72 inches (1800 mm) elsewhere.
- F. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION

SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. For penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items, use UL listed assemblies for the type and installation applied.

1.03 ACTION SUBMITTALS

- A. Submit in accordance with Section 01300:
 - 1. Product data: for each type of product

PART 2 – PRODUCTS

2.01 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40. (For use with grounding electrode conductors only.)
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.

2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.02 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - f. or Approved Equal.
 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Stainless steel.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, water stop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber water stop collar with center opening to match piping OD.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pre-sealed Systems.
 - b. or Approved Equal.

2.04 GROUT

- A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 – EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall, so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install steel pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 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 water-stop 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.

END OF SECTION

SECTION 26 05 48.16

SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Post installed anchor bolts.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories"
2. Section 033000 "Cast-In-Place Concrete"
3. Section 055000 "Metal Fabrications"
4. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.
5. Section 265200 "Emergency Lighting, for product and installation requirements associated with seismic restraint/protection.

1.3 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 318 – Building Code Requirements for Structural Concrete
2. ACI 530.1/ASCE 6/TMS 602 – Masonry Standards Joint Committee's (MSJC) Building Code Requirements for Masonry Structures

B. American Institute of Steel Construction (AISC):

1. AISC 325 – Steel Construction Manual

C. American Society of Civil Engineers (ASCE):

1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures

D. ASTM International:

1. ASTM A 36/A 36M
 2. ASTM A 307
 3. ASTM A492 – Standard Specification for Stainless Steel Rope Wire
 4. ASTM A603 – Standard Specification for Zinc-Coated Steel Structural Wire Rope
- E. American Welding Society (AWS)
1. AWS D1.1 – Structural Welding Code – Steel
- F. International Code Council (ICC):
1. IBC – International Building Code
 2. ES – Evaluation Service
 - a. ESR – Evaluation Service Report
- G. Metal Framing Manufacturers Association (MFMA)
1. MFMA-4 – Metal Framing Standards Publication
- H. Underwriters Laboratories (UL)

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate the application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal: For each seismic-restraint device, as applicable, for each connection type and/or connection detail associated with adequate flexibility.
1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic and wind forces required to select seismic and wind restraints and for designing vibration isolation bases. Calculate anticipated differential movement or vibration between adjacent structures, or portions of the same structure that may move independently, required to select a type(s) of, and/ or provide a detail(s) for, flexible connection(s).
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 3. Seismic and Wind Restraint Details:

- a. Design Analysis: To support the selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices. Vibration isolators used for component mounting shall comply with ASCE 7.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
4. Details to Provide Adequate Flexibility During a Seismic Event:
- a. Compliance with the provisions of ASCE 7.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Electrical components include but not be limited to:
- 1. Control and/or monitoring panels.
 - 2. Generators.
 - 3. Luminaires.
 - 4. Motor control centers and/or motor starters.
 - 5. Panelboards.
 - 6. Photovoltaic system components.
 - 7. Substations.
 - 8. Switchboards.
 - 9. Switchgear.
 - 10. Transformers.
 - 11. Unit substations.
 - 12. Raceways.
 - 13. Busways.
 - 14. Uninterruptible Power Supplies.
- B. Qualification Data.
- C. Welding certificates.
- D. Field quality-control reports.

1.6 QUALITY CONTROL

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.

- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from Structural EOR in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: **159**.
 - 2. Building Classification Category: **II**.
 - 3. Exposure classification: Exposure **D**.
 - 4. Minimum 85 lb./sq. ft. (415 kg/sq. m) (Ultimate pressure - to get allowable pressure multiply by 0.6) multiplied by the maximum area of component projected on a vertical plane normal to wind direction and 45 degrees on either side of normal.
- B. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: **B**.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: **II**.
 - a. Component Importance Factor: **1.0**.
 - b. Component Response Modification Factor: **5.0**.
 - c. Component Amplification Factor: **2.5**.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): **0.13 %**.
 - 4. Design Spectral Response Acceleration at 1.0-Second Period: **0.068%**.

2.2 RESTRAINT CHANNEL BRACINGS

- A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to the braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

B. Manufacturer:

1. Unistrut
2. Gripple
3. Badger Industries
4. nVent (Caddy)
5. or equal approved

2.3 RESTRAINT CABLES

A. Restraint Cables: **ASTM A492 stainless**]-steel cables. End connections shall be made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

B. Manufacturer:

1. Gripple
2. Badger Industries
3. nVent (Caddy)
4. or Equal and approved.

2.4 SEISMIC-RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener shall be galvanized, or stainless steel bolted or clamped to hanger rods.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables].

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings shall be designed for rigid equipment mountings and matched to the type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to the type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 POST-INSTALLED CONCRETE AND GROUTED MASONRY ANCHORS

- A. Furnish and install post-installed mechanical, adhesive, and undercut concrete and grouted-masonry anchors as indicated on the drawings.
- B. Mechanical Anchors: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with the strength required for anchor and as tested according to ASTM E488
 - 1. Manufacturer:
 - a. Hilti Kwik-Bolt TZ (ICC ESR No. 1917, Latest Edition)
- C. or Approved Equal Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with the strength required for anchor and as tested according to ASTM E488.
 - 1. Manufacturer:
 - a. Hilti HAS (all threaded), HIS (internally threaded), HIT-Z (Cone-shaped)
 - b. or Approved Equal.
- D. Epoxy Anchor Bolts: Drilled-in and capsule anchor system containing epoxy. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with the strength required for anchor and as tested according to ASTM E488.
 - 1. Manufacturer:
 - a. Hilti-HY 200 (ICC ESR No. 3187, Latest Edition)
 - b. or Approved Equal.
- E. Undercut Anchor Bolts: Drilled-in concrete as per manufacturer recommendation. Provide Stainless Steel anchor bolts for overhead and wall installations where the dynamic load is expected. Select anchor bolts with the strength required for anchor and as tested according to ASTM E488 and ASTM F593.
 - 1. Manufacturer:
 - a. Hilti HAD-TR or PR
 - b. or Approved Equal.
- F. FLEXIBLE CONNECTIONS
 - 1. Permissible products include those that permit rotational and/or translational movement without degradation of performance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and/or seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting the performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze members with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners as indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for the component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to the wall.
- E. Attachment to Structure: If a specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or concrete members.
- F. Post-Installed Anchors:

1. Identify the 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 the sleeve fully engaged in the structural element to which the 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 the introduction of air pockets in the adhesive.
5. Epoxy Anchors: Clean holes to remove loose material and drilling dust prior to installation of Epoxy. Place epoxy in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid the introduction of air pockets in the epoxy.
6. Undercut Anchors: Install anchors as per manufacturer recommendation.
7. Set anchors to the manufacturer's recommended torque using a torque wrench.
8. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.
9. Install all anchors as per manufacturer recommendation.

G. Seismic Restraint of Conduit:

1. Conduit offsets, loops, anchors, and guides shall be installed as required to provide specified motion capability and limit motion of adjacent distribution systems.
2. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wire-ways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative to ensure that the applicable provision of ASCE 7 Chapters 13 and 15 are met:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Engineer, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days advance notice.

3. Obtain Engineer's approval before transmitting test loads to the structure. Provide temporary load-spreading members.
 4. Test at least 10 percent of each type and size of installed anchors and fasteners selected by Engineer.
 5. Test to 90 percent of the rated proof load of the device.
- C. Seismic restraints/controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within the normal mode of operation.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.3 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.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1, ANSI C2, and ANSI Z635.4.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, 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.
- E. Install all signs and labels horizontal (level) and consistent for similar equipment and panels.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb., minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with snap-around label.
 - 1. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, snap-around, color-coding bands:
 - 1. Snap-Around Labels: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
 - 2. Fire Alarm System: Red.
 - 3. Fire-Suppression Supervisory and Control System: Red and yellow.
 - 4. Combined Fire Alarm and Security System: Red and blue.
 - 5. Security System: Blue and yellow.
 - 6. Mechanical and Electrical Supervisory System: Green and blue.
 - 7. Telecommunication System: Green and yellow.
 - 8. Control Wiring: Green and red.
- C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and hand holes use metal tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
 - 1. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.
- D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
 - 1. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- E. Conductor Color Code Identification: Where the premises wiring system has branch circuits supplied from more than one nominal voltage system, each ungrounded conductor of a given branch circuit shall be identified by color coded tape or cable insulation at all termination, connection or splice points.
- F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
 - 1. Write-On Tags: Polyester tag, 0.015-inch-thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
 - 2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data 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 Operation and Maintenance Manual.
 4. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway. During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches above duct. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
1. Description:
 - a. Permanent, bright-colored, continuous-printed, polyethylene tape.
 - b. Not less than 6 inches wide by 4 mils thick.
 - c. Compounded for permanent direct-burial service.
 - d. Embedded continuous metallic strip or core.
 - e. Printed legend shall indicate type of underground line.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. 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. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
 2. Comply with NFPA 70 and 29 CFR 1910.145.
 3. 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.
 4. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
 5. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
 6. Warning label and sign shall include, but are not limited to, the following legends:
 - a. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

- b. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- J. Instruction Signs:
 - 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with ENGINEER/OWNER APPROVED instructions where needed for system or equipment operation. Instructions are needed for all equipment unless otherwise noted.
 - a. Signs shall be engraved, laminated acrylic or melamine plastic, minimum 1/16-inch-thick for signs up to 20 sq. in. and 1/8-inch-thick for larger sizes.
 - b. The engraved legend shall be ½ "White letters on Brown face and punched or drilled for mechanical fasteners.
 - c. The signs shall be installed with stainless hardware.
 - 2. Emergency Operating Instructions: Install emergency operating instruction signs at equipment used for power transfer, safety shutdown, or any other locations requiring operation in an emergency.
 - a. Signs shall be engraved, laminated acrylic or melamine plastic, minimum 1/16-inch-thick for signs up to 20 sq. in. and 1/8-inch-thick for larger sizes.
 - b. The engraved legend shall be ½ "White letters on Red face and punched or drilled for mechanical fasteners.
 - c. The signs shall be installed with stainless hardware.
- K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and 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 and Outdoor Equipment: Use engraved, laminated acrylic or melamine labels, punched or drilled for screw mounting. Identification labels shall have white letters on a dark-gray background. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high. Mount labels with stainless hardware.
 - b. Elevated Components: Increase the size of the labels and letters to those appropriate for viewing from the floor.
 - 2. Equipment to Be Labeled:
 - a. Identification labeling of some items listed below may be required by individual Sections or by NFPA 70.
 - b. Panelboards, electrical cabinets, and enclosures.
 - c. Access doors and panels for concealed electrical items.
 - d. Electrical switchgear and switchboards.
 - e. Transformers.
 - f. Electrical substations.
 - g. Emergency system boxes and enclosures.

- h. Motor-control centers.
- i. Disconnect switches.
- j. Enclosed circuit breakers.
- k. Motor starters.
- l. Push-button stations.
- m. Power transfer equipment.
- n. Contactors.
- o. Battery inverter units.
- p. Battery racks.
- q. Power-generating units.
- r. Voice and data cable terminal equipment.
- s. Television/audio components, racks, and controls.
- t. Fire-alarm control panel and annunciators.
- u. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- v. Monitoring and control equipment.
- w. Uninterruptible power supply equipment.
- x. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- y. Control systems
- z. Field mounted control devices
- aa. Field mounted instruments

3.2 INSTALLATION PRACTICES

- 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. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- D. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes LARGER than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. 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.
5. Where the premises wiring system has branch circuits supplied from more than one nominal voltage system, the color codes used to identify each phase, neutral (if applicable) and ground conductor throughout the system shall be permanently posted at each branch-circuit panelboard or similar branch-circuit distribution equipment. Provide factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- E. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- F. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

END OF SECTION

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

1.3 This Section includes dry-type distribution transformers rated 600 V and less, with capacities up to 1000 kVA SUBMITTALS.

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer 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. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. 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. 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.
- B. Qualification Data: For testing agency.
- C. Source quality-control test reports.
- D. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.
- B. Manufacturer shall provide copies of following documents to owner for review and evaluation:
 - 1. Product data and spare parts list.

1.6 QUALITY ASSURANCE

- A. Testing Qualifications: Engage manufacturer with the experience and capability to conduct the testing to NETA standards.
- B. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Electric Corporation.
 - 2. Challenger Electrical Equipment Corp.

3. Controlled Power Company.
4. Eaton Electrical Sector; Eaton Corporation; Cutler-Hammer Products.
5. Federal Pacific Transformer Company.
6. General Electric Company.
7. Hammond Co.
8. Magnetek Power Electronics Group.
9. Micron Industries Corp.
10. Myers Power Products, Inc.
11. Siemens Energy & Automation, Inc.
12. Sola/Hevi-Duty.
13. Square D Co./Schneider Electric.
14. Alternate as approved by Engineer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 1. Internal Coil Connections: Brazed or pressure type.
 2. Coil Material: Copper unless otherwise specified.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Cores: One leg per phase.
- D. Indoor Transformer Enclosure: Ventilated, NEMA 250, Type 2.
 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Outdoor Transformer Enclosure: Totally enclosed, nonventilated, NEMA 250, Type 4X, stainless steel.
 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- F. Transformer Enclosure Finish: Comply with NEMA 250.
 1. Finish Color: ANSI 61 gray.
- G. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.

- H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- J. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- K. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- L. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.
 - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - 2. Indicate value of K-factor on transformer nameplate.
- M. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - 2. Include special terminal for grounding the shield.
 - 3. Shield Effectiveness:
 - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
 - c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.
- N. For wall mounted transformers, wall Brackets: Manufacturer's standard brackets.
- O. For tropical or sub tropic environments, provide fungus proofing, permanent fungicidal treatment for coil and core.
- P. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.
- Q. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:
 - 1. 9 kVA and Less: <40 dBA
 - 2. 30 to 50 kVA: <45 dBA
 - 3. 51 to 150 kVA: <50 dBA
 - 4. 151 to 300 kVA: <55 dBA

5. 301 to 500 kVA: <60 dBA
6. 501 to 750 kVA: <62 dBA
7. 751 to 1000 kVA: <64 dBA

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 1. Brace wall-mounting transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions Section 260548.16 "Seismic Controls for Electrical Systems.", and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.
- C. Adjust all access doors and operating handles for free mechanical operation as described in manufacturer's instructions.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
- B. Repaint scratched or marred exterior surfaces to match original finish.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Electronic-grade panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge Protection Device

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems." Include the following:
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. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing indicating the connected load for each breaker in accordance with the NEC. Schedule to be typed and dated.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

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. Keys: Two spares for each type of panelboard cabinet lock.
 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Provide spare breakers as shown in the schedules on the drawings
 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. 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.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with the manufacturer's recommendations.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Engineer and Owner no fewer than 10 working days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Engineer and Owner's written permission.
 - 3. Comply with NFPA 70E.

1.11 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Enclosures: See Plan Sheet Panel Schedule for Enclosure Types and Mounting.
 - 1. Provide rated enclosures as shown below unless otherwise indicated on plans:
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Indoor Damp or Wet Locations: NEMA 250, Type 4X.
 - c. Indoor Corrosive Locations: NEMA 250, Type 4X Fiberglass
 - d. Outdoor Locations: NEMA 250, Type 4X
 - e. Wash-Down Areas: NEMA 250, Type 4X 316 stainless steel
 - f. Other Wet or Damp Indoor Locations: NEMA 250, Type 4X.
 - g. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - h. For conditions not addressed above, provide rated enclosures for environmental conditions at installed locations.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 6. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel unless indicated otherwise on panel schedule.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components. (Only required with the relative humidity is above 90% and the electrical room or space is not conditioned.)
 7. Directory Card: Inside panelboard door, mounted in transparent card holder. All breaker text to be typed and dated. Directory card shall include the source of supply to the panelboard. Directory card shall include typed contact information for the electrical contractor.
- C. Incoming Mains Location: Top or bottom per contractors installation method unless specifically indicated on the drawings.
- D. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 4. Neutral Bus: 100% of the phase bus capacity unless otherwise indicated.
 5. Extra-Capacity Neutral Bus (when shown on the drawings): Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
 6. Split Bus: Vertical buses divided into individual vertical sections.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Sub feed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
 8. >.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 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."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2]. Provide SPD devices per Section 264313 "Low-Voltage Surge Protection" of the project documents.

2.3 DISTRIBUTION PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: As shown on the drawings
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains as shown on the drawings
- D. Branch Overcurrent Protective Devices:] Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Provide Door-in-Door Construction with concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.5 ELECTRONIC-GRADE PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Current Technology; a subsidiary of Danahar Corporation.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 4. Liebert Corporation.
 - 5. Siemens Energy & Automation, Inc.
 - 6. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 after installing SPD.
- C. Doors: Provide Door-in-Door Construction with Secured with vault-type latch with tumbler lock; keyed alike.
- D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- F. Buses:
 - 1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
 - 2. Copper equipment and isolated ground buses.

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I squared x t response.
 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 6. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted or Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Communication Capability: as shown on the controls drawings when specifically indicated.
 - f. Shunt Trip: as shown on the drawings.
 - g. Undervoltage Trip, as shown on the drawings.
 - h. Auxiliary Contacts: Where shown on the drawings, two SPDT switches with "a" and "b" contacts; "a" contact's mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - i. Alarm Switch: Where shown on the drawings, single-pole, normally open contact that actuates only when circuit breaker trips.

- j. Key Interlock Kit: Where shown on the drawings, externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- k. Zone-Selective Interlocking: Where shown on the drawings, integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
- l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
- m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
- n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.7 ACCESSORY COMPONENTS AND FEATURES (if call for on the contract drawings)

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting:
- C. Floor Mounted panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete in the project specifications. If no concrete is specified use 3000 psi.

- a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - b. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to panelboards.
 - e. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 - 2. Wall/Rack Mounted:
 - a. Mount to wall/rack using Unistrut with bolts/mounting hardware approved by the structural engineer or architect.
 - D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
 - E. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
 - F. Mount panelboards such that the highest operator is less than 78" above finished floor.
 - G. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
 - H. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - I. Install filler plates in unused spaces.
 - J. Stub a minimum of four 1-inch (27-GRC) empty conduits but not less than 25% of the combined cross-sectional area of all other live conduit from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub a minimum of four 1-inch (27-GRC) empty conduits but not less than 25% of the combined cross-sectional area of all other live conduit into raised floor space or below slab not on grade. This is for recessed panelboards only.
 - K. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
 - L. Comply with NECA 1.
- ### 3.3 IDENTIFICATION
- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 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. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Panelboards will be considered defective if they do not pass tests and inspections.

- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in the "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 26 43 13

LOW-VOLTAGE SURGE PROTECTION

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 field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Requirements:
 - 1. Section 262416 "Panelboards" for factory installed SPDs.

1.3 DEFINITIONS

- A. I_n : Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, In nominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion, including replacement.

1.8 MANUFACTURERS

- A. Subject to compliance with requirements, **[provide products by one of the following]**:
 - 1. ABB France. (Current Technology)
 - 2. Advanced Protection Technologies Inc. (APT).
 - 3. Eaton Corporation, (Innovative Technology.)
 - 4. Emerson Electric Co. (Liebert)
 - 5. Schneider Electric Industries SAS.
 - 6. Siemens Industry, Inc.
 - 7. Surge Suppression, Inc
 - 8. Total Protection Solutions
 - 9. DEHN Inc.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

- A. SPD with 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. . All Surge Protective Devices (SPDs) shall be tested and listed to the latest edition of ANSI/UL 1449-2006. “Manufactured in accordance with UL 1449” is not equivalent to being listed to ANSI/UL 1449-2006 and does not meet the intention of this specification.

- D. MCOV of the SPD shall be the nominal system voltage.
- E. SPD units shall be UL 1283 Listed as an Electromagnetic Interference Filter and marked accordingly.
- F. Provide SPDs with the following modes of protection:
 - 1. Three-Phase, Four Wire systems: 10 Modes: L1-L2, L2-L3, L3-L1, L1-N, L2-N, L3-N, L1-G, L2-G, L3-G, N-G
 - 2. Three-Phase, Three Wire systems: 6 Modes: L1-L2, L2-L3, L3-L1, L1-G, L2-G, L3-G
 - 3. Single-Phase, Three Wire Systems: 6 Modes: L1-L2, L2-N, N-L1, L1-G, L2-G, N-G

2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

- A. SPDs: Listed under UL 1449, Type 1.
 - 1. SPDs with the following features and accessories:
 - a. Integral disconnect switch and overcurrent protection.
 - b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - c. Indicator light display for protection status.
 - d. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
 - e. Digital Display Surge counter that counts the number of surges the device has experienced since installation.
 - f. Audible alarm
- B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 240kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- C. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, 208Y/120 V or 240/120 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 & 240/120 V.
 - 2. Line to Ground: 1200 V for 480Y/277 V; 1200 V for 208Y/120 & 240/120 V.
 - 3. Line to Line: 2000 V for 480Y/277 V 1000 V for 208Y/120 & 240/120 V.
- D. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V.
 - 2. Line to Ground: 1000
 - 3. Line to Line: 1000 V.
- E. SCCR: Equal or exceed 200 kAIC.
- F. Nominal Discharge Current (I_n) Rating: 20 kA.

2.3 SWITCHBOARD, PANELBOARD AND MCC SUPPRESSORS

- A. SPDs: Comply with UL 1449, Type 2.
 - 1. Include LED indicator lights for power and protection status.
 - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - 3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
- B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA $\diamond$. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- C. Protection modes and UL 1449 VPR for grounded wye circuits with, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 1200 V for 480Y/277 V or 700 V for 208Y/120 V & 240/120 V.
 - 2. Line to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V & 240/120 V.
 - 3. Neutral to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V & 240/120 V.
 - 4. Line to Line: 2000 V for 480Y/277 V or 1200 V for 208Y/120 V & 240/120 V
- D. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 600V.
 - 2. Line to Ground: 600V.
 - 3. Neutral to Ground: 600V.
 - 4. Line to Line: 1000V.
- E. SCCR: Equal or exceed 100K AIC min or per the one-line diagram.
- F. Nominal Discharge Current (I_n) Rating: 20 kA
- G. Sinewave Tracking/Frequency Responsive Capability.
 - 1. SPDs installed to protect Switchboards, Panelboards or MCCs serving sensitive electronic equipment shall utilize voltage independent, frequency responsive dedicated Sinewave Tracking circuitry to mitigate the effects of switching or ringing surges.
 - a. Sensitive Electronic Equipment shall include, but is not limited to:
 - 1) Variable Frequency Controllers
 - 2) Lighting with Electronic Ballasts
 - 2. EMI/RFI filtering specifically will not be considered as equal to sinewave tracking.
 - 3. Devices with Sinewave Tracking circuitry shall be tested in accordance with the latest edition of IEEE C62.41.2 for a Category A Ring Wave (2000 volt – 67-amp ring wave)
 - a. The maximum amplitude shall be less than 50V peak deviation from the insertion point of the surge on the sine wave to the peak of the transient.

2.4 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250, Type 4X.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD. DO NOT WIRE DIRECT TO PANEL BUS
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
 - 1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION

SECTION 26 51 19

LED INTERIOR LIGHTING

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. Provide all materials, equipment and perform all operations for complete installation of interior LED luminaires and related Work as indicated on the Drawings and specified herein, including but not limited to the following:
 - 1. Interior Luminaires.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Luminaire supports.
- B. Related Sections:
 - 1. Division 26

1.3 DEFINITIONS

- A. CCT: Correlated Color Temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire."
- E. IESNA: Illumination Engineering Society of North America
- F. IP: International Protection or Ingress Protection Rating.
- G. LED: Light-Emitting Diode.
- H. Lumen: Measured output of LED and luminaire, or both.
- I. Luminaire: Complete lighting unit, including LED, driver, 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" for each luminaire type. The adjustment factors shall be for LED's 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. 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. Samples: When requested by the engineer, provide a sample luminaire of each type and style including all specified options, mounting brackets, and accessories. Each Sample shall include the following:

1. LED's and drivers, installed.
2. Cords and plugs.
3. Pendant support system.

D. Product Schedule: For luminaires, emergency lighting units, exit signs and LED's. Use same designations indicated on Drawings.

E. Samples: Submit one complete operating unit for each type of luminaire specified, if requested by the Design Professional.

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 (300 mm) of the plane of the luminaires.
4. Structural members to which suspension systems for luminaires will be attached.

5. Initial access modules for acoustical tile, including size and locations.
6. Other items in finished ceiling, including the following:

- a. Other luminaires.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.
- f. Ceiling-mounted projectors.
- g. Occupancy sensors.
- h. Smoke and Heat Detectors.
- i. Fire alarm audible and visual devices.
- j. Security sensors.
- k. Cameras.
- l. Wireless access points.

7. Moldings.

- B. Calculations: Provide lighting calculations for all interior spaces in accordance with IESNA guidelines. All calculations shall be performed under the supervision of a person holding a PE registered in the state in which the project is being constructed. All calculations shall include all assumptions. All rooms shall have point to points with the following summaries per room: Max/Min, Ave/Min, and Average Illumination.
 - a. The contractor shall call special attention to the engineer for any spaces that do not meet IESNA Guidelines.
- C. Qualification Data: For testing laboratory providing photometric data for luminaires.
- D. Product Certificates: For each type of luminaire.
- E. Sample of special 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 LED types used on Project; use ANSI and manufacturers' codes.
 2. Provide luminance test results within each room that verify that the lighting calculation levels (fc) at the working plane have been achieved.

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. LED Assembly: Five for every 100 of each type and rating installed. Furnish at least two 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. LED Driver: One for every 100 of each type and rating installed. Furnish at least two of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least two of each type.
5. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least two 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 and complying with the applicable IES testing standards.
- 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. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Manufacturer's Qualifications: Firms regularly engaged in manufacture of interior LED Luminaires of sizes, types and ratings required, whose products have been in satisfactory use in similar service for not less than 10 years.
- F. [Delete for Public Bid Projects in NJ] Installer's Qualifications: Firms with at least 5 years of successful installation experience on projects with interior luminaires similar to that required for this Project.

1.9 COORDINATION

- A. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, partition assemblies and other items indicated in section 1.5.A.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver luminaires in factory-fabricated containers or wrappings, which properly protect luminaires from damage.
- B. Store luminaires in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.
- C. Handle luminaires carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

- D. All luminaires shall be protected from damage during the installation. Any damaged luminaires, diffusers, glassware, sockets, stems and the like, shall be replaced with new parts, without additional cost to the Owner.
- E. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.11 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires, emergency power units and exit signs that fail in materials or workmanship within one-year period from date of Substantial Completion.
- B. [Or]Manufacturer's Warranty: Five year(s) from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings per the General Provisions of the Contract.

2.2 LUMINAIRE GENERAL REQUIREMENTS

- A. It is the intent to provide and install a fully functional luminaire, and multiples thereof, on each and every outlet shown on the Drawings. Therefore, in the event a type designation is omitted from any luminaire indicated on the plans, provide units typical of those in similar locations within the scope of the project.
- 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. Factory-Applied Labels: Comply with UL 1598 and the requirements of all authorities having jurisdiction. Include recommended LED assemblies and drivers. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when LED assemblies are in place.
 - 1. Label shall include the following LED characteristics:
 - a. "USE ONLY" and include specific LED type.
 - b. LED assembly dimensions, shape, size, wattage, and coating.
 - c. CCT and CRI.
- D. Recessed luminaires shall comply with NEMA LE 4.

- E. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- F. Luminaires installed in hazardous locations shall be suitable for the area classification class, division and group.
- G. Luminaires installed in corrosive locations shall be NEMA 4X rated.
- H. Luminaires installed in wet locations shall be NEMA 3R rated.
- I. Luminaires installed in damp locations shall be rated for damp location.
- J. Luminaires installed in washdown areas shall be sealed and gasketed.
- K. All luminaires shall be furnished complete with necessary devices and appurtenances to completely install luminaires in operating condition, including all hanging and supporting devices, plaster rings, studs, hickeyes, canopies, stems, clamps, leveling devices, glassware, etc.
- L. Nominal Operating Voltage: Operating Voltage for all luminaires shall be as indicated in Luminaire Schedule on the Drawings with a range of 108-132 volts for 120-volt circuits and 249-305 for 277-volt circuits.
- M. LED Drivers and Modules shall include the following features unless otherwise indicated:
 - 1. Light output lumens (lm) as indicated in the Luminaire Schedule.
 - 2. Minimum allowable efficacy of 80 lm/W.
 - 3. CRI: Minimum 85: As indicated on Luminaire Schedule.
 - 4. CCT of maximum of 4000 K: As indicated on Luminaire Schedule.
 - 5. Rated LED life of minimum 50,000 hours per IES L70.
 - 6. Dimmable from 100 percent to 5 percent of maximum light output.
 - 7. Internal LED driver.
 - 8. User-Replaceable LED assembly's:
 - 9. Minimum efficiency: 90% at half and full load.
 - 10. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
 - 11. Integral short circuit, open circuit, and overload protection.
 - 12. Power Factor ≥ 0.85 at 50% load and ≥ 0.90 at full load.
 - 13. Total Harmonic Distortion: $\leq 20\%$ at 50% load and $\leq 15\%$ at 100% load.
 - 14. Comply with FCC 47 CFR Part 15.
- N. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit replacing LED assembly's without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during replacing LED assembly's and when secured in operating position.

2.3 GENERAL REQUIREMENTS FOR EMERGENCY LUMINAIRES

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.

2.4 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. AC Operation: LED's, 50,000 hours minimum rated life.
 - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes LED from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects LED's from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.5 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
 - 1. Battery: Sealed, maintenance-free, lead-acid type.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns LED on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. LED automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects LED's from battery, and battery is automatically recharged and floated on charger.
 - 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 6. Wire Guard: Heavy-chrome-plated wire guard protects LED heads or fixtures.

7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.6 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.

2.7 LUMINAIRE SUPPORT COMPONENTS

- 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 (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to 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.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Owner's representative, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting.

3.3 INSTALLATION

- A. Provide a label on each luminaire outlet shown on the Drawings, the type of luminaire indicated and as specified in the "Luminaire Schedule" on the Drawings.
- B. Each room/area shall have its luminaires controlled from a local switch for each circuit serving the room, where not controlled by an occupancy sensor. Provide local toggle switches so that all luminaires can be locally controlled, whether or not the switches are shown on the Drawings.
- C. Install interior luminaires at locations and heights as indicated on the Drawings and in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that luminaires fulfill requirements.
- D. Coordinate construction and design of trim and supports for all stem mounted and recessed luminaires for conformity with ceilings in which the units are installed. Any special Work that may be required to overcome unusual difficulties in fitting the luminaire designs to particular locations, or to clear unforeseen obstacles, etc., shall be done without extra cost to the Owner.
- E. Support all recessed luminaires, other than downlights from at least two diametrically opposite corners, independent of the ceiling structural system and directly to the building slab and/or primary structural steel. Fasten luminaires securely at all other points to the ceiling structural system. Do not fasten to any trades other than those indicated.
- F. Securely support downlights from at least two points on the ceiling structural system. Do not fasten to other trades other than the ceiling structural system trade.
- G. Support all surface and pendent luminaires independently of the ceiling structural system and directly to the building slab and/or primary structural steel. Provide pendant/surface fixtures longer than 2 feet with two hangers. Fasten luminaires securely at all other points to the ceiling structural system. Do not fasten to any trades other than those indicated. Ensure that pendant luminaires are plumb and level. Provide stem hanger with ball aligners and provisions for minimum one-inch vertical adjustment. Mount continuous rows of fixtures with an additional stem hanger greater than number of fixtures in the row.
- H. Attach wall-mounted luminaires to structural members in walls. Do not attach luminaires directly to gypsum board.
- I. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- J. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and replacing LED assembly.
 - 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 a vertical force of 400 percent of luminaire weight.
 - 5. Sized and rated for luminaire and emergency power unit weight.
 - 6. Able to maintain luminaire position when testing emergency power unit.

- K. 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 STARTUP SERVICE

- A. Upon completion of installation of interior luminaires, emergency power units and exit signs, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

3.7 EMERGENCY POWER UNIT AND EXIT SIGN CHARGING

- A. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
- B. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.8 CLEANING

- A. Clean interior lighting fixtures of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses.
- B. Protect installed fixtures from damage during remainder of construction period.

3.9 ADJUSTMENTS

- A. 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. Provide 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 LED assembly's, LED drivers, luminaires emergency power units, batteries and exit signs, 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 Owner's representative.

END OF SECTION

SECTION 31 23 33

EXCAVATION, BACKFILL, AND COMPACTION

PART 1 – GENERAL

1.01 SCOPE

- A. Description of Work
 - 1. Perform all work necessary pertaining to earthwork for excavations, fills and embankments for structures, pavements, rights-of-way, and sites and trench excavating, backfilling, and compacting for underground pipelines and appurtenant structures.
 - 2. All excavation and backfill for utilities shall be in accordance with the geotechnical engineering report included with these specifications.
 - 3. A geotechnical report for this project is included at the end of this specification as an appendix.
- B. Related Work Specified Elsewhere
 - 1. Erosion, Section 33 05 04, Selective Demolition for Utilities.

1.02 STANDARDS

- A. Determine the density of soil in place, by nuclear methods, ASTM D2922, sand cone method, ASTM D1556, or drive cylinder method, ASTM D2937, as appropriate.
- B. Determine laboratory options moisture-density relations of cohesive soils by ASTM D1557 (modified proctor) or AASHTO T-180 (Method A).
- C. Sample backfill materials by ASTM D75, (aggregate) or ASTM D5434 (soils).

1.03 DEFINITIONS

- A. Subgrade: The undisturbed material immediately below the bottom of an excavation, below an area of fill, or below a structure.
- B. Excavation: Removal of earth or buried material, either temporarily or permanently, as specified or as necessary for construction of the project.
- C. Over-excavation: Excavation exceeding that specified or shown on the plans.
- D. Backfill: Earth material placed permanently in an excavated area.
- E. Fill: Earth material placed permanently above the existing grade.
- F. Borrow: Earth material brought from off the site to be used as fill or backfill.

- G. Structural Backfill: Backfill placed beneath structures and in over-excavated areas.
- H. Structures: Buildings, foundations, and other man-made, stationary features above or below ground.

PART 2 – PRODUCTS

2.01 BACKFILL AND FILL

- A. For Structures: Backfill and fill shall be clean soils that is free from clay balls contain no more than 12% by dry weight passing the No. 200 sieve. The gradation of this granular material shall be such as to achieve the specified compaction. See geotechnical report for more specific recommendations.
- B. For pipe and appurtenance structures, conform as follows:
 - 1. First Lift: From the excavation grade to a level 12 inches above the top of the pipeline. Exclude material with fragments larger than the following.

Pipe Type	Fragment Size (Greatest Dimension – inches)
Concrete, Steel, Cast or Ductile Iron and Corrugated Metal	0.5
Vitrified Clay	0.5
Polyvinyl Chloride (PVC) and Polyethylene (PE)	0.5

- 2. Second Lift: From the top of the First Lift to the ground surface. Exclude material with fragments larger than two inches.
- 3. In the event there is insufficient satisfactory material from the excavation to meet the requirements for backfill or fill material, obtain borrow which meets the requirements for backfill material from sources secured by the Contractor.

2.02 STRUCTURAL BACKFILL

- A. Structural backfill shall be free from clay balls, organic, and rubble, and shall conform to USCS SP, SP-SM, SP-SC, SC.

2.03 WATER FOR COMPACTION

- A. Water shall be free of acid, alkali, or organic materials and shall have a pH of 7.0 to 9.0. Provide all water needed for earthwork. Provide temporary piping, valves, and trucks to convey water from the source to the point of use. Provide any meters required if the water is taken from a public water system.

PART 3 – EXECUTION

3.01 DEWATERING

- A. Contractor shall be responsible for obtaining all Federal, State, and local regulatory agencies' permit(s) before starting any dewatering operation. Additionally, contractor shall be responsible for meeting all requirements set forth in the permit. There will be no separate payment for such work.
- B. Provide and operate equipment adequate to keep excavations free of water. Remove water during periods when concrete is being deposited, when pipe is being laid, during the placing of backfill, and for proper inspection and/or testing of the exposed subgrade. These provisions shall apply during the noon hour as well as overnight. Do not drain trench water through the pipeline under construction. Avoid settlement or damage to adjacent property. Dispose of water in a manner that will not damage adjacent property or interfere with normal drainage. When dewatering open excavations, dewater from outside the structural limits, and from a point below the bottom of the excavation. Obtain and comply with all required discharge permits from appropriate regulatory authorities.

3.02 EXCAVATION

- A. Excavate to the elevations shown on the drawings, to the bottom elevations of the slabs, structures, and foundations or the bottom of the roadway sub-base (top of sub-base if only to be compacted), whichever is the lowest elevation. See geotechnical report for more specific recommendations.
- B. Perform all excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction. Excavate for foundations to a point 5' horizontally behind the outside face of footings and base mats.
- C. After the excavation has been completed, the Owner or his representative will observe the exposed subgrade to determine the need for any additional excavation. It is intended that additional excavation be conducted in all areas within the influence of the structure where unacceptable subgrade removal of all such unacceptable material that exists directly beneath the hole or structure for the full width of the hole or structure and to a depth required to reach suitable foundation material. Refill the over-excavated areas with structural backfill. All such over-excavation and refilling shall be executed in accordance with a change order. Payment for over-excavation and refill shall be made in accordance with the Standard General Conditions. No payment will be made by the Owner for over-excavation of wet subgrade materials. It shall be the Contractor's responsibility to dry wet subgrade materials as necessary for proper compaction and stabilization.
- D. Do not carry excavation for footings, slabs, or conduits deeper than the elevations shown on the plans. Backfill over-excavated areas below the elevations shown to the proper elevation

with compacted structural backfill material. Correct cuts below grade by similarly cutting adjoining areas and creating a smooth transition.

- E. The Contractor will not receive any additional payment for over-excavation or refill material used for his convenience or which is not authorized by the Owner or his representative.
- F. The Contractor shall acquaint himself with existing conditions and locate all structures and utilities within the project area in order to avoid conflicts.
- G. Protect any pipes, conduits, wires, mains, footings or other underground structures encountered in trenching/excavating/backfilling from damage or displacement. Replace any pipes, conduits, wires, mains, footings or other structures disturbed during construction.
- H. Contact all utility companies with underground utilities in the project area and obtain their assistance in locating facilities prior to excavation.
- I. Excavate sufficiently in advance of pipe laying to discover obstructions in time to modify alignment, if necessary, to avoid the obstruction. The Owner or his representative must review and approve such alignment modifications before they are encountered.

3.03 PREPARATION OF SUBGRADE PRIOR TO PLACING FOUNDATIONS

- A. Excavate and shape subgrade to line, grade, and cross section. Remove soft material encountered and replace with structural backfill. Fill holes and depressions to the required line, grade, and cross sections with structural backfill. The finished subgrade shall be within a tolerance of " 0.08 feet of the grade and cross section shown, smooth and free from irregularities, and at the specified relative density.

3.04 PREPARATION FOR PLACING FILL OR BACKFILL

- A. Remove loosened and disturbed materials at the subgrade.
- B. Remove form materials and trash before placing any fill or backfill. Obtain the specified compressive strength and finish of concrete work before backfilling.
- C. Do not operate earthmoving or excavation equipment within five feet of existing structures or newly completed structures. Place fill or backfill adjacent to concrete walls and compact with hand-operated tampers or other equipment that will not damage the structure.

3.05 COMPACTION

- A. Unless otherwise specified or shown on the Drawings, areas outside pipe trenches must meet the following compaction requirements:
 - 1. Structural Backfill: 95% modified proctor density in 8-inch maximum layers.
 - 2. Subgrade Under-fill or Backfill: 95% modified proctor density to a depth of 12 inches.

3. Sub-grade Under Structural Backfill or Structures: 95% modified proctor density to a depth of 12 inches.
 4. Backfill or Fill Under Pavement: In accordance with ALDOT Standard Specifications for Road and Bridge Construction, latest edition. See geotechnical report for specific recommendations.
 5. All other areas: 92% modified proctor density in 8-inch maximum layers.
- B. Compact by using methods acceptable to the Engineer (powered tampers, vibrators, etc.). Compact the first 2 feet of backfill over pipe either by hand-operated tamping devices or with powered equipment which will not damage the pipe. Flooding with water to consolidate backfill is not acceptable, except where sand is encountered and the specified density can be obtained using this method.
- C. During the compacting operations, maintain material within 2% of optimum moisture. Aerate material containing excessive moisture by blading, discing, or harrowing to hasten the drying process.
- D. Pipe, conduit, and Appurtenant Structures: Unless otherwise shown on the drawings or otherwise described in the specifications for the particular type of pipe installed, compact soil in pipe trenches to the following minimum.
1. First Lift: 92% modified proctor density (95% modified proctor beneath paving, structures, and tanks).
 2. Second Lift not Beneath Paving: 90% modified proctor density.
 3. Second Lift in Paved Areas, Under Structures, and tanks: 95% modified proctor density.
 4. Refill for Over-excavation: 92% modified proctor density. (95% modified proctor beneath paving, structures, and tanks).

3.06 SHEETING, SHORING, AND BRACING OF TRENCHES

- A. Install adequate sheeting and bracing to prevent damage to property and injury to persons. Comply with all applicable safety regulations and laws.
- B. Remove sheeting when the trench has been backfilled to at least one-half its depth or when removal will not endanger proper pipe alignment or support.
- C. When conditions or plans and specifications require that sheeting be left in place, cut off the top at an elevation 2.5 feet below finished grade, unless otherwise specified.

3.07 SIDEWALK, PAVEMENT AND CURB REMOVAL

- A. Cut and remove bituminous and concrete pavements, curbs and sidewalks prior to excavation of the trenches. Width of the pavement or brick pavement cut shall be at least one foot wider than the required width of the trench at ground surface. Haul pavement and concrete materials from the site to disposal site secured by Contractor. Do not use for trench backfill.

3.08 TRENCHING

- A. Cut trenches to a minimum width equal to the outside diameter of the pipe at the joint plus eight inches for un-sheeted trenches, or 12 inches for sheeted trenches. The maximum width of trench, measured at the top of the pipe, shall not exceed the outside pipe barrel diameter plus two feet, unless otherwise shown on the plans or details.
- B. Maintain vertical trench walls from the bottom of the trench to a line measured 12 inches above the top of the pipe.
- C. Utility Bedding: The minimum utility bedding allowable shall consist of a shaped trench bottom which provides firm bedding for the utility pipe. Bed the pipe in undisturbed firm soil of hand-shaped unyielding material, so that the pipe will be in continuous contact therewith for its full length and provide a minimum bottom segment support for the pipe equal to 0.6 of the outside diameter of the barrel. All bedding materials and installation for pipe shall be in accordance with the manufacturer's recommendations.
- D. Construct special bedding as called for on the plans or in the contract documents as recommended by the pipe manufacturer(s).
- E. Excavate the trench to the lines and grades shown on the drawings with allowance for pipe thickness and for pipe base or special bedding. If the trench is excavated below the required grade, refill any part of the trench excavated below the required grade at no additional cost to the Owner. Place the refilling material over the full width of trench in compacted layers not exceeding six inches deep to the established grade with allowance for the pipe base or special bedding.
- F. During trench excavation, place the excavated material only within the project area. Do not obstruct any roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.
- G. Limit the length of open trench to 800 feet in advance of pipe laying or amount of pipe that may be installed in one working day. Complete backfilling and temporary or first layer paving not more than 1200 feet in the rear of pipe laying.

3.09 TRENCH EXCAVATION IN BACKFILL AND FILL AREAS

- A. Construct trench excavation for pipe, pipes, or conduit in backfill or fill areas in accordance with the following procedures:
 - 1. Construct and compact the backfill or fill to an elevation of one foot minimum over the top of the pipe or conduit to be installed.
 - 2. Excavate trench in the compacted backfill or fill. Place pipe base material, install pipe or conduit, and backfill to 12 inches above the pipe as specified for the type of pipe used. Backfill shall be compacted above this point to the same relative density as the adjacent embankment.

3.10 STRUCTURAL BACKFILL

- A. Place structural backfill where specified and in over-excavation areas, to the lines and grades shown or specified. Compact each layer. Stop structural backfill at least 6 inches below finished grade in all areas where topsoil is to be replaced. Moisten material as necessary to aid compaction.

3.11 TRENCH BACKFILLING

- A. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint.
- B. Backfill for non-plastic pipe and appurtenant structures in accordance with the following procedures:
 - 1. After pipe has been bedded, place "First Lift" material simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or un-compacted areas are left beneath the pipe. Place material on the underside of the pipe in such a manner as to prevent lateral movement during subsequent backfilling.
 - 2. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.
 - 3. Push the backfill material carefully onto the backfill previously placed in the "First Lift". Do not permit free fall of the material until at least two feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.
- C. Place backfill material in maximum 12 inch layers and compact each lift to the specified density.

3.12 SITE WORK

- A. Shape the surface of earthwork to conform to lines, grades and cross sections that existed prior to beginning work or as shown on the drawings, within 1/10 of a foot. Round tops of banks to circular curves to not less than a 6-foot radius. Neatly and smoothly trim rounded surfaces. Do not over-excavate and backfill to achieve the proper grade.
- B. Remove excess, unsuitable, or cleared material resulting from the facility installation from the work site and dispose of at locations secured by the Contractor.

3.13 DRAINAGE, EROSION AND SEDIMENTATION

- A. Maintain all existing drainage patterns and control run-off from the construction area to prevent erosion, sedimentation, or flooding due to the construction in accordance with Federal, State, and local regulatory agencies' permit(s), including but not limited to NPDES Permit.

3.14 PROTECTION OF PROPERTY

- A. Protect the trunks of trees adjacent to this work by enclosure with padding or wood. Operate excavating machinery and cranes with care to prevent damage to trees, particularly to overhanging branches and limbs.
- B. Do not cut branches, limbs and roots unless they are within six inches of the facility under construction. Make all necessary cuts smoothly and neatly without splitting or crushing. Neatly trim and cover the tree with healing paint at all cut or damaged portions.
- C. Do not cut or operate on paved surfaces any equipment with treads or wheels which will cut or otherwise damage paved surfaces. Provide adequate protective measures to avoid damages to the paved surfaces.
- D. As promptly as practicable, restore existing property or structures. Do not leave restoration until the end of the construction period.

3.15 TESTING

- A. Field density tests will be made in locations reviewed by the Owner, normally in each vertical layer, and using the following approximate spacing.
 - 1. Under structures, pavements, and slabs, one per 700 square feet with at least three per structure per lift or area. See geotechnical report for specific recommendations.
 - 2. In trenches, one every 300 feet in continuous trenches under pavements or future pavements plus one at each intersection or one every 500 feet in continuous trenches not under pavements, plus one at each pavement of driveway crossing.
- B. If any field density tests are below the specified density, re-compact or re-excavate re-backfill and re-compact the area until the specific density is obtained. Make a minimum of two field density tests per re-compacted and/or re-excavated area, but do not exceed the spacing specified above.

END OF SECTION

SECTION 31 62 13

PRESTRESSED CONCRETE PILES

PART 1 – SCOPE OF WORK

1.01 GENERAL

- A. This Section of the Specifications covers all plant, equipment, labor, and material and performing all operations in connection with fabrication, transporting, handling, storing, installing Precast Concrete Piles, and survey of installed piles. All the work shall conform in full to ALDOT Standard Specification for Highways Construction (2022). Related sections:
 - 1. ALDOT Section 505 “Piling”
 - 2. ALDOT Section 513 “Prestressed Concrete Bridge Members”
 - 3. ALDOT Section 367 “Production and Inspection of Precast non-Prestressed and Prestressed Concrete”
- B. Loads imposed during fabrication and construction such as prestressing, pre-casting, lifting, transportation, placement, and installation have not been evaluated. The piles shall be analyzed and evaluated by the Contractor’s precast fabricator to incorporate reinforcing modifications required for loads induced during the Contractor’s proposed installation plan.
- C. Prestressing of piles shall be in accordance with PCI MNL-116 “Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products”.

1.02 RELATED SECTIONS

- A. 01 33 00 – “Submittals”

1.03 SUBMITTALS

- A. The following items shall be part of the Shop Drawings and Work Plan and shall be submitted to the Engineer for review at least 30 days prior to the start of onsite construction activities in accordance with Section 01 33 00 – Submittals:
 - 1. Pile Placement Plan: Submit pile placement plan. The pile placement plan shall include installation sequence, installation procedures, methods for controlling the location and alignment of piles, and installation template design and configuration.
 - 2. Pile Driving Plan: Submit a pile driving plan. Plan shall include all equipment, including the pile driving hammer, hammer cushion, helmet, pile cushion, and other appurtenances to be furnished by the Contractor. Installation of piles using vibration will not be permitted. Plan shall be submitted two weeks in advance of pile installation to the Engineer for review.
- B. Shop Drawings and Installation Drawings: Before any precast concrete items are constructed, submit shop drawings and installation drawings, with reinforcing details to the Engineer for review and approval. Drawings shall show number and size of

prestressing strands; prestress force; anchor and pipe layout and pertinent details for pipe supports including anchor type to avoid impacting prestressing strands; blockouts; mark numbers; sections and details showing connections, edge conditions and support conditions of the precast concrete panels; estimated cambers; and all other details necessary for the manufacture and installation of the precast concrete piles.

- C. Pile Manufacturer Experience: Submit qualifying Manufacturer experience documentation which demonstrates previous experience manufacturing prestressed piles for Department of Transportation projects.
- D. Installation Contractor: Submit qualifying Contractor experience documentation which demonstrates a minimum of 10 years of experience in the installation of prestressed concrete piling.
- E. Provide at least one person who shall be present at all times during execution of this work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this Technical Specification. The producer of the precast prestressed concrete products shall have a least one Quality Control technician present on each line of production. The Technician shall be certified as an ALDOT Concrete Technician and shall be certified as a PCI Level I/II Technician.
- F. Work sequence plan: Submit a work plan detailing method for fabrications and installation of the prestressed concrete piles.
- G. Plant QA/QC: Submit precast concrete plant quality control plan and proof of PCI certification.
- H. Steel reinforcement shop drawings: Submit fabrication and erection detail shop drawings to include steel reinforcement and handling information. Shop drawings shall conform to ACI and CRSI standards.
- I. Concrete mix design: Submit concrete mix, mill certifications, admixtures, and test specimens in accordance with ALDOT Specifications Section 505 and 513.
- J. Schedule: Submit the schedule for casting, transporting, and placing the precast, prestressed pile units for approval by the Engineer. Schedule shall include adequate timelines as for the receipt, review, and approval of submittals as required prior to initiation of the related work as described herein.
- K. Transporting/lifting/placement plan: Submit descriptions, shop drawings, and fabricator developed supporting calculations for the Contractor proposed method of transportation and lifting and placement methods.
- L. Concrete delivery slips: Keep a record at the casting site showing time and place of each pour of concrete, together with mix delivery slip certifying the contents of the mix.
- M. Make the record available to the Engineer and Owner upon request.
- N. As-built pile survey.

1.04 QUALITY ASSURANCE

- A. Work shall comply with the ASPA, ALDOT standard specifications 2022, Federal, and industry standard regulations regarding safety for construction work.
- B. Provide skilled workman at all times who shall be experienced and familiar with construction of marine structures. Supervisory personnel shall have a minimum of five (5) years of experience with the work performed in this contract.
- C. The Contractor shall facilitate and assist in keeping a complete record of each pile installed, facilitate and assist shall include, but not be limited to providing access to the pile installation site, providing visual access to the site, and access to Contractor records. Data shall be recorded on a "Pile Driving Record Sheet."
- D. Records: Maintain accurate driving records for each pile, compiled and attested to by the Geotechnical Engineer of Record. Include the following data:
 - 1 Project name and number.
 - 2 Name of Contractor.
 - 3 Type of pile and date of casting.
 - 4 Pile location in pile group and designation of pile group.
 - 5 Sequence of driving in pile group.
 - 6 Pile dimensions.
 - 7 Ground elevation.
 - 8 Soil type.
 - 9 Elevation of tips after driving.
 - 10 Final tip and cutoff elevations of piles after driving pile group.
 - 11 Total penetration.
 - 12 Records of redriving.
 - 13 Elevation of splices.
 - 14 Type, make, model, and rated energy of hammer.
 - 15 Weight and stroke of hammer.
 - 16 Type of pile-driving cap used.
 - 17 Cushion material, thickness and area.
 - 18 Actual stroke and blow rate of hammer.
 - 19 Pile-driving start and finish times, and total driving time.
 - 20 Time, pile-tip elevation, and reason for interruptions.
 - 21 Number of blows for each 12 inches of penetration, and number of blows per 1 inch for the last 6 inches of driving.
 - 22 Bearing of pile (in tons).
 - 23 Pile deviations from location and plumb.
 - 24 Pre-boring, jetting, or special procedures used.
 - 25 Unusual occurrences during pile driving.
- E. The Contractor's responsibility includes retaining an independent Surveyor to provide an as-built pile survey. The survey shall be performed prior to proceeding with pile caps, beams, or slabs. A Land Surveyor licensed in the State the Project is located shall certify

that each pile is within the tolerances indicated or provide the deviations of the piles in writing to the Engineer of Record for review.

PART 2 - PRODUCTS

2.01 CONCRETE

- A. All the concrete for this portion of work shall conform with ALDOT Specifications Section 501 and 513. Prestress concrete piles shall meet the special requirements for piles constructed in severe exposure conditions per section 513.02(c).5.
- B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type III, 70%
 - 2. Fly Ash: Type F, 20%.
 - 3. Silica Fume: ASTM C 1240, 10%
- C. Permeability: 2,000 coulombs, max
- D. Concrete Strength: As specified on the drawings.

2.02 REINFORCEMENT

- A. Reinforcing bars: Unless specified otherwise, deformed bars shall meet requirements of ASTM A615, Grade 60.
- B. Prestressing Steel: Unless otherwise shown by plan details, stressing strands shall meet the requirements of AASHTO M203, Grade 1860 (270 ksi).

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

- A. All handling, storing, and transporting of prestressed concrete members shall be in accordance with ALDOT Specifications Section 513.
- B. Care shall be exercised during handling operations so as to not damage the piles, any damage incurred due to Contractor mishandling or accident shall be repaired by the Contractor at no additional cost to the Owner, and any piles unit damage deemed by the Engineer as beyond repair shall be removed from the site and replaced by the Contractor at no additional cost to the Owner.
- C. Contractor shall provide adequate equipment for proper rigging and lifting of the piles.

3.02 PILE DRIVING

- A. General: All pile driving, testing, monitoring, and tolerances shall be performed in accordance with and meet the requirements given in ALDOT Specifications Section 505 – Piling. The Contractor shall engage the Geotechnical Engineer of Record for all tests and monitoring of pile driving activities. Provide signed and sealed written

reports to Engineer for review.

- B. Deviations from Referenced Tolerances: When the Contractor has failed to meet the referenced tolerances, the Contractor may request from the Engineer of Record design changes in the pile caps, footings, or beams to incorporate piles driven out of tolerance. The Contractor shall bear the expense of all redesign and Unforeseeable Work resulting from approved design changes to incorporate piles driven out of tolerance.
- C. All pile driving equipment, including the pile driving hammer, hammer cushion, helmet, pile cushion, and other appurtenances to be furnished by the Contractor shall be submitted for review in advance by the Engineer before any driving can take place.
- D. Pile Installation Equipment: An impact hammer of sufficient size and capacity shall be used to install precast piles. The Contractor is to consider the effects the pile installation equipment operation will have on the adjacent infrastructure, as well as environmental measures to be implemented during pile driving operations as required by the environmental permits and as otherwise required in this and other technical specifications. Selection of the pile installation hammer(s) with adequate capacity to drive piles to the required tip elevation is the responsibility of the Contractor. The hammer used shall have a delivered energy suitable for the total weight of the pile, the character of subsurface material to be encountered and the design length. The selected hammer shall be such that it does not damage the piles as determined by a wave equation analysis.
- E. Wave Equation Analysis: In selecting the appropriate hammer, the Contractor shall perform a wave equation analysis for the piles. The wave equation analysis shall be performed by a registered professional engineer and shall be based on the specific equipment to be used in this contract. For each hammer to be used by the Contractor, the Contractor shall perform a bearing graph analysis as part of the wave equation analysis.
- F. Jetting of piles is permissible provided the following criteria are met:
 - 1. Jetting must be stopped 10 ft or more above the required tip elevation.
 - 2. Jetting must be stopped 10 ft or more above the tip elevation of already driven piles within 5 pile diameters of the pile being installed.
 - 3. After jetting is stopped, piles shall be driven with an impact hammer to reach the required tip elevation.
 - 4. Should any adjacent, already driven piles show indications of movement, the use of jetting shall be stopped immediately, and the Engineer of Record shall be informed.
- G. Drive prestressed concrete piles any time after the concrete has been cured in accordance with Section 513, and the concrete compressive strength is equal to or greater than the specified 28-day compressive strength.

END OF SECTION

SECTION 31 63 16

AUGER CAST PILES

PART 1 - GENERAL

1.1 SUMMARY

- A. Description of scope and intent:
 - 1. Contractor to provide all material, labor, and tools required to complete the installation of specified system.
 - 2. Any omission of reference to items required to complete the full operational and functional system specified in the section does not relieve the contractor of the obligation to provide it.
 - 3. To provide installation of all items, including delivery, dispersing to the proper locations within the building, and affixing in place.
 - 4. Installation shall be accomplished by workers skilled in their craft who will perform their work in a professional manner and will leave the premises safe, orderly and clean.
 - 5. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - 6. Contractor is responsible for coordination of work included in this specification with all other specification sections related to furnishing of all materials, labor, permits, fees and services necessary for completion of work in this section.
 - 7. In the event of a conflict between the design drawings, referenced standards and these Specifications, the more stringent shall govern unless directed otherwise by the Engineer. Contractor shall strictly adhere to OSHA requirements and local codes or those of any regulatory agency or body with jurisdiction.
- B. Section includes all labor, equipment, materials, and supervision required to install the auger cast pile system as indicated on the Drawings and specified herein including, but not limited to:
 - 1. Pile load tests.
 - 2. Pile reinforcement.
 - 3. Cutting of piles at elevations indicated on the drawings.
 - 4. As-built pile survey.
- C. Related sections:
 - 1. Site Work: Division 2.
 - 2. Structural Concrete: Division 3.

1.2 REFERENCES:

All referenced standards refer to the edition in force at the time these plans and specifications are issued.

- A. ACI 201.2R – Guide to Durable Concrete; American Concrete Institute.
- B. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute.
- C. ACI 301 – Specifications for Structural Concrete for Buildings; American Concrete Institute.
- D. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete

Institute.

- E. ACI 305R – Hot Weather Concreting; American Concrete Institute.
- F. ACI 306R – Cold Weather Concreting; American Concrete Institute.
- G. ASTM C 33 – Standard Specification for Concrete Aggregates
- H. ASTM C 109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
- I. ASTM C 150 – Standard Specification for Portland Cement
- J. ASTM D 1143 – Standard Test Method for Piles Under Static Axial Compressive Loads
- K. ASTM D 3689 – Standard Test Method for Individual Piles Under Static Axial Tensile Load.
- L. Augered Cast-In-Place Manual – Deep Foundations Institute (DFI)

1.3 DEFINITIONS

- A. Payment Length: The distance from the bottom of a pile to the final cut-off elevation indicated on the drawings.
- B. Grout overage: Total volume of grout of at least 115% of the theoretical volume for each pile, excluding spillage or rejected grout.
- C. Refusal shall be defined as the depth where the penetration of the standard auger equipment is one (1) foot per minute or less.

1.4 DESIGN

- A. Auger cast piles, cap reinforcement, pile locations, and pile lengths are shown and detailed on the drawings and are based upon the recommended pile capacity, diameter, and lengths indicated in the geotechnical report. Required adjustment to pile capacity and pile length as determined by the Geotechnical Engineer due to actual conditions will be made per unit price stated in the Bid Form.
- B. Minimum ultimate pile load capacities shall be two (2) times the minimum working load capacity indicated on the Drawings.
- C. Design shall be based upon the geotechnical report indicated on the Drawings. The Architect, Engineer and Owner assume no responsibility for accuracy, completeness, or interpretation of the data and conclusions stated in the geotechnical report.

1.5 SUBMITTALS

- A. Product Data including the following:
 - 1. Auger equipment.
 - 2. Pumping equipment.
 - 3. Test data on proposed mortar mix from an approved testing agency.
 - 4. Engineering data on proposed pile types.
- B. Shop Drawings indicating the following:

1. Storage of materials.
2. Storage of equipment.
3. Pile layout plan referenced to the Drawings including a numbering system identifying each individual pile.
4. Plan indicating sequence of pile installation.
5. Method of providing head of mortar during auger removal.

C. Method of Mobilization Report.

D. Quality Control Submittals:

1. Qualification data and references for firms and persons involved in pile installation as specified in "Quality Assurance" Article.
2. Provide a load test dimension sketch of the loading arrangement, including sizes of primary members, data on testing, and measuring equipment including required jack and /or gauge calibrations.

E. Prior to proceeding with construction, submit an auger cast log providing the following information:

1. Project identification including name and number.
2. Name of Contractor.
3. Pile number.
4. Design pile capacity.
5. Pile reinforcing steel.
6. Dates of placement, inspection, and testing.
7. Design location of pile centerlines at top.
8. Actual location of pile centerlines at top.
9. Diameter of auger pile.
10. Design evaluation of pile bottom and top.
11. Actual elevation of pile bottom and top.
12. Ground elevation.
13. Starting and finishing times.
14. Total placement time.
15. Auger penetration rate for each foot of penetration.
16. Rate of auger extraction
17. Grout pressure measured at the pump while placing the pile
18. Volume of grout placed.
19. Description of any breaks in the grout pumping operation.
20. Any unusual conditions encountered.
21. Grout mix proportions and materials.
22. Grout cube test results including actual compressive strength for both 7- and 28-day tests.
23. Dimensions shall be accurate to the nearest 1/4 inch, except that record elevations of pile bottoms shall be accurate to the nearest foot.
24. Logs shall be prepared daily and be jointly signed by this Contractor and the Testing Laboratory.

F. As-built pile survey.

1.6 QUALITY ASSURANCE:

A. Installer Qualifications: A company installing piles that have performed in a satisfactory manner under comparable conditions for a period of 10 years. The company shall be acceptable to the Geotechnical Engineer of Record. The installer shall have an experienced superintendent in charge of the work, who shall have supervised five prior projects of similar magnitude and design.

B. Testing and Inspection:

1. Testing agency:
 - a. Contractor shall employ Geotechnical Engineer of Record to perform load tests and perform pile installation testing.
 - b. Testing agency's service responsibilities are described under Field Quality Control section in Part 3.
 2. Testing laboratory shall have authority to verify that refusal has been met. If piles must be relocated from their original location, the Engineer must be consulted before new location is determined.
 3. Testing laboratory shall have authority to determine if a void has occurred in a pile based on sustained loss of pressure, withdrawal rates, volume of grout, etc.
 4. Provide testing agency with access to work and data.
 5. Provide help for checking the progress and coordination.
 6. Provide testing agency with 48 hours (minimum) advance notice before beginning of grout placement operations.
- C. Pre-Installation Conference:
1. Schedule and attend conference with owner, architect/engineer, testing agency, subcontractors, and agencies affected by work of this section.
 2. Schedule meeting before any work is performed.
- D. The Contractor's responsibility includes retaining an independent Surveyor to provide an as-built pile survey. The survey shall be performed prior to proceeding with pile caps, beams, or slabs. A Land Surveyor licensed in the State the Project is located shall certify that each pile is within the tolerances indicated or provide the deviations of the piles in writing to the Engineer of Record for review.

1.7 BASIS OF PAYMENT:

Auger cast pile installer shall visit the site and familiarize himself completely with existing conditions and extent of site preparation required under the Contract Documents. He shall familiarize himself completely with geological formations of the area and possibilities of encountering water, gas, boulders, unsound soil and /or bedrock, and other conditions affecting auger cast pile placement. No claim for extra compensation will be considered for these or similar conditions encountered during progress of the Work, except for boulders requiring removal by special equipment, or additional auger cast piles and other construction required because of presence of large boulders interfering with the shaft, or other conditions governed by unit prices or negotiated costs as follows:

- A. The Bid price shall be based upon the auger cast pile system with pile sizes, pile lengths, top of pile elevation, and reinforcement as indicated on the Drawings as specified herein.
- B. Base bid and bid additive shall be a lump sum amount.
1. Base the lump sum amount on total footage indicated on the Drawings.
 2. Include:
 - a. Test piles.
 - b. Reaction piles.
 - c. Exploratory auger operations.

- C. Use the number of test piles indicated on the Drawings, but not less than one (1) load test pile shall be included in the base sum bid. The soils Engineer shall locate load tests.
- D. Payment Adjustment:
 - 1. Adjustments shall be based on total aggregate length of all piling and not on individual piles. The testing laboratory will calculate the actual total net quantity of piles and the total net footage of piles placed based on the data obtained during the placing of auger cast piles.
 - 2. No payment will be made for piles that are abandoned or replaced because they do not comply with the contract documents.
 - a. The contractor shall be responsible for engineering costs incurred if analysis or redesign is required due to nonconforming piles.
 - b. Contractor shall at own expense install piles as required by redesign.
 - c. Payment will be made only for those piles replacing the abandoned or rejected piles on a one for one basis.
 - 3. Test piles that fail load tests shall be replaced with new test piles and tested at no additional cost to the owner.
 - 4. If load test piles in addition to the test piles included in base price are requested, payment will be made per contract unit price.
 - 5. The testing agency shall make additional tests of in-place grout as directed by the Engineer when test results indicate that specified strength and other grout characteristics have not been attained. The cost of additional testing and engineering shall be borne by the Contractor.
- E. Unit Prices:
 - 1. Provide the following unit prices in the Bid Form (including set-up charges):
 - a. Price per foot for adding footage to the base vertical pile footage.
 - b. Price per foot for deleting footage from the base vertical pile footage. (credit)
 - c. Price per test pile. Include installation of test pile, reaction piles, and performing test.
 - d. Price per yard for grouting voids if encountered.

1.8 DELIVERY, STORAGE, AND HANDLING:

- A. Packing and Shipping:
 - 1. All materials shall be protected from damage by factory packing. Factory packing shall be clearly marked, indicating contents.
- B. Acceptance at Site:
 - 1. Reject any damaged materials upon arrival.
- C. Storage and Protection:
 - 1. Store all materials above grade and in a manner to prevent damage.

PART 2 - PRODUCTS

2.1 GROUT AND COMPONENTS

- A. General:
 - 1. The high strength grout used to fill the holes shall consist of mixture of Portland cement, fluidifier, sand and water so proportioned and mixed as to provide a grout capable of maintaining the solids in suspension without appreciable water gain, yet which may be placed without difficulty, and which will laterally penetrate and fill any voids in the foundation material. The materials shall be so proportioned as to provide a hardened grout having an ultimate compressive strength as indicated on the Drawings.

- B. Portland Cement:
 - 1. ASTM C 150.
- C. Fine Aggregate:
 - 1. ASTM C33.
 - 2. The sand shall consist of hard, dense, durable, uncoated rock particles and be free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances. If washed, the washing method shall be such as will not remove desirable fines, and the sand shall subsequently be permitted to drain until the residual free moisture is reasonably uniform and stable. The sand shall be well-graded from fine to coarse, with fineness modules between 1.40 and 3.40.
- D. Fluidifier:
 - 1. ASTM C494 Type A.
 - 2. Fluidifier shall be a compound possessing characteristics which will increase the fluidity of the mixture, reduce bleeding, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the high-strength grout.
- E. Water:
 - 1. ASTM C94.
 - 2. Fresh, clean and potable.
- F. Mild Reinforcing:
 - 1. ASTM A615, Grade 60.
 - 2. Refer to Section 03 20 00 "Concrete Reinforcement."

2.2 GROUT MIX DESIGN AND TEST INFORMATION

- A. The auger cast pile installer shall be responsible for mix proportions and have a grout design mix (proportions) prepared by the grout supplier or an independent testing laboratory based on trial mixes or previous projects.
- B. The grout shall consist of the materials specified herein and be proportioned and mixed to produce a grout capable of maintaining the solids in suspension, pumpable, and that will penetrate and fill open voids in the adjacent soils.
- C. Standard Flow Cone Rate: 15 to 20 seconds.
- D. Minimum Compressive Strength: 5000 psi at 28 days.
- E. Maximum Allowable Design Stress: 0.25 fc
- F. Grout Testing: See Field Quality Control Section in Part 3

2.3 EQUIPMENT

- A. Auger Equipment:
 - 1. Grout outlet shall be at the bottom of the auger head below the bar containing the cutting teeth.
 - 2. Maintain cutting teeth in serviceable condition.
 - 3. Do not use teeth which are worn more than 50%
 - 4. Auger flighting shall be continuous from auger head to the top of the auger with no gaps or breaks.

5. Maximum Auger Pitch: 9 inches.
 6. Auger hollow shaft shall allow placement of #11 reinforcing bar or Dywidag as specified in the Drawings.
 7. Provide an auger guide for augers over 40 feet long.
 8. Prevent piling leads from twisting with a stabilizing arm.
 9. Accomplish drilling with a rig capable of providing 30,000 ft-lbs of torque at the gearbox.
- B. Provide automated monitoring equipment for accurate measurement of auger depth, penetration rate, and volume of grout per unit depth increment and print results.
- C. Pumping Equipment:
1. Pump shall be a positive displacement, piston type with a known volume per stroke.
 - a. Minimum head capacity: 350 psi
 - b. Provide pressure gauges at pump discharge to ensure proper grout pressures.
- D. Agitating Storage Tank:
1. Provide agitating tank when ready-mix grout is used.
 2. Size tank to maintain homogeneous mix and continuity of grout between ready-mix truck and grout pump.
- E. Provide sufficient equipment to conduct work without delays.
- F. Provide centralizers or spacers on all rebar and rebar cages.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Contractor shall inspect area to receive the work and report immediately in writing to the Engineer any unacceptable conditions.

3.2 PREPARATION

- A. The site shall be brought to its final grade prior to commencement of this work. Verify all grades and coordinate work with the General Contractor prior to placing auger cast piles.
- B. The Contractor shall establish:
1. Building layout lines.
 2. Temporary bench marks.
 3. Line and level of the auger cast piles.
- C. Once line and level are established the auger pile installer shall be entirely responsible for, and shall bear the entire cost of correcting any auger cast piles that are out of position or cutoff at incorrect elevations.
- D. Cooperate with others to locate utility lines extending into the site or which might be cut or distributed by auger cast pile operations. Excavate pits near ends of lines to determine exact utility locations.
- E. Review the proposed work with all utilities, and arrange for removal, relocation, or disconnecting and capping of all lines.
- F. The Installer has the entire responsibility for costs incurred because of damage to utilities by his

operations.

- G. Prior to the commencement of operations and after final Shop Drawings have been reviewed by the Engineer arrange for representatives responsible for field procedures to meet with the Engineer, Installer, and testing laboratory to finalize all procedures relating to auger cast pile placement.
- H. Excavated material shall be handled in strict accordance with the recommendations.

3.3 PILE LOAD TESTS

- A. Perform the number of pile load tests indicated on the Drawings. A minimum of one (1) pile load test will be required prior to the commencement of production pile installation at the location directed by the soils Engineer.
- B. Test piles may be located and become part of foundation system provided they conform to requirements of the Contract Documents. Refer to the drawings for location of test piles.
- C. Use test piles of same size as indicated on the Drawings for permanent piles and place with appropriate equipment to be used in placing permanent piles.
- D. Load test pile to the short term design compression capacity listed on the drawings in accordance with ASTM D 1143.
- E. Provide pile reaction frame, anchor piles, equipment, and instrumentation with enough reaction capacity to perform tests. Remove all testing apparatuses on completion. Allow a minimum of seven days to elapse after installing test pile before testing.
- F. Prepare written report and record for each test pile. Provide to the Engineer for review prior to start of production piles.

3.4 TOLERANCES

- A. Install the auger cast piles within the following tolerances:
 - 1. Install piles in locations indicated on the Drawings.
 - 2. Deviation of the pile center from specified center in plan: plus or minus 3 inches at the cut-off elevation measured radially from locations indicated on the Drawings.
 - 3. Deviation of the pile from vertical: 2 percent (2%).
 - 4. Deviation of the pile cut off elevations: plus or minus 1 inch.
 - 5. Maximum tolerance in diameter: minus 2 percent.
 - 6. Reinforcing bar placement: plus or minus ½ inch relative to center of installed pile.
- B. Deviations from Above Tolerances: When the Contractor has failed to meet the above tolerances, the Contractor may request from the Engineer of Record design changes in the pile caps, footings, beams, or slabs to incorporate piles driven out of tolerance. The Contractor shall bear the expense of all redesign and Unforeseeable Work resulting from approved design changes to incorporate piles driven out of tolerance.

3.5 INSTALLATION

- A. Do not proceed until the load tests have been evaluated by the Geotechnical Engineer and written authorization has been issued.
- B. Auger cast piles are placed by rotating a continuous flight hollow-shaft auger into the ground to a

predetermined pile depth or until the auger has reached refusal. Upon reaching refusal, the auger should be raised approximately 6 inches to allow for the start of the flow of grout. After grout pumping has commenced and grout has reached the top of the auger, the auger, while still rotating, shall again be lowered to the point of refusal to assure that the contact area between the pile and bearing point has been cleaned of any debris. High-strength grout shall be pumped with sufficient pressure as the auger is withdrawn to fill the hole preventing hole collapse and to cause the lateral penetration of the grout into soft or porous zones of the surrounding soil. A head of at least ten (10) feet of grout above the injection point or above the water level, whichever is higher, shall be maintained at all times during the raising of the auger so that the high-strength grout has a displacing action removing any loose material from the hole. The maximum auger withdrawal rate is 10 feet per minute. This method of placement shall be used at all times and not be dependent on whether the hole is sufficiently stable to retain its shape without support from the earth-filled auger.

- C. Reinforcing shall be placed while the grout is still fluid. Place singular bar, full-length reinforcement throughout the hollow shaft auger prior to pumping or auger removal. Contractor shall insure that reinforcement is placed in the center of the pile with adequate grout coverage all around.
- D. Only approved pumping, continuous mixing and agitating equipment shall be used in the preparation and handling of the grout. All oil or other rust inhibitors shall be removed from mixing drums and pumps. If ready-mix grout is used, an agitator of sufficient size shall be used between the ready-mix truck and the pumping operations.
- E. All materials shall be such as to produce a homogeneous grout of the desired consistency. If there is a lapse in the operation, the grout shall be re-circulated through the pump. A single addition of water to ready-mix grout made upon arrival at the job site to adjust fluidity is permissible. Subsequent additions of water will not be allowed.
- F. All grout materials shall be accurately measured by volume or weight as they are fed to the mixer. Time of mixing shall be not less than one minute at the site. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding two and one-half hours from time of batching at grout temperatures below 70 degrees F and for a period not exceeding two hours from time of batching at higher temperatures, not exceeding 90 degrees F. Grout shall not be place when its temperature exceeds 100 degrees F.
- G. The total volume of grout placed in the hole shall be between 115 percent of the theoretical volume of the auger hole. Monitor pumped grout volumes using automated monitoring equipment..
- H. Protect grout from physical damage or reduced strength that could be caused by frost, freezing actions or low temperatures or from damage during high temperatures in accordance with ACI 305/306.
- I. Adjacent piles shall not be placed until the grout in the piles has reached its initial set in order that there will be no interconnection between adjacent piles while the grout is in a fluid state. No pile shall be placed within eight (8) hours of the installation of an adjacent pile at the same group, if the adjacent pile is within six feet (6'-0" center to center). The Engineer reserves the right to increase this time if there are indications of grout bridging between piles.
- J. Should any obstruction (including but not limited to boulders and timber) be encountered which shall prevent placing the pile to the depth required, or shall cause the pile to drift from the required location, remove the obstruction if practical. If the obstruction cannot be economically removed:
 - 1. The pile shall be completed in accordance with these specifications and this short pile shall be added to the unit lengths for payment.
 - 2. Place an additional adjacent pile as directed by the Engineer or his representative. The additional pile shall be paid for in accordance with the bid basis for additional footage.

- K. If less than the theoretical volume of grout is placed in any five foot increment, the pile shall be reinstalled by advancing the auger 10 feet or to the bottom of the pile if that is less, followed by controlled removal and grout injection.
- L. If pumping grout is interrupted for any reason, the Installer shall reinsert the auger by drilling at least five feet below the tip of the auger when the interruption occurred, and then re-grouting.
- M. All piles placed with a cutoff elevation at or above grade or within 2 feet of grade shall have a metal collar or casing of the proper diameter and at least 18 inches in length set to protect the fresh concrete grout in the top of the piles and to facilitate establishing the cutoff elevation.
- N. Screens no larger than 1/4" mesh shall be used between the mixer and pump, or between the mixer and agitator.
- O. During Pile Installation, grout pressure shall be maintained between 100 and 300 psi. If pressure falls below 75 psi at the pump during grouting, the auger shall be advanced 3 feet below the point of question and grouting should be continued.
- P. Time of grout mixing shall be no less than one (1) minute. If agitated continuously, the grout may be held by the mixer or agitator for a period not to exceed 90 minutes. The grout may be held in the mixer for a longer period as allowed by Section 3.5.F if temperature measurements are taken and additional standard flow cone rate measurements satisfy Section 2.2.C.
- Q. Addition of Water at the site:
 - 1. One addition of water in accordance with ASTM C94 will be permitted to bring the consistency of the grout to within tolerance, provided that:
 - a. A positive means is available to measure the amount of water added at the site.
 - b. The specified (or approved) maximum water-cement ratio is not exceeded.
 - c. Not more than 45 minutes have elapsed since batching.
 - 2. The grout supplier shall provide the maximum amount of water that can be added to each truck to meet Section 3.5.Q.1.b. above.
 - 3. When grout test cubes are taken, they shall be taken after any additions of water to the grout.

3.6 PILE ACCEPTANCE

- A. An auger cast pile will be considered faulty and be rejected by the Engineer when:
 - 1. It fails to meet the tolerances for installation.
 - 2. It is damaged by poor materials, faulty construction procedure, inadequate equipment, or installation.
- B. This Installer shall correct damaged or faulty piles or provide additional construction satisfactory to the Engineer at no additional cost to the Owner.

3.7 FIELD QUALITY CONTROL

- A. Pile Load Tests:
 - 1. Conduct load tests as directed by the Geotechnical Engineer of Record. The number of load tests conducted shall be as indicated on the Drawings, but not less than one (1).
 - 2. Conduct compression load tests on a test pile in accordance with ASTM D 1143.
 - 3. Conduct tension (uplift) tests on a test pile in accordance with ASTM D 3689.
 - 4. Testing agency shall direct loading procedures.

5. Grout shall reach its 28-day strength prior to testing.
 6. Test piles without overburden.
 7. Advise the Engineer and the testing agency at least 48 hours prior to conducting load tests.
 8. The Engineer may authorize additional load tests as deemed necessary.
- B. Exploratory Holes: Provide exploratory holes required by the testing agency or the Engineer.
- C. Testing Agency:
1. Qualifications:
 - a. The Agency shall be accredited by ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
 - b. The Agency shall meet "Recommended Requirements for Independent Laboratory Qualification," published by American Council of Independent Laboratories.
 - c. The Laboratory shall be authorized to operate in the state in which the Project is located.
 - d. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - e. Personnel performing field tests shall have available to them a copy of ACI SP-15, "Field Reference Manual."
 2. Employment of the testing agency shall in no way relieve Contractor's obligations to perform the Work of the Contract.
 3. Services and Responsibilities:
 - a. Cooperate with the Engineer, Contractor, and Subcontractors in order to provide qualified personnel after due notice.
 - b. All testing by the Agency shall be performed in a timely manner to prevent installation of non-conforming materials or to allow for their removal before additional work and placement of materials renders their removal impossible unnecessarily expensive to the Contractor.
 - c. Promptly notify the Contractor and Engineer of observed irregularities deficiencies of work or products.
 - d. Perform specified inspections, sampling, and testing of materials and methods of construction. Ascertain compliance of materials with requirements of Contract Documents and specified Related Documents.
 - e. The testing agency shall observe all auger cast pile operations, including pile load tests. Submit four (4) copies of all records and tests associated with auger cast piles to the Engineer, Contractor, and the Installer.
 - f. Pile Load Tests:
 - 1) Monitor installation of test piles.
 - 2) Direct loading procedures.
 - 3) Monitor and evaluate load tests of test piles.
 - 4) Prepare installation record for, and certify each test pile within two (2) days after testing. Include with test pile records, record of drilling equipment used, pile deviation, if any, and remarks concerning any unusual occurrence during placement or loading of pile. Include a tabulation of the loads and settlement readings during loading and unloading of pile together with graphic representation of test results in form of a time-load-settlement curve.
 - g. Prepare pile installation operations report and confirm production pile installation criteria.
 - h. Grout Testing:
 - 1) The grout mix shall be tested by making six (6) - 2 inch cubes for each day during which auger cast piles are installed. Test 2 cubes at 7 days and 2 cubes at 28 days. Retain 2 cubes for later testing if required.
 - 2) Additional grout cubes shall be taken from any truck for which there is a question regarding the grout properties.
 - 3) Test cubes shall be made and tested in accordance with ASTM C 109, with exception

- that the grout should be restrained from expansion by a top plate.
- i. Measure pay length of piles and quantities for payment for additional work.
4. All tests shall be reported in writing to the Contractor, Subcontractor, Engineer, and Owner. All tests showing non-conformance of items of the work shall be reported verbally immediately to the Contractor and Engineer. Written reports of test results shall be delivered to the above parties on a weekly basis within two weeks of the date of testing unless stated otherwise. Each report shall include, as a minimum, the following:
 - a. Report number.
 - b. Date issued.
 - c. Project title and number.
 - d. Name of Contractor and Subcontractor if applicable.
 - e. Supplier.
 - f. Testing Agency name, address, and telephone number.
 - g. Name and signature of Agency Field Technician.
 - h. Date and time of sampling or inspection.
 - i. Record of temperature and weather conditions.
 - j. Date of test.
 - k. Identification of product and Specification Section.
 - l. Location of sample or test in the Project.
 - m. Type of inspection or test.
 - n. Results of tests and compliance with Contract Documents.
 - o. Interpretation of test results when requested by the Engineer.
 5. The Agency shall not:
 - a. Release, revoke, alter or enlarge, on requirements of Contract Documents.
 - b. Approve or accept any portion of the Work.
 - c. Perform any duties of the Contractor.
 6. Contractor's Responsibilities:
 - a. Cooperate with the Agency to facilitate the execution of its required services.
 - b. Provide the Agency, for their review, proposed concrete design mixes to be used that requires control by the Agency.
 - c. Secure and deliver to the Agency adequate quantities of representative samples of materials proposed to be used and which require testing, including but not limited to the following:
 - 1) Samples of mix design for purposes of performing air content testing.
 - 2) Samples of mix design for purposes of performing chloride permeability test.
 - 3) Samples of mix design for purposes of performing plastic and hardened concrete corrosion inhibitor tests.
 - d. Provide and maintain for the sole use of the Agency adequate facilities for safe storage and curing of concrete test cylinders for the first 24 hours as required by ASTM C 31.
 - 1) In cold weather, provide stable, insulated storage boxes equipped with thermostatically controlled devices to maintain the temperature between 60 degrees and 80 degrees F. or as approved by the Agency.
 - 2) In hot weather, cylinders shall not be stored in closed boxes or spaces subject to high temperatures and drying conditions, nor should they be left exposed to the sun and wind. Storage of cylinders during initial curing in damp sand is an acceptable practice or as approved by the Agency.
 - e. Notify Agency sufficiently (a minimum of 48 hours) in advance of inspections and tests to allow for assignment of personnel.
 - f. Observe procedures of Field Technicians sampling concrete, making field tests, and handling and transporting test specimens and promptly report any irregularities to the Engineer.
 - g. Patch holes resulting from concrete curing.
 7. Submittals:
 - a. Upon request submit for review and approval certification and qualifications of Agency.
 - b. Upon request submit for review and approval certification and qualifications of Agency

Field Technicians.

- c. Provide upon request evidence of inspection of the Agency's facilities by the Materials Reference Laboratory of the National Bureau of Standards during their last tour of inspection and be required to show that any deficiencies mentioned in the report of that inspection have been corrected.

3.8 CORRECTIVE WORK

- A. Replace all abandoned or rejected piles with additional piles as directed by the Engineer and following procedures stated in the Installation Section above.
- B. Cut off rejected or abandoned piles one foot below the bottom elevation of the pile cap or slab.

3.9 CLEANING:

- A. Remove all excess material, equipment, spoil, and debris resulting from pile installation.

END OF SECTION

SECTION 33 05 04

SELECTIVE DEMOLITION FOR UTILITIES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected site elements as shown in the plans and specifications in accordance with the various phasing and demolition plans.
 - 2. Modification and repair procedures for selective demolition operations.
 - 3. Where building demolition permits are required, it shall be the demolition contractor's responsibility to obtain all applicable permits and include in the price of his work. Where demolition requires special handling, the demolition contractor shall include in his price all requirements to permit, demolish and dispose of all materials including these which require special handling and disposal fees. Any such work of this nature shall be executed by individuals and companies properly licensed to perform the work.

1.03 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 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.

1.04 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.05 SUBMITTALS

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

- B. Proposed Dust-Control: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. 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.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Coordination of Owner's continuing occupancy of portions of existing site and of Owner's partial occupancy of completed Work.
- D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- E. Pre-demolition Photographs or Videotape: 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.
- F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.06 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241
- D. Pre-demolition Conference: Conduct conference at Project prior to initiating demolition. 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 and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.07 PROJECT CONDITIONS

- A. Owner will occupy portions of site immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Maintain access to existing railways, roads, corridors, and other adjacent occupied or used facilities as identified in the phasing plans to remain in use and/or outside of the phase of construction being implemented.
 - 1. Do not close or obstruct railways, roads, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- C. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- D. Hazardous Materials other than those items of asbestos and lead based paint identified in the report included in the appendices, the owner is not aware of any hazardous materials that may be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site will not be permitted.
- F. 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.

PART 2 – PRODUCTS

2.01 MODIFICATION AND REPAIR MATERIALS

- A. Use modification and repair materials identical to existing materials and/or in accordance with drawings showing modifications.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

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 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 intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.
- E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.02 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - 1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.

3.03 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, railways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct roads, railways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
- B. Temporary Shoring: Provide and maintain exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction 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.

3.04 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
 - 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3.05 SELECTIVE DEMOLITION

- 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:
- B. Existing Facilities: Comply with Owner's requirements for using and protecting loading docks, storage areas, roads, railways, and other building facilities during selective demolition operations.
- C. Removed and Salvaged Items: Comply with the following:
 - 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 transport and storage.
- D. Removed and Reinstalled Items: Comply with the following:
 - 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 transport and 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 Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- F. Asphalt Roadway Slabs: Saw-cut perimeter of area to be demolished, then break up and remove.

3.06 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

- C. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them. At the Contractors option, excess excavated materials acceptable to the Port can be moved and disposed of at a location determined by the Alabama State Port Authority in Mobile, Alabama.

END OF SECTION

SECTION 33 05 05

BURIED PIPE INSTALLATION

PART 1 – GENERAL

1.01 SCOPE

- A. The work under this Section consists of furnishing all labor, equipment and materials and performing all operations in connection with the trench excavation and backfill required to install the pipelines and associated structures shown on the Drawings and as specified.
- B. Excavation shall include the removal of any trees, stumps, brush, debris or other obstacles which remain after the clearing and grubbing operations, which may obstruct the work, and the excavation and removal of all earth, rock or other materials to the extent necessary to install pipe and appurtenances in conformance with the lines and grades shown on the Drawings and as specified.
- C. Backfill shall include the refilling and compaction of the fill in the trenches and excavations up to the surrounding ground surface or road grade at crossing.
- D. The trench is divided into five specific areas:
 - 1. Foundation: The area beneath the bedding, sometimes also referenced to as trench stabilization and is required when the native trench bottom is unstable.
 - 2. Bedding: The bedding is directly underneath the pipe and brings the trench bottom to grade. The purpose of the bedding is to provide a firm, stable, and uniform support of the pipe.
 - 3. Haunching: The haunching area begins at the bottom of the pipe and ends at the springline of the pipe. This area is important in terms of limiting pipe deflection.
 - 4. Initial Backfill: The area above the haunching material and below a plane 12 inches above the top of the barrel of the pipe.
 - 5. Final Backfill: The area above the initial backfill to a level below that required for the trench restoration.
- E. The choice of method, means, techniques and equipment rests with the Contractor, subject to the approval of the Owner. The Contractor shall select the method and equipment for trench excavation and backfill depending upon the type of material to be excavated and backfilled, the depth of excavation, the amount of space available for operation of equipment, storage of excavated material, proximity of man-made improvements to be protected, available easement or right-of-way and prevailing practice in the area.

1.02 DESCRIPTION OF WORK

- A. Codes and Standards
 - 1. Perform all work in compliance with applicable codes and requirements of governing authorities having jurisdiction.
- B. Testing and Inspection
 - 1. Contractor must employ, at Contractor's expense, an independent testing laboratory approved by the Owner.

2. Contractor will engage a geotechnical firm with a certified testing laboratory for quality control testing during earth work operations.
3. It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Owner's Engineer, testing service, and applicable agency inspectors 48 hours in advance of testing and inspections.
4. The geotechnical firm will submit the following reports directly to Engineer: Test reports on borrow material; field density; optimum moisture-maximum density curves; gradation curves.
5. Density: All references to "maximum dry density" shall mean the maximum dry density defined by the "Maximum Density-Optimum Moisture Test", ASTM D 698, except that for non-cohesive materials "maximum dry density" shall mean the maximum index density as determined by the "Maximum Index Density of Soils Using a Vibratory Table", ASTM D 4253. Determination of the density of foundation, bedding, haunching, or backfill materials in place shall meet the requirements of ASTM D 1556, "Density of Soil in Place by the Sand Cone Method", ASTM D 2937, "Density of Soil in Place by the Drive-Cylinder Method" or ASTM D 6938, "Nuclear Density Method".
6. All costs associated with compaction testing ordered by the Owner shall be paid for by the Contractor. The extent of testing required shall be reasonable, but shall also be dependent upon soil conditions, Contractor's means and methods of operation, and regulatory requirements. As a minimum, compaction tests shall be performed in alternating fill lifts at a single location per each 500 LF of pipeline or 750 square yards of excavation, but in no case less than 3 test locations.

1.03 SAFETY

- A. Perform all trench excavation and backfilling activities in accordance with the Occupational Safety and Health Act of 1970 (PL 91-596), as amended. The Contractor shall pay particular attention to the Safety and Health Regulations Part 1926, Subpart P "Excavation, Trenching & Shoring" as described in OSHA publication 2226. The Contractor is responsible for safety.

1.04 JOB CONDITIONS

- A. Site Information
 1. Any data provided regarding subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn by Contractor from data provided by the Owner.
 2. Any data provided is made available for convenience of Contractor.
 3. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.
- B. Underground Utilities
 1. The plans show certain features of topography and certain underground utilities, but they do not purport to show in complete detail all such lines or obstructions. Such topography and notes on the plans were inserted from records available are for the Contractor's convenience only, and shall not be used as a basis for claims of extra compensation.

2. Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose.
 3. Any damage to existing facilities resulting from the Contractor's operations shall be immediately repaired by the Contractor at no cost to the Owner.
- C. Existing Utilities
1. The Contractor shall be responsible to locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
 2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate fully with Owner and utility companies in keeping respective services and facilities in operation.
 3. Do not interrupt existing utilities serving facilities occupied and used by Owner or others during occupied hours, except when permitted in writing by Engineer, and then only after acceptable temporary utility services have been provided. Provide minimum of 48 hours' notice to Engineer and receive written notice to proceed before interrupting a utility.
 4. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.
- D. Protection of Persons and Property
1. Open excavations occurring as part of this work shall be barricaded and posted with warning lights. Operate warning lights as recommended by authorities having jurisdiction.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 3. Perform excavation by hand within drip line of large trees to remain and protect the root system from damage or dry out to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap.

PART 2 – MATERIALS

2.01 SOIL MATERIALS

- A. Definitions
1. Satisfactory soil materials are defined as those complying with unified soil classification groups SP, SP-SM.
 2. Unsatisfactory soil materials are defined as those complying with unified soil classification groups SC, SC-SM, SM, CL, ML, CH, MH and PT.
 3. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials, and stones larger than two inches.
 4. Unyielding material shall consist of rock and gravelly soils with stones greater than three inches.

5. Unstable material shall consist of material too wet to properly support the utility pipe, conduit, or appurtenance structure.
- B. Bedding, Haunching, and Initial Backfill Material
1. Satisfactory soil materials free of clay, rock, or gravel larger than one inch in any dimension, debris, waste, vegetable, and other deleterious matter and less than 15% passing No. 200 sieve.
- C. Final Backfill Material
1. In areas not subject to vehicular or pedestrian traffic, the final backfill material shall be general excavated earth materials, and shall not contain cinders, stumps, limbs, man-made wastes, other materials and shall not contain more than 33% broken rock, of which no stone or boulder shall weight more than 50 pounds.
 2. If materials excavated from the trench are not suitable for use as final backfill material, as determined by the Owner, provide select material conforming to the requirements of this Section.
 3. In areas where the backfill is beneath a roadway or sidewalk and subject to vehicular or pedestrian traffic, the backfill shall meet the requirements for select backfill.
- D. Trench Foundation Material
1. Crushed stone shall be utilized for trench foundation (trench stabilization) when required, and shall conform to the Alabama Department of Transportation Specifications with the exception that slag or crushed slag shall not be used.
 2. Stone sizes shall be No. 57.
- E. Select Backfill Material
1. Select backfill shall be materials which meet the requirements as specified for bedding, haunching and initial backfill, including compaction requirements.
- F. Select Granular Material
1. Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough, and durable particles and shall contain no more than 12% by weight of material passing a No. 200 mesh sieve and not less than 95% by weight passing the one inch sieve.
 2. The maximum allowable aggregate size shall be one inch or the maximum size recommended by the pipe manufacturer, whichever is smaller.
- G. Concrete
1. Concrete for bedding, haunching, initial backfill or encasement shall have a compressive strength of no less than 3,000 psi, with no less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches.
 2. Ready mixed-concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

PART 3 – EXECUTION

3.01 EXCAVATION

- A. Excavation includes excavation to the required subgrade elevations and includes excavation of pavements and other obstructions visible on ground surface, underground structures, utilities, and other items indicated to be demolished and removed, together with earth and other materials encountered.
- B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.
- C. Unsuitable Materials
 - 1. Where muck, rock, clay or other material within the limits of the roadway or other work is unsuitable (unsatisfactory soils and materials) in its original position, the Contractor shall excavate each material to the cross sections indicated on the plans or as directed by the Engineer.
 - 2. The unsuitable material shall be disposed off-site in accordance with applicable codes and regulations and the excavated area backfilled with suitable material to the lines, grades, and elevations indicated on the plans or as directed by the Engineer.
- D. Stability of Excavations
 - 1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction.
 - 2. Shore and brace where sloping is not possible because of space restrictions or instability of material excavated.
 - 3. Maintain sides and slopes of excavations in safe condition until completion of backfilling
- E. Dewatering
 - 1. Excavation shall be free from water, at Contractor's expense, before bedding, pipe, or structures are installed. To insure that bottom of trench can be adequately compacted, maintain groundwater level two feet below bottom of trench.
 - 2. Provide all necessary pumps, under drains, well point systems, and other means for removing water from trenches and other parts of the work. Continue de-watering operations until the backfill has progressed to a sufficient depth over the pipe to prevent flotation or movement of the pipe in the trench and so that it is above the natural water table.
 - 3. Water from the trenches and excavations shall be disposed in such a manner as will not cause injury to public health, to public or private property, to the work completed or in progress, to the surface of the streets, or cause any interference with the use of same by the public.
 - 4. The Contractor is responsible for obtaining any ADEM permits required for dewatering.
- F. Trench Excavation
 - 1. Top Soil and grass shall be stripped a minimum of 6 inches over the trench excavation site and stockpiled separately for replacement over the non-paved, finished grading areas.

2. Trenches shall be excavated to the lines and grades shown on the Drawings with the centerlines of the trenches on the centerlines of the pipes.
- G. Trench Width for Pipeline
1. The sides of all trenches shall be as vertical as is practical from the bottom of the trench to a minimum of one foot above the top of the pipe. Unless otherwise indicated on the Drawings, the trench width shall be equal to the sum of the outside diameter of the pipe plus two feet.
 2. Excavate the top portion of the trench to any width within the construction easement or right-of-way which will not cause unnecessary damage to adjoining structures, roadways, pavement, utilities, trees or private property. Where necessary to accomplish this, provide sheeting and shoring.
 3. Where rock is encountered in trenches, excavate to remove boulders and stones to provide a minimum of 6 inches clearance between the rock and any part of the pipe or appurtenance.
- H. Depth
1. The trenches shall be excavated to the required depth or elevation which allow for the placement of the pipe and bedding to the proposed grade or to provide minimum cover.
 2. For sanitary sewer force mains, re-use water mains and potable water mains excavate trenches to provide a minimum cover of 36 inches. Within the right-of-way of highways, streets or roadways; also excavate to place the top of the pipe a minimum of 36 inches below the nearest pavement edge or drainage ditch.
 3. Increase the depth of cover where specifically shown on the Drawings and where necessary to avoid interference with underground utilities and obstructions.
 4. Where rock is encountered in trenches for pipelines, excavate to the minimum depth which will provide clearance below the pipe barrel of 8 inches for pipe 21 inches in diameter and smaller and 12 inches for larger pipe, valves and manholes. Remove boulders and stones to provide a minimum of 6-inches clearance between the rock and any part of the pipe, manhole or accessory.
- I. Bottom Preparation
1. Trench bottom shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe.
 2. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing.
 3. Stones of two inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.
- J. Excavated Materials
1. Excavated materials shall be placed adjacent to the work to be used for backfilling as required. Top soil shall be carefully separated and lastly placed in its original location.
 2. Excavated material shall be placed sufficiently back from the edge of the excavation to prevent caving of the trench wall, to permit safe access along the trench and not cause drainage problems. Excavated material shall be placed so as not to damage existing landscape features or man-made improvements.

K. Removal of Unyielding Material

1. Where unyielding material is encountered in the bottom of the trench, such material shall be removed four inches below the required grade and replaced with select materials.

L. Removal of Unstable Material

1. Where unstable material is encountered in the bottom of the trench, such material shall be removed to the proper grade as hereinbefore described.
2. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Owner.

M. Excavation for Appurtenances

1. Excavation for manholes, catch-basins, inlets, or similar structures shall be at least 12 inches clear between the outer structure surfaces and the face of the excavation, or support members shall be of sufficient size to permit placement and removal of forms for the full length and width of structure footings and foundations as shown.
2. Removal of unstable material shall be as specified above.
3. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation.
4. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.02 SHEETING, BRACING AND SHORING

A. Sheeting, bracing and shoring shall be performed in the following instances:

1. Where sloping of the trench walls do not adequately protect persons within the trench from slides or cave-ins.
2. In wet, saturated, flowing or otherwise unstable materials.
3. Where necessary to prevent damage to adjoining buildings, structures, roadways, pavement, utilities, trees or private properties which are required to remain.
4. Where necessary to maintain the top of the trench within the available construction easement or right-of-way.

B. In all cases, excavation protection shall strictly conform to the requirements of the Occupational Safety and Health Act of 1970, as amended.

C. Timber

1. Timber for shoring, sheeting, or bracing shall be sound and free of large or loose knots and in good, serviceable condition.
2. Size and spacing shall be in accordance with OSHA regulations.

D. Steel Sheeting and Sheet Piling

1. Steel sheet piling shall be the continuous interlock type. The weight, depth and section modulus of the sheet piling shall be sufficient to restrain the loads of earth pressure and surcharge from existing foundations and live loads.

2. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth that the ground under existing structures shall be protected against lateral movement at all times.
 3. The Contractor shall provide closure and sealing between sheet piling and existing facilities.
- E. Trench Shield
1. A trench shield or box may be used to support the trench walls. The use of a trench shield does not necessarily preclude the additional use of bracing and sheeting. When trench shields are used, care must be taken to avoid disturbing the alignment and grade of the pipe or disrupting the haunching of the pipe as the shield is moved. When the bottom of the trench shield extends below the top of the pipe, the trench shield will be raised in 6-inch increments with specified backfilling occurring simultaneously. At no time shall the trench shield be “dragged” with the bottom of the shield extending below the top of the pipe or utility.
- F. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the pipe and adjacent property. Leave sheeting in place when in the opinion of the Owner it cannot be safely removed or is within three feet of an existing structure, utility, or pipeline. Cut off any sheeting left in place at least two feet below the surface.

3.03 ROCK EXCAVATION

- A. Definition of Rock
1. Any material which cannot be excavated with conventional excavating equipment, and is removed by drilling and blasting, or mechanically fracturing by means other than a trench excavator, and occupies an original volume of at least one-half cubic yard
- B. Blasting
1. Provide licensed, experienced workmen to perform blasting.
 2. Conduct blasting operations in accordance with all existing ordinances and regulations.
 3. Protect all buildings and structures from the effects of the blast. Repair any resulting damage.
 4. If the Contractor repeatedly uses excessive blasting charges or blasts in an unsafe or improper manner, the Owner may direct the Contractor to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.
- C. Removal of Rock
1. Dispose of rock off site that is surplus or not suitable for use as rip rap or backfill.
- D. The Contractor shall notify the Owner prior to any blasting. Additionally, the Contractor shall notify the Owner and local fire department before any charge is set.
- E. The Contractor shall conduct pre-blast and post-blast inspections of structures, including photographs or videos, and maintain a detailed written log.

3.04 BACKFILLING

A. General

1. Control soil compaction during backfilling operations providing minimum percentage of density specified for each area classification indicated below.

B. Percentage of Maximum Density Requirements

1. Compact soil to not less than the required percentages of maximum density determined in accordance with ASTM D 1557.

C. Replacement of Unyielding Material

1. Unyielding material removed from the bottom of the trench shall be replaced with satisfactory material placed in layers not exceeding six inches loose thickness.

D. Replacement of Unstable Material

1. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding six inches loose thickness.

E. Bedding and Haunching

1. Prior to placement of bedding material, the trench bottom shall be free of any water, loose rocks, boulders or large dirt clods.
2. Bedding material shall be placed to provide uniform support along the bottom of the pipe and to place and maintain the pipe at the proper elevation. The initial layer of bedding placed to receive the pipe shall be brought to the grade and dimensions indicated on the Drawings. All bedding shall extend the full width of the trench bottom. The pipe shall be placed and brought to grade by tamping the bedding material or by removal of the excess amount of the bedding material under the pipe. Adjustment to grade line shall be made by scraping away or filling with bedding material. Wedging or blocking up of pipe shall not be permitted. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted. Each pipe section shall have a uniform bearing on the bedding for the length of the pipe, except immediately at the joint.
3. At each joint, excavate bell holes of ample depth and width to permit the joint to be assembled properly and to relieve the pipe bell of any load.
4. After the pipe section is properly placed, add the haunching material to the springline of the pipe. The haunching material shall be shovel sliced, tamped, vigorously chinked or otherwise consolidated to provide uniform support for the pipe barrel and to fill completely the voids under the pipe, including the bell hole. Prior to placement of the haunching material, the bedding shall be clean and free of any water, loose rocks, boulders or dirt clods.
5. The types of trench bedding are identified as follows:
 - a. Class "A" (Bedding Factor – 2.8): Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Lay pipe to line and grade on concrete block. Place concrete to the full width of the trench and to a height of one-fourth of the outside diameter of the pipe above the invert.

- b. Class “B” (Bedding Factor – 1.9): Excavate the bottom of the trench at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. The bottom of the trench shall be rounded such that at least the bottom quadrant of the pipe rests firmly on the bedding. The bedding shall be undisturbed soil if suitable or placed material. Haunching material shall then be carefully placed by hand and compacted to provide full support under and up to the centerline of the pipe.
 - c. Class “C” (Bedding Factor – 1.5): Excavate the bottom of the trench at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. The bottom of the trench shall be rounded such that at least the bottom quadrant of the pipe rests firmly on the bedding. The bedding shall be undisturbed soil if suitable or placed material. Haunching material shall then be carefully placed by hand and compacted to provide full support under and up to a height of one-fourth the outside diameter of the pipe above the bottom of the pipe barrel.
 - 6. PVC and HDPE pipe shall be installed with Class “B” bedding, unless shown otherwise herein or on the drawings. The bedding and haunching shall be hand tamped to achieve a compaction of approximately 90% maximum density.
 - 7. Ductile Iron and other non-plastic pipes shall be installed with Class “C” bedding, unless shown otherwise herein or on the drawings. The bedding and haunching shall be hand tamped to achieve a compaction of approximately 90% maximum density.
 - 8. Manholes: Excavate to a minimum of 12-inches below the planned elevation of the base of the manhole. Place and compact crushed stone bedding material to the required grade before constructing the manhole.
- F. Initial Backfill
- 1. Initial backfill shall be placed to anchor the pipe, protect the pipe from damage by subsequent backfill and ensure the uniform distribution of the loads over the top of the pipe.
 - 2. Initial backfill material shall be placed in layers of a maximum of six inches loose thickness and compacted with approved tampers to 95% maximum density and to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of pipe for the full length of the pipe. Backfill material in this portion of the trench shall consist of satisfactory material at a moisture content that will facilitate compaction, free from stones larger than two inches in any dimension, except where the pipe is coated or wrapped for protection against corrosion, the backfill material shall be free of stones larger than one inch in any dimension.
 - 3. If materials excavated from the trench are not suitable for use as backfill materials, provide select backfill material conforming to the requirements of this section.
- G. Concrete Encasement for Pipelines
- 1. Where concrete encasement is shown on the Drawings for pipelines, excavate the trench to provide a minimum of 6-inches clearance from the bell of the pipe. Lay the pipe to line and grade on concrete blocks. In lieu of bedding, haunching and initial backfill, place concrete to the full width of the trench and to a height of not less than 6 inches above the pipe bell. Do not backfill the trench for a period of at least 24 hours after concrete is placed.

H. Final Backfill

1. Backfill carefully to restore the ground surface to its original condition. For earth or vegetated areas, replace the top 6 inches of the trench with top soil that was stock piled during excavation.
2. Excavated material which is unsuitable for backfilling, excess material and rock shall be disposed of, at no additional cost to the Owner, in a manner approved by the Owner.
3. If materials excavated from the trench are not suitable for use as backfill materials, provide select material conforming to the requirements of this Section.
4. After initial backfill material has been placed and compacted, backfill with final backfill material. Place backfill material in uniform layers, compacting each layer thoroughly as follows:
 - a. In 6 inch layers, if using light power tamping equipment*
 - b. In 12 inch layers, if using medium sized tamping equipment*
 - c. In 24 inch layers, if using heavy tamping equipment*
 - d. *The allowable layer thickness for different compaction equipment is dependent on the soil conditions. The Engineer of Record shall give project specific instruction related to the compaction equipment proposed for use by the contractor

I. Final backfill shall be compacted as follows:

1. Under proposed or existing pavement, dirt roads, sidewalks, or within four feet of pavement edge, compact to a minimum of 95% of the maximum density. Type of material and compaction effort may vary within the top 12" under areas designated for pavement replacement as reflected on the Drawings.
2. Around structures (manholes, inlets) compaction shall be 100% of the maximum density.
3. Seeded areas, or non-traffic areas, compact to a minimum of 90% of the maximum density.

J. Settlement

1. If trench settles, re-fill and grade the surface to conform to the adjacent surfaces.

3.05 ADDITIONAL MATERIAL

- A. Where final grades above the pre-construction grades are required to maintain minimum cover, additional fill material will be as shown on the Drawings. Utilize excess material excavated from the trench, if the material is suitable. If excess excavated materials are not suitable, or if the quantity available is not sufficient, provide suitable fill material.

3.06 TESTING AND INSPECTION REQUIREMENTS

A. Quality Control Testing During Construction

1. Contractor shall engage geotechnical firm to inspect and approve subgrades and fill layers before further construction work is performed.
2. In alternating compacted fill lifts, make one field density test for every 300 linear feet horizontally or 300 square yards, but in no case less than three tests. The Owner has the right to select the location of compaction test.

3. If, in the opinion of the Engineer, geotechnical firm reports indicate inspection, subgrade, or fill which have been placed are below specified density, the Contractor shall provide additional compaction and testing at no additional expense to the Owner.
4. The Contractor shall provide excavation as necessary for geotechnical personnel to conduct test.

3.07 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Off-Site Disposal

1. Remove all waste materials, including unacceptable excavated material, trash, and debris, and properly dispose at a location selected by the Contractor in accordance with local, state and federal criteria.

END OF SECTION

SECTION 33 05 19

PIPING AND VALVES

PART 1 – GENERAL

1.01 SCOPE

- A. Provide all labor, materials and equipment necessary to furnish and install all piping, fittings, valves and appurtenances as shown on the Drawings and/or as specified herein.

1.02 DESCRIPTION OF WORK

- A. Extent of work is shown on the drawings.
- B. The work includes, but is not limited to: Piping, valves, fittings, appurtenances.
- C. Comply with the requirements of applicable sections for excavation and backfilling require in connection with work.

1.03 QUALITY ASSURANCE

- A. Codes and Standards
 - 1. Perform all work in compliance with applicable requirements of governing authorities having jurisdiction and the applicable standards of the American Water Works Association (AWWA). American National Standards Institute (ANSI), and the American Society for Testing and Materials (ASTM), of the latest edition.
- B. Testing and Inspection Service
 - 1. Employ, at Contractor's expense, testing laboratory to perform necessary testing.
 - 2. It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Owner's Engineer, testing service and applicable agency inspectors 48 hours in advance of testing and inspection.

1.04 SUBMITTALS

- A. Operating instructions, manual, and shop drawings shall be submitted in accordance with Section 01300, SUBMITTALS.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All materials shall be in accordance with the Material Standard and shall, in no event, be less than that necessary to conform to the requirements of any applicable law, ordinances and codes.
- B. All materials shall be new, unused, correctly designed, and shall be of standard first grade quality and intended for the use for which they are offered. Materials or equipment which, in the opinion of the Owner's Engineer, are inferior or of a lower grade than indicated, specified or required, will not be accepted.

2.02 PIPING AND VALVES

- A. Piping and valves shall be in accordance with the Pipe and Valve Specification Sheets at the end of this Section.
- B. All PVC pipe shall be marked using a solid No. 10 copper wire buried between 3 and 6 inches above the top of the pipe. Backfill shall be carefully placed to a depth of 3 inches by hand to assure that the wire is secured in place over the pipe. It is the intent of the paragraph to provide a means to locate PVC pipe using standard pipe location equipment. The wire shall be carried up through valve boxes and terminated at least 2 feet above the ground line to permit connecting of location equipment. Excess wire at valve boxes shall be neatly rolled and stored in the valve box for easy accessibility. Number 10 locating wire splice shall be heat sealed or waterproof splicing connector.
- C. All ductile iron pipe for sewer shall have a green stripe at third points around the pipe for its full length. All PVC pipe for sewer shall be green.
- D. All ductile iron for reclaimed effluent shall have a purple stripe at third points around the pipe for its full length. All PVC pipe for reclaimed effluent shall be purple.

2.03 FITTINGS

- A. General
 - 1. Fittings three inches and larger shall be ductile iron unless otherwise noted on the plans.
 - 2. Fittings smaller than three inches shall be PVC unless otherwise noted on the plans.

2.04 DUCTILE IRON FITTINGS (3 Inch or Larger)

- A. Fittings
 - 1. Fittings three inches and larger shall be ductile iron manufactured in accordance with AWWA C-153 or C-110.
 - 2. The minimum pressure rating for fitting shall be 250 psi.
- B. Joints
 - 1. Fitting joints shall meet the specifications of the pipe joints as specified on the Pipe Specification Sheet for the appropriate joint, push on joints, mechanical joints or flange joints.
- C. Coating
 - 1. All fittings shall receive an interior and exterior coating specified on the pipe specification sheet for the appropriate joint.

2.05 TAPPING SLEEVES

- A. General
 - 1. Tapping sleeves shall be constructed of Grade 18-8 Type 304 stainless steel, and shall be in two halves. All tapping sleeves shall be Ford or Smith Blair #662 or approved equal.

2.06 MISCELLANEOUS ITEMS

- A. Pipe Couplings for Steel or Ductile Iron Pipe:
1. Pipe couplings shall be provided in sizes and at locations shown on the Drawings. Couplings shall be of gasketed, sleeve type, with diameter to properly fit the pipe, and shall consist of one steel middle ring; two steel follower rings; two rubber compound wedge section gaskets and sufficient steel track-head bolts to properly compress the gaskets. Provide galvanized steel bolts and nuts for outdoor and underground couplings. All underground couplings shall be coated with bitumastic. Aboveground couplings shall be painted. Couplings shall be assembled to provide permanently tight joints, and shall be as manufactured by Dresser Mfg. Div., Bradford, PA, Smith Blair, or equal.
- B. Pipe Restraints
1. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Glands shall be manufactured of ductile iron conforming to ASTM A 536-80. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA C111/A21-11, and ANSI/AWWA C153/21-53 of latest revision. Twist-off nuts shall be used to insure proper actuating of the restraining devices.
 2. The mechanical joint restraining device shall have a working pressure of at least 350 psi with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc. MEGALUG series or equal for ductile iron pipe, and Series 2000 or 2200 PV for PVC pipe or equal.
 3. Push-on joint restraints shall be Fast-Grip Gasket by American D.I. Pipe Co. or equal, or EBAA Iron Service 1700 for ductile iron pipe, and Series 1600, 2800 and 6500 for PVC pipe or equal.
- C. Non-Shrink Grout
1. Non-shrink grout for closing masonry and concrete openings at pipe and sleeve locations shall be EMBECO 636 Grout by Master Builders, Philadelphia, PA, or equal.
- D. Pipe Tie Rods
1. Pipe tie rods shall be made of steel, with steel tie-rod plates as detailed on the Drawings.
- E. Floor Boxes
1. Cast-iron floor boxes shall be furnished and installed where valve is operated from floor above. They shall be approximately 6 inches inside diameter by 8 inches deep. The frames and covers shall be cast iron with an arrow cast upon the lid showing the direction for opening the valve. The valve boxes shall be equipped with a guide bearing for accommodating the valve stem. Both the inside and outside of the valve boxes shall be thoroughly cleaned and coated with asphaltum before leaving the foundry.
- F. Extension Stems

1. Extension stems of cold rolled steel shall be provided for buried valves and shall be of sufficient size to withstand, without buckling, the loads which will be imposed upon them. The different sections of each stem shall be jointed together by rigid coupling. The coupling shall be keyed or pinned to the stems.
- G. Floor Stands
1. Floor stands shall be of the indicating type, cast or clear gray iron, substantial in construction and neat in appearance. They shall be provided for bolting to concrete floors with through bolts. The bolts shall be furnished under this contract. Handwheels shall be cast-iron of approved diameter, not less than 12 inches, however, having cast thereon in raised letters the word "OPEN" and an arrow indicating the direction of turn to open. The stands shall be properly finished on the outside to the satisfaction of the Engineer and both the inside and outside shall be thoroughly cleaned and coated with asphaltum varnish applied hot before leaving the foundry.
- H. Valve Boxes
1. Valve boxes are required on all buried valves, unless otherwise noted on Drawings. Valve boxes shall be of cast-iron. Provide extension stems complete with operating nut not more than 12 inches below top of valve box. Provide spacers every 5 feet for extension stem. The minimum thickness of the metal of the valve box at any point shall be not less than 3/16 of an inch. The cover shall have cast thereon the words "SEWER" or "WATER" and "OPEN" and a direction arrow. In areas other than paved, the Contractor shall construct a Class "B" concrete pad 2' X 2' X 4" under the valve box. The valve box shall be sufficient in size to enclose any exposed working part of the valve, such as the valve stem. Provide one "T" wrench for each 4 buried valves but in no case less than 3 wrenches shall be supplied.
- I. Pressure Gages
1. Gages shall be dial size, 4-1/2 inches, accuracy 1 percent, bronze bourdon tube, phenol turret type case, 1/2 inch NPT threaded bottom connection dial graduated as tabulated.
 2. Gages shall be factory assembled to a diaphragm seal having a steel bottom bowl, 316 stainless steel diaphragm 3/4 inch NPT threaded process connection. Assembly to be liquid filled.
 3. Each gage shall be supplied with one size 3/4 inch ball valve.
 4. Gage shall be Type 1220A, diaphragm seal Type 101 and gage cock Type No. 1092, all products of Ashcroft, or equal.
 5. Maximum graduations shall not exceed 2 times the operating pressure and/or shut off head for pumps.
- J. Saddles
1. Service saddle shall be Ford Iron style FC 202 with stainless steel bond and epoxy coating or equal.

PART 3 – EXECUTION

3.01 GENERAL (Applies To All Installations)

- A. Pipe, fittings, valves and appurtenances shall be installed in accordance with the manufacturer's recommendation and the applicable sections of the codes and standards listed in the quality and assurance section of these specifications.
- B. All valve operators and handwheels, etc., shall face and be accessible to platforms or operating areas. The Contractor is responsible for proper orientation to meet this requirement.
- C. The Contractor shall coordinate all piping and conduit for proper clearances and avoidance of conflicts.
- D. All interior pipe couplings shall have tie rods of the size and quantity as shown on the Drawings.
- E. Piping and valves shall not be supported from mechanical equipment unless otherwise permitted by the equipment manufacturer.
- F. All new mechanical or push-on joint pressure piping, fittings, valves, plugs, reducers bends, tees, etc. at the wastewater treatment facility shall be restrained utilizing restrained joint gasket or mechanical joint retainer gland (no exception).
- G. All yard pressure piping, fittings, valves, plugs, reducers, bends, tees, etc. shall be restrained with mechanical joint retainer gland or pipe bell restrained harness in accordance with manufacturer's recommendations. No thrust block will be allowed.

3.02 HANDLING PIPE (Applies To All Pipe Installation)

- A. General
 - 1. All material, unless otherwise directed, shall be unloaded at the job site and distributed at the site of the project by the Contractor. Materials shall be handled with care to avoid damage. In loading and unloading, pipe shall be lifted by hoists or slid or rolled on skidways in such a manner as to avoid shock. Under no circumstances shall pipe be dropped. Pipe handled on skidways must not be allowed to roll against pipe already on the ground. The Contractor shall be responsible for the safe handling of all materials. Damaged materials will not be installed.
 - 2. Pipe shall be handled so as to avoid damage to the coating and lining. If, however, any part of the coating or lining is damaged by the Contractor, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Owner's Engineer before installation.
 - 3. Pipe shall be distributed on the site of the work parallel with and opposite or near the place it is to be laid in the trench and with bell ends facing the directions in which the installation will proceed unless otherwise directed.

3.03 INSTALLATION OF FITTINGS (Applies To All Pipe Installation)

- A. Fittings

1. Fittings shall be handled with care to avoid damage. All fittings shall be loaded and unloaded by lifting, and under no circumstances shall fittings be dropped, skidded or rolled. Fittings shall not be placed, under any circumstances, against pipe or other fittings in such a manner that damage could result. Slings, hooks or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surface or interior lining of fittings. If any part of the fittings' coating or lining is damaged by the Contractor, the repair or replacement shall be made by the Contractor at his expense in a manner satisfactory to the Owner's Engineer before installing. Fittings shall also be stored at all times in a safe manner to prevent damage and kept free of dirt, mud or other foreign matter. All fittings gaskets shall be stored and placed in a cool location out of direct sunlight and out of contact with petroleum products. All gaskets shall be used on a first-in, first-out basis.
2. Fittings shall be set and joined to the pipe in a manner specified previously for joint assembly. When conditions warrant, fittings should be provided with special support trussing and blocking.

3.04 ANCHORAGE OF BENDS, TEES AND PLUGS (Applies To All Installations)

A. General

1. Adequate precautions shall be taken to prevent the separation of joints at bends, tees and plugged ends.

B. Retainer Glands

1. Retainer glands shall be installed in conformance with manufacturer's recommendations.

C. Anchoring Devices

1. All anchoring devices shall be suitable for use with mechanical joint fittings meeting AWWA C-110, and/or C-111.
2. All anchoring devices shall be constructed of ductile iron (at least ASTM A536 Grade 70-50-05) and manufactured in accordance with AWWA C-110, and/or C-111.
3. All anchoring devices shall have a sufficient number of set screws so as to properly restrain various fittings or pipes at the rated pressure without the need for additional thrust restraint.

D. Thrust Blocking

1. Where reaction or thrust blocking is required, it shall be of concrete of a mix not leaner than one part cement, two and one-half sand, five stone and having a compressive strength of not less than 3,000 pounds per square inch after 28 days and shall have a minimum curing time of three days. The poured concrete shall be left exposed for a minimum of 24 hours before backfilling, but not more than 48 hours. Before concrete thrust blocks are covered, contractor will have City inspect installation.
2. Blocking shall be placed between undisturbed earth and the fitting to be anchored; the area of bearing on pipe and on ground in each instance shall be that shown in the Construction Details. The blocking shall, unless otherwise directed, be so placed that the pipe and fitting joints will be accessible for repair.

3.05 INSTALLATION OF VALVES

A. General

1. Valves shall be handled with care to avoid damage. All valves shall be loaded and unloaded by lifting, and under no circumstances shall valves be dropped, skidded or rolled. Valves shall not be placed, under any circumstances, against pipe or other fittings in such a manner that damage could result. Slings, hooks or tongs used for lifting shall be padded in such a manner as to prevent damage. If any part of the valves' coating and lining is damaged by the Contractor, the repair or replacement shall be made by the Contractor at his expense in a manner satisfactory to the Owner's Engineer before installing. Valves shall also be stored at all times in a safe manner to prevent damage and kept free of dirt, mud or other foreign matter. All valve gaskets shall be stored and placed in a cool location out of direct sunlight and out of contact with petroleum products. All gaskets shall be used on a first-in, first-out basis.
2. Gate valves and butterfly valves shall be set and joined to new pipe in the manner previously specified for cleaning, laying and joining pipe.

B. Valve Boxes

1. Cast iron valve boxes shall be firmly supported and maintained centered and plumb over the operating nut of the valve by the Contractor with box cover flush with the surface of the finished pavement or at such other level as may directed. All valve boxes set in non-paved areas shall have concrete pads poured around the top section of the valve box. The pad shall be 24 inches square or 24 inches in diameter and shall be centered on the valve box. All valve covers shall be cast with the word sewer or the letter S.

3.06 INSTALLATION OF TAPS

A. General

1. All material supplied, and drilling and tapping equipment used to make taps will be in accordance with AWWA Standards.
2. After the tapping sleeve and valve have been installed and before the tap is made, the sleeve will be tested to ensure a watertight joint. A test plug will be provided in the sleeve and after the sleeve has been installed it will be filled with water and the pressure increased between 150 psi and 190 psi. All leaking joints will be repaired to the satisfaction of the Owner's Engineer at the Contractor's expense.

3.07 UNDERGROUND PIPE INSTALLATION – PLANT SITE

A. General

1. All pipe, fittings and appurtenances shall be carefully inspected in the field before lowering into the trench. All pieces found to be defective shall be rejected. Such rejected pipe shall be clearly tagged in such a manner as not to deface or damage it, and the pipe shall then be removed from the job site by the Contractor at his own expense.
2. Results of pipe plant tests shall be submitted to the Engineer prior to installation of the pipe for which such test results were ordered.

3. Any conflicts during the installation of piping shall be brought to the attention of the Inspector. No improvising or field changes will be permitted without the approval of the Engineer.
4. Handling of Pipe and Fittings
 - a. All pipe and fittings shall be carefully handled by equipment of sufficient capacity and proper design to avoid damage to the pipe and fittings. Under no circumstances shall materials be dropped or dumped into the trench. No defective pipe or fittings shall be laid or placed in the system. Any piece discovered to be defective after having been laid shall be removed and replaced by a sound and satisfactory piece at the expense of the Contractor.
5. Preparation
 - a. Each pipe and fitting shall be thoroughly cleaned before it is placed, and it shall be kept clean and dry. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. The entrance of earth into pipe will not be permitted, and the Engineer may require the placing of a heavy canvas bag of suitable size over each end of the pipe before it is lowered into the trench. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.
6. Laying
 - a. Pipe and fittings shall be laid accurately to the lines and grades indicated on the Drawings. Care shall be taken to ensure alignment both horizontally and vertically, and to give buried pipe a firm bearing along its entire length. Pipes shall not be laid in water nor shall water be allowed to flow through them. The Contractor shall take all necessary precautions to prevent floatation of the pipe in the trench.
7. Excavation and Backfilling
 - a. Excavation and backfilling of the pipe trench shall be done as specified in Division 2, SITE WORK.
8. Temporary Plugs
 - a. At all times when pipe laying is not actually in progress, the open ends of pipe shall be closed with temporary watertight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.
9. Pipe Supports
 - a. Install all supports necessary to hold the piping and appurtenances in a firm substantial manner at the lines and grades indicated on the Drawings.
 - b. Where the above anchorage is not feasible the pipe and fittings shall be harnessed as shown on the Drawings.
 - c. All bends, tees, plugs, etc. on pressure main shall be restrained with mechanical joint retainer glands. The mechanical joint retainer glands shall be each side of the fitting using mechanical joint pipe.
 - d. Ductile iron pipe joints and fittings on gravity lines and pressure lines, located within and above the excavated area around a structure shall be restrained with mechanical joint retainer glands. The retainer glands shall be installed at all joints at a minimum 20 feet beyond the limit of the structural excavation.

- e. In fill area or in areas of over excavation around a structure; pipes shall be supported on concrete piers designed for the Contractor by a registered professional engineer. The design calculations for the pipe supports shall be reviewed by the Engineer prior to being installed.
- f. Pipes shall be installed between structures with all necessary fittings required for changes in elevations and direction whether or not shown on the Drawing.
- g. All pipe shall have minimum cover of 2'-6" from finished grade to top of pipe, unless otherwise noted.
- h. Corrosion resistant bolts shall be used for all underground bolted pipe joints.

B. Ductile Iron Pipe

1. Handling

- a. Pipe and accessories shall be handled in such a manner as to insure delivery on the work in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating. No other pipe or material of any kind shall be placed inside of any pipe or fitting any time after the coating has been applied.

2. Cutting

- a. Cutting of pipe shall be done in a neat manner by method which will not damage the pipe. All cutting of pipe shall be done by means of mechanical cutters of an approved type.

3. Placing / Laying

- a. Before lowering and while suspended, the pipe shall be inspected for defects and rung with a light hammer to detect cracks. Any defective, damaged or unsound pipe will be rejected. Pipe shall be laid with the bells facing in the direction of laying and for lines on an appreciable slope bells shall face up-grade.

4. Coupling DIP with Push-On Rubber Gasket Joints

- a. Gasket seat in the socket and the gasket should be wiped with a cloth. The gasket should be placed in the socket with the large round end entering first, then sprung into gasket seat so that the groove fits over the bead in the seat. A thin film of lubricant shall then be applied to the inside surface of the gasket that will come in contact with the entering pipe. Only non-toxic vegetable soap lubricant as recommended by pipe manufacturers shall be used. Mineral oil or petroleum base lubricant shall never be used.
- b. The plain end of the pipe to be entered shall be wiped clean and placed in approximate alignment with the bell of the pipe to which it is to be joined. In some cases it might be desirable to apply a thin film of lubricant to the outside of the plain end for about 1 inch back from the end. After lubrication, the plain end of the pipe should then be lifted and started into the socket so that it is in contact with the gasket. The joint should be made up with entering pipe deflected at an angle.
- c. When pipe is cut in the field, the cut end shall be conditioned so that it may be used to make up the next joint. The outside of the cut end should be tapered back about 1/8 inch at an angle of about 30 degrees with the center line of the pipe by using a coarse file or portable grinder. The operation should remove any sharp, rough edges which otherwise might damage the gasket. Any coating that is damaged shall be repaired in accordance with manufacturer recommendations.

- d. When installing rubber gasket joint pipe in below freezing temperatures, keep lubricant and gaskets workable by leaving them in hot water bath when not actually in use or in a heated storeroom.
 - e. Pipe pulling tools may be rented or purchased from the pipe manufacturer by the Contractor.
 - f. With "Push-On Joints," the joint deflection angle should not exceed 50 % of the amounts recommended by manufacturer.
5. Mechanical Joints
- a. Mechanical joints shall conform to ANSI Std. A21.11, latest issue, be of stuffing box type, adapted for use of a gasket, cast iron gland and bolts.
 - b. In making each mechanical joint, the surfaces with which the rubber gasket comes in contact shall be brushed thoroughly with a wire brush just prior to assembly to remove all loose rust or foreign material and to provide clean surfaces, which should be brushed with soapy water just prior to slipping the gasket over the spigot end and into the bell. Soapy water brushed over the gasket prior to installation also removes loose dirt, and lubricates the gasket as it is forced into its retaining space.
 - c. The sequence of assembly is to be as follows: the gland followed by the rubber gasket is to be placed over the spigot end which is inserted into the socket. The gasket should be pushed into position so that it is evenly seated in the socket. The gland is then moved into position against the face of the gasket. Bolts are then to be inserted and made finger tight.
 - d. When tightening bolts, it is essential that the gland be brought toward the pipe flange evenly maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolts next to the bolts at either side, and last the remaining bolts. This cycle is to be repeated until all bolts are within the following range of bolt torque.

C. Plastic Pipe Installation

- 1. Unloading, Handling and Storage
 - a. Unloading and handling of plastic pipe shall be the responsibility of the Contractor. Do not drop, impact or bump pipe; particularly at ends. When unloading, use pliable straps, slings or rope to lift. Do not use steel cables or chain to lift or transport pipe.
 - b. When transporting pipe, support all pipe sections on cradle conforming to shape of the pipe and spaced on a maximum of 20 foot centers.
 - c. When storing plastic pipe outdoors for extended periods of time, pipe shall be protected from direct exposure to sunlight.
 - d. Plastic pipe and fittings should be stored in such a way so that the surfaces to be mated are protected from physical damage and are kept as clean as possible.
 - e. The pipe shall be stored by providing support at each end and intermediate support at 5 foot intervals along the length of the pipe. The pipe shall be stored in such a way as to prevent sagging or bending.
 - f. Pipe which is found to be defective or is damaged during installation shall be replaced at the Contractor's expense.

2. Joints
 - a. The pipe and fittings shall be joined by the elastomeric gasket system. The joining shall provide a permanent and efficient seal against excessive ex-filtration and infiltration.
 - b. The pipe may be of the "plain end" type to be assembled using couplings or it may be of the "bell and spigot" type wherein the bell is integral to the pipe. For pipe with belled ends, the thickness of the wall in the bell may be considered satisfactory if the bell was formed on pipe meeting the requirements of the applicable standards.
3. Joining Systems
 - a. Elastomeric Joint
 - 1) The critical sealing dimensions of the bell, spigot and gasket should be in accordance with the manufacturer's standard dimensions and tolerances.
 - 2) The elastomeric gasket shall be rubber and shall comply with the physical requirements specified in ASTM D1869.
 - 3) The joint design shall provide for the development by the gasket of an adequate compressive force against the sealing surfaces of the bell and spigot so as to effect a positive seal. The gasket shall be the only element depended upon to make the joint flexible and watertight.
 - 4) Lubricants, if necessary for the assembly of the elastomeric gasket joint, should not support bacterial growth nor have any deteriorating effect on pipe, fitting or gasket materials and should be the type recommended by the pipe manufacturer.
 - 5) The joint should be assembled in accordance with the manufacturer's recommended procedure.
4. Installation
 - a. Plastic piping installation shall be made in accordance with ASTM D2321, "Underground Installation of Flexible Thermoplastic Sewer Pipe".
 - b. Any requests for changes, modifications, exceptions and/or relief of the requirements of these Specifications, relating to procedure, construction method or technique, materials or any other condition, shall be submitted to the Engineer, in writing, and accompanied by supporting plan and documents.
 - c. The pipe shall be bedded true to line and grade with uniform and continuous support from a firm base. Blocking shall not be used to bring the pipe to grade.

3.08 INTERIOR AND ABOVE GROUND PIPE INSTALLATION – PLANT SITE

A. General

1. Any conflicts during the installation of piping shall be brought to the attention of the Inspector. No improvising or field changes will be permitted.
2. All piping shall be installed in such a manner as to obtain sufficient flexibility and to prevent excessive stresses in materials and excessive bending moments at joints or connections to equipment.
3. Full lengths of pipe shall be used wherever possible. Short lengths of pipe with couplings will not be permitted. All pipe shall be cut to exact measurement and shall be installed without forcing or springing unless otherwise shown on the Drawings.

4. Tool marks and unnecessary pipe threads shall be avoided. Burrs formed when cutting pipe shall be removed by reaming. Before installing any pipe, care shall be taken that the inside is thoroughly cleaned and free from cuttings and foreign matter.
5. Where lines are purposely pitched for drainage, an accurate grade shall be maintained. No lines shall be supported in such a manner as to permit deflection due to gravity, sufficient to pocket the lines when full of liquid. All changes in direction shall be made by using pipe and fittings unless otherwise shown on the Drawings.
6. Unions shall be installed in all piping connections to equipment, regulating valves and wherever necessary to facilitate the dismantling of piping and/or removal of valves and other items requiring maintenance. Flanges on equipment may be considered as unions. At least one union shall be provided in every straight run of pipe unless otherwise noted or permitted.
7. Raised face flanges shall not be used to connect to cast-iron flanges. The raised face shall be turned off before use and full face gaskets shall be employed. In general, all service lines shall come off the top of headers and if possible, service lines shall have some slope for drainage.
8. Pipe anchors, expansion joints, loops and bends shall be installed where indicated on the Drawings and as required to properly protect the piping against vibration, misalignment and overstressing.
9. Exposed piping shall be neatly arranged, straight, run parallel to or at right angles to walls and shall be so graded that the entire system can be drained. Drain valves shall be installed at the low points of piping as shown on Drawings.
10. Installed piping shall not interfere with the operations or accessibility of doors or windows and shall not encroach on aisles, passageways and equipment and shall not interfere with the servicing or maintenance of any equipment. Adjacent pipe lines shall be grouped in the same horizontal or vertical plane.
11. Where possible, all piping shall be concealed by installation above ceilings and in pipe ways.

B. Pipe Sleeves, Hangers and Supports

1. Pipe Hangers
 - a. Pipe supports shall be installed in an approved manner.
 - b. Pipe lines close to the floor may be supported from the floor by structural shapes or by poured concrete blocks or piers. In such cases, care shall be taken to avoid blocking floor drainage.
 - c. Building steel as indicated on the Drawings shall be used wherever possible for supporting pipe hangers. Structural members shall not be drilled or welded for hangers.
 - d. Expansion bolts may be used where practicable and as noted on the Drawings.
 - e. All vertical piping shall be properly supported with suitable steel brackets to prevent swinging or sagging.
 - f. Heavy valves or fittings shall be supported by hangers, poured concrete, blocks, or special provisions shall be taken to avoid undue line deflection.
 - g. The maximum spacing of hangers for steel and cast iron piping shall be in accordance with the following table, except where otherwise indicated on the Drawings.

Pipe Hanger Table

h.	All	Pipes	Hanger Rods	Hanger Spacing Center to Center
		1/2 in. and 3/4 in.	3/8 in.	Not more than 6 ft.-6 in.
		1 in. and 1-1/4 in.	3/8 in.	Not more than 8 ft.-0 in.
		1-1/2 in. and 2 in.	1/2 in.	Not more than 10 ft.-0 in.
		3 in and 4 in	1/2 in	Not more than 14 ft.-0 in.
		6 in. and 8 in.	5/8 in.	Not more than 16 ft.-0 in.
		10 in. and larger	3/4 in.	Not more than 20 ft.-0 in.

hangers of different services running parallel with and near each other shall be installed parallel to the lines of the building.

2. Pipe Supports

a. Adjustable Pipe Supports

- 1) Cast iron type shall consist of a factory assembled nipple and reducer and a pipe saddle. A minimum adjustment shall be possible with the reducer. Support pipe and flange shall also be included.
- 2) Steel pipe supports, optional type should be made of following materials: the saddle to be cut to size from heavy steel and forged to shape. Supporting column is steel pipe with an ANSI 125 pound companion flange to form the base. Adjustable support shall consist of shank of threaded solid steel rod. Adjustment shall be by means of heavy steel nut mounted on reinforced malleable iron cap screwed to top of support column.

3. Wall Castings

- a. Castings shall be placed in position before the concrete is poured to insure a water-tight connection between wall and casting. Pipe lines should be connected to wall casting after concrete has cured.

C. Plastic Pipe

1. Socket Solvent Welding for Jointing

- a. Field cut pipe must be cut square and de-burred. Remove dust and dirt from mating surfaces.
- b. Use solvent cement recommended by PVC pipe manufacturer.
- c. Apply thin coating of solvent to inside of socket, over entire mating surface.
- d. Apply liberal coating of solvent over spigot end, equal to socket depths making sure that entire mating surface is covered.
- e. Immediately, while surfaces are still wet, push spigot end of pipe into socket until spigot reaches socket bottom. Hold in place until surfaces are firmly bonded (5 to 15 seconds normally).
- f. Allow 4 hours cure time before testing.

D. Ductile Iron Pipe Installation

1. Flanged Pipe

- a. All flanges shall have standard drilling, ANSI Class 125. All flanged joints shall be firmly bolted with machine bolts; however, where valves or specials are attached to a flanged pipe, stud or tap bolts may be used, providing the number used and diameter for each joint is the same for each respective size of pipe or special or valve as recommended by the manufacturer's standards for flange drilling. If studs are used, holes shall be tapped entirely through the flange and studs shall be of sufficient length to extend entirely through the thickness of two flanges and one end provided with a nut. All bolts shall be of ASTM A307 carbon steel of sufficient length to pass through two flanges and the threads shall be ANSI. Bolt heads shall be cut square and nuts hexagonal in shape with both the heads and the nuts being chamfered.

PART 4 – TESTING

4.01 GENERAL

- A. All pipe testing shall be performed by Contractor at his expense in presence of Engineer as follows:
 1. Gravity and drain piping tests shall be performed before backfilling to measure joint tightness. Basic minimum internal head of 30 psi.
 2. Force Mains and process piping shall be tested for leakage in accordance with AWWA Standard C600 Latest Edition for DI pipe and AWWA Standard M23 Latest Edition for PVC pipe. (No leakage will be permitted inside or under buildings or structures.). Test pressure shall be at a minimum 150 psi.
 3. Allowable leakage, for force mains and process piping outside buildings or structures, shall conform to limits indicated in applicable table in AWWA Std. C600 Latest Edition for DI pipe and AWWA Standard M-23 Latest Edition for PVC. Test pressure shall be at a minimum 150 psi.
 4. All other pipes not listed shall be tested to 50 percent above normal operating pressure but not less than 50 psi. (No leakage will be permitted inside or under buildings or structures).
 5. The Contractor shall provide a certification of all pipe tests. Duration of tests shall be at minimum two (2) hours.

PART 5 – SPECIFICATION SHEETS

- A. Piping Specifications shall be as follows:

Service: **Water, sewage or other liquids - 200 psig at 150°F maximum.**
 Above Grade Piping Installations.

Pipe: Ductile Iron - Grade 60-42-10 in accordance with ANSI/AWWA C151/A21.51, latest revision

3”- 64” = AWWA C150 and C151 pressure class 250

Pipe Joints: Ductile Iron Cast-On-Flange in accordance with ANSI/AWWA

A21.10/C110 and/or threaded-on-flange in accordance with ANSI/AWWA
A21.15/C115. Bolt holes and bolt circles shall match those of ANSI B16.1
Class 125 flanges and ANSI B16.5 Class 150 flanges.

Gaskets: 1/8" thick red rubber ring gaskets or American Cast Iron Pipe Company,
Toruseal* gaskets designed for AWWA C110 or C115 flanges.

Pipe Line Couplings: Plain-end to plain-end pipe couplings shall utilize a steel cylindrical
middle ring, two resilient gaskets, two follower rings and a set of trackhead bolts. The couplings shall
be specifically coated for underground service. The couplings shall be Dresser* style 38 or equal.

3" to 12" plain-end pipe to valve couplings shall utilize Dresser*~ Style 127 cast iron flanges
adapters. 14" to 24" plain end to valve couplings shall utilize Dresser* style 128 steel flanged
adapters.

Other field made flanged connections shall utilize cast iron set screw type flange adapters.

Fittings: Fittings shall be 250 PSI pressure rated, Ductile Iron flanged in accordance with
ANSI/AWWA A21.1/C110 or ANSI/AWWA A21.53/C153. Flanges shall have facing and drilling to
match AWWA C115 and ANSI B16.1 Class 125 flanges.

Wall Pipe: Wall pipes shall be integrally cast with wall collars or shall be shop
fabricated with full length penetration weld-on collars. All wall pipes shall
be designed for use in thrust and load bearing conditions.

Service: **Water, sewage or other liquids - 200 psig at 150°F maximum.**
Below Grade Piping Installations.

200 psig to 150°F - Lined pipe

Laying condition - Type 2 per ANSI/AWWA C151/A21.51.

Pipe: 3" – 12" dia. - ductile iron – Pressure Class 350

14" – 20" dia. - ductile iron – Pressure Class 250'

24" – 64" dia. – ductile iron – Pressure Class 200

60,000 psi tensile, 42,000 psi yield, 10% elongation, ANSI/AWWA
C151/A21.51 (see Note 2 - Remarks)

Fittings: 250 psi rating, ductile iron, mechanical joint in accordance with
ANSI/AWWA C110/A21.10

Pipe Connections: Push-on joint in accordance with ANSI/AWWA C111/A21.11, Sections 11-7 and 11-8.

Gaskets: To be of type and materials as recommended by pipe supplier for service indicated on drawings.

Bolting: To be of type recommended by pipe supplier of material with minimum 45,000 psi tensile, with semi-finished heavy nuts in accordance with ANSI/AWWA C111/A21.11

Remarks: 1. Required Marking: Each piece, pressure rating, metal thickness, weight, manufacturers name, letters D.I. or ductile and length.

A. Valve Specifications shall be as follows:

ENGINEERING STANDARD

ISSUED	05/11/83	VALVE SPECIFICATION SHEET	V-513
REVISED	08/30/21		

Type: Gate (Resilient Seated)

Rating: 250 PSI Working Water Pressure – to meet or exceed AWWA C509 requirements

Ends: Mechanical Joint – AWWA Spec. C111 and ANSI A21.11

Body: Cast Iron, ASTM A-126

Bonnet: Cast Iron, ASTM A-126

Body & Bonnet Bolting: ASTM A-307, Gr. B

Disc: Cast Iron with Resilient Seat of SBR, Nitrile, or Buna 'N' Rubber

Stem: Bronze with Bronze Nut Independent of Gate (Non-Rising)

Seat: Resilient Seated Gate

Seals (or Packing): O-Ring Stem Seals, S.S., Delrin, Teflon or Polymer Thrust Washers

Operator: 2" AWWA Operating Nut

Service: Water or Wastewater

Remarks: Valve shall be furnished with valve box, tee wrench and all accessories for proper installation.

ACCEPTABLE VALVE EQUIVALENTS

MANUFACTURER	FIG. NO.	SIZE RANGE	REMARKS
Clow	F-6100	2" – 30"	Valve shall meet or exceed these minimum painting requirements; epoxy coated inside, AWWA outside.
Kennedy	Ken-Seal	2" – 12"	

American Flow Control	Series 2500	2" – 36"
M&H Valve	Series 4067	2" – 24"

END OF SECTION

SECTION 33 14 16

SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 – GENERAL

1.01 SCOPE

- A. This Section describes products to be incorporated into the water distribution system and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.
- B. It is the intent of these specifications to provide information supplemental to the contents of the construction drawings on the quality of materials, execution, measurement, etc. These specifications are general in nature and may contain products and requirements which are not applicable to the project. Discrepancies between these specifications and the construction drawings, either imagined or real, shall be brought to the attention of the Owner for clarification.

1.02 DESCRIPTION OF WORK

- A. Extent of work is shown on the drawings.
- B. Domestic water system work includes but is not limited to: Water mains, fire hydrants, valves, service connections and appurtenances.
- C. Comply with the requirements of applicable sections for excavation and backfilling required in connection with water distribution system work.
- D. Comply with requirements of Paragraph 2.13 of this section for concrete work required in connection with water distribution system work.
- E. Contractor is advised that existing water mains may be of various pipe materials, including asbestos cement. The Contractor shall be responsible for protection of existing water mains during construction and shall be responsible for repairing any pipes damaged during construction. Repair sections shall be PVC or ductile iron. The Contractor shall comply with all work site, air emission, solid waste and personal safety and protection regulations as related to the excavation, exposure, cutting, handling, containment and disposal of existing water main pipe material.
- F. The removal, encapsulation or enclosure, storage and disposal of pipe materials containing asbestos shall be in accordance with American Water Works Association Manual of Water Supply Practices No. M16 “Work Practices for Asbestos – Cement Pipe”; 29 CFR 1910.19; 29 CFR 1926.1101, Appendix F; Asbestos NESHAP (40 CFR 61, Subpart M); 40 CFR 763, Appendix D; and all other industry and regulatory requirements.

1.03 QUALITY ASSURANCE

- A. Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction and the applicable standards of the American Water Works Association (AWWA).

- B. Testing and Inspection Service
 - 1. Employ, at Contractor's expense, testing laboratory to perform bacteriological testing of water mains.
 - 2. It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Owner, testing service, and applicable agency inspectors 48 hours in advance of testing and inspections.
 - 3. Hydrostatic test shall be completed by the Contractor in the presence of the Owner or Owner's representative.
- C. The manufacturer shall provide written certification to the Owner that all products furnished comply with all applicable requirements of these Specifications.

1.04 SUBMITTALS

- A. Prior to construction commencing, the Contractor shall submit for approval by the Owner manufacturer's certifications and cut sheets for the following items:
 - 1. Fire hydrant assemblies
 - 2. Valves
 - 3. Water main pipe
 - 4. Fittings
 - 5. Water services
 - 6. Water meters
 - 7. Tapping sleeves
 - 8. Other appurtenances
- B. Qualifications: If requested by the Owner, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.
- C. Test Reports: Submit Bacteriological Test Reports directly to the Owner's Engineer from the testing services with copy to Contractor.

1.05 EXISTING UTILITIES AND OBSTRUCTIONS

- A. The Drawings indicate utilities or obstructions that are known to exist according to the best information available to the Owner. The Contractor shall call Alabama 811. (1-800-292-8525), as required by Alabama Law and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site, at least 72 hours (three business days) prior to construction, to verify the location of the existing utilities.
- B. Conflict with Existing Utilities
 - 1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed water main does not permit safe installation of the water main by the use of sheeting, shoring, tie-back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the water main to avoid horizontal conflicts, if the new

alignment remains within the available right-of-way or easement, complies with regulatory agency requirements, and after a written request to, and subsequent approval by the Owner. If, in the opinion of the Owner, the water main's proposed location cannot be adjusted, thus requiring the relocation of an existing utility, the Owner will direct the Contractor to relocate the utility as part of the Contract with the costs of such relocation being paid for as part of a change order.

2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed water main does not permit the crossing without immediate or potential future damage to the utility, main, service, or the water main. The Contractor may change the proposed grade of the water main to avoid vertical conflicts if the changed grade maintains adequate cover and complies with regulatory agencies requirements after written request to and subsequent approval by the Owner. If, in the opinion of the Owner, the water main's proposed location cannot be adjusted, thus requiring the relocation of an existing utility, the Owner will direct the Contractor to relocate the utility as part of the Contract with the costs of such relocation being paid for as part of a change order.

- C. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipe lines or other obstructions.

D. Water Main Separation Requirements

1. Water mains constructed as part of this project shall be laid to provide a minimum horizontal distance of at least three feet between the outside of the water main and the outside of any existing or proposed vacuum-type sanitary sewer, storm sewer, storm water force main, or pipeline conveying reclaimed water. A horizontal distance of at least six feet shall be provided between the outside of the water main and the outside of any existing or proposed gravity-type sanitary sewer, pressure-type sanitary sewer, wastewater force main, or pipeline conveying reclaimed water. A horizontal distance of at least ten feet shall be provided between the outside of the water main and all parts of any existing or proposed "on-site sewage treatment and disposal system".
2. Water mains constructed as part of this project, that will cross any existing or proposed gravity- or vacuum-type sanitary sewer or storm sewer will be laid so the outside of the water main is at least six inches above the other pipeline or at least 12 inches below the other pipeline. Water mains that will cross any existing or proposed pressure-type sanitary sewer, wastewater or storm water force main, or pipeline conveying reclaimed water will be laid so the outside of the water main is at least 12 inches above or below the other pipeline.
3. At the utility crossings described above, one full length of water main pipe will be centered above or below the other pipeline so the water main joints will be as far as possible from the other pipeline or the pipes will be arranged so that all water main joints are at least three feet from all joints in vacuum-type sanitary sewers, storm sewers, or storm water force mains, and at least six feet from all joints in gravity or pressure-type sanitary sewers, wastewater force mains, or pipelines conveying reclaimed water.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All materials shall be new and unused. They shall be of standard, first grade quality and intended for the use for which they are offered. Materials or equipment which, in the opinion of the Owner, are inferior or of a lower grade than indicated, specified, or required will not be accepted.

2.02 WATER MAINS

- A. Ductile Iron Pipe (DIP)
 - 1. Ductile iron pipe shall be manufactured in accordance with AWWA C151. All pipes, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes will be as shown on the Drawings. All pipes shall be Pressure Class 250 and have corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings.
 - 2. Pipe and fittings shall be cement lined in accordance with AWWA C104. Pipe and fittings shall be furnished with a bituminous outside coating.
 - 3. Fittings shall be ductile iron and shall conform to AWWA C110 or AWWA C153 with a minimum rated working pressure of 250 psi.
 - 4. Joints: Unless shown or specified otherwise, joints shall be push-on or restrained joint type for pipe and standard mechanical, push-on or restrained joints for fittings. Push-on and mechanical joints shall conform to AWWA C111. No field welding of restrained joint pipe will be permitted. Restraining gasket joints shall be assembled with American Fast-Grip gaskets or US Pipe FIELD LOK gaskets.
 - 5. Provide the appropriate gaskets for mechanical and flange joints. Gaskets for flange joints shall be made of 1/8-inch thick, cloth reinforced rubber; gaskets may be ring type or full face type. The gasket for a standard push-on or mechanical joint, shall be of BUNA-5, vulcanized styrene rubber (SBR) and in accordance with AWWA C111.
 - 6. Bolts and Nuts
 - a. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit. All bolts and nuts shall be made in the U.S.A.
 - b. Bolts and nuts for mechanical joints shall be Tee Head Bolts and nuts of high strength low-alloy steel in accordance with ASTM A 242 to the dimensions shown in AWWA C111/ANSI A21.11.
 - c. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A 307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A 563. Zinc plating shall conform to ASTM B 633, Type II.
 - 7. Mechanical joint glands shall be ductile iron.
 - 8. Thrust collars shall be welded-on ductile iron body type designed to withstand thrust due to 250 psi internal pressure on a dead end.
 - 9. Ductile iron pipe shall be encased in polyethylene film where shown on the Drawings. Polyethylene film shall have a minimum thickness of 8 mils and shall meet the requirements of AWWA C105.
 - 10. Acceptance will be on the basis of the Owner's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

11. Ductile iron pipe exterior shall have continuous blue stripe if applied during manufacturing, the stripe is parallel that runs parallel to the axis of the pipe, that is located at no greater than 90 degree intervals around the circumference of the pipe, and that will remain intact during and after pipe installation. If tape or paint is used to stripe pipe during installation of the pipe, the tape or paint shall be applied in a continuous line that runs parallel to the axis of the pipe and that is located along the top of the pipe.
- B. Polyvinyl Chloride (PVC) Pipe
1. Smaller than 4-inch Pipe: All PVC pipe and fittings less than four inches in diameter shall be manufactured in accordance with ASTM D2241, with a standard dimension ratio (DR) of 21, rated pressure 200 psi, and bear the National Sanitation Foundation Seal for potable water pipe.
 2. 4-inch and Larger Pipe: PVC pipe shall be manufactured in accordance with AWWA C900, latest edition. Pipe shall be pressure class 235 and must meet dimension requirements of dimension ratio (DR) 18 and shall bear the National Sanitation Foundation seal for potable water pipe.
 3. Joints: Joints shall be "push-on" and shall meet all requirements of ASTM D3139. Each bell shall be an integral wall section joint assembly using elastomeric gasket seals. All gaskets shall meet all requirements for performance as specified by ASTM F477.
 4. Pipe Marking: All pipe shall be marked as prescribed in ASTM D2241 (e.g., nominal pipe size, type of plastic pipe material, pipe dimension ratio, pressure rating, ASTM specification designation number, manufacturer's name and code), and the National Sanitation Foundation Seal for potable water.
 5. PVC Pipe for water lines shall be blue.
 6. Acceptance will be on the basis of the Owner's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards, including the National Sanitation Foundation. Additionally, each piece of pipe shall be stamped "NSF Approved".

2.03 FITTINGS (3-inch and Larger)

- A. General: Fittings three inches and larger shall be ductile iron manufactured in accordance with ANSI/ AWWA C110/ A21.10 or C153/ A21.53. The minimum pressure rating for fittings shall be 250 psi.
- B. Coating: All fittings furnished with bituminous outside coating and shall be cement mortar lined and coated in accordance with AWWA C104.
- C. Anchoring Devices
1. All anchoring devices shall be suitable for use with mechanical joint fittings meeting AWWA C110 and/ or AWWA C111.
 2. All anchoring devices shall be constructed of ductile iron (at least ASTM A536 Grade 70-50-05) and manufactured in accordance with AWWA C110 and/ or C111.
 3. All anchoring devices shall have a sufficient number of set screws so as to properly restrain various fittings or pipes at the rated pressure without the need for additional thrust restraint.

D. Retainer Glands

1. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Glands shall be manufactured of ductile iron conforming to ASTM A536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI A21.11 and ANSI/AWWA C153/ A21.53, latest revision. Twist-off nuts shall be used to insure proper actuating of the restraining devices.
2. Retainer glands for ductile iron pipe shall be Megalug Series 1100, as manufactured by EBAA Iron, Uni-Flange Series 1400, as manufactured by Ford Meter Box Company, or Star Pipe Products Star-Grip Series 3000.
3. Retainer glands for polyvinyl chloride pipe shall be Megalug Series 2000 PV, as manufactured by EBAA Iron, Inc.

E. Push-on Restraints

1. Push-on joint restraints shall be Fast-Grip Gasket by American Ductile Iron Pipe Co., or equal.
2. Bell harness restraints shall be Megalug Series 2500 by EBBA Iron or equal.

2.04 GATE AND TAPPING VALVES

- A. Smaller than 2-Inches in Diameter: Gate valves shall be bronze, heavy duty, rising stem, wedge type with screwed or union bonnet. Valve ends shall be threaded type. Valves shall have a minimum 200 psi working pressure for water (125 psi working pressure for steam). Valves shall be made in the U.S.A. Gate valves shall be Crane No. 428 (threaded).
- B. 2-Inches through 36-Inches in Diameter: Gate valves shall be resilient seat wedge encapsulated with EPDM rubber type conforming to the requirements of AWWA C509 or AWWA C515 rated for 200 psi working pressure.
 1. Valves shall be provided with two O-ring stem seals with one O-ring located above and one O-ring below the stem collar. The area between the O-rings shall be filled with lubricant to provide lubrication to the thrust collar bearing surfaces each time the valve is operated. At least one anti-friction washer shall be utilized to further minimize operating torque. All seals between valve parts, such as body and bonnet, bonnet and bonnet cover, shall be flat gaskets or O-rings.
 2. The valve gate shall be made of cast or ductile iron having a vulcanized, synthetic rubber coating, or a seat ring attached to the disc with retaining screws. Sliding of the rubber on the seating surfaces to compress the rubber will not be allowed. The design shall be such that compression-set of the rubber shall not affect the ability of the valve to seal when pressure is applied to either side of the gate. The sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction.
 3. All internal ferrous surfaces shall be coated with epoxy to a minimum thickness of 4 mils. The epoxy shall be non-toxic, impart no taste to the water and shall conform to AWWA C550.

4. Stem nuts shall be independent of wedge and shall be of solid bronze conforming to ASTM B62.
5. All valves shall open by turning a two-inch square operating nut counterclockwise.
6. Gate Valve: Joints shall be mechanical joints and shall conform to AWWA C111, and all bolts and nuts for mechanical joints shall be high-strength, low-alloy steel in accordance with AWWA C111. All gaskets shall be for a standard mechanical joint of BUNA-S (SBR Buna) in accordance with ANSI/ AWWA C111/ A21.4. All mechanical joint accessories shall be furnished with the valves.
7. All tapping valves shall have flange-by-mechanical joint ends.
8. All valves shall be furnished with operating nuts.
9. One operating wrench will be provided for each five valves furnished; at least one wrench shall be supplied.
10. All tapping valves shall be interchangeable with other makes of tapping sleeves.
11. Approved models are:
 - a. American Flow Control Series 2500 Resilient Wedge Valve
 - b. M & H C515
 - c. Mueller Company A-2362-78 Resilient Wedge Gate Valve with Aqua Grip
 - d. AVK Resilient Seated Gate Valve Series 65

2.05 BUTTERFLY VALVES

- A. Butterfly valves shall be resilient seated, short body design, and shall be designed, manufactured, and tested in accordance with all requirements of AWWA C504 for Class 150B.
- B. Valve bodies shall be ductile iron conforming to ASTM A 536, Grade 65-45-12 or ASTM A 126, Grade B cast iron. Shafts shall be ASTM A 276, Type 304 stainless steel, machined and polished. Valve discs shall be ductile iron, ASTM A 536, Grade 65-45-12 or ASTM A 126, Grade B cast iron. The valve shall have an EPDM seat.
- C. Valves shall be installed with the valve shafts horizontal. Valves and actuators shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water. Actuator mounting brackets shall be totally enclosed and shall have gasket seals.
- D. Actuators
 1. Valves shall be equipped with traveling nut, self-locking type actuators designed, manufactured and tested in accordance with AWWA C504. Actuators shall be capable of holding the disc in any position between full open and full closed without any movement or fluttering of the disc.
 2. Actuators shall be furnished with fully adjustable mechanical stop-limiting devices. Actuators that utilize the sides of the actuator housing to limit disc travel are unacceptable.
 3. Valve actuators shall be capable of withstanding a minimum of 450 foot pounds of input torque in either the open or closed position without damage.
- E. Operators: Valves for buried service shall have a nut type operator and shall be equipped with a valve box and stem extension, as required.

- F. Valve ends shall be mechanical joint type, except where flanged or restrained joint ends are shown. Flange joints shall meet the requirements of ANSI B16.1, Class 125.
- G. Butterfly valves shall be manufactured by Mueller, M & H Valve, DeZurik, Val-Matic, or Pratt.

2.06 TAPPING SLEEVES

- A. General
 - 1. Tapping sleeves shall be full circle, constructed of stainless steel and in two halves.
 - 2. All tapping sleeves shall be Smith Blair #662 or equal.
- B. The Contractor shall be responsible for determining the outside diameter of the pipe to be connected to prior to ordering the sleeve.

2.07 TAPPING SADDLES

- A. General
 - 1. Tapping saddles shall be constructed of heavy gray cast iron or ductile iron, with the attachment straps, nuts, and washers constructed of corrosion-resistant, alloy steel in accordance with AWWA C111.
 - 2. All tapping saddles shall be Smith Blair #317 or equal.
 - 3. Tapping saddles 3" and larger shall have a 3/4" threaded test port with plug for pressure testing on the tapping saddle and the tap valve.

2.08 FIRE HYDRANT

- A. All fire hydrants shall conform to the requirements of AWWA C502 for 150 psi working pressure. Hydrants shall be the compression type, closing with line pressure. The valve opening shall not be less than 5-1/4-inches.
- B. In the event of a traffic accident, the hydrant barrel shall break away from the standpipe at a point above grade and in a manner which will prevent damage to the barrel and stem, preclude opening of the valve, and permit rapid and inexpensive restoration without digging or cutting off the water.
- C. The means for attaching the barrel to the standpipe shall permit facing the hydrant a minimum of eight different directions.
- D. Hydrants shall be fully bronze mounted with all working parts of bronze. Valve seat ring shall be bronze and shall screw into a bronze retainer.
- E. All working parts, including the seat ring shall be removable through the top without disturbing the barrel of the hydrant.
- F. The operating nut shall match those on the existing hydrants. The operating threads shall be totally enclosed in an operating chamber, separated from the hydrant barrel by a rubber O-ring stem seal and lubricated by a grease or an oil reservoir.

- G. Hydrant shall be a non-freezing design and be provided with a simple, positive, and automatic drain which shall be fully closed whenever the main valve is opened.
- H. Hose and pumper connections shall be breech-locked, pinned, or threaded and pinned to seal them into the hydrant barrel. Each hydrant shall have two 2-1/2-inch hose connections and one 4-1/2-inch pumper connection, all with National Standard threads and each equipped with cap and non-kinking chain.
- I. Hydrants shall be furnished with a mechanical joint connection to the spigot of the 6-inch hydrant lead.
- J. Minimum depth of bury shall be 3.5 feet. Provide extension section where necessary for proper vertical installation and in accordance with manufacturer's recommendations.
- K. All outside surfaces of the barrel above grade shall be painted with enamel equal to Koppers Glamortex 501 in a color to be selected by the Owner.
- L. Hydrants shall be traffic model and shall be American Flow Control B-84-B, Mueller Super Centurion, AVK Dry Barrel Hydrant Series 2780, or M & H Valve 929.
- M. Placements of fire hydrants
 - 1. Residential area; spacing shall be every 500 ft.
 - 2. Rural area; spacing shall be every 1,000 ft., or determined on a case by case basis.

2.09 VALVE BOXES AND EXTENSION STEMS

- A. Valve boxes shall be provided for all buried valves. Valve boxes shall be one complete assembled unit composed of the valve box and extension stem. All moving parts of the extension stem shall be enclosed in a housing to prevent contact with the soil. Valve box assembly shall be adjustable to accommodate variable trench depths.
- B. Covers shall have "WATER VALVE" or "WATER" cast into them. Valve boxes shall be manufactured in the United States.
- C. The stem assembly shall be of a telescoping design that allows for variable adjustment length. The material shall be galvanized square steel tubing. The stem assembly shall have a built-in device that prevents the stem assembly from disengaging at its fully extended length. The extension stem must be capable of surviving a torque test to 1000 ft-lb without failure. Valve box shall be equal to American's trench adapter.
- D. Valve box collars shall be poured in place concrete.

2.10 VALVE MARKERS

- A. The Contractor shall provide a Carsonite Utility Markers or approved equivalent with U.V. resistant decal for each valve installed. Valve decal shall be stamped "CAUTION WATER VALVE".

2.11 HYDRANT TEES

- A. Hydrant tees shall be mechanical joint anchoring tee or mechanical joint tee with anchor coupling.

2.12 CONCRETE

- A. Concrete shall have a compressive strength of not less than 4,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5-inches.
 - 1. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60. The thrust box shall not be poured over bolts or in such a way to prevent bolt removal.

2.13 DETECTION TAPE

- A. Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket.
- B. Tapes shall be color coded in accordance with APWA color codes with the following legends: Water Systems, Safety Precaution Blue, "Caution: Water Line Buried Below". Colors may be solid or striped. Tape shall be permanently printed with no surface printing allowed.
- C. Tape width shall be minimum 2-inches when buried less than 10-inches below the surface. Tape width shall be minimum 3-inches when buried greater than 10-inches and less than 20-inches.
- D. Detection tape shall be equal to Lineguard Type III Detectable or Allen Systems Detectatape.
- E. In addition, the Contractor shall furnish and install 10 gauge coated copper tracing wire.

2.14 FLUSHING HYDRANTS

- A. Flushing hydrants shall be Safety-Guard Bacteriological Sampling Station model SG-BSS-01.

2.15 WATER SERVICES

- A. It is the intent of these Specifications that the water service connections shall duplicate those presently provided by the Owner in order to be compatible with their service maintenance procedures. All materials shall be NSF 61 "Approved".
- B. All materials installed under this Section shall have the approval of the NSF for water services.
- C. Residential Service

1. Contractor will install water service lines between the water main and existing right-of-way, terminating at the right-of-way with a curb stop. Water service separations between storm sewer and sanitary sewer shall be the same as for water mains.
2. Tubing: Water service tubing shall be polyethylene Class 200, SDR9 manufactured in accordance with AWWA C902.
3. Curb Stop shall be B11-233W ball valve as manufactured by Ford Meter Box Company, Inc. Curb stop shall have wings for locking the valve in the closed position.
4. Corporation Stop shall be Ford B-11-333.
5. Gate Valve
 - a. Gate valves shall be bronze, heavy duty, rising stem, wedge type with screwed or union bonnet.
 - b. Valve ends shall be threaded or solder type as appropriate.
 - c. Valves shall have a minimum 200 psi working pressure for water (125 psi working pressure for steam).
 - d. Valves shall be made in the U.S.A.
 - e. Gate valves shall be equal to Crane No. 428 (threaded) or Crane No. 1334 (solder end).
6. Fittings shall be manufactured of brass, cast with full port of full open valve and machined in accordance with AWWA C800.
7. Service Saddle shall be Smith Blair 313 Iron, Double Strap.
8. Meter Box
 - a. Meter boxes shall be plastic or polymer concrete. Material shall meet or exceed the following:

Tensile Strength	3,400 psi	(ASTM D 638)
Flexural Modulus	191,000 psi	(ASTM D 790)
Impact Strength, Izod	0.6 feet 16/inch	(ASTM D 256)
Deflection Temperatures	200 degrees F	(ASTM D 648)
 - b. Plastic meter boxes shall be equal to Ametek, Plymouth Products Division or Brooks Products, Inc.
 - c. Traffic rated polymer concrete meter boxes for driveways, roads and sidewalks shall be equal to Glasmaster Tuff Box Series.
 - d. Meter box shall be fitted with a plastic cover with touch-read pads.
 - e. Minimum dimensions shall be 10-3/4 x 16-inches top and 18-1/2 x 13-1/4-inches at bottom and 18-inches deep.
9. Water meters are not to be furnished; however, the water meter connection must be compatible with the water meters currently used by the Owner.
10. Backflow Preventers: Shall be furnished and installed by Contractor/Developer and be owned and maintained by Customer.
 - a. Backflow preventers shall be rated for operation with inlet water pressures up to 175 psig and water temperatures up to 140-1/2 degrees F.
 - b. Backflow preventers shall be tested and certified in accordance with ASSE 1013 and AWWA C506 and C511.
 - c. Provide with bronze body construction, rubber check valve and relief valve assemblies, and Clecon check seats.
 - d. Provide bronze ball body valve test cocks.
 - e. Provide bronze body strainer on the inlet of each backflow preventer.

- f. Acceptable Manufacturers: Watts Series 909, Wilkins, Hersey.
 - g. Residential dual check valve backflow preventers shall be equal to Apollo Valve 4N-355-4A Dual Check Valve.
 - h. RPZ backflow preventer shall be Watts Model 909 or approved equal.
11. Locate wire shall be Number 10, coated.

D. Commercial Service

- 1. A commercial service shall be constructed similar to a watermain or residential service base on the size requirement. Regardless of size, a commercial service shall include a backflow preventer.
- 2. Provide isolation valves on the inlet and outlet of each backflow preventer for maintenance. These valves shall be quarter turn, full port, resilient seated, bronze ball valves.

2.16 VALVE AND METER VAULTS

- A. Valve and meter vault walls shall be made up of precast concrete sections. The top and bottom sections shall also be precast unless shown otherwise or approved by the Engineer.
- B. All coarse aggregate shall be made from 100 percent calcareous rocks. The contractor shall furnish manufacturer's certificate stating the type of aggregate used in the manufacture of the valve vault.
- C. The materials shall conform to the following standards:
 - 1. Concrete shall be 4000 psi using ASTM C150 Type 11 cement.
 - 2. Wire mesh shall conform to ASTM A185.
 - 3. Reinforcing rods shall be ASTM A615 grade 60.
- D. The top slab shall be cast with the access hatch in place. Access hatch shall be as specified on the drawings.

PART 3 – EXECUTION

3.01 HANDLING PIPE

- A. General
 - 1. All material, unless otherwise directed, shall be unloaded at the job site and distributed at the site of the project by the Contractor.
 - 2. Materials shall be handled with care to avoid damage. In loading and unloading, pipe shall be lifted by hoists or slid or rolled on skids in such a manner as to avoid shock. Under no circumstances shall pipe be dropped.
 - 3. Pipe handled on skids must not be allowed to roll against pipe already on the ground.
 - 4. The Contractor shall be responsible for the safe handling of all materials. Damaged materials will be rejected by the Owner.

- B. Pipe shall be handled so as to avoid damage to the coating and lining. If, however, any part of the coating or lining is damaged by the Contractor, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Owner before installation.
- C. Pipe shall be distributed on the site of the work parallel with and opposite or near the place it is to be laid in the trench, and with bell ends facing the directions in which the installation will proceed unless otherwise directed.
- D. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.
- E. No pipe shall be strung further along the route than 1,000 feet beyond the area in which the Contractor is actually working without written permission from the Owner. The Owner reserves the right to reduce this distance to a maximum distance of 200 feet in residential and commercial areas based on the effects of the distribution to the adjacent property owners.
- F. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.
- G. No distributed pipe shall be placed inside drainage ditches.
- H. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than five feet from the roadway pavement, as measured edge-to-edge.

3.02 INSTALLATION OF PIPE

- A. General
 - 1. Upon satisfactory installation of the pipe bedding, as specified in the "Earthwork for Utilities" section of these specifications, a continuous trough for the pipe barrel and recesses for the pipe joints shall be excavated by hand digging so that, when the pipe is laid in the trench true to line and grade, the pipe barrel will receive continuous, uniform support, and the joint will receive no pressure from the trench bottom.
- B. The interior of all pipe shall be thoroughly cleaned of all foreign material before being lowered into the trench and shall be kept clean during laying operations by means of plugs or other approved methods.
- C. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench, piece by piece, by means of hoisting apparatus, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to pipe, pipe coating, and pipe lining. Under no circumstances shall pipe or accessories be dropped, dumped or rolled into the trench from finished ground level.
- D. The gasket material for each joint shall be properly positioned before the pipe is lowered into the trench. The joining of the pipe shall proceed in accordance with the manufacturer's requirements.

- E. Watertight plugs shall be installed in the open ends of the pipe at all times when pipe laying is not in progress. At no time shall trench water be permitted to enter pipe.
- F. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe. Wherever it is necessary to cut gray or ductile cast iron pipe which is equipped with a push-on joint type bell end, the cut end of the pipe shall be adequately beveled so as to prevent the edge of the cut pipe from cutting or tearing the gasket as the plain end is inserted into the bell of the adjoining pipe or fitting. All field-cut pipe shall be beveled by the Contractor, and the pipe "short" shall be used as part of the pipeline construction.
- G. Whenever necessary to deflect pipe after proper homing from a straight line, either in the vertical or horizontal plane to avoid obstructions, the maximum allowable deflection shall be in accordance with 75% of manufacturers recommendation.
 - 1. Only after the pipe has been properly homed will it be allowed to deflect.
- H. No pipe shall be laid in water or when the trench conditions or the weather is unsuitable for such work.
- I. All water lines and services shall be located a minimum of 36 inches below grade unless noted otherwise on the drawings.
- J. Any pipe which is disturbed or found to be defective after laying shall be removed and re-laid or replaced.
- K. Prior to connecting new work to existing lines or appurtenances, the Contractor shall verify location and elevation of existing connection point and notify Owner of any conflicts or discrepancies.
- L. Joints
 - 1. Before laying the pipe, all lumps, blisters, and excess coal tar coating shall be removed from the bell and plain ends of each length of pipe. The pipe ends shall then be wire brushed and wiped until clean and dry. Where mechanical joints or push-on joints are specified, oil and grease also shall be removed. Pipe ends shall be kept clean until joints are made. The plain end of pipe for mechanical joints shall be lubricated with a soapy solution before installing the gaskets.
 - 2. In making up the push-on type joint, the gasket shall be placed in the socket per manufacturer's recommendation. A thin film of lubricant (approved by the pipe manufacturer) shall then be applied to the inside surface of the gasket that will come in contact with the entering pipe. The plain end of the pipe to be entered shall be thoroughly cleaned and placed in alignment with the bell of the pipe to which it is to be joined. The joint shall be made by exerting sufficient force on the entering pipe so that the plain end is moved past the gasket until it seats as per manufacturer's recommendation.
 - a. Pipe lubricant shall be Ease-On Pipe Joint Lubricant or equivalent.

- b. Shall be brushed over the gasket and the plain end of the pipe for push on joints and mechanical joints, where needed.
3. Backhoe buckets or excavation equipment are not to be applied directly to the pipe.
4. Mechanical joints shall be assembled in accordance with AWWA Standards. Mechanical joints shall be centered in the bells. Soapy water shall be brushed over the gasket just prior to installation. The gasket and gland shall be placed in position, the bolts inserted, and the nuts tightened by hand.
5. The bolts shall be tightened on opposite sides of the pipes by means of a torque wrench in such a manner that the gland shall be brought up evenly into the joint. The following range of bolt torques shall be applied:

<u>Bolt Size (Inches)</u>	<u>Range of Torque</u>
3/4" Diameter	85 to 95 ft.-lbs.
1" Diameter	95 to 100 ft.-lbs.

6. If effective seal is not obtained at a maximum torque listed above, the joint shall be disassembled and reassembled after thorough cleaning.
7. If a joint is defective, it shall be cut out and entirely replaced or, if permission is given by the Owner, it may be repaired by a suitable clamp.

M. Expediting of Work

1. Excavate, lay the pipe, and backfill as closely together as possible.
2. Do not leave un-joined pipe in the trench overnight.
3. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress.
4. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push-on, mechanical joint, restrained joint or as approved by the Owner.

N. Polyethylene Encasement

1. Installation shall be in accordance with AWWA C105 and the manufacturer's instructions.
2. All ends shall be securely closed with tape and all damaged areas shall be completely repaired to the satisfaction of the Owner.
3. Installation shall be at locations shown on the Drawings.

3.03 INSTALLATION OF FITTINGS, VALVES AND TAPS

- A. Fittings shall be handled with care to avoid damage. All fittings shall be loaded and unloaded by lifting, and under no circumstances shall fittings be dropped, skidded, or rolled. Under no circumstances shall fittings be placed against pipe or other fittings in such a manner that damage could result. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surface or interior lining of fittings. If any part of the fittings' coating or lining is damaged by the Contractor, the repair or replacement shall be made by the Contractor at his expense and in a manner satisfactory to the Owner before installing. Fittings shall also be stored at all times in a safe manner to prevent damage and kept free of dirt, mud, or other foreign matter. All fitting gaskets shall be stored and placed in a cool

location out of direct sunlight and out of contact with petroleum products. All gaskets shall be used on a first-in, first-out basis.

- B. Fittings shall be set and joined to the pipe in a manner specified previously for joint assembly. When conditions warrant, fittings should be provided with special support trussing and blocking. Valves that are 12 inches and larger valves shall be provided with special support, such as treated timbers, crushed stone, concrete pads or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve. Valves shall be installed in the closed position.
- C. Prior to installation, valves shall be inspected for direction of opening, number of turns to open, freedom of operation, tightness of pressure-containing bolting and test plugs, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Defective valves shall be corrected or held for inspection by the Owner.
- D. A valve box shall be provided on each underground valve. They shall be carefully set, centered exactly over the operating nut and truly plumbed. The valve box shall not transmit shock or stress to the valve. The bottom flange of the lower belled portion of the box shall be placed below the valve operating nut. This flange shall be set on brick, so arranged that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe. Extension stems shall be installed where depth of bury places the operating nut in excess of 60-inches beneath finished grade so as to set the top of the operating nut 30-inches below finished grade. The valve box cover shall be flush with the surface of the finished area or such other level as directed by the Owner.
- E. All valve boxes set in non-paved areas shall have concrete pads poured around the top section of the valve box. The pad shall be a 24 inch square and shall be centered on the valve box. All water valve covers shall be painted safety blue as prescribed by the American Public Works Association (APWA) uniform color code for utility systems. All valve covers shall be cast with the word WATER. A 2" brass monument will be set on the North East corner of each 24" poured pad of the valve box indicating the valve size, type, and number of turns required.
- F. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.
- G. A valve marker shall be provided for each underground valve. Unless otherwise detailed on the Drawings or directed by the Owner, valve markers shall be installed 6 inches inside the right of way or easement. Raised pavement markers (RPM's) shall be provided and installed along the appropriate roadway centerline for each in-line valve installed. RPM's for in-line valves shall be Type I, two-way, and white in color.
- H. Blow-Offs: Blow-offs shall not be connected to any sewer or submerged in any stream or be installed in any other manner that will permit back-siphoning of contaminated water.
- I. The valve and valve box shall be installed so water department personnel can insert a valve key through the valve box and completely open and close the valve.

3.04 CONNECTIONS TO WATER MAINS

- A. Make connections to existing pipe lines with tapping sleeves and valves, unless specifically shown otherwise on the Drawings.
- B. Location
 - 1. Before laying pipe, locate the points of connection to existing water mains and uncover as necessary for the Owner to confirm the nature of the connection to be made.
- C. Interruption of Services
 - 1. Make connections to existing water mains only when system operations permit. Operate existing valves only with the specific authorization and direct supervision of the Owner.
- D. Testing
 - 1. The Owner or their Representative must be present for the pressure test of the tapping saddle and tapping valve before the tap is allowed.
 - 2. Test shall be done through the saddle and the test machine or the saddle and tap valve.
- E. Tapping Saddles and Tapping sleeves
 - 1. Holes in the new pipe shall be machine cut, either in the field or at the factory. No torch cutting of holes shall be permitted. The coupon shall be delivered to the Owner or their Representative.
 - 2. Prior to attaching the saddle or sleeve, the pipe shall be thoroughly cleaned, utilizing a brush and rag, as required.
 - 3. Before performing field machine cut, the water tightness of the saddle or sleeve assembly shall be pressure tested. The interior of the assembly shall be filled with water. Then using a hydro-static hand pump, pump to a pressure of 150 psi to insure all air is expelled. No leakage shall be permitted for a period of thirty minutes.
 - 4. After attaching the saddle or sleeve to an existing main, but prior to making the tap, the interior of the assembly shall be disinfected. All surfaces to be exposed to potable water shall be swabbed or sprayed with a one percent hypochlorite solution.
- F. Connections and Repairs
 - 1. Where connections or repairs are required, Contractor shall only use solid sleeves and provide all materials and labor necessary to make the connection or repair to the existing pipeline, excluding service lines 2" or smaller.

3.05 INSTALLATION OF FIRE HYDRANTS

- A. Prior to installation, inspect all hydrants for direction of opening, nozzle threading, operating nut and cap nut dimensions, tightness of pressure-containing bolting, cleanliness of inlet elbow, handling damage and cracks. Defective hydrants shall be corrected or held for inspection by the Owner.

- B. All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the roadway, with pumper nozzle facing the roadway, except that hydrants having two-hose nozzles 90 degrees apart shall be set with each nozzle facing the roadway at an angle of 45 degrees.
- C. Hydrants shall be set to the established grade, with the centerline of the lowest nozzle at least 12-inches above the ground or as directed by the Owner.
- D. Each hydrant shall be connected to the main with a 6-inch branch controlled by an independent 6-inch valve. When a hydrant is set in soil that is pervious, drainage shall be provided at the base of the hydrant by first wrapping the weephole/drainhole with a felt/mesh material that will allow the hydrant to drain. Then place coarse gravel or crushed stone mixed with coarse sand from the bottom of the trench to at least 6-inches above the drain port opening in the hydrant to a distance of 12-inches around the elbow.
- E. When a hydrant is set in clay or other impervious soil, a drainage pit 2 x 2 x 2 feet shall be excavated below each hydrant and filled with coarse gravel or crushed stone mixed with coarse sand under and around the elbow of the hydrant and to a level of 6-inches above the drain port.
- F. Hydrants shall be located as shown on the Drawings or as directed by the Owner. In the case of hydrants that are intended to fail at the ground-line joint upon vehicle impact, specific care must be taken to provide adequate soil resistance to avoid transmitting shock moment to the lower barrel and inlet connection. In loose or poor load bearing soil, this may be accomplished by pouring a concrete collar approximately 6-inches thick to a diameter of 24-inches at or near the ground line around the hydrant barrel.
- G. Raised pavement markers (RPM's) shall be provided and installed along the appropriate roadway centerline for each fire hydrant installed. RPM's for inline valves shall be Type I, two-way, and blue in color.

3.06 THRUST RESTRAINT

- A. Retainer Glands
 - 1. Provide retainer glands at all points where hydraulic thrust may develop and on fire hydrants and all associated fittings, valves and related piping.
 - 2. Retainer glands shall be installed in accordance with the manufacturer's recommendations, particularly; the required torque of the set screws.
 - 3. The Contractor shall furnish a torque wrench to verify the torque on all set screws which do not have inherent torque indicators.
- B. Thrust Collars (Requires Engineer's Approval)
 - 1. Concrete collars shall be constructed as shown on the Drawings.
 - 2. The welded-on collar shall be attached to the pipe by the pipe manufacturer.
 - 3. Filter fabric shall be installed between the thrust collar and the adjacent soil.
 - 4. Thrust collars require Engineer's approval.
- C. Concrete Blocking (Requires Engineer's Approval)

1. Provide concrete blocking for all bends, tees, valves, and other points where thrust may develop, except where other exclusive means of thrust restraint are specifically shown on the Drawings. Filter fabric shall be installed between the concrete blocking and the adjacent soil.
2. Form and pour concrete blocking at fittings as shown on the Drawings and as directed by the Owner. Pour blocking against undisturbed earth. Increase dimensions when required by over excavation
3. Concrete blocking requires Engineer's approval.

3.07 DETECTION TAPE AND LOCATE WIRE

- A. Provide detection tape and locate wire for all water mains.
- B. Locate wire shall not be wrapped around the pipe.
- C. Locate wire shall be laid parallel to the 12 o'clock position of the main with at least 4" of separation.
- D. Locate wire shall be looped into each valve box and pulled out a minimum of two feet from the top of the valve box.

3.08 WATER SERVICE CONNECTIONS

- A. Water service connections shall be installed to the properties adjacent to the water transmission mains both to the same side of the roadway (Short Side Service) and to the opposite side of the roadway (Long Side Service) as directed by the Owner.
- B. Water service connections installed under roadway shall be pulled through a casing. Casings shall be installed through a bored hole approximately equal in diameter to the external diameter of the casing. Minimum cover under roadway shall be four feet. At other locations, minimum cover shall be two feet.
- C. Installation shall conform to the details for water service connections appearing schematically on the Drawings. Contractor shall provide any and all appurtenant work required to provide the intended water service connections.
- D. Transfer Service
 1. Immediately before connecting to the relocated or existing meter, all service lines shall be flushed to remove any foreign matter.
 2. Any special fittings required to reconnect the existing meter, to the new copper service line, or the existing private service line, shall be provided by the Contractor.
 3. To minimize out of service time, the Contractor shall determine the connections to be made and have all the required pipe and fittings on hand before shutting off the existing service.
 4. After completing the connection, the new corporation stop shall be opened and all visible leaks shall be repaired.

- E. Backflow preventers shall be provided on all water services. Please refer to Paragraph 2.16(C)10 for further backflow specifications.
- F. GPS coordinates shall be provided for each service connection.

3.09 TESTING AND INSPECTION REQUIREMENTS

- A. It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Owner and applicable agency inspectors 48 hours in advance of testing and inspections.

3.10 HYDROSTATIC TEST

- A. All sections of the water main subject to internal pressure shall be pressure tested in accordance with AWWA C600. A section of main will be considered ready for testing after completion of all thrust restraint and backfilling.
- B. All tests shall be in the presence of the Owner or their Representative.
- C. Each segment of water main between main valves shall be tested individually.
- D. Test Preparation
 1. Flush sections thoroughly at flow velocities, greater than 2.5 feet per second, adequate to remove debris from pipe and valve seats.
 2. Partially operate valves and hydrants to clean out seats.
 3. Provide temporary blocking, bulkheads, flanges and plugs as necessary, to assure all new pipes, valves and appurtenances will be pressure tested.
 4. Before applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Insert corporation cocks at highpoints to expel air as main is filled with water as necessary to supplement automatic air valves. Corporation stops shall be constructed as detailed on the Drawings with a meter box.
 5. Fill pipeline slowly with water. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure.
 6. The differential pressure across a valve or hydrant shall equal the maximum possible, but not exceed the rated working pressure. Where necessary, provide temporary backpressure to meet the differential pressure restrictions.
 7. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure.
- E. Test Pressure
 1. Test the pipeline at 150 psi or 1.5 times the operating pressure, whichever is greater, measured at the lowest point for at least two hours.
 2. Maintain the test pressure within 5 psi of the specified test pressure for the test duration (at least two hours).
 3. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure.
 4. Provide an accurate pressure gauge with graduation not greater than 5 psi.

F. Leakage

1. Leakage shall be defined as the sum of the quantity of water that must be pumped into the test section, to maintain pressure within 5 psi of the specified test pressure for the test duration. Leakage shall be the total cumulative amount measured on a water meter.
2. The Owner assumes no responsibility for leakage occurring through existing valves.

G. Test Results

1. No test section shall be accepted if the leakage exceeds the limits determined by the following formula:

$$L = \frac{SD \sqrt{P}}{133,200}$$

Where: L = allowable leakage, in gallons per hour
S = Length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test in pounds per square inch (gauge)

As determined under Section 4 of AWWA C600.

Allowable leakage at various pressures and pipe sizes is shown in the Table below (from AWWA C600 – Table 4.A) for 1000' of Pipe: *

Avg.	Pipe Diameter (inches)												
Average Pressure (PSI)	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85
225	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65
200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98
125	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72
100	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43

* If the water main section being tested contains lengths of various pipe diameters, the allowable leakage shall be the sum of the computed leakage for each diameter. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results.

H. Completion

1. After a pipeline section has been accepted, relieve test pressure. Record type, size and location of all outlets on record drawings.
- I. Re-Testing
 1. Any alterations made to pipeline performed after initial testing shall be re-tested and passed again, regardless of initial test results.
- J. Notification
 1. Owner shall be notified 24-hours in advance prior to Contractor performing pressure and leakage testing.

3.11 DISINFECTING PIPELINE

- A. After successfully pressure testing each pipeline section, disinfect in accordance with AWWA C651 for the continuous-feed method and these Specifications.
- B. Specialty Contractor
 1. Before disinfection is performed, the Contractor shall submit a written procedure for approval before being permitted to proceed with the disinfection. This plan shall also include the steps to be taken for the neutralization of the chlorinated water.
- C. Chlorination
 1. Apply chlorine solution to achieve a concentration of at least 25 milligrams per liter free chlorine in new line. Retain chlorinated water for 24 hours.
 2. Chlorine concentration shall be recorded at every outlet along the line at the beginning and end of the 24 hour period.
 3. After 24 hours, all samples of water shall contain at least 10 milligrams per liter free chlorine. Re-chlorinate if required results are not obtained on all samples.
- D. Disposal of Chlorinated Water
 1. Reduce chlorine residual of disinfection water to less than one milligram per liter if discharged directly to a body of water or to less than two milligrams per liter if discharged onto the ground prior to disposal.
 2. Treat water with sulfur dioxide or other reducing chemicals to neutralize chlorine residual.
 3. Flush all lines until residual is equal to existing system.
- E. Bacteriological Testing
 1. After final flushing and prior to ADEM approval and the water main being placed into service, the Contractor shall collect samples from the line and have tested for bacteriological quality in accordance with the rules of the Alabama Department of Environmental Management (ADEM).
 2. The Contractor shall give Owner Utilities 48-hour written notice of the planned bacteriological testing. The Owner's Engineer representative must be present when samples are taken. Immediately after samples are taken, the Contractor shall be responsible for delivering the samples to the laboratory for testing. The bacteriological samples shall be analyzed for both coliform and non-coliform growth. Testing shall be performed by a laboratory certified by the State of Alabama and approved by the Owner.

3. All sampling and testing costs shall be paid for by the Contractor prior to final acceptance.
4. Re-chlorinate lines until required results are obtained.

END OF SECTION

SECTION 34 11 00

RAILROAD TRACK AND ACCESSORIES

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Work Included

1. The provisions of this section outline the requirements for furnishing necessary labor, materials, tools, equipment, and services requires to furnish and install all the track work as shown on the design drawings and as specified herein.
2. A railroad is defined as a permanent line of two rails fixed to ties and laid on a roadbed providing a track for rolling equipment, such as locomotives and railcars.
3. Furnish any work not specifically mentioned in the specifications or shown on the drawings, but which is necessary, either directly or indirectly, for proper progress of the work. This work shall be required and performed as though it were delineated or described.
4. All track construction shall comply with the Genesee and Wyoming specification entitled “Industrial Track Construction Specification” included in the Appendix to and immediately following the specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- ###### **A. The provisions and intent of the Contract, including the General Conditions, Supplementary Conditions, and General Requirements, apply to the work as if specified in this section. Work related to this section is described in:**
1. Section 02 41 00 – Demolition
 2. Division 3 – Concrete

1.03 REFERENCED STANDARDS

- ###### **A. Norfolk Southern (NS) – Specifications for Design and Construction of Privately Owned Industry Tracks (Appendix to this Section).**
- ###### **B. NARSCO – Assembly Instructions for Steel Tie Track and Turnouts (Appendix to this Section 02850)**
- ###### **C. American Railway Engineering and Maintenance-of-Way Associations- Manual for Railway Engineering (AREMA).**
- ###### **D. AREMA- Portfolio of Trackwork Plans.**
- ###### **E. Federal Railway Engineering Administrations (FRA).**
- ###### **F. American Society for Testing and Materials (ASTM).**
- ###### **G. American Welding Society (AWS).**

1.04 QUALITY ASSURANCE

- A. The Contractor or the Subcontractor performing railroad work shall be regularly engaged in the furnishing and installation of the railroad trackwork, and shall employ at least one (1) supervisory person who is thoroughly trained and experienced in trackwork construction. The supervisor shall be completely familiar with the design and application of the work described in this Section and shall direct all work performed under this Section.
- B. The manufacturer of rail, rail hardware and associated products shall have not less than five years experienced in the manufacture of these items.

1.05 SUBMITTALS

- A. Before any Contractor furnished materials are delivered to the site, submit manufacturer's literature and shop drawings (as applicable) to the Engineer for the following:
 - 1. Rail and Relay Tracks
 - 2. Joint bars
 - 3. Tie plates
 - 4. Track bolts, nuts, and washers
 - 5. Track spikes
 - 6. Screw spikes
 - 7. Isolation/Compromise joints
 - 8. Rail Anchors
 - 9. Bumping Posts
 - 10. Ballast and gradation
 - 11. Crossties
- B. Certifications of compliance from suppliers or manufacturers that materials delivered to the site are in conformance with the Specifications.
- C. Source of all rail materials.

1.06 PRODUCT HANDLING

- A. Protection: Use whatever means necessary to protect the trackwork materials before, during and after installation and to protect the installed work and materials of all other trades or sections.
- B. Replacements: In the event of damage, make all repairs and replacements necessary at no additional cost to the Port.

1.07 RAIL SHIPMENTS

- A. Shipment of rail, ties, ballast, and other track materials in rail cars on the connecting railroad or other railroad shall be arranged for by the Contractor with the railroad(s) involved and shall be at the Contractor's expense.

1.08 ACCEPTANCE TESTING

- A. Before acceptance of trackwork, the Owner will provide for a suitable test train to be run over the entire length of new trackage in the presence of the Engineer. There shall be no noticeable settlement or deflection of ties and rail during the test. The Contractor shall reline,

surface, tamp, or otherwise correct any and all deficiencies as directed by the Engineer, at no additional cost of the Owner.

END OF SECTION



*NORFOLK SOUTHERN RAILWAY COMPANY
SPECIFICATIONS FOR DESIGN
AND CONSTRUCTION OF
PRIVATELY OWNED
INDUSTRY TRACKS*

JULY 2020

TABLE OF CONTENTS

ITEM		PAGE
I.	INTRODUCTION	1
II.	DEFINITIONS	2
III.	INDUSTRIAL SIDETRACK PROCESS	5
IV.	SAFETY AND ENVIRONMENTAL PERMITTING	7
V.	FIELD SURVEY AND STAKEOUT	8
VI.	INDUSTRY TRACK DESIGN	12
VII.	INDUSTRY PLAN SUBMITTAL	21
VIII.	SITE WORK	26
IX.	TRACK MATERIALS & CONSTRUCTION	32
X.	GENERAL CONSTRUCTION	38
XI.	CROSSINGS	39
XII.	BRIDGES, TRESTLES, BOX CULVERTS AND UNLOADING PITS	42
XIII.	SCALES	45
XIV.	HAZARDOUS COMMODITIES	46
XV.	ATTACHMENTS	48

I. INTRODUCTION

All requests for new Industry track should be directed to the appropriate Norfolk Southern Industrial Development Manager. Specific contact information is located on Norfolk Southern Corporation's website at <http://www.nscorp.com/content/nscorp/en/industrial-development.html>.

The intent of these specifications is to provide Industry desiring rail service from Norfolk Southern with all necessary information required for the design and construction of Industry track. Please note that these specifications are subject to revision without notice.

INFORMATION CONTAINED WITHIN THESE SPECIFICATIONS APPLY TO PRIVATELY OWNED INDUSTRY TRACKS AND DO NOT APPLY TO TRACKS OWNED OR TO BE OWNED BY THE RAILWAY COMPANY. MATERIALS AND SPECIFICATIONS FOR TRACKS TO BE OWNED BY THE RAILWAY COMPANY MUST BE APPROVED BY THE RAILWAY COMPANY'S CHIEF ENGINEER - DESIGN AND CONSTRUCTION OR DESIGNATED REPRESENTATIVE.

In general, the Industry shall construct, or cause to be constructed, the subgrade (embankment and / or excavation), sub-ballast, and all drainage structures necessary for installation of the track on both the Industry and Railway Company's right-of-way.

Prior to the commencement of train service, an industry track agreement in accordance with the standard procedures of the Railway Company shall be executed by both the Industry and the Railway Company.

The following pages include specifications, requirements, and/or recommendations for the design and construction of Industry tracks to be served by the Railway Company and shall supersede all prior publication of same. General engineering questions may be directed to the Norfolk Southern Design & Construction Department at NSENG.ContactD&C@nscorp.com.



II. DEFINITIONS

2.01 When the following words and acronyms are used in these Specifications, they shall have the meaning as defined below:

2.01.1 AASHTO

American Association of State Highway and Transportation Officials

2.01.2 AREMA

American Railway Engineering and Maintenance-of-Way Association

AREMA design information and specifications can be purchased on the website www.arema.org.

2.01.3 CHIEF ENGINEER, ENGINEER, OPERATING OFFICER

The officer of the Railway Company acting for, or on behalf of the Railway Company in its transactions, or the authorized representative of such officer.

2.01.4 CLEAR POINT

That point on spur, lead, or siding track located adjacent to main line track where the distance between tracks is 15 feet, or where the distance between adjacent tracks other than main line track is 14 feet. The clear point is established by horizontal measurement between the centerlines of each track and provides the minimum clear distance that will allow for the safe passage of freight cars and/or locomotives.

2.01.5 COMPANY

Norfolk Southern Railway Company (NSRC), or the Operating Rail Subsidiary Company of NSRC within whose territory the Industry track is located.

2.01.6 DERAIL

A device built on, or attached to, track for the purpose of derailing rail cars, locomotives, and on-track equipment.

2.01.7 EOT (END OF TRACK) DEVICE

A contrivance built on, or established at the end of a track, for the purpose of stopping the movement of rail cars, locomotives, and on-track equipment at the end of a track.

2.01.8 FOULING A TRACK

The placement of an individual, or equipment in such proximity to a track that the individual, or equipment could be struck by a train, engine, or other on-track equipment, or in any case is within four feet of the field side of the near running rail.*

2.01.9 FROG

A track structure used at the intersection of two running rails to provide support for wheels and passageways for their flanges, thus permitting wheels on either rail to cross the other.**

2.01.10 INDUSTRY

That company and/or individual for which a rail spur, siding, and/or lead track is to serve.

2.01.11 INDUSTRY TRACK AGREEMENT

An agreement between Norfolk Southern Railway Company and Industry that sets forth predetermined conditions regulating track construction, liability, insurance, clearances, and other standard requirements of Norfolk Southern Railway Company, while clearly delineating the division of ownership and maintenance point(s) for the industry track, all to ensure safe and efficient rail service to the industry.

2.01.12 LEAD TRACK

Track serving, or with the ability to serve more than one industry with individual spur tracks for each industry.

2.01.13 MAIN LINE TRACK

Any track, not specifically designated otherwise, owned by the Company which has a milepost.

2.01.14 OTM (OTHER TRACK MATERIAL)

Acronym used to describe track structure components other than rail, ties, and ballast such as rail anchors and spikes.

2.01.15 PLANS

Drawings, maps, cross-sections, and/or profiles showing the character of the work to be performed and prepared as a guide for construction of track.

2.01.16 RAIL OR RUNNING RAIL

A single piece of steel usually paired with another to form a track.

2.01.17 RUNAROUND TRACK

Track used by locomotive(s) to run around to the other end of a cut (group) of cars.

2.01.18 “SHALL”

Where the term “shall” appears in these specifications, it is to mean that the information following is a requirement.

2.01.19 “SHOULD”

Where the term “should” appears in these specifications, it is to mean that the information following is a recommendation.

2.01.20 SIDING

Track owned by the Company and used for meeting and passing trains.

2.01.21 SPUR TRACK

Track serving only one industry.

2.01.22 SWITCHING TRACK

Track used to set off cars, run around cars, and/or to facilitate the general switching operations required to serve an industry.

2.01.23 TRACK

Structure consisting of two rails, crossties, OTM, and ballast which is designed to carry railroad cars, locomotives, and equipment.

2.01.24 TURNOUT (SWITCH)

An arrangement of switch points and a frog with closure rails, and appurtenances by means of which rolling stock may be diverted from one track to another.

**Source:* Norfolk Southern Roadway Worker Protection Rules

***Source:* Practical Guide to Railway Engineering, AREMA, pg. Glossary-11, 2003

III. INDUSTRIAL SIDETRACK PROCESS

3.01 OVERVIEW

The typical sequential process for the handling of Industry projects involving new or expanded rail service by Company is as follows:

1. Initial contact between Industry and Company
2. Development of a preliminary Industry plan
3. Company Transportation approval
4. Development of agreement and sidetrack design plans
5. Company Engineering approval
6. Secure construction and track operating agreements
7. Trackbed construction by Industry
8. Track construction
9. Inspect track and place in service

3.01.01 INITIAL CONTACT BETWEEN INDUSTRY AND COMPANY

The Industry contacts the Company's Industrial Development Manager (IDM) to initiate the project and discuss requirements for rail service to the Industry. The IDM provides assistance to the Industry in identifying possible sites for industry location, developing a preliminary Industry plan, and beginning the Industrial Sidetrack Process for new or expanding rail-served facilities.

3.01.02 DEVELOPMENT OF A PRELIMINARY INDUSTRY PLAN

The IDM works with the Industry to make appropriate site, track and/or building layout recommendations and provides assistance as needed to develop a preliminary Industry plan.

3.01.03 COMPANY TRANSPORTATION APPROVAL

The IDM provides Company's Transportation Department (Transportation) the preliminary Industry plan (with anticipated commodities, volumes and service levels) to secure Transportation approval of the proposal ensuring required service can be provided.

3.01.04 DEVELOPMENT OF AGREEMENT AND SIDETRACK DESIGN PLANS

With Transportation approval of the preliminary Industry plan, the Company's IDM will provide Industry with Company requirements for development of agreement and sidetrack design plans and Company's Design & Construction Department (D&C) contact information. Industry shall contact D&C prior to beginning work on the plans to discuss the project and any questions that the Industry may have. The IDM and D&C will work with Industry to develop final agreement and sidetrack design plans.

3.01.05 COMPANY ENGINEERING APPROVAL

Upon completion of the agreement and sidetrack design plans, the Industry will submit the plans to the Company's IDM. The IDM will forward the plans to D&C for review, comments, and/or engineering approval. D&C will contact the Industry and IDM to discuss any required revisions for engineering approval. ***PLEASE NOTE THAT SIDETRACK DESIGN PLANS THAT DEVIATE FROM THE TRANSPORTATION APPROVED PRELIMINARY INDUSTRY PLAN MAY REQUIRE ADDITIONAL REVIEW AND APPROVAL OF THE COMPANY'S TRANSPORTATION DEPARTMENT.*** Upon engineering approval of the sidetrack design plans by the Assistant Chief Engineer Design, the Assistant Chief Engineer Design will provide notice of approval to the IDM.

3.01.06 SECURE CONSTRUCTION AND TRACK OPERATING AGREEMENTS

The IDM will prepare a Track Proposal Letter and Siding Agreement and send to Industry for review. Upon approval, Industry will execute the Siding Agreement and return with a valid Certificate of Insurance and required funds. The IDM, with D&C, will then coordinate installation of the portion of track to be owned by the Company.

3.01.07 TRACKBED CONSTRUCTION BY INDUSTRY

The Industry shall be responsible for construction of all required site work, including sub-ballast, required for installation of both Industry and Company owned track.

3.01.08 TRACK CONSTRUCTION

The Industry shall notify the Company's D&C engineer upon completion of the trackbed work and at least 2 weeks prior to the field stakeout of the proposed track centerline. It is preferred that D&C be present during the field stakeout of the Industry track for verification that the stakeout is accurate. Also, at this time, D&C will inspect the trackbed for compliance with the approved track construction plans and specifications. The Industry shall perform all track work on the Industry owned portion of the track, and the Company shall perform all track work for the Company owned portion of the track in accordance with the approved plans.

3.01.09 INSPECT TRACK AND PLACE IN SERVICE

The Industry shall notify the Company upon completion of all Industry track work. Company representatives from the Maintenance-of-Way (MW&S) and Transportation Departments will inspect the Industry track and components to verify compliance with the approved track construction plans and specifications, providing written notice of defects or approval. Upon approval, the track will be placed in service. The IDM will ensure that the Industry has been established as a new customer prior to the ordering or placement of any railcars.

IV. SAFETY AND ENVIRONMENTAL PERMITTING

4.01 SAFETY

The Company's highest priority is the safety of its employees, customers and the public. The Company gives careful consideration to anything that could adversely affect customer service and cause risk to railroad operations.

Industry and/or anyone contracted by Industry that will be surveying for, staking out or inspecting Industry track(s) on Company property shall first obtain a right of entry permit from the Company's Industrial Development Manager for that region. Company owned track shall not be fouled without a Company flagman or watchman/lookout present. **A RIGHT OF ENTRY IS NOT A RIGHT TO FOUL COMPANY TRACK.** Please see the following URL for details:

<http://www.nscorp.com/content/nscorp/en/industrial-development/contact-norfolk-southern-industrial-development/project-management-contact-directory.html>

The applicant will be responsible for the costs of Company flagman if flagging protection is required by the Company's Division Superintendent.

4.02 ENVIRONMENTAL PERMITTING

The Industry is responsible for all required environmental permitting for the project, including work on Company property. If it is determined that wetland and/or stream delineation is required on Company property for permit application(s), the Industry shall contact the Company's Design & Construction representative **PRIOR TO PERFORMANCE OF THE DELINEATION.**

Upon completion of the environmental field delineation, the Industry shall provide Company with copy of all data, notes, photographs, and/or other information related to the delineation and shall provide a copy of any draft report(s) prepared for submittal to any governmental entity, court, or third party prior to submittal for Company review and comment. The Industry shall maintain all information regarding such information as confidential except as required for the purpose of obtaining permit(s).

V. FIELD SURVEY AND STAKEOUT

5.01 FIELD SURVEY

Accurate field survey and data collection is of utmost importance for the development and approval of an acceptable plan. In particular, the following five categories are typically the most important elements of industry track surveys: existing track, utilities, structures, control points and topography. Below is a categorized list of information for each element that should be collected and shown on the plans. A field survey performed by drone or other aerial methods shall be tied to local ground control. A Right of Entry shall be executed and on file prior to access being granted onto the Company's property.

5.01.01 EXISTING TRACK

Proper depiction of the existing track is essential to developing a workable design. Photogrammetry shall not be used to determine track alignments, features and top of rail elevations. The following items should be located and shown on the plans:

- centerline of existing track at top of rail
 - for tangent track, measurements should be taken at a maximum interval of 100 feet
 - for curved track, measurements should be taken at a maximum interval of 50 feet
 - Measurements should be collected at closer intervals as needed to define sudden changes in horizontal and vertical alignments such as kinks and dips in the track. Sufficient measurements should be collected to extrapolate existing vertical curves and identify grades.
 - Measurements should be collected every 50 feet or less in vertical curves to allow for identification of crests and / or sags.
 - Measurements should be collected for the greater of :
 - at least 300' or to the nearest curve, on both sides of the proposed turnout location
 - the entire length of the project site
- point of curve (PC), point of tangent to spiral (TS), point of tangent (PT) and point of spiral to tangent (ST)
- existing super-elevation tags
- point of switch (PS) for all turnouts and method of operation i.e. hand throw, spring, power operated
- whether switch is right hand or left hand throw
- point of frog (PF), diverging and straight side, for all turnouts
- derails and type (Hayes Model HB or double switch point)
- division of ownership and maintenance signs
- close clearance signs
- nearest milepost and direction of increasing mileposts

- track centerline location for all pipes and / or utility lines passing under and / or over track
- bumping posts, rail stops, and / or earth mounds
- road crossings (centerline of track at edge of crossing surface)
- type, size, or weight of all key track components including compromise joints (used between rails of different sizes)
- construction of rail, i.e. jointed rail (JTR) or continuously welded rail (CWR)
- rail lubricators
- insulated joints
- track wires for signal circuits connecting to the rails (including crossing activators)
- signals and signal structures including AEI tag readers, hot box detectors, dragging equipment detectors, pedestals, signal pole lines, and bungalows

5.01.02 UTILITIES

Utilities must be accurately depicted. A missed utility pole or manhole can drastically alter project acceptability and cost if not identified prior to construction. The following utility items should be located and shown on the drawings:

- aerial utility and light poles, guy wires, and guy poles
- natural gas line (valves, markers, and/or vents)
- telephone or fiber optic lines (junction boxes, or markers)
- water lines (taps, valves, meters, markers)
- sewer lines (taps, cleanouts, manholes, markers)
- storm water facilities (inlets, outfalls, catch basins, manholes, headwalls, pipe inverts, pipe diameter, top of pipe)

Overhead wires should be surveyed for their elevation at the point at which they cross the existing track, if applicable. Their location and elevation should also be determined at the point of their greatest sag and referenced to the corresponding existing ground elevation along with an additional point at the center line of proposed track.

5.01.03 STRUCTURES

Structures, existing and / or proposed, have the potential to adversely impact side and/or overhead clearances. The following items shall be shown on the plans with measured clearances to the centerline of track:

- doorways, sides and top
- corners of docks and finished floor elevations
- fences and gates
- unloading pits and scales, inside and outside walls
- corners/sides of buildings and finished floor elevations
- roadways
- retention pond levees and drainage structures
- retaining walls

- utility poles for side clearances
- overhead and under grade bridges
- other structures that might impact clearances

5.01.04 CONTROL POINTS

All control points established or found during the course of the field survey should be shown and labeled with description (PK nail, iron pin, survey monument, etc.) and NEZ coordinates based on the controlling datum. The controlling datum shall be identified in the corresponding NAD83, NGVD88 state plane coordinate system for the project site allowing Company to incorporate the project into the Company GIS database.

Real estate information, such as property pins or corners, should also be collected and shown on the plans.

5.01.05 TOPOGRAPHY

Although the Company does not typically require submittal of complete grading plans, the collection of adequate ground shots to accurately depict the nature of the ground topography in the vicinity of track and employee walkways, and drainage features is very important. Large or sudden changes in ground topography adjacent to proposed track must also be measured.

5.02 STAKEOUT

For projects designed by the Industry, the Industry shall be responsible for the field stakeout of proposed track, including the portion of track to be owned by the Company. Field stakeout work will not be performed on Company property until the industry track agreement has been executed and the Industry secures flagging protection through the Company's Division Superintendent. The Industry shall be responsible for this flagging cost. Additionally, the Industry must notify the Company's Design & Construction Department and Maintenance of Way Department at least two weeks prior to performing field stakeout so that Company representative may be present for stakeout verification. For proposed track alignment(s) designed by Company and used in the industry track agreement, Company will provide field stakeout of Company portion of Industry spur track.

The following shall be performed during field stakeout for portion of track to be owned by Company:

- For main line track, the centerline of track at the proposed Point of Switch (PS) and Point of Frog (PF) shall be set with flagging with legible note(s) indicating station and point description. Pins, nails, spikes, etc. shall be nailed flush into the cross-tie or set so that the top is flush with the ballast line to prevent tripping hazards.

- For the Industry spur, the centerline for the PS, PF, PC, PT, PVC, PVT and every 50' beyond the turnout (Sta. 1+50, 2+00, etc.) up to and including the proposed derail shall be set with flagging indicating the station and point description. Pins, nails, spikes, etc. shall be nailed flush into the cross tie or set so that the top is flush with the ballast/sub-ballast to prevent tripping hazards.
- Offset stakes for the above described points on the Industry spur track shall be set at 12' offset to the proposed Industry spur track centerline. Stakes shall be painted fluorescent orange and flagged. The station, point description, offset distance, and top of rail elevation with reference mark shall be legibly written on the stake.

VI. INDUSTRY TRACK DESIGN

6.01 GENERAL

The following sections describe the criteria to be used in the design of industry track(s) served, or to be served, by the Company. Any exception to these requirements must be approved by the Company's Chief Engineer or designated representative.

6.02 HORIZONTAL CURVATURE

DEGREE OF CURVE

All horizontal curve calculations shall be based on the chord definition.

The chord definition for horizontal curves is as follows:

$$R \text{ (chord definition)} = \frac{50}{\sin (D/2)}$$

where: R = Radius (feet)
D = Degree of Curve

Tracks should be designed utilizing the minimum degree of curvature practicable, but must be limited to a maximum of 12 Degrees (R = 478.34 feet) on spur tracks and 10 Degrees (R = 573.69 feet) on lead and loop tracks.

Tracks for rail cars with coupler to coupler length exceeding 73 feet should be designed based on maximum degree of curvature of 10 Degrees (R = 573.69 feet).

Horizontal curves should be at least 100 feet in length if at all possible, but not less than 50 feet.

REVERSE CURVES

Tangent distance between the points of tangency of reverse curves should be at least 100 feet if at all possible, but not less than 70 feet.

Distance between facing point switches leading from opposite sides of a through track (creating a reverse effect) should be at least 100 feet if at all possible, but not less than 70 feet.

RETURN CURVES

Return curves, C₂ (in Degrees), shall correspond to *NSRC Plan 2-17* for the proposed turnout(s) to be used for all parallel sidetracks and industry tracks at minimum track centers.

SPIRALS AND SUPER-ELEVATION

Spiral curves and/or super-elevation are required where the speed of operation dictates. Design for lead tracks of one mile or longer will be evaluated by the Company on an individual basis to determine if spirals and super-elevation are required.

CURVE PLACEMENT

Horizontal curves shall not begin on the long ties of a turnout. Horizontal curves should not be located within a double switch point derail (DSPD).

6.03 VERTICAL CURVATURE

CURVE PLACEMENT

Vertical curves shall be provided at break points in the profile of the track and should be as long as practicable. A minimum vertical curve length of 100 feet is preferred.

Vertical curves shall not begin or end on the long ties of a turnout. The track profile through the proposed turnout shall match the track profile of the existing track from which it diverges.

Tangency between crest and sag curves should be 50-100' preferred.

VERTICAL CURVE RATE OF CHANGE

Vertical curve rate of change (r) shall be calculated as follows:

$$r = \frac{(G_2 - G_1)}{L}$$

where: r = Rate of Change
L = Length of Curve in 100' Stations
G₁ = Entrance Grade
G₂ = Exit Grade

MINIMUM CURVE LENGTH FOR LEAD TRACKS

The calculated minimum vertical curve length for lead tracks, in feet, is 100 times the algebraic difference of grades in percent for summits and sags, i.e., maximum rate of change for summits and sags = 1.0.

MINIMUM CURVE LENGTH FOR SPUR TRACKS UP TO 1500 FT IN LENGTH

The calculated minimum vertical curve length for spur tracks up to 1500 feet in length is 33.3 times the algebraic difference of grades in percent for summits and 40 times the algebraic difference for sags, i.e., maximum rate of change for summits = 3.0 and maximum rate of change for sags = 2.5.

MINIMUM CURVE LENGTH FOR SPUR TRACKS OVER 1500 FT IN LENGTH

The calculated minimum vertical curve length, in feet, for spur tracks over 1500 feet in length shall be 40 times the algebraic difference of grades in percent for summits and 50 times the difference for sags, i.e., maximum rate of change for summits = 2.5 and maximum rate of change for sags = 2.0.

6.04 GRADES

Track grades should be kept to a minimum and shall be restricted to a maximum of 2 percent (compensated) on lead tracks, and 3 percent (compensated) on individual spur tracks. Loop track grades shall be 0% preferred, 0.2 percent maximum, with the pit/loading area on a 0% grade. Any grade should be ascending to the pit/loading area.

Grade compensation for curvature shall be a 0.04 percent reduction per degree of curvature. For example, the maximum grade on a lead track with a 10° horizontal curve is: $2.0\% - (0.04 \times 10) = 1.6\%$.

6.05 LOADING, UNLOADING AND STORAGE TRACKS

Industry track where rail cars are loaded and unloaded shall be on a 0% (flat) grade. Storage tracks shall be on a 0% grade, unless approved by the Company.

Tracks are to be designed to avoid coupling cars in curves during switching operations.

Industry tracks should have 30 feet or 1/2 the proposed car length, whichever is greater, between the end of any vertical curve and the beginning of the nearest car spot for loading / unloading.

Industry tracks shall have 30 feet or 1/2 the proposed car length, whichever is greater, between the end of the last car spot for loading / unloading and the end of track device (see section 6.09).

Tracks with turnouts and ladders at both ends shall be designed to include a clearance buffer equal to 30 feet or 1/2 the proposed car length, whichever is greater.

Loop tracks shall include a minimum safety buffer of at least 100 feet.

6.06 TRACK CENTERS AND CLEAR POINTS

TRACK CENTERS

(TRACK LOCATED ON INDUSTRY PROPERTY)

Track centers for parallel Industry tracks located on Industry property shall be no closer than 14 feet, centerline of track to centerline of track, and shall be adjusted (increased) for curvature in accordance with *NSRC Plan 7-1*.

(TRACK LOCATED ON COMPANY RIGHT-OF-WAY)

Track centers for Industry track located on Company right-of-way and parallel to main line or siding shall be no closer than 15 feet, centerline of track to centerline of track, to main line or siding and shall be adjusted (increased) 1" per degree of curve on curved tracks. In multiple curved track territory, when the track on the inside of the curve has less super-elevation than the track on the outside of the curve, track centers shall be increased by 4-1/2 inches for each inch difference in super-elevation between the involved tracks. Track centers between multiple industry tracks shall be no closer than 14 feet and shall be similarly adjusted for curvature.

Where public law or regulation requires clearances greater than Company standard, such laws or regulations will govern.

(YARD LADDERS)

Tracks parallel to yard ladders shall be no closer than 22 feet, centerline of track to centerline of track.

CLEAR POINTS

The following apply to clear points and car storage limits:

- Clear points shall be shown on the plans and indicated in the field by the presence of a derail, clearance post or crosstie painted green.
- Rail cars shall not be spotted within 300 feet of the edge of public or private at-grade crossing on any tracks on Company right of way where practical.
- At locations where Industry track crosses privately owned Industry at-grade road crossings, cars shall be spotted as far as practicable from the grade crossing to provide adequate site distance.

6.07 TURNOUTS

All main line turnout shall be No. 10 or larger. Turnouts in Industry tracks shall also be No. 10 unless space will not permit, in which case a No. 8 turnout will be considered.

Turnout geometry, layout and materials are shown on the attached *NSRC Plans 2-4, 2-6, 2-8 and 2-17*.

Mainline turnouts shall not be placed within horizontal or vertical curves. Industry turnouts should not be placed within horizontal curves and shall not be placed within vertical curves.

For two turnouts in the same track diverging in opposite directions, thereby creating a reverse curve situation, it shall be necessary to provide preferably 100 feet but at a minimum of 70 feet between the points of switches of the two turnouts.

Facing point switches located in the same track and diverging to the same side of said track shall be separated by a minimum distance of 14 feet.

For a main line turnout diverging in the same direction as a preceding curve, the turnout should be placed 50 feet preferred, 25 feet minimum from the end of the curve.

For an industry turnout diverging in the same direction as a preceding curve, the turnout should be placed at least 10 feet from the end of curve.

For a main line turnout diverging in the opposite direction from the preceding curve, the turnout cannot be placed before 100 feet beyond the end of the curve.

All work on Company tracks, including main line turnouts, shall be accomplished by the Company.

Turnouts in the main line should not be placed within 100 feet of an at-grade road crossing.

Turnouts in Industry tracks shall not be placed within 10 feet of an at-grade road crossing.

Turnouts in the main line shall not be placed within 50 feet of a railroad signal.

Turnouts in the main line should not be placed on a railroad bridge or within 100 feet of a railroad track bridge face or back-wall.

Turnouts in the main line shall not be placed underneath an overpass.

6.08 DERAILS

Derails are installed on Industry track(s) at the clear point to derail away from the main line anything moving on the Industry track that does not have authority to use Company tracks.

Derails can also be used where safety is a concern. For example, derails can be placed before tracks cross public or private streets at grade or at the top of steep grades to prevent "run-away" situations.

All derails to be operated by Company personnel shall be equipped with a Company supplied lock and key. These locks shall be operated by Company personnel **Only**.

A double switch point (DSP) derail shall be installed by the Company, with the non-switch end of the derail at the clear point of the Industry track, on Industry track with descending grade towards the Company track. The entire DSP derail (43' long) shall be located in vertical tangent track outside of any vertical curves. The long timber (end) of the derail shall be placed at the clear point, NOT the point of switch (beginning). See attachment for derail details.

Hayes Model HB Derails will be installed, by the Company, at the clear point of tracks which have no grade or a descending grade away from the Company track.

A DSP derail will be installed at the clear point on *any* track that handles hazardous materials (*NSRC MW&S Standard Procedure 100*).

Derails are to be painted international orange. Glass beads should be sprinkled on after painting while paint is still wet to increase night time viability (*NSRC MW&S Standard Procedure 100*).

Additional derails may be required due to site specific safety concerns and / or operational considerations.

6.09 END OF TRACK DEVICES

End of Track (EOT) Devices shall be placed at the open end of all stub-ended tracks.

Earth mounds are the preferred EOT Device. Earth mounds should be of an approved design sufficient to stop a moving car and should be protected against erosion.

Where earth mounds are impractical, bumping posts shall be used on all stub end tracks which end at a structure, dock, or road. Bumping posts shall be either new or second-hand, of good quality and approved design.

Use of wheel stops should be avoided and are only allowed with the expressed written consent of the Company.

6.10 SIDE AND OVERHEAD CLEARANCES

Standard vertical and horizontal clearances based on the centerline of Industry track at top of rail are shown on *NSRC Plan 7-1*, attached to these guidelines. ***Where law or regulation requires clearance(s) greater than Company standard, such laws and regulations will govern.*** All substandard clearances must be approved by the responsible Operating Officer of the Company provided that the Company Clearance Engineer determines that there are no issues related to the proposed substandard clearance.

NSRC Plan 7-1 should be referenced for design clearance requirements for all structures including buildings, loading racks, stairways, and overhead fall arrest protection supports, etc... to be constructed adjacent to or over Industry tracks. ***The Industry should review all federal, state and local safety and environmental regulations to determine what structures and/or appurtenances will be required for their particular method of operation and commodity early in the design process.***

Although the maximum vertical distance from the proposed top of rail to a platform, loading dock, or building finished floor elevation is shown as 4 feet – 0 inches on *NSRC Plan 7-1*, the Company recommends a design distance of 3 feet – 9 inches. This is the average floor height of a standard box car. The Industry's engineer should coordinate rail car information with the Company's engineer to verify the proper design distance between the top of rail and the finished floor elevation of the dock or building.

Standard vertical clearances from the centerline of track at top of rail for overhead electric lines are shown on *SP-1621*, attached to these guidelines.

Required side clearances for storage of rail cars and storage tanks for hazardous commodities can be found in Chapter 14 of these guidelines.

“Close Clearance” signs, if required, shall be posted as directed by the Company. Close clearance signage shall be as shown in *NSRC Plan 6–14*, attached.

6.11 ROADBED SECTION

Requirements for roadbed shoulder width, ditches, and slopes are shown on the following Company Plans (attached to these guidelines):

NSRC Plan 1–21 - ROADBED SECTION FOR HEAVY TONNAGE TRACKS
OTHER THAN MAIN TRACKS

NSRC Plan 1–22 - ROADBED SECTION FOR INDUSTRIAL TRACKS

NSRC Plan 1-22A - TURNOUT PAD FOR No. 10 INDUSTRY TURNOUTS

Industry should note the importance of constructing these typical roadbed sections which will provide an adequate walkway for both Company and Industry personnel. This is especially true in the area between switch stands and derails and any other areas as required by federal, state and/or local regulations.

Consideration of operational and tonnage requirements must be taken into account when designing roadbed sections for new track. The *NSRC Plan 1–22* roadbed section can be used for most spur tracks.

Heavy tonnage spur tracks such as those serving coal facilities typically require a roadbed section as shown on *NSRC Plan 1–21*.

Lead tracks of considerable length such as those serving an industrial park typically require a roadbed section as shown on *NSRC Plan 1–21*.

6.12 GRADE CROSSINGS AND ROADS

Roads Crossing or Parallel to Company Tracks

New at-grade road crossings over Company Tracks should be avoided. Design, permitting, and approval for new grade crossings over Company tracks can be an extensive and time consuming process. The applicant should initiate the crossing permit application early in the conceptual phase of project planning with the Industrial Development Manager, who will coordinate the application with the various departments involved in the approval process. The Industry should work closely with the Company's Engineering Department on design and location of the proposed crossing and preparation of plans for final approval submittal to the Division Superintendent.

Safety is always the controlling factor in design of new at-grade road crossings. Factors such as sight distance of train and vehicle operators, type of vehicles utilizing the proposed crossing, grade of the proposed road, vehicle braking ability, and accessibility of the location to be served by the crossing if the crossing is blocked by a stopped train are examples of factors which must be considered, to name a few. It is the Industry's responsibility to incorporate any local, state or federal regulations, guidelines or

NSRC Specifications for Design and Construction of Privately Owned Industry Tracks
Chapter VI. Industry Track Design
July, 2020

mandates which may govern grade crossing design at their proposed location. This is often, but not always, governed by the type (e.g. local, state or federal highway) of road.

Grade crossing warning devices such as cross bucks (Passive Warning) or flashing light signals with or without gates (Active Warning) are highway traffic control devices. The Division Superintendent shall determine the level of warning or device to be installed for a crossing over a private road. For a crossing over a public road or street the state agency or local authority (road authority) with jurisdiction over the road shall evaluate and determine the level of warning or device required for that crossing. The Industry should work closely with both the road authority and the Company to assist in determining the adequate level of warning device for the proposed crossing.

If the governmental agency having jurisdiction requires that automatic warning devices be installed at the crossing, before industry purchases and installs said devices, it will be necessary that the plans for installation for such control apparatus and equipment be submitted to the Company's Signal and Electrical Department for review and approval. Engineering plans for installation of the grade crossing warning devices must also be reviewed and approved by the governmental agency prior to installation. This level of involvement may vary depending on the type of Company owned track involved, i.e. main line vs. lead track serving an industrial park.

Asphalt paving with rubber flange way (a.k.a. Rubber Rail Seal) is the current standard crossing surface for at-grade road crossings over Company tracks (see *NSRC Plan 7-05B*). Any desired use of alternative surface types, such as Concrete Panels (see *NSRC Plans 7-6 and 7-6A*), by any party should be discussed with the Company's Engineering personnel and will be covered in the crossing agreement.

Roads parallel to Company tracks on Company property shall be designed to provide for the safety of all parties using the proposed road. Many factors contribute to roadway design and the Industry should work closely with the Company in this regard. This type of use of the Company's property almost always requires a formal agreement with the Company.

Roads Crossing Industry Tracks

Private at-grade road crossings and roads parallel to Industry tracks located beyond the Company's Division of Ownership and Maintenance point in the track shall meet or exceed Company standards and will only be permitted under the terms of the Industry Track Agreement.

Crossing surface types for private at-grade crossings are at the discretion of the Industry but shall be built in accordance with Company standards. Attached *NSRC Plans 7-5, 7-5a, and 7-5b* govern timber and rubber rail seal crossings while *NSRC Plans 7-6 and 7-6A* govern concrete crossings.

Safety of rubber tired vehicular traffic around railroad tracks inside Industry facilities is the responsibility of the Industry. Design of proper side clearances to tracks from adjacent roads, site distances at grade crossings, and proper signage shall be in accordance with Company standards.

6.13 AT-GRADE TRACK CROSSINGS

Rail crossings should be used as little as possible. All rail crossings shall be approved by the Company. The angle of the rail crossing shall be that shown on the approved plans and/or as further defined as staked in the field. Detailed manufacturer's plans and specifications shall be furnished for approval by the Company.

VII. INDUSTRY PLAN SUBMITTAL

7.01 GENERAL

Sample agreement and sidetrack design plans are shown in the attachments for reference.

The Industry submitted plans will be utilized by the Company for internal review and approval. This process ensures compliance with engineering and safety standards and verifies the feasibility of the proposal from an operational stand point. A clear, well labeled plan is essential for a successful submittal and prompt review.

The plans will also be utilized as attachments in track usage agreements between the Industry and the Company. As such, clear reference to ownership and parties to the sidetrack agreement should be included on the plan.

In addition to Industry submitted sidetrack design plans, a separate agreement plan shall be provided for final review and approval by the Company, unless deemed unnecessary by the Company. The agreement plan should be as shown in the attachments and not include construction related details such as contours, erosion control devices, etc...

It is the Company's desire to be a cooperative partner in progressing projects owned by Industry; however the safety of Company employees and the equipment it operates is of paramount importance. Plans provided shall clearly define all existing and proposed conditions and allow for sound decisions to be made by the Company in its approval process.

When overhead and under track structures, utilities and retaining walls are involved, submitted plans for these structures shall bear the seal of a current Registered Licensed Professional Engineer in the state of the project.

Plans produced and submitted by Industry or its contractor shall be provided to the appropriate Company Industrial Development Manager's office in MicroStation (.dgn) or other equivalent and compatible format. A PDF version of the completed plans shall also be attached.

Plans submitted shall be drawn to scale and show all essential features affecting the track layout. The preferred scale for drawings is 1"=100'. Smaller projects may utilize a scale of 1"=50' and larger projects may utilize a scale of 1"=200'. No other scales will be accepted. The agreement plan should use one of the preferred scales and be sized to have all track fit on one plan sheet.

All tracks depicted on the drawings shall be shown as CENTER LINE of track. Tracks showing crossties and rails, or two lines representing rails are not acceptable. Existing track center lines shall be shown as light weight (thin) and solid lines. Proposed track center lines shall be shown as a heavy weight (thick) with a dashed line. Tracks to be relocated or removed shall be shown light weight and with a dashed line style distinctly

different than the style used for proposed track. Tracks in relocated position shall be shown heavy weight and with a dashed line style distinctly different than the style used for proposed track. See the attached sample plans for examples.

Any questions regarding design specifications not answered in these specifications should be directed to the assigned Company Design and Construction engineer assigned to the Industry project.

7.02 REQUIRED PLAN SIZES

The Company allows 6 different standard plan sizes. The sizes are:

- AA – 8.5" x 11" (ANSI A)
- AB – 11" x 17" (ANSI B)
- AC – 17" X 22" (ANSI C)
- AD – 22" x 34" (ANSI D)
- ARN – 11" X >34"
- ARM – 22" X >34"

AB and AD plans are the preferred size subject to layout requirements and should be utilized when possible for ease of reproduction. When possible a single sheet including both site plan and profile drawing should be submitted. Cross-sections, grading and drainage details are required for work on Company right-of-way. Typically, grading details and cross sections beyond Company right-of-way are not required but may be requested on a case by case basis.

All drawings shall leave a 3" vertical by 5" horizontal clear area in the lower right hand corner (within inner border) of all plan sheets for insertion of a drawing identification label by Company.

7.03 TITLE BLOCK

Completed plan drawings submitted to Company for review and approval shall include the following title block information for the Industry:

- Facility owner
- Facility address
- Drawing title
- Drawing number or file reference.
- Date
- Firm responsible for production of drawing including contact information

7.04 SITE AND TRACK PLAN

Sidetrack Design Plan shall include the following as applicable:

- English units, engineering format (decimal)
- Centerline stationing for all track
- Point of Switch (PS) with stationing, turnout size, whether right hand (RHTO) or left hand (LHTO) turnout, and whether switch is hand throw or power operated
- Point of Curve (PC) or Point of Tangent to Spiral (TS) with stationing
- Point of Tangency (PT) or Point of Spiral to Tangent (ST) with stationing
- Curve data for all curves based on the chord definition including delta, degree of curvature, radius, tangent, and length of curve
- Track clearance points (CP) with stationing
- Door/dock clearances with stationing for door centers and dock ends
- Track centers or minimum track centers
- Derails / Division of Ownership & Maintenance with stationing
- Track capacities in number of cars and stationing limits
- Existing tracks with description (i.e. Main Track, Industry Track, etc...)
- Proposed tracks with description (i.e. Main Track, Industry Track, etc...)
- Show vertical & horizontal clearance for all structures within 15 feet of center line of proposed or existing track with stationing
- North arrow
- Drainage structures, both proposed and existing
- Utilities with horizontal and vertical clearances to proposed / existing track centerline
- Fiber optic cables with line identification
- Signals, signal equipment and shelters
- Direction to and name of the nearest city located along railway tracks
- Distance between the proposed point of switch and the nearest railway milepost with a directional arrow towards the milepost
- Distance to the nearest major land mark in each direction if not shown on the plan (i.e. road crossing, bridge, mile post, etc...)
- County in which the project is located, shown in upper right corner of plan
- Location map
- Location of Railway right-of-way (R/W) lines, with dimensions to track center line
- Location of property lines, other than Railway R/W, where possible
- End of track device (both existing and proposed) with stationing
- Level (0%) grades for all loading / unloading areas
- Spill containment devices and systems with stationing
- Coordinate table for all survey control points (point #, Northing, Easting, Elevation, and Description)
- The proposed point of switch shall be tied to the local State Plane coordinate system
- The State Plane coordinates for the proposed point of switch, derail and end of track(s) shall be shown on the plan either at the location shown, or in a

table. In addition, Lat/Long coordinates shall be included on the agreement plan for the proposed Division of O&M, Begin Track Lease and End of Track Lease.

- Detailed plans and calculations for proposed unloading pits and scales shall bear the seal of a current Registered Licensed Professional Engineer. These plans shall be approved by the Norfolk Southern Bridges and Structures Department prior to the commencement of any site work involving the track.
- Safety buffer with stationing
- Grade crossing length and stationing at each end
- Track lease and stationing

7.05 TRACK PROFILE

The Sidetrack Design Plan Profile shall include the following items as applicable:

- Point of Switch (PS) with stationing
- Derails with stationing
- Stationing in the same direction as the proposed track alignment and displayed on the same scale as the plan view
- Average grade of existing and proposed tracks
- Profiles of the existing track, proposed track, and proposed sub-grade
- Points of Vertical Curvature (PVC) with stationing
- Points of Vertical Tangency (PVT) with stationing
- Vertical curve lengths and “r” (rate of change) value
- Top of rail elevations for the proposed track every 100 feet
- Storage capacity in number of cars in loading/unloading zones and station limits
- Dock height and elevation
- End of track device with stationing
- At-grade road crossings with stationing at each end of crossing
- Unloading pits and loading structures with stationing
- Overhead and underground utilities with stationing and elevations
- Existing and proposed culverts with stationing, elevations and depth of cover
- Safety buffer with stationing
- Top-of-rail to top-of-subgrade measurement

7.06 ADDITIONAL PLAN REQUIREMENTS

Additionally, all sidetrack design plans shall include the following as applicable:

- A typical roadbed cross-section of the track showing the depth of the sub-ballast, ballast, and design of the sub-grade in compliance with Norfolk Southern standards
- Cross-sections at locations of overhead and underground utility and culvert crossings, including labelling inverts, diameter and cover

- Legend clearly defining all line types
- An applicable clearance diagram in compliance with Norfolk Southern standards
- Turnout Pad Plan 1-22A
- Typical section and detail for any grade crossings
- Typical section and/or detail plan for any unloading pit, or loading/unloading apparatus
- Detail of end of track device
- Detail and typical section for spill containment devices and systems
- Chart or table listing car type and length, commodity, unloading/loading method, and method of operations i.e. switching by Company, Industry or both
- Land lease area with both acreage and square footage shown. Include dimensions to proposed and existing tracks.
- A master plan view of the entire industrial site as a separate attachment
- A full set of cross-sections are to be submitted for review. Cross-sections shall include existing surfaces and tracks, proposed surfaces and tracks, including NS mainline tracks, drainage crossings and other special cases as needed. Cross-sections shall be fully annotated with slopes, elevations and offsets, track centerline offsets and top of rail elevations, and in a scale that is legible. The Company Design & Construction engineer will advise if this submittal will be required.
- A complete set of construction plans for the entire industrial site are to be submitted for review. The Company Design & Construction engineer will advise if this submittal will be required.

7.07 AGREEMENT PLAN REQUIREMENTS

A separate agreement plan shall be included in the plan submittal. Requirements for information to be presented on the agreement plan are shown on the agreement plan checklist and sample agreement plan in the attachments.

7.08 SUBMITTAL TO STATE AGENCIES

Where required by state law, the industry is responsible for submitting sidetrack design plans to the appropriate state agency for review and approval prior to performing site and track work.

VIII. SITE WORK

8.01 CLEARING AND GRUBBING

Clearing and grubbing includes the removal of all trees, brush, logs, debris and other undesirable materials from locations where new construction is to occur.

The Industry shall be responsible for the clearing and grubbing of that portion of the Company's right-of-way affected by new construction. All material removed from the Company's right-of-way, excepting that reserved by the Company, shall be disposed of by the Industry. The Industry shall be responsible for the identification and protection of overhead and underground utility easements, including fiber optic cable easements, within the Company's right-of-way.

Prior to the commencement of clearing and grubbing on Company right-of-way, the Company's Division Engineer and Division Superintendent's office shall be contacted in order to schedule the clearing and grubbing operation so as not to interfere with train operations.

8.02 GRADING

The Industry shall construct or cause to be constructed all grading necessary for the installation of the track. This includes all grading required for that portion of the track located on the Company's right-of-way. The requirement for a wider roadbed to provide a proper walkway in the area of all turnouts is of particular concern. This additional roadbed width shall be graded as shown on attached *NSRC Plan 1 – 22A* and shall continue along the diverging track until it transitions back to the diverging track's standard roadbed section.

The Industry shall be responsible for compliance with all local, state, and/or Federal regulations governing site construction including, but not limited to erosion control, grading, and storm water runoff.

Fills and subgrades shall be compacted to a minimum of 90 percent Modified Procter based on American Association of State Highway and Transportation Officials (AASHTO) Designation T-180, or 95 percent Standard Procter based on AASHTO Designation T-99.

Moisture content of soil should be controlled as necessary to obtain specified densities, based on the moisture-density relationship developed by AASHTO tests.

All topsoil shall be removed from the area of the proposed roadbed. Slopes of all cuts shall be true and straight and all loose stones and boulders removed. Slopes of all fills shall be carefully formed and trimmed as they are compacted. Where a fill is placed on sloping ground or on the side of an existing fill, the surface shall be deeply plowed or stepped and the new material thoroughly mixed and embodied with the old material as the new fill is constructed.

The finished subgrade shall conform to such elevations as shown or otherwise noted on the plans, within a tolerance of ± 0.1 foot.

8.03 DITCHES

The Industry shall provide temporary or permanent ditches in order to maintain the Company's existing drainage of the tracks. No ponding of water against the Company's existing roadbed shall be allowed. Ditches draining Company tracks shall be designed to carry the expected runoff of a storm with a 100-year recurrence interval.

No drainage is to be diverted to railroad ditches without the specific notification and written approval of the Company.

8.04 SEEDING

A seed and fertilizer mixture, adhering to local, county or state DOT specifications shall be applied so as to provide adequate slope protection. Creeping grasses shall not be used.

8.05 DRAINAGE CULVERTS AND STRUCTURES

Except as otherwise specified hereafter, the current AREMA Chapter 1, Part 4 applies to all work under this section. This Section applies to under track culverts conveying storm water run-off only. Closed pipeline systems for roadway stormwater management shall be designed in accordance with the NSCE-8, Section 4. A "Closed pipeline system" is defined as a system that conveys stormwater entirely across the right-of-way. If the drainage system empties onto the NS right-of-way, then the under track culvert requirements apply.

The Industry shall be responsible for constructing at its own expense all drainage structures for the proposed track including that portion on the Company's right-of-way. The Industry shall ensure that post-development storm water runoff rate / volume towards Company right-of-way does not exceed pre-development conditions. The Industry shall be liable for all damage claims arising from adverse effects caused by Industry alteration of pre-development drainage patterns.

Any required changes or additions to existing drainage structures under Company track(s) due to Industry track, shall be the responsibility of the Industry. The Industry shall furnish to the Company, for review and approval, plans, specifications and computations for proposed drainage structures and drainage modifications involving the Company's right-of-way prior to start of construction. In no case shall the hydraulic capacity of a Company drainage structure be reduced. In addition, ponding of water on Company right-of-way shall not be allowed.

Culverts shall be designed for Cooper's E-80 Live Loading and the 100 year storm event. The proposed design shall be approved by the Chief Engineer – Bridges and Structures. Maximum headwater build up (for Q 100) for inlet control conditions shall be limited to an HW/D= 1.5 provided the roadbed fill is of sufficient height to maintain the high water elevation below the toe of ballast and the fill material is capable of resisting water infiltration for short durations. With the approval of the Chief Engineer – Bridges and Structures, the HW/D limit may be adjusted for special field conditions.

All plans and calculations for work impacting drainage structures under the Company's tracks shall bear the seal of a current registered licensed professional engineer in the state of the project.

Culverts shall be sized based on the actual drainage basin. The minimum culvert size shall be 36 inches in diameter for all culverts on NS right-of-way unless otherwise approved by the Chief Engineer – Bridges and Structures. The "Rational Method" shall be used for drainage areas less than 200 Acres. For drainage areas greater than 200 Acres, one of the following methods should be considered and may provide more realistic runoff estimates provided data is available:

- a. Soil Conservation Service (Unit Hydrograph Theory Method) SCS
- b. Frequency Regression Theory

8.05.01 CULVERT OPTIONS

The following requirements shall be met for all culverts placed under Company tracks or tracks that will be owned by the Company in the future.

All culverts shall be installed to the line, grade, and elevations and be of the size as shown on plans approved by the Company. All culverts shall be installed for the full width of the section, properly bedded as per the attached *'Installation Instructions Corrugated Metal Pipe Culverts'* detail and shall be backfilled with select material and carefully compacted.

Corrugated metal with various coatings, corrugations, shape, and manufacturing processes, smooth wall steel pipes and concrete, both pre-cast and cast-in-place, HDPE, SDPE, and Schedule 80 PVC can be considered. Polymer coated pipe requires special care to avoid damage during handling and installation.

Corrugated metal, galvanized and asphalt coated circular pipes will be our basic design with variations permitted with the approval of the Engineer Structures.

- 1. Aluminized Type 2 uncoated or Bituminous coated galvanized steel pipe - may be used for a PH range of 5-8. Suggested uses are runoff from non-industrial rural areas.
- 2. Fiber Bonded Bituminous coated pipe or Polymer coated pipe - may be used where soil and water conditions warrant such as Midwest farm fields (high concentrations of fertilizer runoff), coal fields (acidic runoff), salt water marsh areas, and in areas where high soil concentrations of heavy metals are present.
- 3. Pipe Arch - may be considered for special cases where physical constraints and opening requirements warrant.
- 4. Corrugated metal culverts of 42" or larger diameter shall be formed to a specified 5 percent vertical elongation with tension wires or turnbuckle rods at horizontal axis. These tension wires are to be removed when grading is complete.
- 5. At no time shall the corrugated metal pipe gage exceed 12. See attached *'Corrugated Metal Culvert Gage Selection and Installation'* detail.

High Density Polyethylene (HDPE) pipe is approved for non-main track under track applications. See *NSRC Plans DR-HDPE-1 and DR-HDPE-2* for material and installation requirements for HDPE pipe.

Smooth Wall Casing pipe will be our basic design for culverts where jack and bore method of installation is required due to traffic condition or fill height greater than 10 feet. Liner Plate installed by Tunneling method may be required when diameter, length, presence of rock or other unusual site conditions exist. Refer to Table 1 – SMOOTH WALL CASING PIPE MINIMUM WALL THICKNESS and Table 2 – MINIMUM LINER PLATE GAGE TABLE shown on Page 30.

Except as approved by the Chief Engineer – Bridges and Structures, concrete pipe culverts or pre-cast concrete culverts may not be used under Company owned tracks or tracks to be owned by the Company due to the risk for differential settlement and joint separation. Concrete pipe culverts or pre-cast concrete culverts may be used under industry tracks where NS has no maintenance responsibilities. Concrete culverts shall be of adequate cross section to provide the proper drainage opening conforming to ASTM C-76 Class V, reinforced Wall B.

The use of pre-cast concrete box culverts is acceptable. Boxes shall be designed and fabricated in accordance with the current AREMA Manual for Railway Engineering, Chapter 8, for Cooper's E-80 Live Loading. Cast-in-place concrete structures may be used where appropriate.

Structural Plate pipes and pipe arches are to be used where size and conditions dictate (generally considered culverts greater than 72-inch diameter). The coating to be either bituminous coated or fiber bonded depending on soil and runoff water condition (PH range).

Tunnel Liner shall be used when the culvert diameter exceeds pipe sizes economically installed by the jack and bore method (culverts generally larger than 60-inch diameter). All tunnel liner pipe shall be bituminous coated and have paved inverts. Grouting of voids between the pipe and adjacent soil at regular intervals, not to exceed once daily, is required.

8.05.02 PAVED INVERTS AND END TREATMENTS FOR BCCMP

Paved inverts shall be used in corrugated metal pipes where water velocities are medium to high (above 10 f.p.s.) or the possibility of excessive wear from sand and gravel is likely.

1. Corrugated metal culverts shall have bituminous or asphalt paved inverts where needed due to high water velocities or the possibility of excessive wear from sand and gravel is likely.
2. Concrete or Asphalt paved inverts shall be used in structural plate, tunnel liner and pipe arches that are field assembled. If concrete is used, a minimum concrete compressive strength shall be 3000 p.s.i. after 28 days. The bottom 25% of culvert periphery shall be covered with concrete (or asphalt) to a depth of 1 inch above the crest of the corrugations for circular pipes and 40% of the periphery for pipe arches. The concrete pavement shall be reinforced with 6 x 6 (W2.9 x W2.9) welded wire fabric. This wire shall be attached to the pipe by either directly welding to the pipe or by mechanical attachment to the bolts.

Preformed bituminous coated end sections may be used in place of headwalls when erosion at the inlet is expected, and shall conform to AASHTO M218 requirements. Headwalls and/or End Sections should be considered on both ends of all culverts greater than or equal to 60-inch diameter.

8.05.03 CONNECTING BANDS FOR BCCMP

Connecting bands for annular bituminous coated corrugated metal pipe shall consist of a single piece 24" wide, one gage thinner, with the same corrugations and same cover treatment as the drainage pipe. Connecting bands for drainage pipe 48" and larger diameter shall be fully bolted with a minimum of four - 0.5 inch diameter rods and silo-type lugs. Dimpled bands are not acceptable.

8.05.04 STEEL CASING PIPE AND TUNNEL LINER PLATE SIZE CHARTS

TABLE 1 -SMOOTH WALL CASING PIPE MINIMUM WALL THICKNESS

Nominal Size (Inches)	Minimum Wall Thickness (Inches)
12	0.250
18	0.312
24	0.375
30	0.469
36	0.532
42	0.625
48	0.688
54	0.781
60	0.844
66	0.938
72	1.000

TABLE 2 - MINIMUM LINER PLATE GAGE TABLE

Diameter (feet)	2 Flange		4 Flange	
	Gage	Cover (feet)	Gage	Cover (feet)
4	12	4 to 50	12	4 to 50
5	12	4 to 50	12	4 to 50
6	12	4 to 50	10	4 to 50
7	12	6 to 50	10	4 to 50
7	10	4 to 50	--	--
8	10	4 to 50	8	6 to 50
9	10	4 to 50	8	8 to 50
10	8	4 to 32	5	8 to 50
10	7	34 to 50	--	--

Notes: The above Minimum Liner Plate Gage Table was developed using 1992 AREMA Specifications Chapter 1, Part 4.

The following factors of safety are used:

Joint Strength = 3.0

Minimum Stiffness = ("3.0" for 2-Flange and "1.5" for 4-Flange)

Critical buckling = 2.0.

The effects of high corrosive environments may be compensated for by adding one (1) gage to the above Liner Plate Gage Table values.

8.06 BLASTING

Use of explosives on and adjacent to railroad property and right of way is subject to strict provisions and safety precautions. If use of explosives during grading is anticipated, the Industry shall contact the Company for a copy of **Guidelines for Use of Explosives on Norfolk Southern Corporation Property**. This publication outlines insurance requirements, safety, method, and procedures. Failure to plan ahead with regard to these requirements can cause significant delays to the construction process; the Industry should fully investigate ahead of time if blasting will be necessary.

IX. TRACK MATERIALS & CONSTRUCTION

9.01 SUB-BALLAST

Sub-ballast shall be crusher-run dense graded aggregate, preferably limestone or granite material, and shall meet the requirements as set out in Chapter 1, Part 2, Section 2.11, "Sub-ballast Specifications" of the AREMA Manual.

Gradation as follows:

Sieve Size	2"	1"	3/8"	No. 10	No. 40	No. 200
% Passing Size (optimum)	100	95	67	38	21	7
Permissible Range % Passing	100	90-100	50-84	26-50	12-30	0-10

Sub-ballast shall be spread on a graded roadbed as a base, with sufficient width to accommodate the desired number of tracks (see *NSRC Plans 1-21* and *1-22*). The sub-ballast shall be compacted to 95 percent of its maximum dry density and have a minimum depth of 6 inches.

For sub-ballast quantity estimates, placement of 6 inches of compacted sub-ballast on a single track industry roadbed requires approximately 0.84 ton of sub-ballast per foot of track construction.

9.02 BALLAST

Material for ballast used on Industry tracks shall be clean crushed stone with a minimum depth of 9 inches for lead tracks and 6 inches for spur tracks between bottom of tie and top of sub-ballast (see *NSRC Plans 1-21* and *1-22*). Cribs between adjacent ties shall be filled with ballast and be level with the top of the ties.

Stone for use as ballast on tracks, or portions of tracks, to be owned by the Company, shall be furnished by a Company approved quarry and shall be granite crushed stone conforming to the requirements of Company Specification No. 702 (2009).

Subject to approval of the Company's Chief Engineer, limestone ballast conforming to Company Specification No. 702 (2009) may be used on tracks not owned by the Company. If material meeting this specification is not available, limestone ballast meeting AREMA Specifications may be used on tracks not owned by the Company if approved by the Company's Chief Engineer.

#3 Modified ballast shall be used under all main tracks, lead tracks, and switching tracks parallel to a main track on the Company side of the division of ownership and maintenance.

Yard tracks and turnouts, spur tracks, switching tracks (where a #3 Modified ballast is not required), and runaround tracks may use either a #3 Modified or #5 ballast.

Gradation shall conform to the following table:

Sieve Designation	Sieve Opening	#3 Modified Ballast % Passing Sieve	#5 Ballast % Passing Sieve
2 ½"	2.5"	100	-
2"	2"	95-100	-
1 ½"	1.5"	30-65	100
1"	1"	0-15	90-100
¾"	0.75"	-	40-75
½"	0.5"	0-5	15-35
3/8"	0.375"	-	0-15
No. 4	0.187"	-	0-5
No. 200	0.0029"	0.5 Max	0.5 Max

9.03 RAIL

Rail shall be new or relay of good quality, with minimum section of 100 pounds/yard, 115 pounds/yard for loop tracks. Relay rail should be free from local bends, kinks, battered ends, excessive engine burns and surface corrugations. Rail should be furnished in lengths not less than 31 feet and should be drilled to accept the proper size joint bars for the section of rail being used.

Based on planned track usage and/or tonnage a heavier rail section (continuous welded rail) should be considered. If welded rail is used, the type of welding should have approval of the Company's Chief Engineer or his representative.

Existing industry track with a rail section of less than 100 pounds/yard that is out of service or inactive may be subject to rail replacement as determined by NS MW&S track inspection, and/or track geometry, type of commodity, traffic volume, and operations.

Rails should be laid one at a time. The bottom of the rail and the bearing surface of the tie plate should be cleaned of all debris before the rail is laid. Joints in opposite rails shall be staggered not less than 8 feet and not more than 14 feet apart, except as close joints may be required at insulated joints or turnouts. To minimize the cutting of full length rails, short rails of not less than 15 feet may be used in adjusting for proper spacing of joints. Proper allowance for expansion should be provided at rail joints by installing rail expansion shims conforming to the section of rail being used.

When necessary to cut and/or drill a rail, it should be cut with an approved rail saw, and drilled with an approved rail drill. Flame cutting of rail will not be permitted.

9.04 TURNOUTS

Turnouts shall be new or relay of good quality of the same or greater rail section as the parent track. The turnouts shall be the size and shape as called for on the plans and shall meet all requirements in accordance with an approved design, AREMA, or equal. The turnout material shall be complete in every respect to construct the needed turnouts ready to receive train traffic. Package switches shall be of an approved design, AREMA, or equal, equipped with standard reinforced points and of correct length for the size of turnout of which they are a part. Frogs shall be of an appropriate design, AREMA or equal, equipped with plates of the proper size and type to fit the designed track layout. Frogs shall be of the same or heavier rail section as that of the parent track. Where the

Company has plans to upgrade the parent track, then the rail and frog section shall be as required by the Company. Turnouts to be used in tracks to be owned by the Company shall conform to the Company's standard turnout plans, not AREMA turnout plans. Reference *NSRC Plan 2-17* for turnout geometry.

9.05 TIES

TIMBER

Ties shall be new and conform to the Company's Quality Assurance Specifications for Ties and Timbers, Section No. 2, NS Specifications for Wooden Industrial Grade Crossties, Revised May 1, 2017.

Ties used in tracks to be owned by the Company shall be purchased from a Company approved supplier. Certification of the ties must be furnished to Company from the contractor and/or supplier based on Company specifications.

Ties shall be placed on the prepared sub-ballast at right angles or normal to the centerline of the track. Ties shall be spaced 20 inches, center to center (60 ties per 100 feet) with the ends of the ties along one side of the centerline on tangent track and along the inside on curved track being placed 1' 10 ¾" from the gage of the nearest rail.

STEEL

The use of steel ties on lead and switching tracks (or similar) to be owned and/or maintained by the Company requires approval of the Company's Chief Engineer. The Industry may elect to use steel ties on industry owned tracks.

Steel ties shall meet the requirements listed in the most current version of Chapter 30, Part 6 of the AREMA Manual. Ties shall be new North American Railway Steel Tie Corporation (NARSTCO) Type M10 or equivalent. Rail fastening clips and hook-in-shoulders shall meet manufacturer's specifications for the ties used.

Ties shall be placed on the prepared sub-ballast at right angles or normal to the centerline of the track. Ties shall be spaced 24" center to center in tangent track and 20" center to center in curved track and installed per the manufacturer's specifications, including ballast depth.

It is essential for surfacing and lining of track constructed with steel ties to be performed properly to ensure proper tie support and prevent track settlement.

Steel ties shall be installed as described in the most current version of Chapter 30, Part 6 of the AREMA Manual. It is of utmost importance to ensure the tamping machine used for surfacing is equipped with traversing vibratory work heads with 16 tamping tools in good condition and with depth properly adjusted for steel tie track surfacing.

9.06 SWITCH TIES

TIMBER

Switch ties shall be new oak and mixed hardwood ties of 7" x 9" in cross section and in 12" length increments as required for the turnout being used. All switch ties shall be air-dried and treated per the Company's Quality Assurance Specifications for Ties and

NSRC Specifications for Design and Construction of Privately Owned Industry Tracks

Chapter IX. Track Materials & Construction

July, 2020

Timbers, Section No. 2, NS Specifications for Wooden Industrial Grade Crossties, Revised May 1, 2017. No second hand switch ties may be used.

Switch ties used in turnouts to be owned by the Company shall be purchased from a Company approved supplier. Certification of the ties must be furnished to the Company from the contractor and/or supplier based on Company specifications.

Switch ties shall be placed on finished sub-ballast and spaced according to the Company's Standard Plan for the turnout being used.

STEEL

The use of steel switch ties in turnouts on lead and switching tracks (or similar) to be owned and/or maintained by the Company requires approval of the Company's Chief Engineer. The Industry may elect to use steel switch ties in turnouts on industry owned tracks.

Steel switch ties shall meet the requirements listed in the most current version of Chapter 30, Part 6 of the AREMA Manual. Switch ties shall be new North American Railway Steel Tie Corporation (NARSTCO) or equivalent. All OTM shall meet manufacturer's specifications for the ties used.

It is essential for surfacing and lining of track constructed with steel ties to be performed properly to ensure proper tie support and prevent track settlement.

Steel switch ties shall be installed as described in the most current version of Chapter 30, Part 6 of the AREMA Manual. It is of utmost importance to ensure the tamping machine used for surfacing is equipped with traversing vibratory work heads with 16 tamping tools in good condition and with depth properly adjusted for steel tie track surfacing.

9.07 TIE PLATES

Tie plates should be new or second hand, of good quality and of an approved design for the weight of rail to be used. Two tie plates per tie, under the base of rail, must be used. Also, tie plates shall be used on all switch ties not protected by switch plates, frog plates, or guard rail plates.

The tie plates shall be double shouldered and have a minimum size of 7 ½" x 11" with proper punching to fit the base of the rail being used. The down slope (1:40 cant) of the tie plate shall be directly over and parallel with the centerline of the crosstie. The tie plate shall be set so that the outside shoulder of the tie plate shall bear squarely against the base of the rail, having a full bearing for the rail and at the same time, a full bearing on the crosstie.

9.08 RAIL JOINTS

Joint bars should be either new or second hand, of good quality and of the size, drilling, and hole spacing to fit the rail being used. Joint bars should be properly installed with the full number of and the correct size of bolts, nuts and spring washers. Bolts shall be placed with nuts alternately on inside and outside of rail and shall be drawn tight before spiking. Bolts shall be tightened by the use of approved track wrenches or track bolt machines.

Rail joints should be kept out of grade crossings.

When different size rails are to be connected, forged compromise joint bars shall be used. The above mentioned recommendation for rail joints should apply to compromise joints.

Any field fabrication of compromise joints shall be strictly prohibited, that is, the cutting down of larger standard joints to fit smaller rail shall not be allowed.

9.09 BOLTS AND NUTS

Bolts and nuts for the track and turnouts should be new or approved relay and of the correct diameter and length to fit the rail and joints being used. Bolts and nuts must conform to the latest AREMA Specifications.

9.10 LOCK WASHERS

Lock washers should be new and of correct diameter to fit the bolts being used. Each track bolt should be equipped with a spring lock washer, conforming to the most current AREMA Specifications for Spring Washers.

9.11 RAIL ANCHORS

Rail anchors should be new or relay of good quality and should be the correct size and of approved design for the rail used. Rail anchors to be used on tracks to be owned by the Company shall conform to Company's Specifications and be purchased from a Company approved supplier.

The anchor pattern for tracks should be in accordance with *NSRC Plan 7-4*. Rail anchors should be installed through the turnouts in accordance with the Company's Standard Plan for the turnout being used.

9.12 TRACK SPIKES

Only standard, new 5/8" x 6" track spikes shall be used and shall conform to current AREMA Specifications for Low Carbon Steel Track Spikes. A minimum of two spikes per tie plate is required on tangent track. Spikes through the turnout should be applied in the number and location required in accordance with the Company's Standard Plan for the turnout being installed. Track spikes to be used on tracks owned by the Company shall conform to Company's Specifications and be purchased from a Company approved supplier.

The spiking pattern for curves shall be in accordance with *NSRC Plan 7-3A*.

9.13 DRIVE SCREW SPIKES

New 7/8" x 7" drive screw spikes shall be used for turnouts in accordance with the Company's Standard Plan for the turnout being used.

New drive screw spikes of appropriate size shall be used for grade crossings in accordance with *NSRC Plans 7-05, 7-05A, 7-05B* and *1-3*.

NSRC Specifications for Design and Construction of Privately Owned Industry Tracks
Chapter IX. Track Materials & Construction
July, 2020

9.14 DERAILS

Derails should be new or approved relay and must be the type indicated on the approved plans at the designated location. Where double switch point derails are required they shall be installed in accordance with the Company's Standard Plan for Derails. The standard double switch point derail is 43 feet long. Derails other than double switch point derails shall be Hayes Sliding Derail, Model HB or approved equal. They shall be sized to fit the rail and thrown with an operating stand per Section 9.18. Operating stands shall be furnished with targets. Care shall be taken when installing derails to insure that they are installed in the proper direction to derail cars away from the main track.

Derails are to be painted international orange. Glass beads should be sprinkled on after painting while paint is still wet to increase night time visibility (*NSRC MW&S Standard Procedure 100*).

9.15 EARTH MOUNDS AND BUMPING POSTS

Earth Mounds should be of an approved design sufficient to stop a moving car and should be protected against erosion.

Bumping posts should be either new or second-hand, of good quality and approved design.

9.16 SWITCH POINT PROTECTORS

Depending upon volume of traffic anticipated through turnouts and/or location of turnouts, switch point protectors may be required. Where required, these protectors should be new or second hand, of good quality and compatible with the size and type of switch point being used. The design for switch point protectors to be used on turnouts owned by the Company shall be approved by the Company.

9.17 FROG GUARD RAILS

Guard rails shall be installed for all frogs except self guarded frogs. They should be new or second hand, of good quality, of an approved design (AREMA or equal), and equipped with proper plates.

9.18 SWITCH STANDS

Switch stands shall be installed for each turnout and derail. Switch stands should be New Century Model 51-A or equivalent equipped with an ergonomic bow handle by G&B Specialties, Inc. or equivalent. All switch stands shall be complete in every respect and throw rods adjusted for proper throw, including grinding of stock rails if necessary for positive closure of switch point against stock rail.

Switch stands and latches shall be securely fastened to head block ties using 5/8" bolts, or standard cut spikes as specified by the Company. Switch stand cranks shall be made of forged steel.

X. GENERAL CONSTRUCTION

10.01 ROADBED

Roadbed width, ditches and slopes shall conform to the current Company standard roadbed section for the proposed track type. State or local regulations may require increased width of roadbed for walkway or other purposes. The controlling entity will always be the most restrictive.

Note: *The State of Tennessee requires a walkway width extending for a distance of 10 feet from the centerline of track on both sides. The walkway is to be level with the top of tie for a distance of 6 inches, and thereafter descending away from the centerline at no greater than an 8 to 1 slope. The walkway, or fill – in ballast is typically comprised of yard ballast with an AREMA gradation #5. Questions regarding the State of Tennessee regulations should be directed to:*

**Tennessee Department of Transportation
Rail Regulatory Section
505 Deadrick Street, Suite 400
Nashville, TN 37243
615-253-1045**

10.02 GAGE

Tracks shall be constructed with a gage of four feet eight and one half inches (4' – 8 ½") on tangents and curves.

10.03 CONSTRUCTION

All tracks shall be constructed to the alignment and grade as shown on approved plans and profiles.

Please note that final approval of the track for service is the prerogative of the Company and that close contact with the Company is desirable. No work is to be performed on Company track by contract forces, or in such proximity to Company track as to interfere with the Company track or roadbed without explicit permission of the Company.

No track or turnout should be laid, and no track or turnout should be placed on the roadbed, until the finished subballast has been approved. All track and turnout materials should be handled in such a manner to protect materials from being damaged. The alignment of the centerline of the track and the locations of turnouts should conform to that shown on the approved plans and further defined by an on-the-ground staked location. The final step for construction of track or turnouts should be the removing of all waste and rubbish from the track project site. The track project should not be considered complete and the final payment made until this clean up of the work site is accomplished.

XI. CROSSINGS

11.01 GRADE CROSSINGS

Where indicated on the plans and/or by the Engineer, grade crossings shall be installed. Each grade crossing shall have either rubber flange way inserts or creosoted hardwood guard timbers on both sides of the rail. Grade crossings owned and maintained by the Company shall be asphalt paved with rubber flange way or other approved crossing material.

The rubber flange way inserts shall be installed in accordance with *NSRC Plan 7-05B*.

The treated timbers for a timber crossing shall be 8 or 10 inches wide and of sufficient length to provide safe crossing for the roadway width by the appropriate depth in accordance with the *NSRC Plans 7-05 or 7-05A*. Drive screw spikes of appropriate length shall be used to install guard timber as per the Company's Standard Crossing Plans attached.

Asphalt paving shall be used between the rails and for a minimum distance of 10 feet on both sides of the centerline of the track. This asphalt paving shall be hot mix and shall meet the requirements of the governmental agency having jurisdiction.

If the governmental agency having jurisdiction requires that automatic warning devices be installed at the crossing, before Industry purchases and installs said devices, it shall be necessary that the plans for installation of such control apparatus and equipment be submitted to the Company for review and approval. Engineering plans for installation of the grade crossing warning devices shall also be reviewed and approved by the governmental agency prior to installation. This level of involvement may vary depending on the type of Company owned track involved, i.e. main line vs. lead track serving an industrial park.

The Industry shall submit complete plans to the Company for approval and preparation of agreements to permit construction of grade crossings or roads parallel to existing Company tracks on Company property.

Private grade crossings or roadways parallel to Industry tracks shall meet or exceed Company standards and will only be permitted under the terms of the Industry Track Agreement. The edge of parallel roadways shall be no closer than 9 feet to the centerline of track in tangent track and greater in track curves and at switch stands as per *NSRC Plan 7-1*.

11.02 PIPELINE

All pipelines located under Company track(s) or on Company right-of-way parallel with Company track(s) shall comply with current American Railway Engineering and Maintenance-of-Way Association (AREMA) specifications for conveying flammable and non-flammable substances, Chapter 1, Part 5, Section 5.1 through Section 5.2.7 and the Specifications for Pipeline Occupancy of Norfolk Southern Property (NSCE-8). All pipeline crossings and parallel right-of-way encroachments shall be approved by the Company's Chief Engineer before installation may be permitted.

NSRC Specifications for Design and Construction of Privately Owned Industry Tracks
Chapter XI. Crossings
July, 2020

For pipeline crossings concerning tracks owned and maintained by the Company, the Industry shall submit complete plans for the proposed crossings to the Company for approval and handling for preparation of an agreement to cover such crossing or encroachment. Pipeline crossings shall not be attached to or located closer than fifty (50) feet to a bridge, culvert, or other major railroad structure. Reinforced concrete pipe will not be allowed except as a carrier pipe when the pipeline is operated under gravity flow and a casing pipe is provided. The jack and bore method of installation is preferred for pipelines crossing under Company tracks.

For pipeline crossings concerning tracks owned and maintained by the Industry, but to be operated over by the Company, the Industry shall submit complete plans for the proposed crossing for approval.

All plans and computations associated with the work under the pipeline agreement shall be prepared by, and bear the seal of, a licensed Professional Engineer in the state where the work will take place.

Specifications (NSCE – 8) and application for the pipeline occupancy can be found at the following URL:

<http://www.nscorp.com/content/nscorp/en/real-estate/norfolk-southern-services/wire-pipeline-fiber-optic-projects.html>

If the Industry is working with the Company's Design and Construction Department in conjunction with a proposed track project, then the application should be completed and submitted directly to Design and Construction personnel assigned to the project for further handling.

No work shall be performed where crossing existing Company tracks until the Company has been notified of the proposed work schedule and a representative of the Company is available to be at the work site during the time the work is performed.

11.03 WIRE LINE

All overhead and underground cable and/or wire lines crossing Company tracks or encroaching on the Company's right-of-way shall have approved plans prior to the commencement of the work and shall comply with Specifications for Wire, Conduit and Cable Occupations of Norfolk Southern Property (NSCE-4).

Specifications (NSCE – 4) and application for the occupancy can be found at the following URL:

<http://www.nscorp.com/content/nscorp/en/real-estate/norfolk-southern-services/wire-pipeline-fiber-optic-projects.html>

If the industry is working with the Company's Design and Construction Department in conjunction with a proposed track project, then the application should be completed and submitted directly to Design and Construction personnel assigned to the project for further handling.

All overhead and underground cable and/or wire lines crossing tracks owned and maintained by the Industry but operated over by the Company shall have approved plans prior to commencement of work.

All plans and computations associated with the work under the wire line agreement shall be prepared by, and bear the seal of, a licensed Professional Engineer in the state where the work will take place.

No work shall be performed where crossing existing Company tracks until the Company has been notified of the proposed work schedule and a representative of the Company is available to be at the project site during the time the work is performed.

See attachment SP-1621 for clearance requirements for cable and wire crossings over railroads.

XII. BRIDGES, TRESTLES, BOX CULVERTS AND UNLOADING PITS

12.01 GENERAL

All proposed bridges, trestles, box culverts, unloading pits and structures over which the Company's equipment will operate shall be designed in accordance with American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering, Chapters 7 (Timber), 8 (Concrete), and 15 (Steel Structures), for E-80 Live Loading and appropriate Impact. Prior to the beginning construction, the proposed design shall be approved by the Company's Chief Engineer - Bridges and Structures. Sufficient time should be allowed for proper review and approval.

Drawings covering temporary sheeting and bulkheads to protect railway tracks during adjacent structure construction shall be approved by Chief Engineer - Bridges and Structures.

Clearances and drainage requirements will be furnished upon request to the Chief Engineer - Bridges and Structures.

All plans and calculations shall bear the seal of a current registered licensed professional engineer in the state of the project.

12.02 UNLOADING PITS

The following guidelines shall be used when designing all unloading pits.

There shall be no rail joints in the running rail over the pit. Welding or torch cutting of running rail shall not be permitted.

The top of the pit shall be equipped with a removable cover which will be kept in place when the pit is not in use and which shall be designed in accordance with AREMA Chapter 15, Section 8.5.3.2.

Minimum distance from centerline of any adjacent track to nearest edge of pit walls is to be 15 feet. Closer clearances require special approval and indemnity if permitted.

Minimum horizontal distance from centerline of pit track to adjacent obstructions above the top of the pit is to be 9 feet, see *NSRC Plan 7-1*.

Pit cover and top of pit are to extend a minimum of 10 feet from the centerline of pit track on open side of pit. Embankment side slopes should not be steeper than 2 to 1.

Applicant is to furnish the distance and direction from centerline of pit to nearest switchpoint and to the switchpoint at the mainline. Application, plans, and details of each pit are to be submitted to the Company and are to be approved before construction begins.

12.02.01 SINGLE SPAN UNLOADING PITS WITH A SPAN LENGTH OF 15 FEET OR LESS

Live Load: Cooper's E-80 with 28 percent impact.

Design specifications and workmanship shall be in accordance with current AREMA Specification, Chapters 7 (Timber), 8 (Concrete) and 15 (Steel Structures).

General pit details can be referenced from Figures 8-5, 8-6, and 8-7 in the AREMA Manual Chapter 15, Section 8. However, Norfolk Southern requires that the top of pit to extend a minimum of 10 feet from the centerline of the pit track, not the eight feet shown by AREMA in Figure 8-5.

12.02.02 SINGLE SPAN UNLOADING PITS WITH A SPAN LENGTH GREATER THAN 15 FEET OR MULTI-SPAN PITS

GENERAL

All portions of the unloading structure that are subjected to train or equipment loading shall be designed as a bridge in accordance with the AREMA Manual (current edition). All plan submittals for proposed unloading structures shall include design calculations stamped by a registered professional engineer certifying that the design is in accordance with AREMA requirements. If computer programs are utilized in the design, the submittal shall include a complete summary of the input data used and all design assumptions. Additional manual calculations may be required to document compliance with AREMA requirements. Thirty days should be allowed in scheduling for the Company's review of unloading structure plans and calculations.

STEEL SUPERSTRUCTURE

Span Type: All spans shall be designed as simple spans. The use of side plates, bolted to beam webs, will be permitted as a means to stabilize or maintain alignment between adjacent spans. All beam ends shall have bearing stiffeners and shall bear directly on pit walls, floorbeams or columns. Attachment of ends of floorbeams to vertical steel plates, embedded in pit wall, is prohibited.

Loadings: All steel super-structure shall be designed for Cooper's E-80 live loading and appropriate impact. All loads outlined in Section 1.3 of AREMA Chapter 15 must be considered in the design. A reduction in wind load (Section 1.3.7) may be considered where justified by local conditions. To the extent possible, hoppers and mechanical features of the unloading structure should be supported independent of the superstructure carrying train loading.

Fatigue: By AREMA definition, all rail support beams and floorbeams are fracture critical members and must be so designated on the plans. The steel superstructure shall be designed to include fatigue consideration for 2,000,000 cycles and allowable stresses reduced, based on the fabrication and connection details used. All material specifications, including notch toughness requirements, shall be shown on plans. All non-destructive testing requirements shall be shown on the plans. When requested to do so, the Industry or its designated representative shall furnish the Company with copies

NSRC Specifications for Design and Construction of Privately Owned Industry Tracks
Chapter XII. Bridges, Trestles, Box Culverts and Unloading Pits
July, 2020

of material certifications and test results, as well as copies of results of testing required during fabrication.

Erection: The steel superstructure supporting train loading shall be shipped, handled and erected in such manner as to avoid injurious bends, nicks or gouges to the steel. Field welding may be used only for minor connections, not subject to train live load force, as outlined in Section 1.5.10 of AREMA Chapter 15.

CONCRETE SUBSTRUCTURE

All concrete portions of undertrack unloading structures that are subjected to train loading shall be designed in accordance with Chapter 8 of the AREMA Manual. Pit end walls shall be designed for the effects of vertical load from rail support beams and live load surcharge from train on ground track adjacent to the pit. Surcharge from adjacent parallel tracks, roadways and buildings shall be considered in the design of pit side walls. Calculation and application of train surcharge loadings shall be as outlined in AREMA Chapter 8.

Foundations: Submittal of unloading structure plans shall include a geotechnical report defining the characteristics of the soils at the site and their suitability for supporting the design loads. All foundations for unloading structures shall be designed in accordance with the requirements in AREMA Chapter 8.

Approach Walls: If approaches to the main pit span, or spans, are to be constructed of parallel reinforced concrete walls, with the rails attached directly to the top of the walls, the approach walls shall be designed in accord with AREMA Chapter 8, Concrete Structures and Foundations. The two parallel walls shall have a single footing supporting both walls. Where necessary to obtain safe bearing capacity, the approach walls shall extend to the same depth as the pit walls. The rails shall be attached to the walls using standard Pandrol plates and clips, unless other attachment is approved by the Chief Engineer - Bridges and Structures. Pandrol plates and clips shall be spaced at 2'-0" maximum.

12.03 RETAINING WALLS

All proposed retaining walls that will support both Company and Industry tracks and roadbeds shall be designed in accordance with AREMA Chapters 7 and 8. The design shall be approved by the Company's Chief Engineer - Bridges and Structures.

All plans and calculations shall bear the seal of a current registered licensed professional engineer in the state of the project.

XIII. SCALES

13.01 GENERAL

All proposed scales over which the Company's equipment will operate shall be designed in accordance with **Section XII**. Furthermore, if the scale will be used for certified weights/commercial purposes then the scale shall also be in compliance with:

- Association of American Railroads (ARR) Scale Handbook
- National Institute of Standards & Technology (NIST) Handbook – 44
- Any additional requirements mandated by local, state and federal agencies.

Proposed design plans shall be approved by Company prior to the beginning of any construction.

Plans shall include, at a minimum, the following:

- Site plan showing scale and instrument building location with track elevations and distances to point of curvature.
- Geotechnical report that includes pertinent recommendations of compliance with Section 2.22.19 Bearing Pressures Under Foundations of the AAR Scale Handbook.
- Complete structural detail with design calculations.
- Plans shall be stamped by a current registered licensed professional engineer.
- The Industry name and location.
- National Type Evaluation Program (NTEP) Certificates of Conformance (COC) for Load Cells, Instrumentation and Weight Bridge.

XIV. HAZARDOUS COMMODITIES

14.01 GENERAL

Rules and regulations governing the location of new loading, unloading and storage facilities for flammable liquids, combustible liquids, pyrophoric liquids, compressed gases and other hazardous commodities on System Lines will be considered on an individual basis upon application by Industry to the Company.

14.02 APPLICATION PROCEDURE

Applications for location or relocation of facilities for loading, unloading or storage of flammable liquids, combustible liquids, pyrophoric liquids, compressed gases or other hazardous commodities, shall be submitted to the Company.

To expedite handling of such applications, it is essential that all available facts be contained in the application and accompanied by a detailed print. Bear in mind these regulations are the minimum. Safety is foremost. Each application shall be considered on its merits and factors, such as exposures to high valued property and density of traffic adjacent to unloading and storage points.

**See Association of American
Railroads Circular NO. OT-55,
latest revision,
Recommended Railroad
Operating Practices for
Transportation of Hazardous
Materials**

In no case will hazardous materials or contaminants be allowed to drain onto Company property or be carried in Company drainage systems. The Industry shall be responsible for researching and complying with all federal, state, and local regulations concerning the safe handling and accidental release containment for the particular material being handled. The Industry shall submit the final state approved spill containment plan to the Company for review and approval.

14.03 STORAGE OF HAZARDOUS MATERIALS

Table 14.03.1 Separation Distance for New Facilities
Loaded Tank Cars and Storage Tanks from Mainline Class 2 Track or Higher

ACTIVITY	PIH (ZONE A, B, C OR D), CLASS 3, DIVISION 2.1, DIVISION 2.2 AND ALL OTHER HAZARD CLASSES	COMBUSTABLE LIQUIDS, CLASS 8, AND CLASS 9
LOADING AND UNLOADING	100 FEET	50 FEET
LOADED TANK CAR STORAGE	50 FEET	25 FEET
STORAGE IN TANKS	100 FEET	50 FEET

NOTE: Above distances are centerline of rail to centerline of rail and/or closest part of structure.

Definitions:

ORM- Oxidized and Radioactive Material

PIH- Poisonous Inhalation Hazard

With regard to existing facilities, maximum reasonable effort shall be made to conform to this standard taking into consideration cost, physical and legal constraints.

The requirements apply to storage on Company property and on Industry property located close to railroad mainline.

14.04 PROTECTION FROM STRAY ELECTRIC CURRENTS

Industry spurs used for loading or unloading of oil, gas, or other flammable or explosive commodities shall be protected from stray electric currents. See *SP-701*, attached to these guidelines, for proper placement of insulated joints, jumpers, grounding, and cross-bonds, etc.

14.05 DOUBLE SWITCH POINT DERAIL

A double switch point derail (See *Section 6.08*) shall be installed at the clear point on *any* track that handles hazardous materials (*NSRC MW&S Standard Procedure 100*).

14.06 SPILL CONTAINMENT SYSTEM

Spill containment devices and systems shall be shown on the design plans and include plan views with proper stationing, typical sections, details and catalog cuts as needed.

XV. ATTACHMENTS

Document:	Agreement and Sidetrack Design Plan Check Lists
PLAN NO. 1-3	Spikes
PLAN NO. 1-3A	Rectangular Head Timber Screw Spike
PLAN NO. 1-21	Roadbed Section for Heavy Tonnage Tracks Other Than Main Tracks
PLAN NO. 1-22	Roadbed Section for Industrial Tracks
PLAN NO. 1-22A	Turnout Pad for No. 10 Industry Turnouts
PLAN NO. 1-23	Roadbed Section for New Siding Parallel to Single Main Line
PLAN NO. 2-4	No. 8 Turnout
PLAN NO. 2-6	No. 10 Turnout (SMSG Frog)
PLAN NO. 2-8	No. 10 Turnout (Spring Frog)
PLAN NO. 2-17	Data on Turnouts and Crossovers
PLAN NO. 3-36	Bow Handle for New Century 51-A & 51-B Switch Stands
PLAN NO. 6-14	Close Clearance Sign
PLAN NO. 7-1	Clearance Diagram
PLAN NO. 7-3A	Industrial Track Spiking Pattern
PLAN NO. 7-4	Rail Anchoring Pattern
PLAN NO. 7-5	Highway Grade Crossing Asphalt Paving
PLAN NO. 7-5A	Highway Grade Crossing Treated Lumber
PLAN NO. 7-5B	Highway Grade Crossing Asphalt Paving w/Rubber Flange Way
PLAN NO. 7-6	Precast Concrete Crossing Shunt Resistant Steel Clad (1 of 2)
PLAN NO. 7-6A	Curved Concrete Panels (2 of 2)
PLAN NO. 7-9	Switch Point Derail
PLAN NO. SP-701	Oil Siding Protection from Stray Electric Current
PLAN NO. SP-1621	Clearance Requirements for Cable and Wire Crossings
NS QA Specs	QA Specifications for Ties and Timbers, Sec. 2, Wooden Industrial Grade Crossties (Rev. 05/01/17)
Detail:	Curve Reduction Table
Detail:	Earth Mound
Detail:	Placement of Industry Turnouts
Detail:	Turnout Design Schematic
Detail:	Sample Agreement Plan
Detail:	Sample Sidetrack Design Plan
Detail:	DR – HDPE – 01
Detail:	DR – HDPE – 02
Detail:	Corrugated Metal Culvert Gage Selection and Installation
Detail:	Installation Instructions Corrugated Metal Pipe Culverts
Detail:	Non – Shunting Track Survey Bar
Detail:	Shoring Design Guide – Shoring Requirements
Detail:	Shoring Design Guide – Lateral Pressures from Train Loads

INDUSTRY SUBMITTED AGREEMENT PLAN PLAN PRESENTATION CHECKLIST

Sheet 1 of 1

				N/A
PLAN VIEW				
7.01	Preferred plan scale is 1" = 100'. Smaller projects may use 1"=50', larger projects may use 1"=200' or other as approved to be able to fit all track on one sheet.			
7.02 & 7.03	3" x 5" space in lower right hand corner for NS Title block. All drawings will have an NS Title block.			
7.02	Add A to drawing number (AD-2016-58A) for agreement plan.			
7.04	City, County and State and Location Map if required.			
7.04	TO Nearest Major Rail Station with arrow in each direction along mainline.			
7.04	Industry & Consultant Company names and contact information, including phone and e-mail.			
7.04	North Arrow.			
7.04	Legend with all line styles and symbols.			
7.01 & 7.04	Centerlines of existing track(s) with labels showing ownership as well as stationing and labels at event points (PS, Derail, Div. O&M, 15' Clear Point, End of Track, Loading/Unloading Structure, Grade Crossing, Gate, Loading Dock, Rail Door, and both Horizontal and Vertical Close Clearances).			
7.01 & 7.04	Centerlines of proposed track(s) with labels showing ownership as well as stationing and labels at event points (PS, Derail, Div. O&M, 15' Clear Point, End of Track, Loading/Unloading Structure, Grade Crossing, Gate, Loading Dock, Rail Door, and both Horizontal and Vertical Close Clearances).			
7.01 & 7.04	Centerlines of track(s) to be removed.			
7.04	Latitude/Longitude for only the Division of O&M, Begin Track Lease and End of Track Lease.			
7.01 & 7.04	Sidetrack Agreement Table per sample Agreement Plan.			
7.04	Extent of track lease with stationing <u>and</u> a Track Lease Table showing information per sample Agreement Plan.			
7.04	Label NS Right-of-Way and dimension from center of main track.			
7.04	Land lease area <u>and</u> a Land Lease Table showing acreage per sample Agreement Plan.			
7.04 & 7.05	Horizontal and vertical close clearances to structures and overhead utilities.			
DRAFTING				
7.01	Thick Dashed Red Line for ALL Proposed Railroad Owned Tracks.			
7.01	Thick Dashed Orange Line for ALL Proposed Industry Owned Tracks.			
7.01	Thin Solid Black Line for ALL Existing Railroad Owned Tracks.			
7.01	Thin Solid Cyan Line for ALL Existing Industry Owned Tracks.			
7.01	Dotted Green Line for ALL Tracks to be Removed.			

INDUSTRY SUBMITTED SIDETRACK DESIGN PLAN - ENGINEERING CHECKLIST

Sheet 1 of 4

				N/A
HORIZONTAL ALIGNMENT				
6.02	Curves Defined by Chord Definition			
6.02	Maximum degree of curvature 12 degrees (10 degrees for tracks serving cars with total length of 73' or more)			
6.02	100' between PT and PC of reverse curves (70' minimum with NS approval)			
6.05	30' or half car length, whichever is greater, between the end of loading/unloading area and the beginning of an end of track device.			
6.06	Minimum 15' Track Centers between NS and Industry Tracks			
6.06	Minimum 14' Track Centers between industry owned Tracks			
VERTICAL ALIGNMENT				
6.03	Vertical Curve at all breaks of grade in profile of track			
6.03	Vertical Curve calculations based on "r"			
6.03	For Lead Tracks maximum r = 1.0 for summits and sags			
6.03	For Spur Tracks over 1,500' in length maximum r = 2.5 for summits and maximum r = 2.0 for sags			
6.03	For Spur Tracks less than 1,500' in length maximum r = 3.0 for summits and maximum r = 2.5 for sags			
6.04	Lead tracks grade maximum 2.0% compensated			
6.04	Spur Track grade maximum 3.0% compensated			
6.05	Loading and Unloading Area for Railcars to have 0.00% grade			
6.05	30' or half car length, whichever is greater, between end of vertical curve and loading/unloading area			
TURNOUTS				
6.07	Proposed Turnout(s) in Tangent Track Only			
Detail	Proposed Turnout(s) located in accordance with Placement of Industry Turnouts in attached details			
6.07	Entire length of turnout located outside of vertical curves			
6.07	Turnout located at least 100' from road at grade crossing			
6.07	Turnout located at least 100' from back wall of railroad bridge			
6.07	Turnout not located underneath a bridge			
Detail	Turnout Return Curve per PLAN 2-17			
Detail	Turnout Layout in Yard and Ladder Tracks per PLAN 2-17			
DERAILS				
6.08	Derail placed at 15' Clear Point			
6.08	Double Switch Point Derail used when Industry Track descends towards NS Track or Placarded Hazardous Materials are handled.			
6.08	DSPD not located in horizontal or vertical curve			

INDUSTRY SUBMITTED SIDETRACK DESIGN PLAN - ENGINEERING CHECKLIST

Sheet 2 of 4

				N/A
CLEARANCES				
6.10	Clearances of all structures to all proposed and existing tracks is in accordance with Plan 7-1			
6.12	Clearances to edge of roads			
6.12	Clearances from end of rail car to grade crossings			
6.1 & 11.03	Clearances between overhead and electric wires in accordance with SP-1621 & NSCE-4			
14.03	Side Clearances for storage of rail cars and storage tanks of Hazardous Materials			
GRADE CROSSINGS				
6.12 & 11.01	Grade crossing surface and flageways meet NS specs			
6.12 & 11.01	Grade crossing has proper warning devices			
CULVERTS				
8.05	Culvert constructed of approved material			
8.05	Proper Cover from T/R to top of culvert per NSCE-8 and Standard Detail			
OVERHEAD AND UNDERGROUND UTILITIES				
11.02-11.03	All overhead and underground utilities which cross track or are adjacent to track to meet NSCE-4 & NSCE-8 with plans stamped by PE			
LOADING/UNLOADING STRUCTURES, BRIDGES & RETAINING WALLS				
12.01-12.03	Detailed construction plans stamped by PE for review by NS Bridge Department			

INDUSTRY SUBMITTED SIDETRACK DESIGN PLAN PLAN PRESENTATION CHECKLIST

Sheet 3 of 4

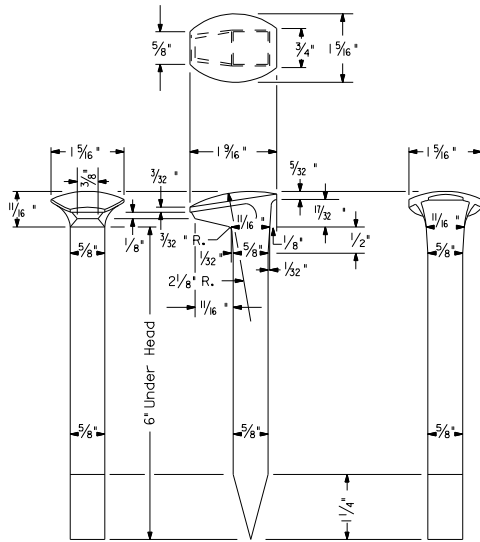
				N/A
ALL DRAWING SHEETS				
7.01	Preferred plan scale is 1" = 100'. Smaller projects may use 1"=50', larger projects may use 1"=200'. NO OTHER SCALES ARE ACCEPTABLE.			
7.02 & 7.03	3" x 5" space in lower right hand corner for NS Title block. All drawings will have an NS Title block			
7.04	City, County and State and Location Map if required.			
7.04	TO Nearest Major Rail Station with arrow in each direction along mainline.			
7.04	Industry & Consultant Company names and contact information, including phone and e-mail.			
7.04	North Arrow			
7.04	Legend with all line styles and symbols			
PLAN VIEW				
7.04	Centerlines of existing track(s) with labels showing ownership as well as stationing and labels at event points (PS, PC, PT, DSPD, Clear Point, Div. O&M etc...) for length of project			
7.04	Centerlines of Proposed track(s) with labels showing ownership as well as stationing and labels at event points (PS, PC, PT, DSPD, Clear Point, Div. O&M, Car Spot End Points, Car Lengths, etc...)			
7.04	Stationing should be provided for every existing or proposed feature along a given track: PS, PI, Derail, Clear Point, Div. O&M, PC, PT, Rail Door, Loading or Unloading Structure, Grade Crossing, gate, Safety Buffers, Car Spots, Culverts, Utilities, End of Track Device, etc...			
7.04	Note for centerline of proposed track(s) with the clear length and railcar capacity plus safety buffer			
7.04	State Plane Coordinates and Latitude/Longitude for all proposed Point of Switches in NS track as well as distance to nearest mainline milepost.			
7.04	Horizontal Curve Data for each proposed horizontal curve including: Δ, Degree of Curvature, Chord Length, and Radius. All Curve Data shall be based on the Chord Definition.			
7.04	Existing and proposed utilities which shall be shown on plan view, profile and cross sections. Clearances should be shown between the utility and centerline of track or top/rail as appropriate. Horizontal clearance shall be based on centerline of track. Vertical clearance shall be based on Top of Rail elevation.			
7.04	Existing and proposed structures shall be shown and side (within 20') and overhead clearances labeled. If necessary include a dimensioned section view. Horizontal clearance shall be based on centerline of track. Vertical clearance shall be based on Top of Rail elevation.			

INDUSTRY SUBMITTED SIDETRACK DESIGN PLAN

PLAN PRESENTATION CHECKLIST

Sheet 4 of 4

				N/A
PLAN VIEW				
7.04	Label NS Right-of-Way and dimension from center of main track. Show adjacent property lines and easements with bearings.			
7.04	Location, size, type and orientation of all existing and proposed culverts and pipes.			
7.04	Table with Horizontal and Vertical Control Data, include control points with descriptions in plan view			
7.04	Table containing proposed track usage, number of cars, commodity (identify if TIH/Hazmat), car type and length, loading/unloading method, switching plan and/or operational narrative.			
PROFILE				
7.05	Profile scale shall be 1"=10' vertical, 1"=100 horizontal. (1=5v,1=50h and 1=20v,1=200h shall be acceptable when the plan view has the corresponding scale)			
7.05	Profile Stationing should begin at -1+00 to show grade leading to proposed PS			
7.05	Profile should include existing track, proposed track, existing ground, proposed subgrade, overhead wires, underground utilities, derails, culverts, pipes, grade crossings,safety buffer, end of track device, loading/unloading structures, etc... All features should be properly stationed and labeled.			
7.05	For all tracks the grades shall be labeled as well as vertical curves with PVC, PVT, PVI, vertical curve length, and r value.			
7.05	Dimensions shall be given between top of rail and top of culverts, pipes, and other underground structures.			
7.05	Dimensions shall be given between top of rail and all overhead structures, wires, pipes, etc...			
7.05	Loading/Unloading Area shall be labeled and stationed with car capacity and track grade shown.			
DETAILS				
7.06	Show Typical Track Roadbed Section			
7.06	Show Turnout Pad Plan 1-22A			
7.06	Show unloading/loading section and details			
7.06	Show NS Standard Clearance Plan 7-1			
7.06	Show End of Track Device detail			
7.06	Show grade crossing section and detail			
DRAFTING				
7.01	Thick Dashed Red Line for ALL Proposed Railroad Owned Tracks.			
7.01	Thick Dashed Orange Line for ALL Proposed Industry Owned Tracks.			
7.01	Thin Solid Black Line for ALL Existing Railroad Owned Tracks.			
7.01	Thin Solid Cyan Line for ALL Existing Industry Owned Tracks.			
7.01	Dotted Green Line for ALL Tracks to be Removed.			
7.06	Applicable Standard Notes included on plan			



5/8" X 6" CUT TRACK SPIKE
AREMA STANDARD
640-903705

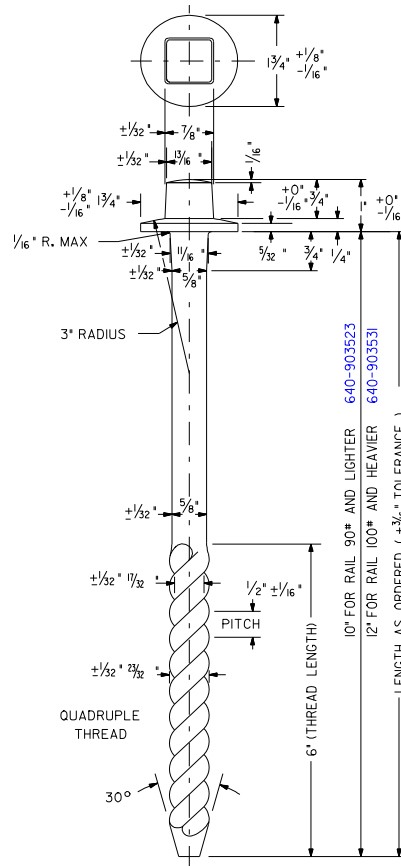
Material and workmanship to be in accordance with current AREMA manual requirements for soft steel track spikes.

Permissible shank straightness variation measured in either plane, shall not exceed 0.0313".

Manufacturer's I.D. shall be pressed on the head of each spike while being formed.

Weight = approximately 0.83-lbs each

24 Spikes per 200-lb keg



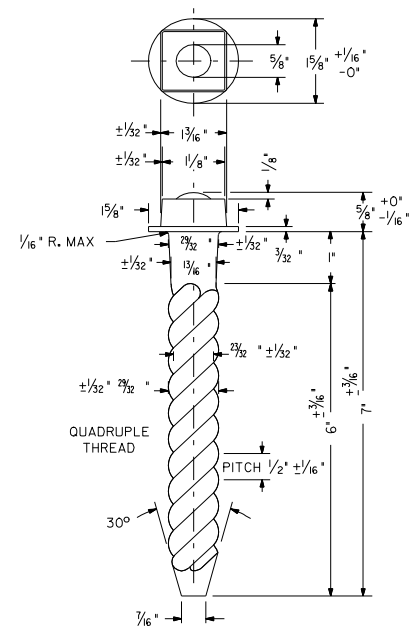
5/8" GALVANIZED DRIVE SCREW SPIKE
AREMA STANDARD
PLAN 2M-63

For fastening crossing timbers.

Drill 1/2" pilot hole in cross-ties.

10' Length for use in rail 90RA and lighter.
125 Spikes per 200-lb keg

12' Length for use in rail 100RE and heavier.
100 Spikes per 200-lb keg



7/8" X 7" GALVANIZED DRIVE SCREW SPIKE
AREMA STANDARD
640-903565

For use where specified in turnouts.

Drill 1/2" pilot hole.

150 Spikes per 200-lb keg

NORFOLK SOUTHERN RAILWAY COMPANY

SPIKES

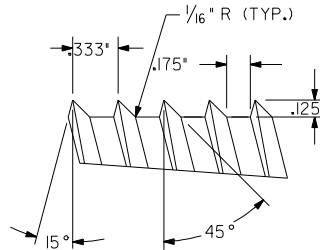
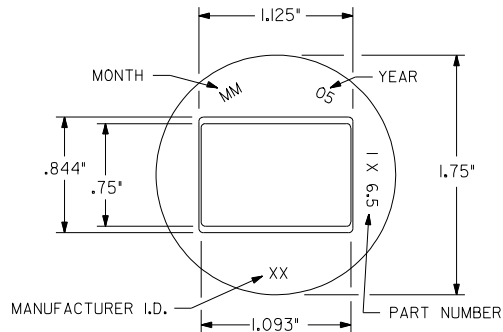
APRIL 1991

Atlanta, Georgia

DATE	REVISION
12-5-05	TRACK SPIKE SPECIFICATIONS

[illegible]

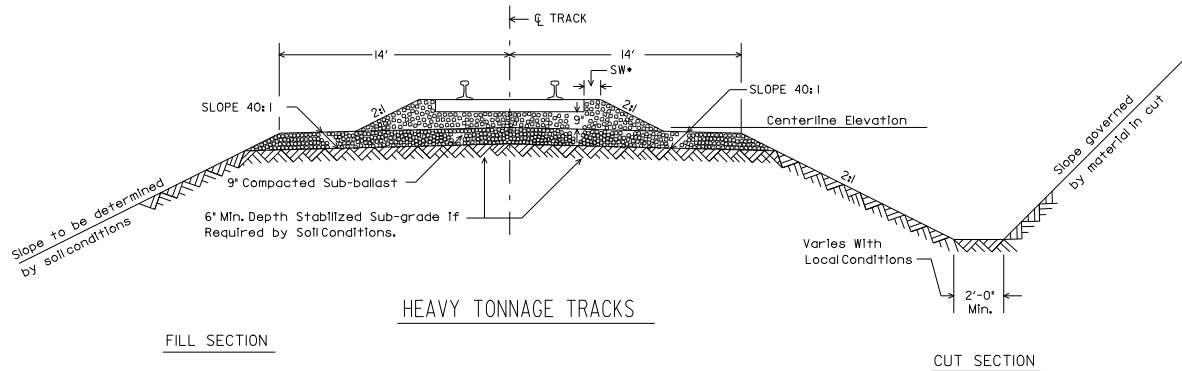
Atlanta, Georgia



THREAD DETAIL

TOP VIEW OF HEAD

NOTE: ALL DRIVE DIMENSIONS $\pm 1/64"$



HEAVY TONNAGE TRACKS

FILL SECTION

CUT SECTION

SHOULDER WIDTH (SW) *

BALLAST WIDTH FROM END OF TIE TO EDGE OF SLOPE

	Jointed Rail	Welded Rail
SW (Inside of Curve)	0'	6'
SW (Outside of Curve)	6'	12'
SW (Tangent both sides)	0'	6'

- (1) Sub-grade may be stabilized with lime, lime-fly ash, cement or stone.
- (2) Tamping of ballast must not disturb compacted sub-ballast.
- (3) Top of sub-grade is to be crowned.

NORFOLK SOUTHERN RAILWAY COMPANY

ROADBED SECTION

FOR HEAVY TONNAGE TRACKS
OTHER THAN MAIN TRACKS

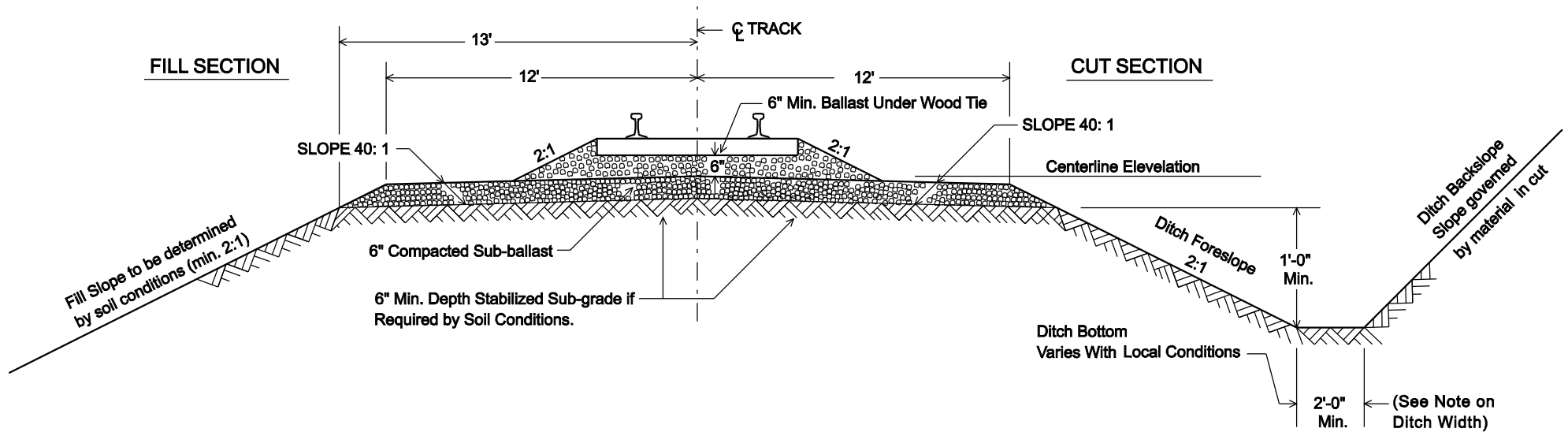
JANUARY 1989

Atlanta, Georgia

DATE	REVISION

INDUSTRIAL TRACKS

PLAN NOT TO SCALE



GENERAL NOTES

- (1) Sub-grade may be stabilized with lime, lime-fly ash, cement or stone.
- (2) Tamping of ballast must not disturb compacted sub-ballast.
- (3) Top of sub-grade is to be crowned.

DITCH WIDTH NOTES

- (1) On NORFOLK SOUTHERN right-of-way, minimum ditch width should be calculated to carry volume of water for a 100 year storm event, or be at a minimum 5' wide, whichever is greater.
- (2) Where ditch back slopes on NORFOLK SOUTHERN right-of-way are in cut sections greater than 25' in height, ditch width should be increased to a minimum of 10' wide.

NOTE:

Roadbed Sections Proposed Near Structures And/Or In Pavement Locations Will Need To Be Designed And Submitted For Review And Approval.

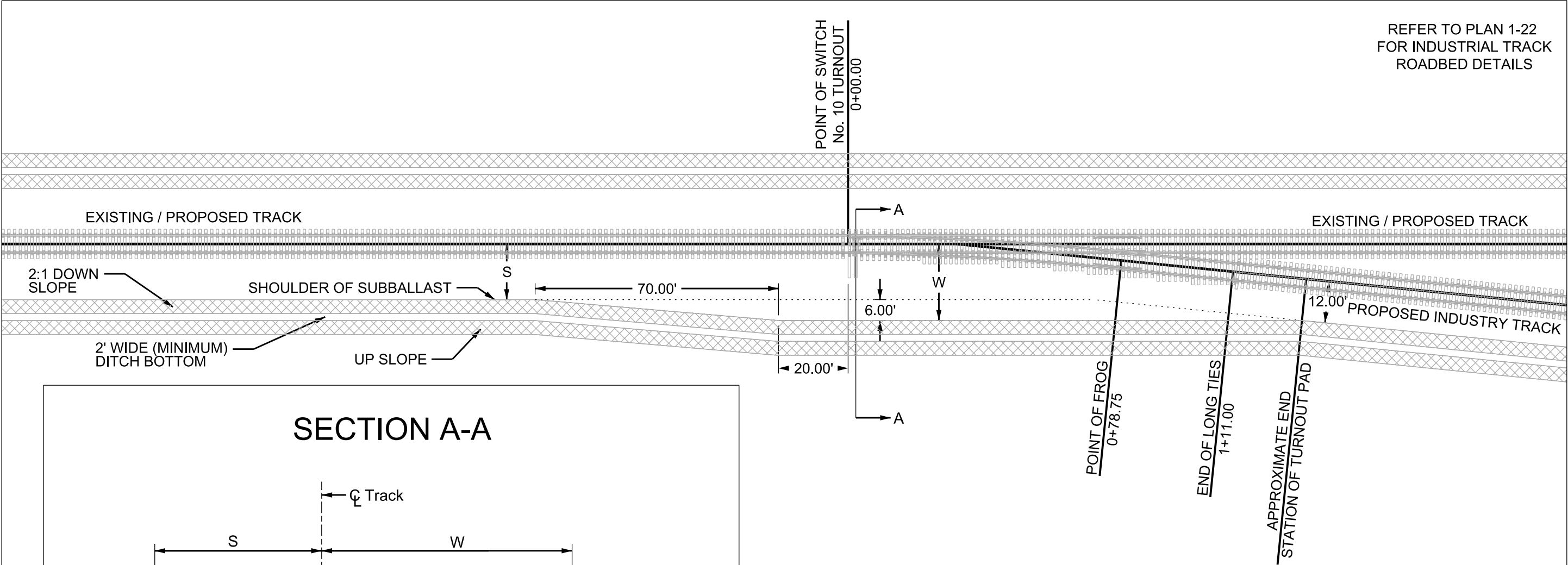
NORFOLK SOUTHERN RAILWAY COMPANY

ROADBED SECTION FOR INDUSTRIAL TRACKS

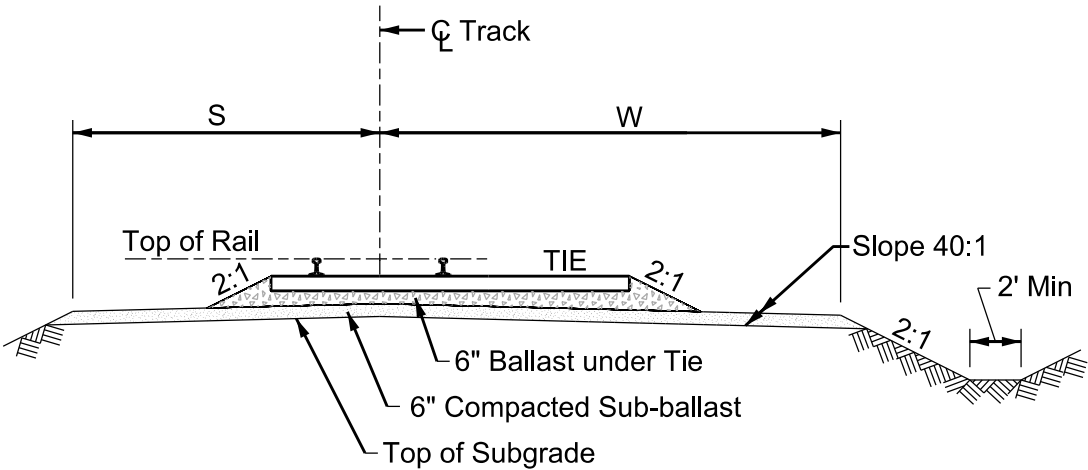
JANUARY 1989
Atlanta , Georgia

DATE	REVISION
11/06	ADDED CUT SECTION NOTES
03/10	ADD NOTE & 1' TO DITCH BOTTOM

REFER TO PLAN 1-22
FOR INDUSTRIAL TRACK
ROADBED DETAILS



SECTION A-A



	SUBBALLAST WIDTH FROM C/L	WALKWAY WIDTH FROM C/L	APPROXIMATE END STATION OF TURNOUT PAD
	S	W	
MAIN TRACK	14 FT	20 FT	1+12
LEAD TRACK	14 FT	20 FT	1+12
INDUSTRY TRACK	12 FT	18 FT	0+92

NORFOLK SOUTHERN RAILWAY COMPANY

TURNOUT PAD

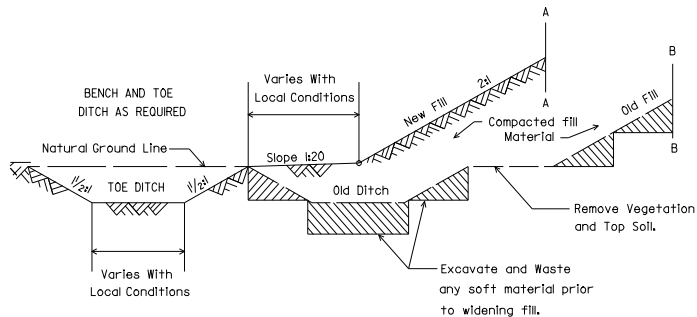
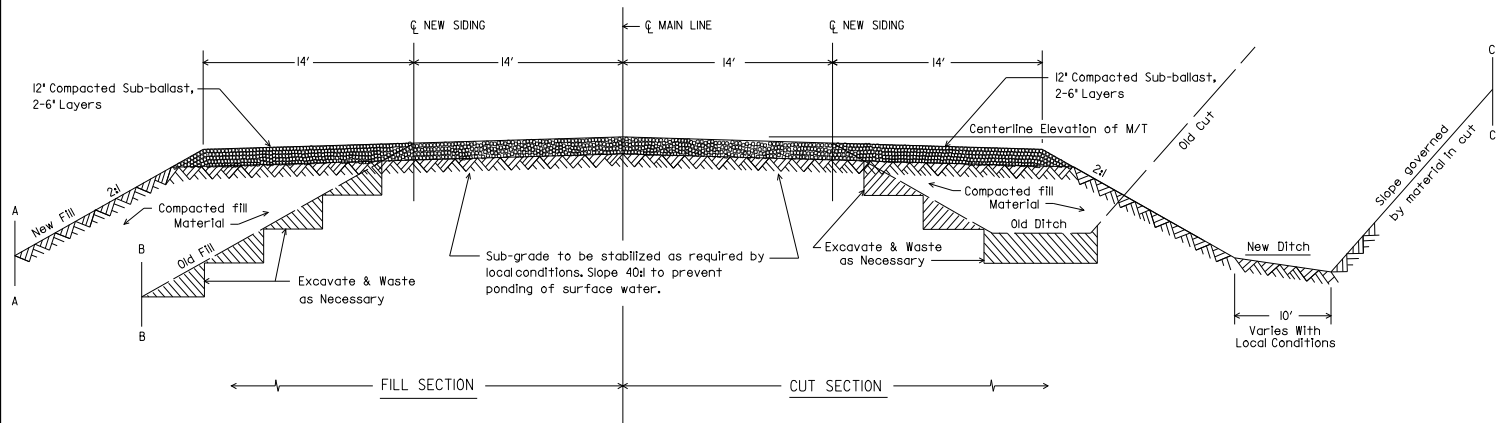
FOR No. 10 INDUSTRY TURNOUTS

MAY 2010

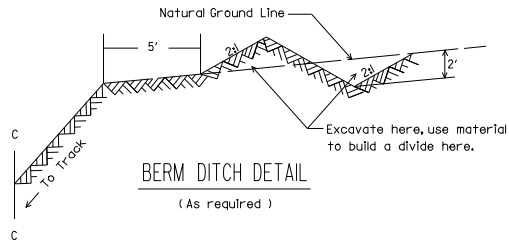
ATLANTA, GA

REVISION		REVISED DISTANCES / ADDED PROP. TRACK		
DATE				
5/7/15				

REFER TO PLAN 1-22
FOR TRACK DETAILS



METHOD OF WIDENING TOE OF FILL



NORFOLK SOUTHERN RAILWAY COMPANY

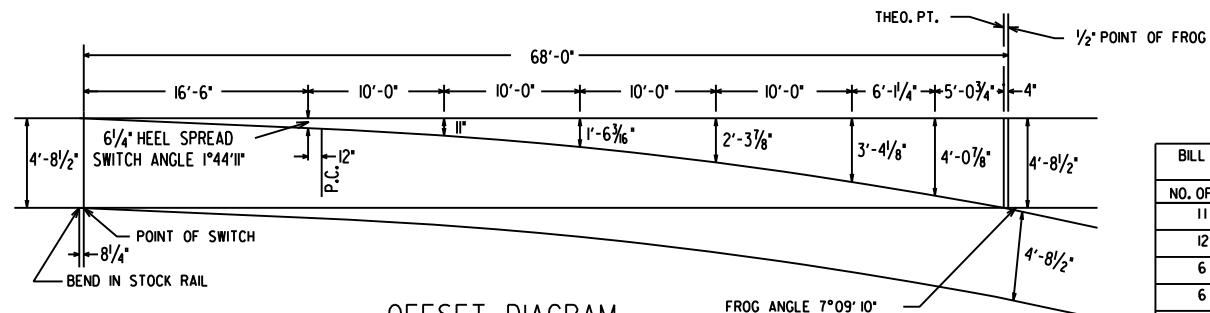
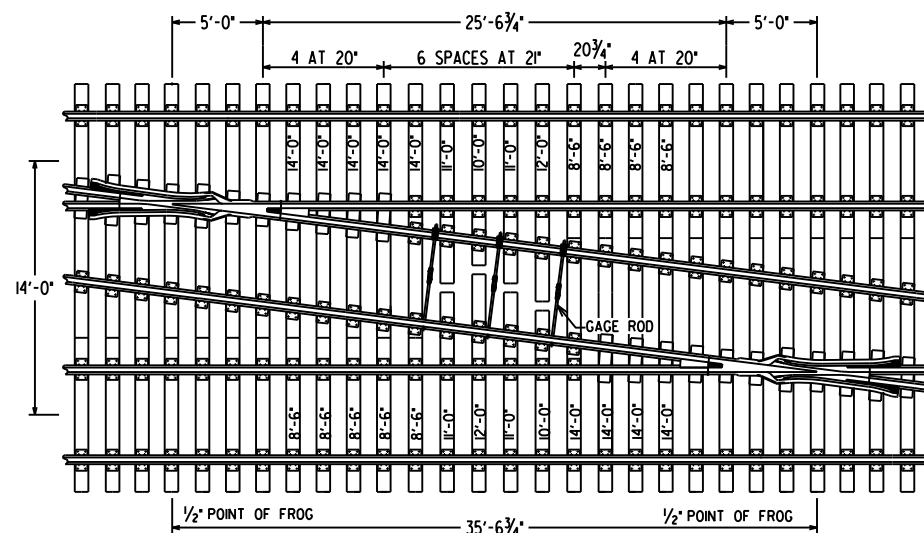
ROADBED SECTION

NEW SIDING PARALLEL TO
EXISTING SINGLE MAIN LINE
JANUARY 1989

Atlanta, Georgia

REVISION

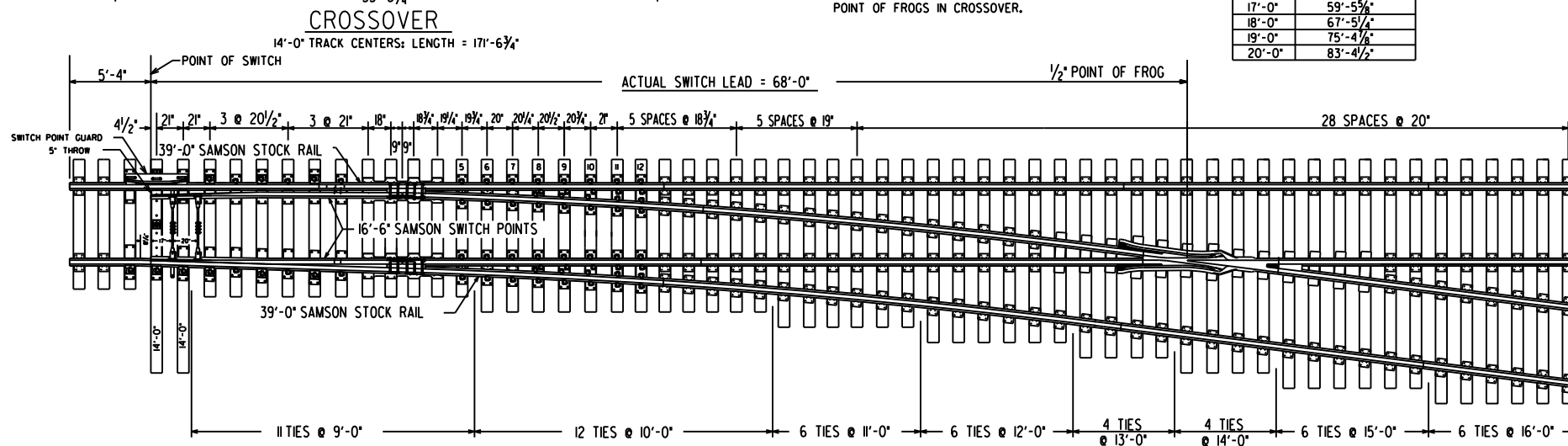
DATE



BILL OF SWITCH TIES-7' X 9' TURNOUT	
NO. OF PCS.	LENGTH
11	9'-0"
12	10'-0"
6	11'-0"
6	12'-0"
4	13'-0"
6	14'-0"
6	15'-0"
6	16'-0"
TOTAL NO. PCS.	57
TOTAL LIN. FT.	679
TOTAL F.B.M.	3,564.75

CROSSOVER DATA FOR TANGENT TRACK	
TRACK CENTERS	DISTANCE BETWEEN 1/2° POINTS
13°-0"	27°-7 1/8"
14°-0"	35°-6 1/4"
15°-0"	43°-6 3/8"
16°-0"	51°-6"
17°-0"	59°-5 5/8"
18°-0"	67°-5 1/4"
19°-0"	75°-4 1/8"
20°-0"	83°-4 1/2"

NOTE : FOR EACH 1" OVER OR UNDER 14'-0" TRACK CENTERS
ADD OR SUBTRACT 8" TO DISTANCE BETWEEN 1/2"
POINT OF FROGS IN CROSSOVER.



SEE PLAN

- 1-4 BOLTS USED IN TRACKWORK
- 3-6 16'-6" SWITCH
- 3-15 SWITCH HEEL BLOCK
- 3-16 SWITCH HEEL BASE PLATE
- 3-19 SWITCH LUGS (CLIPS)
- 3-20 SWITCH RODS
- 3-21 SWITCH PLATES
- 3-22 ADJUSTABLE PLATES & BRACES
- 3-22 1" GAUGE PLATES
- 3-34 & 3-35 SWITCH STANDS
- 4-10 S.M.S.G. FROGS
- 4-11 FROG PLATES FOR SMSG FROGS

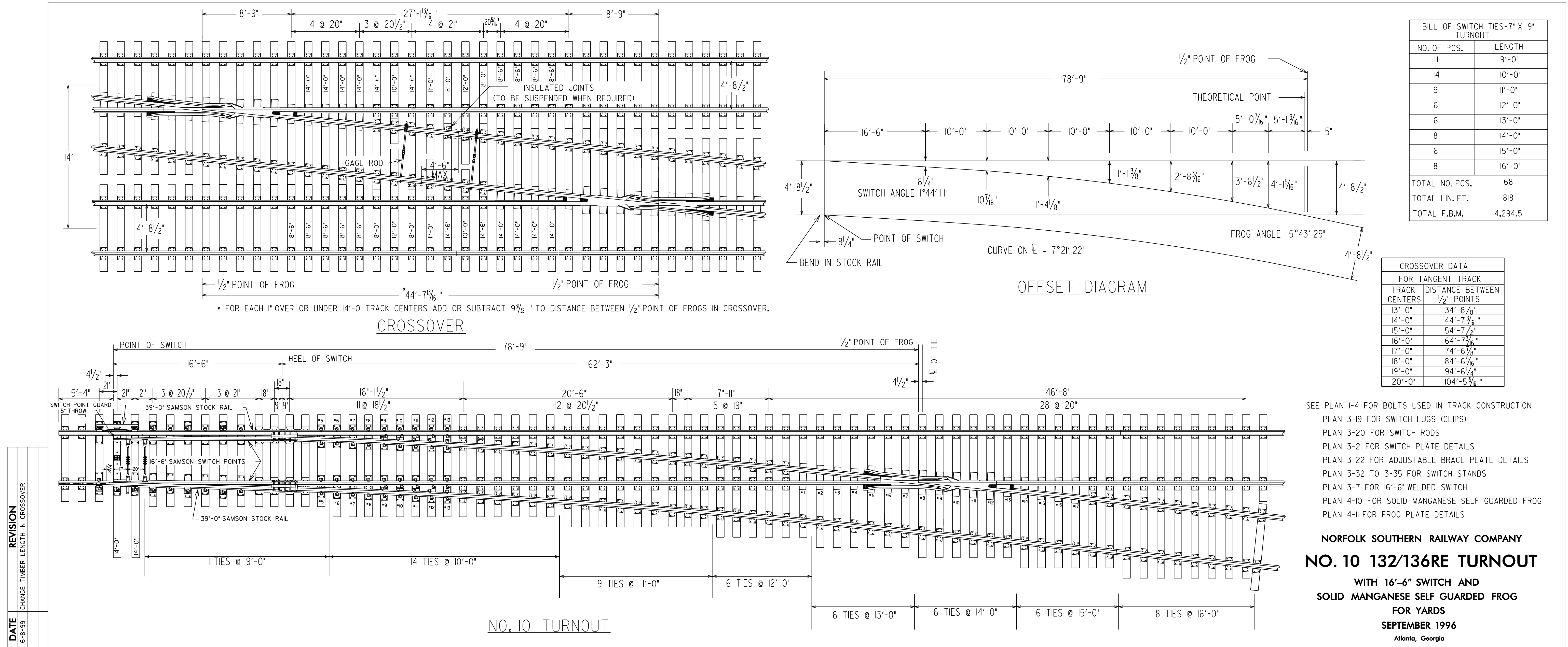
NORFOLK SOUTHERN RAILWAY COMPANY

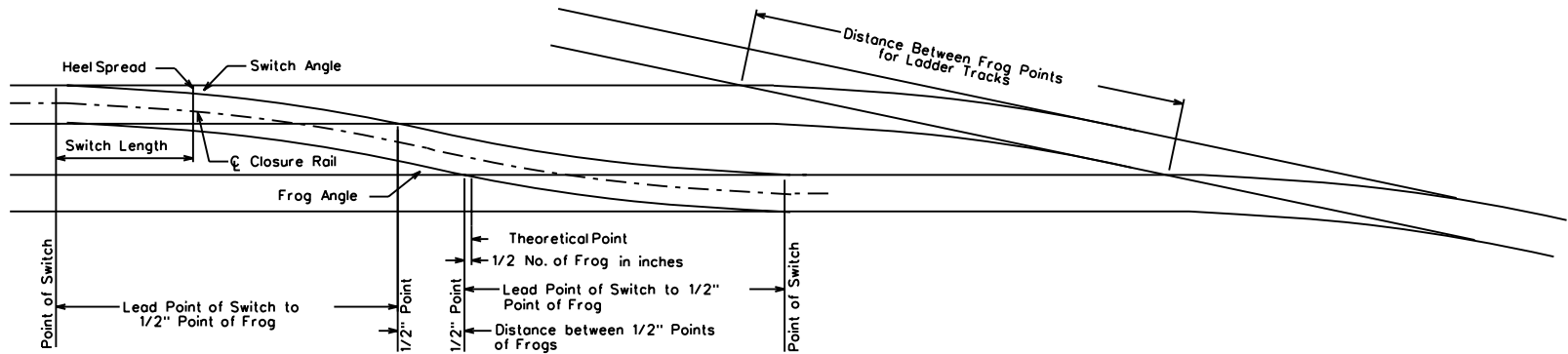
NO. 8 132/136RE TURNOUT

WITH 16'-6" SWITCH, S.M.S.G.
FROG AND SWITCH POINT GUARD
SEPTEMBER 1996

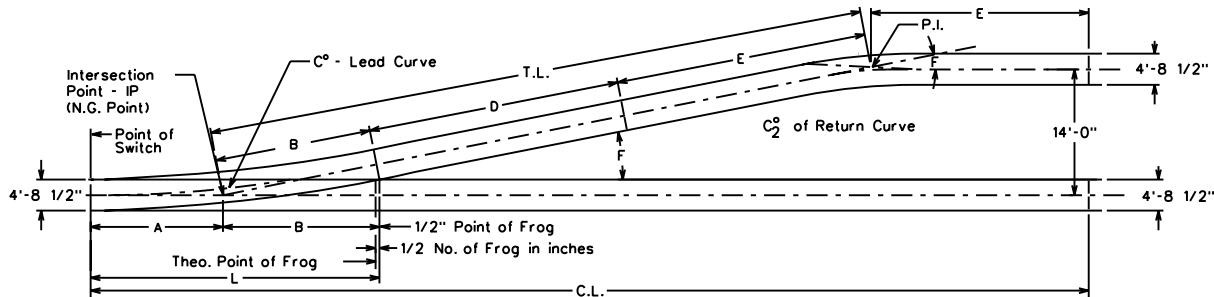
Atlanta, Georgia

DATE	REVISION
7-24-07	REVISE PLAN REFERENCES
3-16-10	REVISE CROSSOVER LENGTH



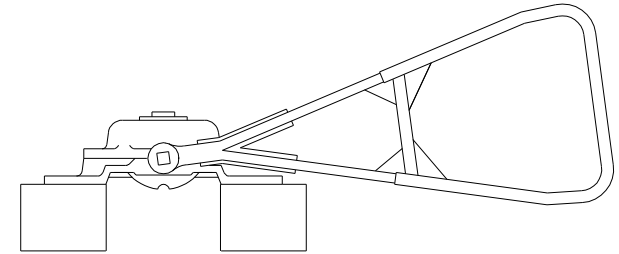
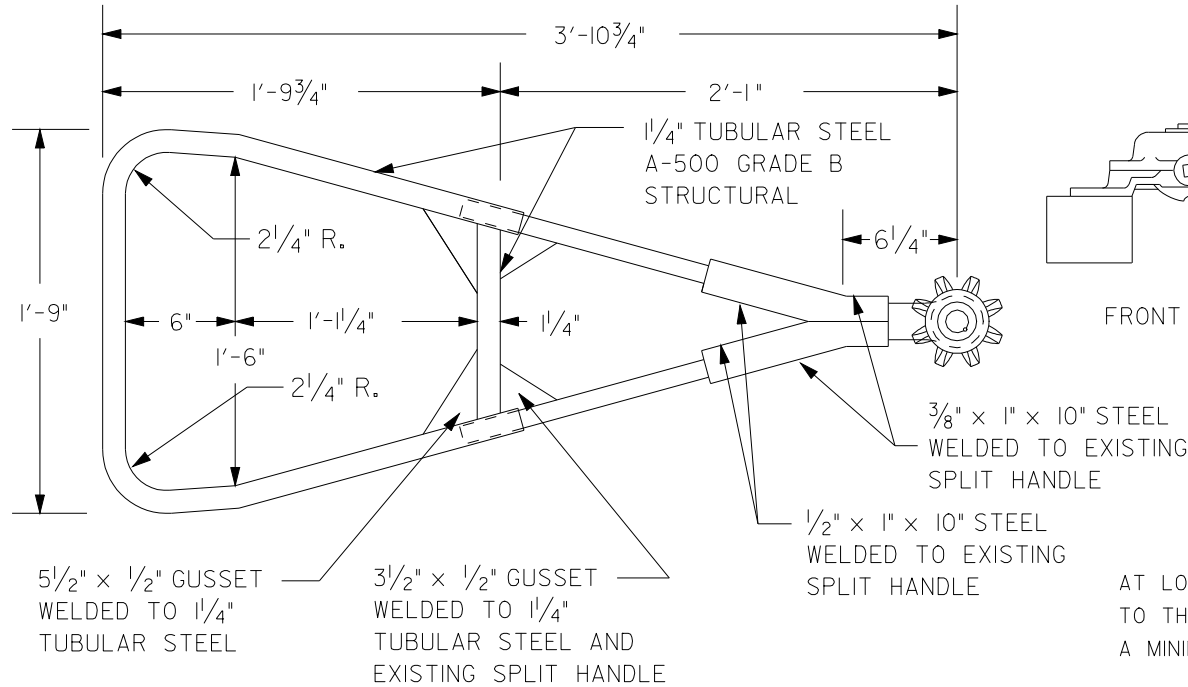


TURNOUT									A	B	D	E	T.L.	C ₂	C.L.	C.L.	P.S. TO 16'-0" LAST TIMBER	CROSSOVER		LADDER TRACKS		FROG NO.
FROG NO.	L POINT OF SWITCH TO 1/2" POINT OF FROG	C° DEGREE OF CURVE CLOSURE RAILS	TURNOUT PLAN NO.	FROG		SWITCH			P.S. TO INT. PT.	I.P. TO 1/2" PT FROG	1/2" P.F. P.C. RET. CURVE	E TANG. RET. CURVE TO INT. PT.	I.P. TO P.I. RET. CURVE 14'-0" T.C.	C ₂ DEGREE RET. CURVE	CLEAR LENGTH 14'-0" T.C.	CLEAR LENGTH 15'-0" T.C.		1/2" POINT OF FROG		1/2" POINT OF FROG		
				F FROG ANGLE	FROG PLAN NO.	LENGTH	ANGLE	HEEL SPREAD										TRACK CENTERS		TRACK CENTERS		
																		14'-0"	15'-0"	14'-0"	15'-0"	
7	62'-1"	16° 31' 26"	2-2	8° 10' 16"	4-10	16'-6"	° 44' 1 1"	6 1/4"	28.83'	33.25'	39.59'	25.66'	98.50'	16° 00'	152.00'	158.96'	93'	30.99'	37.96'	98.50'	105.54'	7
8	58'-11 1/8"	10° 25' 03"	2-3	7° 09' 10"	4-10	curved 13'-0"	2° 54' 0"	6 1/4"	20.93'	38.00'	38.58'	35.86'	112.44'	10° 00'	168.35'	176.34'	84'	35.56'	43.53'	112.44'	120.47'	8
8	68'-0"	1° 58' 03"	2-4	7° 09' 10"	4-13	16'-6"	° 44' 1 1"	6 1/4"	30.00'	38.00'	44.54'	29.90'	112.44'	12° 00'	171.46'	179.43'	93'	35.56'	43.53'	112.44'	120.47'	8
9	72'-3 1/2"	9° 43' 14"	2-5	6° 21' 35"	4-10	16'-6"	° 44' 1 1"	6 1/4"	29.54'	42.75'	50.10'	33.55'	126.39'	9° 30'	188.70'	197.67'	100'	40.11'	49.08'	126.39'	135.41'	9
10	78'-9"	7° 21' 22"	2-7	5° 43' 29"	4-14	16'-6"	° 44' 11"	6 1/4"	31.25'	47.50'	54.63'	38.23'	140.35'	7° 30'	209.13'	219.10'	111'	44.65'	54.63'	140.35'	150.38'	10
12	95'-4"	5° 11' 20"	2-9	4° 46' 19"	4-15	22'-0"	° 18' 08"	6 1/4"	38.33'	57.00'	63.53'	47.76'	168.29'	5° 00'	253.80'	265.78'	129'	53.71'	65.69'	168.29'	180.31'	12
14	106'-0"	3° 51' 39"	2-10	4° 05' 27"	4-16	22'-0"	° 18' 08"	6 1/4"	39.50'	66.50'	78.58'	51.17'	196.25'	3° 45'	286.42'	300.40'	152'	62.76'	76.74'	196.25'	210.27'	14
15	111'-2 3/4"	3° 05' 30"	2-12	3° 49' 06"	4-17	26'-0"	0° 44' 47"	6 1/4"	39.98'	71.25'	70.53'	68.46'	210.23'	2° 48'	318.20	333.22'	161'	67.27'	82.27'	210.23'	225.25'	15
15	126'-4 1/2"	3° 19' 48"	2-11	3° 49' 06"	4-17	30'-0"	0° 57' 18"	6 1/4"	55.13'	71.25'	75.31'	63.67'	210.23'	3° 15'	328.56'	343.54'	172'	67.27'	82.27'	210.23'	225.25'	15
20	156'-0 1/2"	° 43' 15"	2-15	2° 51' 51"	4-18	curved 39'-0"	° 04' 30"	6 1/4"	61.04'	95.00'	89.68'	95.50'	280.18'	° 30'	436.36'	456.35'	220'	89.82'	109.81'	280.18'	283.47'	20



NORFOLK SOUTHERN RAILWAY COMPANY
DATA ON TURNOUTS
AND CROSSOVERS
RETURN CURVES AND LADDERS
JULY 1997
Atlanta, Georgia

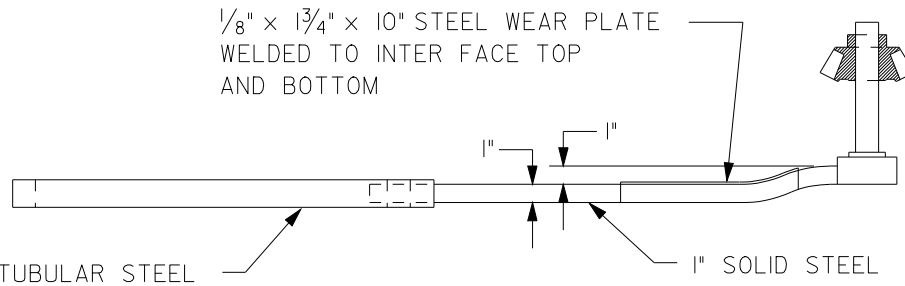
REVISION	DATE
8-14-03 ADD NO. 15 TURNOUT WITH 26'-0" POINTS	
3-15-06 REMOVE NO. 6 TURNOUT	
3-24-08 CORRECT "E" ON NO. 14 & "TL" ON 15	



FRONT VIEW

AT LOCATIONS WHERE A TRACK IS ADJACENT TO THE HANDLE, THE TRACK CENTERS MUST BE A MINIMUM OF 13'-0" APART.

FOR USE WITH THE 5¹/₂" CRANK 640 737525 AND SAFETY PLATE 640 760676.



640 139380

NORFOLK SOUTHERN RAILWAY COMPANY

**BOW HANDLE FOR
NEW CENTURY 51-A & 51-B
SWITCH STANDS**

SEPTEMBER 2005
Atlanta, Georgia

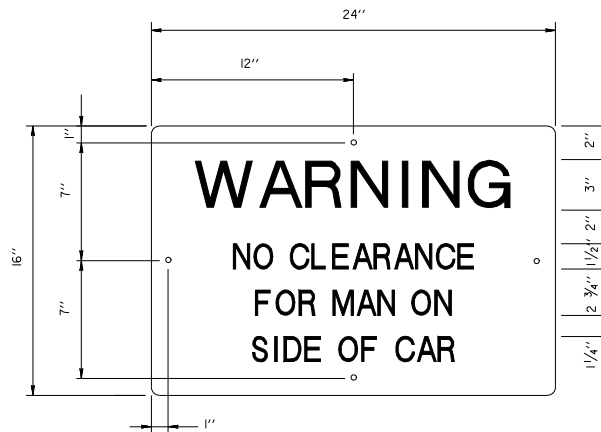
REVISION	
DATE	



CLEARANCE SIGN (ILLINOIS)

(Black Screened Letters On White Background)

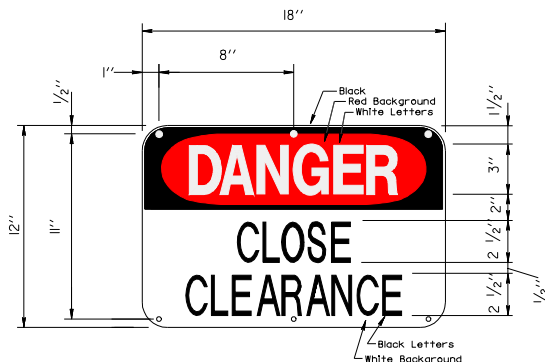
360 001699



CLEARANCE SIGN (INDIANA)

(Black Screened Letters On White Background)

360 001706



CLEARANCE SIGN (ALL OTHER STATES)

(Screened Letters On Indicated Color Background)

360 001714

NOTES:

ALL LETTERS TO BE SERIES C IN ACCORDANCE WITH CURRENT US DOT-FHWA STANDARDS.

SIGNS: 0.080 ALUMINUM.
ALL HOLES SHALL BE 3/8" DIA. UNLESS NOTED.

FACING: ENGINEER GRADE REFLECTIVE SHEETING, COLOR AS SHOWN.

LETTERS: AS NOTED.

POSTS: STANDARD SIGN POST, SEE PLAN 6-20.

LOCATION:

SIGNS SHALL BE PLACED AT RIGHT ANGLE TO TRACK AND A MINIMUM OF 12'-0" FROM CENTERLINE OF TRACK THAT HAS SUB-STANDARD CLEARANCE. ON TRACKS CONNECTED AT BOTH ENDS, SIGNS SHALL BE PLACED ON BOTH SIDES OF STRUCTURE, AT OR NEAR THE CLEARANCE POINT OF TURNOUT NEAREST THE STRUCTURE. IF THERE IS NO ROOM FOR POST, SIGN SHALL BE MOUNTED ON THE STRUCTURE. SIGNS ARE TO BE USED ON INDUSTRY OR LEAD TRACKS ONLY AS DIRECTED BY THE DIVISION SUPERINTENDENT.

NORFOLK SOUTHERN RAILWAY COMPANY
CLOSE CLEARANCE SIGN

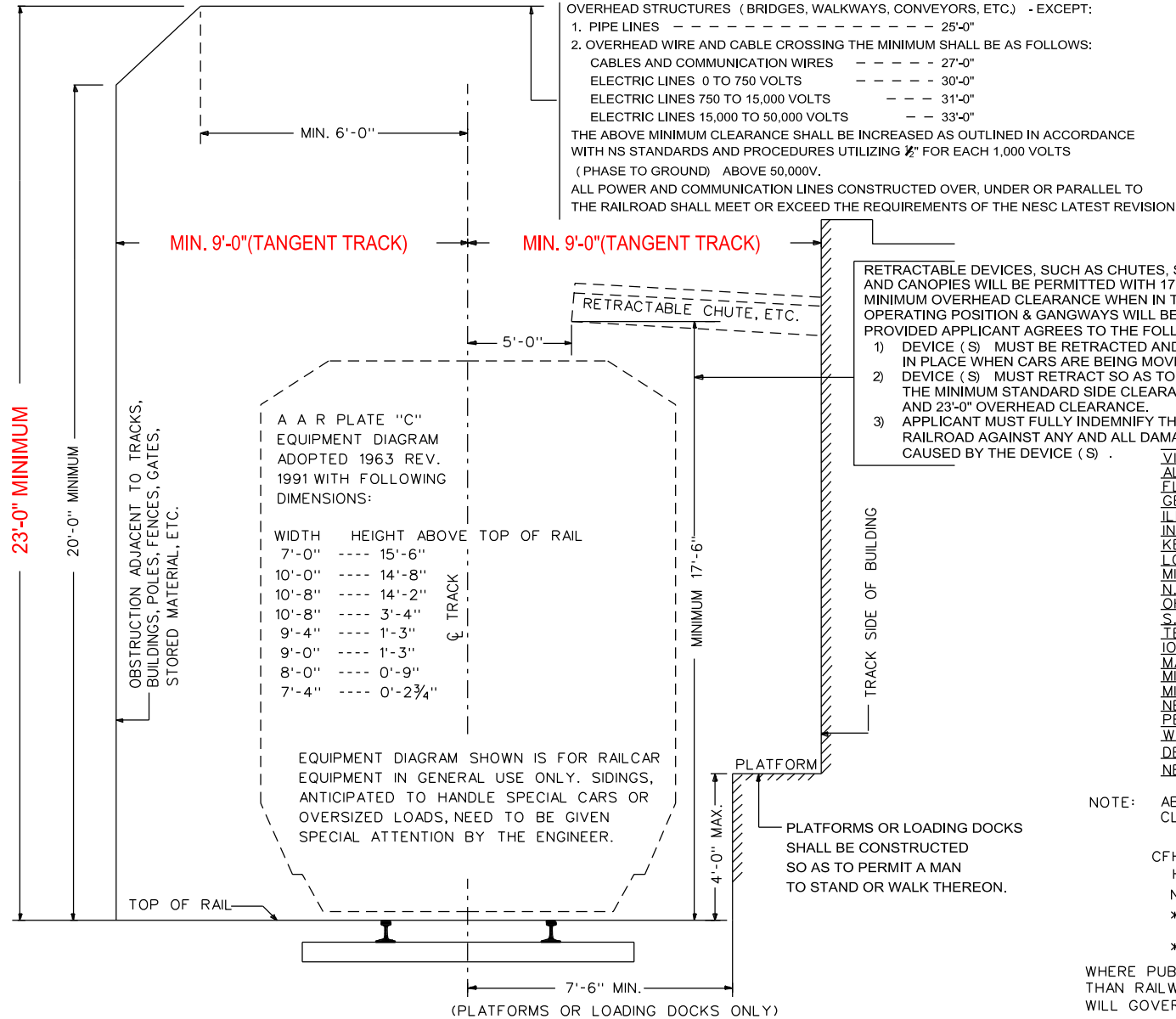
JANUARY 1989

Atlanta, Georgia

REVISION

DATE

DATE	REVISION
1-26-09	REVISE NOTES
5-28-14	REVISE NOTES
6-4-14	RETRACTABLE CHUTE, ETC.
7-20-18	REVISE OVERHEAD MIN. CLEARANCE



- NOTE:
- CLEARANCES APPLY BOTH TO STUB END TRACK AND TRACK CONNECTED AT BOTH ENDS.
 - CLEARANCES APPLY BOTH TO OUTSIDE AND INSIDE OF BUILDING.
 - DOORWAY FOR TRACK ENTERING BUILDING MUST HAVE 8'-0" SIDE CLEARANCE AND 22'-0" OVERHEAD CLEARANCE.
 - SIGN MUST BE PLACED ON EACH SIDE OF DOORWAY TO WARN OF CLOSE SIDE CLEARANCE.
 - INDUSTRY TRACK MUST BE NOT LESS THAN 15'-0" CENTER TO CENTER WITH MAIN AND RUNNING TRACK OF RAILWAY COMPANY. MINIMUM DISTANCE, CENTER TO CENTER, FOR ALL OTHER TRACKS TO BE 14'-0".
 - WHERE THE TRACK IS CURVED ALL SIDE CLEARANCES TO AN ADJACENT OBSTRUCTION MUST BE INCREASED 1 1/2 INCHES FOR EACH DEGREE OF TRACK CURVATURE.
 - WHERE THE TRACK IS CURVED WITHIN 90 FEET OF AN ADJACENT OBSTRUCTION, THE SIDE CLEARANCES MUST BE INCREASED AS PER THE TABLE IN THE UPPER RIGHT HAND CORNER.
 - FOR ANY STRUCTURE CROSSING OR PROJECTING OVER TRACK, INDUSTRY MUST SUBMIT PLANS BEARING THE SEAL OF A REGISTERED PROFESSIONAL ENGINEER TO THE DIVISION SUPERINTENDENT FOR FORWARDING TO THE CHIEF ENGINEER BRIDGES AND STRUCTURES FOR APPROVAL.

- OVERHEAD STRUCTURES (BRIDGES, WALKWAYS, CONVEYORS, ETC.) - EXCEPT:
- PIPE LINES - - - - - 25'-0"
 - OVERHEAD WIRE AND CABLE CROSSING THE MINIMUM SHALL BE AS FOLLOWS:
 - CABLES AND COMMUNICATION WIRES - - - - - 27'-0"
 - ELECTRIC LINES 0 TO 750 VOLTS - - - - - 30'-0"
 - ELECTRIC LINES 750 TO 15,000 VOLTS - - - - - 31'-0"
 - ELECTRIC LINES 15,000 TO 50,000 VOLTS - - - - - 33'-0"

THE ABOVE MINIMUM CLEARANCE SHALL BE INCREASED AS OUTLINED IN ACCORDANCE WITH NS STANDARDS AND PROCEDURES UTILIZING 1/2" FOR EACH 1,000 VOLTS (PHASE TO GROUND) ABOVE 50,000V.
ALL POWER AND COMMUNICATION LINES CONSTRUCTED OVER, UNDER OR PARALLEL TO THE RAILROAD SHALL MEET OR EXCEED THE REQUIREMENTS OF THE NESC LATEST REVISION

- RETRACTABLE DEVICES, SUCH AS CHUTES, SPOUTS AND CANOPIES WILL BE PERMITTED WITH 17'-6" MINIMUM OVERHEAD CLEARANCE WHEN IN THE OPERATING POSITION & GANGWAYS WILL BE PERMITTED PROVIDED APPLICANT AGREES TO THE FOLLOWING:
- DEVICE (S) MUST BE RETRACTED AND LOCKED IN PLACE WHEN CARS ARE BEING MOVED.
 - DEVICE (S) MUST RETRACT SO AS TO PROVIDE THE MINIMUM STANDARD SIDE CLEARANCE AND 23'-0" OVERHEAD CLEARANCE.
 - APPLICANT MUST FULLY INDEMNIFY THE RAILROAD AGAINST ANY AND ALL DAMAGES CAUSED BY THE DEVICE (S) .

ADDED SIDE CLEARANCES, REQUIRED FOR STRAIGHT TRACK AT END OF CURVE	
DISTANCE FROM ADJACENT OBSTRUCTION TO NEAR END OF CURVED TRACK	INCREASE IN SIDE CLEARANCE PER DEGREE OF CURVATURE
0 - 22 FT.	1 1/2 INCHES
23 - 45 FT.	1 INCH
46 - 68 FT.	1/2 INCH
69 - 90 FT.	1/4 INCH

TABLE OF CURRENT STATE LEGAL CLEARANCE REQUIREMENTS

S, SPOUTS 17'-6" N THE BE PERMITTED OLLOWING: AND LOCKED VED. TO PROVIDE RANCE THE MAGES	TRACK CENTERS		CLEARANCE								
	BETWEEN INDUSTRIAL TRACKS BETWEEN MAIN & INDUSTRIAL TRACK		VERTICAL	HORIZONTAL						POLES	GENERAL
			GENERAL	BUILDING DOORS	BUILDING DOORS	C OF TRACK					
						C	A	B			
									A		
VIRGINIA *	N	N	N	N	N	N	N	N	N	N	
ALABAMA *	13'-6"	13'-6"	22'	17'	8'	5'-9"	CFH	8'	10'	8'	
FLORIDA											
GEORGIA *											
ILLINOIS	13'-6"	15'	23'-0"	H	7'	6'-2"	CFH	8'	9'	8'	
INDIANA	N	N	22'	22'	8'	*	N	8'	8'	8'	
KENTUCKY	N	N	N	N	N	N	N	N	N	N	
LOUISIANA *											
MISSISSIPPI *											
N. CAROLINA*											
OHIO	14'	15'	21'	21'	8'	*	N	8'	8'	8'	
S. CAROLINA	N	N	N	N	N	N	N	N	N	N	
TENNESSEE	13'	14'	22'	17'	8'	7'-6"	4'	8'	8'	8'	
IOWA *											
MARYLAND	13'-6"	15'	22'	18'	8'	5'-7"	4'	8'-6"	8'-6"	8'-6"	
MICHIGAN	14'	14'	22'-6"	22'-6"	8'-6"	N	N	8'-6"	9'-0"	8'-6"	
MISSOURI	14'	14'	22'-6"	22'-6"	8'-6"	5'-9"	CFH	8'-6"	8'-6"	8'-6"	
NEW YORK	13'-6"	15'	22'	18'	8'	8'-6"	4'	8'-6"	8'-6"	8'-6"	
PENNSYLVANIA	13'-6"	15'	22'	18'	8'	8'-6"	4'	12'	12'	12'	
W. VIRGINIA	14'	15'	22'	22'	8'	6'-4"	4'	8'	10'	8'	
DELAWARE* *											
NEW JERSEY	N	N	N	N	N	N	N	N	N	N	

- NOTE: ABOVE EXCERPTED FROM AREMA CHART SHOWING LEGAL CLEARANCE REQUIREMENTS LAST REVISED 2004
- + NO CURRENT REGULATIONS
 - CFH - CAR FLOOR HEIGHT
 - H - HEIGHT OF CAR GOVERNS
 - N - NO REGULATION GIVEN
 - * - MUST APPLY TO STATE PUBLIC SERVICE COMMISSION FOR LESS THAN 8'-0" LATERAL CLEARANCE TO PLATFORMS.
 - * * - AREMA STANDARDS APPLY

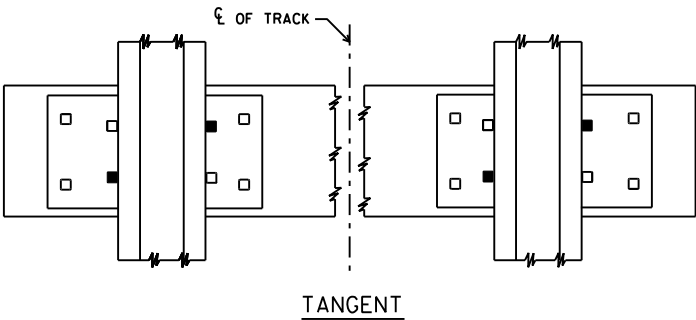
WHERE PUBLIC LAW OR REGULATION REQUIRES CLEARANCE GREATER THAN RAILWAY COMPANY STANDARD, SUCH LAWS AND REGULATIONS WILL GOVERN. SEE ABOVE TABLE.

WHERE NORFOLK SOUTHERN STANDARDS SPECIFY CLEARANCES GREATER THAN STATE STANDARDS, NORFOLK SOUTHERN CLEARANCE SHALL APPLY.

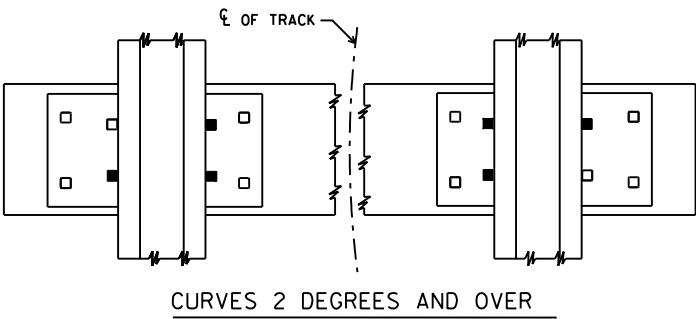
NORFOLK SOUTHERN RAILWAY COMPANY

CLEARANCES FOR TRACKS LOCATED ON INDUSTRY PROPERTY

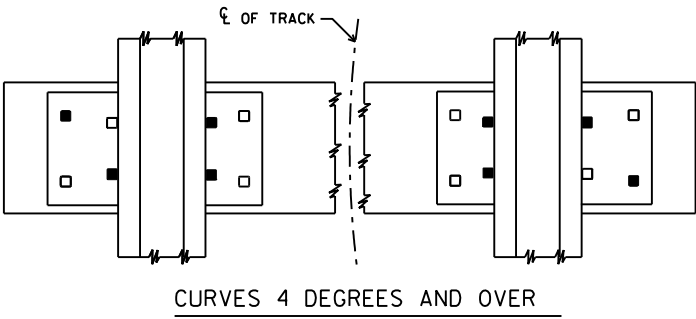
MARCH 1994
Atlanta, Georgia



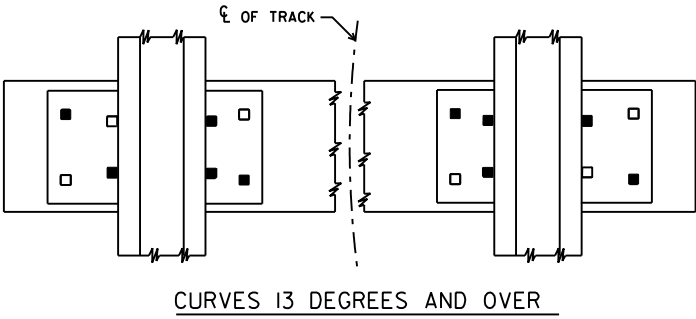
TANGENT



CURVES 2 DEGREES AND OVER



CURVES 4 DEGREES AND OVER



CURVES 13 DEGREES AND OVER

GENERAL NOTES

THE SPIKING PATTERN SHOWN APPLIES TO TRACKS CONSTRUCTED FOR INDUSTRIAL TRACKS; THE SPIKING PATTERN ON CURVES WILL BEGIN AT THE TANGENT AND THE SPIKING PATTERN WILL BE UNIFORM THROUGHOUT THE TOTAL LENGTH OF THE CURVE. THE SPIKING PATTERN ON COMPOUND CURVES WILL BE BASED ON THE HIGHEST DEGREE OF CURVE AND WILL BE USED FOR THE ENTIRE LENGTH OF THE CURVE.

ALL TRACKS WITH TIMBER TIES ARE TO HAVE THE RAILS SPIKED WITH AT LEAST ONE RAIL HOLDING SPIKE ON THE GAGE SIDE AND ONE RAIL HOLDING SPIKE ON THE FIELD SIDE.

STANDARD TRACK SPIKES ARE 5/8"x6" CUT SPIKE SHOWN ON STANDARD PLAN I-3.

OTHER RAIL AND/OR PLATE HOLDING DEVICES MAY BE USED WHEN AUTHORIZED BY AVP MAINTENANCE.

WHEN ANY RE-SPIKING IS PERFORMED, OLD SPIKE HOLES MUST BE PLUGGED WITH WOOD.

SPIKES MAY BE DRIVEN WITH A STANDARD SPIKE MAUL OR WITH A MACHINE. SPIKES MUST BE STARTED AND DRIVEN VERTICALLY AND SQUARE TO THE TIE TO PROVIDE A FULL BEARING AT THE BASE OF RAIL.

RAIL HOLDING SPIKES AT EPOXY INSULATED JOINTS MUST BE REVERSED SO THAT THE TOE OF SPIKE WILL NOT CONTACT JOINT BAR. IF SPIKE IS UNDER THE BOLT, THE TIE MUST BE RE-SPACED.

ADDITIONAL SPIKES MAY BE USED WHERE NECESSARY TO MAINTAIN PROPER GAGE.

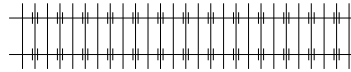
■ = SPIKE

NORFOLK SOUTHERN RAILWAY COMPANY
INDUSTRIAL TRACK
SPIKING PATTERN

SEPTEMBER, 2009
Atlanta, Georgia

DATE	REVISION		

CONTINUOUS WELDED RAIL TERRITORY

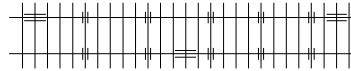


FULLY ANCHOR EVERY OTHER TIE EXCEPT AS
INDICATED IN NOTES FOR ANCHORING WELDED RAIL

CONVENTIONAL BOLTED RAIL TERRITORY



OVER 4 MILLION GROSS TONS ANNUALLY
16 ANCHORS PER 39 FT. RAIL LENGTH



LESS THAN 4 MILLION GROSS TONS ANNUALLY
10 ANCHORS PER 39 FT. RAIL LENGTH

GENERAL NOTES

THE ANCHOR STANDARDS ON THIS PLAN SHOULD BE CONSIDERED AS MINIMUM REQUIREMENTS. ADDITIONAL ANCHORS MAY BE AUTHORIZED BY THE DIVISION ENGINEERS TO PREVENT RAIL MOVEMENT IN LOCATIONS SUCH AS HEAVY GRADES, DIPS, RAILROAD CROSSINGS OR SIMILAR LOCATIONS WHERE THE STANDARD ANCHOR PATTERN DOES NOT ADEQUATELY RESTRAIN RAIL MOVEMENT.

ANCHORS MUST BE APPLIED ON THE SAME SIDE OF THE TIE OF BOTH RAILS WITH A FULL BEARING AGAINST THE SIDE OF THE TIE.

ANCHORS INSTALLED SHOULD BE SPACED UNIFORMLY THROUGHOUT THE RAIL LENGTH AND NOT BE GROUPED IN ONE AREA OF THE RAIL.

ANCHORS THAT ARE APPLIED EITHER BY MACHINE OR BY HAND, MUST NOT BE OVERDRIVEN OR OVER APPLIED.

ANCHORS MUST NOT BE APPLIED WHERE THEY WILL INTERFERE WITH SIGNAL OR OTHER TRACK APPLIANCES, ON THE RAIL OPPOSITE A JOINT OR WHERE THEY ARE INACCESSIBLE FOR ADJUSTMENT OR INSPECTION.

ANCHORS THAT ARE REMOVED FROM THE RAIL MUST BE REAPPLIED IN THE REQUIRED PATTERN.

RELAY (FIT) ANCHORS MAY BE USED IN WELDED RAIL LOCATIONS AS DIRECTED BY THE CHIEF ENGINEER LINE MAINTENANCE OR CHIEF ENGINEER PROGRAM MAINTENANCE.

RAIL ACROSS BALLAST DECK BRIDGES IS TO BE ANCHORED IN THE SAME PATTERN AS THE ADJACENT GROUND TRACK.

RAIL ON OPEN DECK BRIDGES IS NOT TO BE ANCHORED UNLESS SPECIFICALLY AUTHORIZED BY THE CHIEF ENGINEER BRIDGES AND STRUCTURES.

ANCHORS FROM DIFFERENT MANUFACTURERS ARE NOT TO BE INTERMIXED IN TRACK.

ANY MAIN TRACK NOT ANCHORED AS REQUIRED BY THIS PLAN IS CONSIDERED DEFICIENT AND MUST BE SLOW ORDERED. (EXCEPTION: SEE PREFACE MW&S STANDARD PROCEDURE 005.) WHEN RAIL HAS BEEN LAID OR REPLACED, SLOW ORDER MAY NOT BE REMOVED UNTIL RAIL IS PROPERLY ANCHORED AND TIE CRIB FILLED.

IF THE TYPE RAIL OR TONNAGE CHANGES, THEN THE ANCHORING PATTERN SHOULD BE CHANGED TO THE NEW REQUIRED PATTERN.

ANCHORING PROCEDURE

ANCHORING WELDED RAIL

TANGENT TRACK: BOX ANCHOR EVERY OTHER TIE.

CURVES LESS THAN 3 DEGREES: BOX ANCHOR EVERY OTHER TIE.

CURVES 3 DEGREES AND OVER: BOX ANCHOR EVERY TIE.

JOINTS: BOX ANCHOR EVERY TIE FOR SIX 39 FOOT RAIL LENGTHS (234 FEET) ON EACH SIDE OF JOINT.

WELDED TO JOINTED: WHEN WELDED RAIL CONNECTS TO JOINTED RAIL THE FIRST SIX 39 FOOT RAIL LENGTHS OF JOINTED RAIL ARE TO BE BOX ANCHORED FOR EVERY TIE EXCEPT AT AND OPPOSITE JOINTS. THE NEXT SIX RAIL LENGTHS OF JOINTED RAIL ARE TO BE ANCHORED WITH A TRANSITION PATTERN BETWEEN THE WELDED PATTERN AND THE JOINTED RAIL PATTERN.

OPEN DECK BRIDGES: GROUND TRACK IS TO BE BOX ANCHORED EVERY CROSSTIE FOR SIX 39 FOOT RAIL LENGTHS (234 FEET) FROM EACH BRIDGE END.

WHERE EXPANSION JOINTS ARE LOCATED ON THE GROUND, TRACK IS TO BE BOX ANCHORED EVERY CROSSTIE FOR SIX RAIL LENGTHS (234 FEET) FROM THE EXPANSION JOINT AWAY FROM THE BRIDGE. THERE ARE TO BE NO ANCHORS AND NO TRACK JOINTS BETWEEN THE EXPANSION JOINT AND THE BRIDGE.

ANCHORING JOINTED RAIL

LOCATIONS WHERE TONNAGE IS GREATER THAN 4 MILLION GROSS TONS ANNUALLY: BOX ANCHOR 8 TIES PER 39 FOOT RAIL.

SIDINGS WITH LESS THAN 25 M.P.H. TIMETABLE SPEED, YARDS, LEADS, BRANCH LINES AND LOCATIONS WITH LESS THAN 4 MILLION GROSS TONS ANNUALLY: BOX ANCHOR 5 TIES PER 39 FOOT RAIL.

ANCHORING TURNOUTS

MAIN TRACK TURNOUTS AND TURNOUTS IN WELDED RAIL TERRITORY:

TURNOUTS ARE TO BE BOX ANCHORED EVERY CROSSTIE FOR THREE 39 FOOT RAIL LENGTHS (117 FEET) IN EACH DIRECTION FROM THE TURNOUT INCLUDING THE TURNOUT SIDE. ALL SWITCH TIES ARE TO BE BOX ANCHORED, WHERE POSSIBLE.

OTHER THAN MAIN TRACK TURNOUTS AND TURNOUTS IN JOINTED RAIL TERRITORY:

TURNOUTS ARE TO BE BOX ANCHORED EVERY OTHER CROSSTIE FOR THREE 39 FOOT RAIL LENGTHS (117 FEET) IN EACH DIRECTION FROM THE TURNOUT INCLUDING THE TURNOUT SIDE. EVERY OTHER SWITCH TIE TO BE BOX ANCHORED, WHERE POSSIBLE.

IF THE TURNOUT IS IN WELDED RAIL TERRITORY WITH A JOINT, THEN THE PROCEDURE FOR ANCHORING JOINTS IN WELDED RAIL APPLIES.

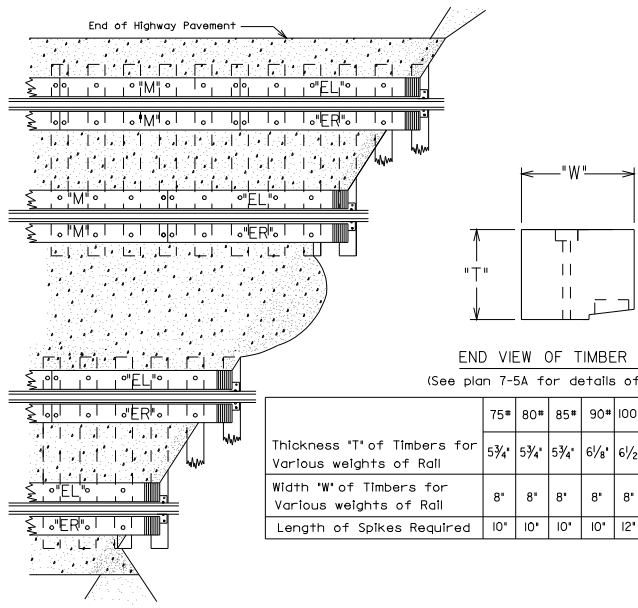
NORFOLK SOUTHERN RAILWAY COMPANY

**RAIL ANCHORING
PATTERN**

APRIL 1991

Atlanta, Georgia

REVISION			
DATE			

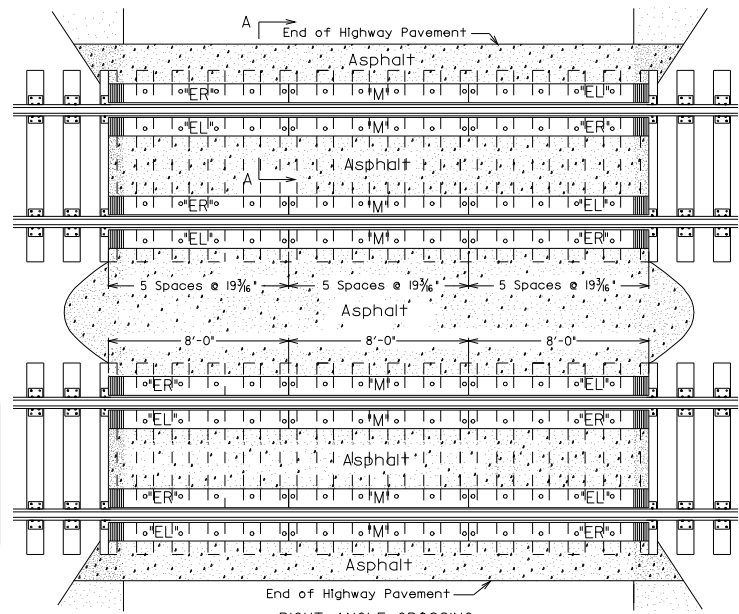


END VIEW OF TIMBER

(See plan 7-5A for details of timber)

	75"	80"	85"	90"	100"	110"	112"	115"	132"
Thickness "T" of Timbers for Various weights of Rail	5 3/4"	5 3/4"	5 3/4"	6 1/8"	6 1/2"	7"	7 1/2"	8"	
Width "W" of Timbers for Various weights of Rail	8"	8"	8"	8"	8"	10"	10"	10"	
Length of Spikes Required	10"	10"	10"	10"	12"	12"	12"	12"	

ACUTE ANGLE CROSSING



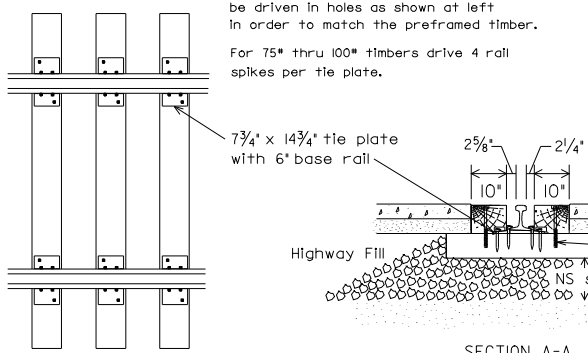
RIGHT ANGLE CROSSING

SPIKING PATTERN

All spikes for 110" thru 132" timbers shall be driven in holes as shown at left in order to match the preframed timber.

For 75" thru 100" timbers drive 4 rail spikes per tie plate.

7 3/4" x 14 3/4" tie plate with 6" base rail



NOTES

Timbers to be shaped and bored prior to creosote treatment.

Pavement to be full depth asphalt, except lightly used private crossings and farm crossings. These type crossings are to have compacted NS standard sub-ballast with 4" maximum asphalt.

Where highway or street have separate sidewalks, the entire width of crossing to the outside edge of sidewalk, will be paved, where practical.

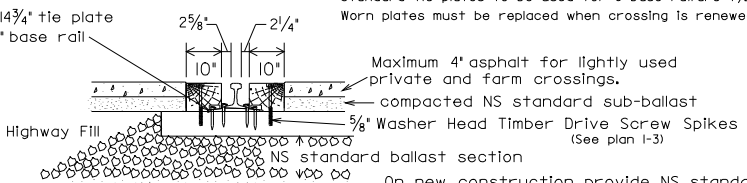
When necessary provide drainage between tracks.

To allow for compaction of paving under vehicular traffic, the surface of the asphalt paving shall be raised 3/8" above the top of the crossing timbers for the width of the roadway.

To increase width of crossing use additional "M" timbers.

Standard tie plates to be used for 6" base rail are 7 3/4" x 14 3/4".

Worn plates must be replaced when crossing is renewed.



SECTION A-A

NORFOLK SOUTHERN RAILWAY COMPANY

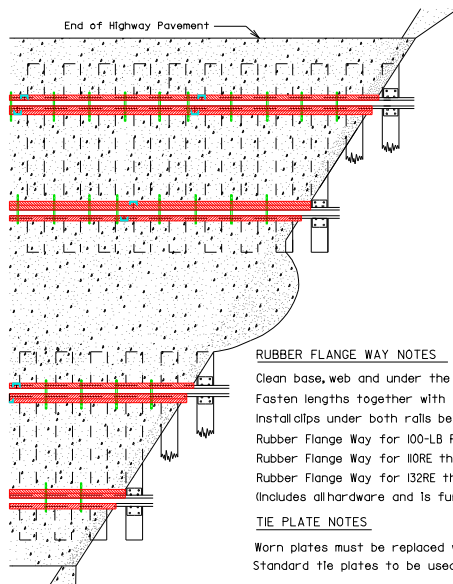
**HIGHWAY GRADE CROSSING
ASPHALT PAVING**

JANUARY 1995

Atlanta, Georgia

DATE	REVISION
1-6-95	Added notes NS standard sub-ballast
1-10-95	Added rail spikes 100" thru 132" timber
8-7-02	Added tie plate designation

Atlanta, Georgia



RUBBER FLANGE WAY NOTES

Clean base, web and under the head of the rail.
Fasten lengths together with end clips and lay rubber against the rail.
Install clips under both rails between every tie in the crossing.
Rubber Flange Way for 100-LB Rail 270 995291
Rubber Flange Way for 110RE through 115RE Rail 270 991789
Rubber Flange Way for 132RE through 141AB Rail 270 008791
(Includes all hardware and is furnished in 8 track foot sections.)

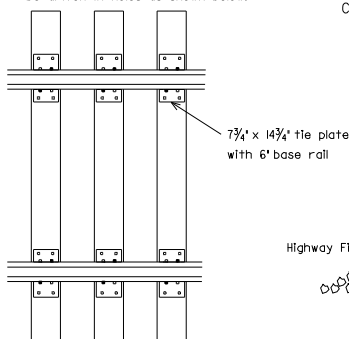
TIE PLATE NOTES

Worn plates must be replaced when crossing is renewed.
Standard tie plates to be used for 6" base rail are 7 $\frac{3}{4}$ " x 14 $\frac{3}{4}$ ".

ACUTE ANGLE CROSSING

SPIKING PATTERN

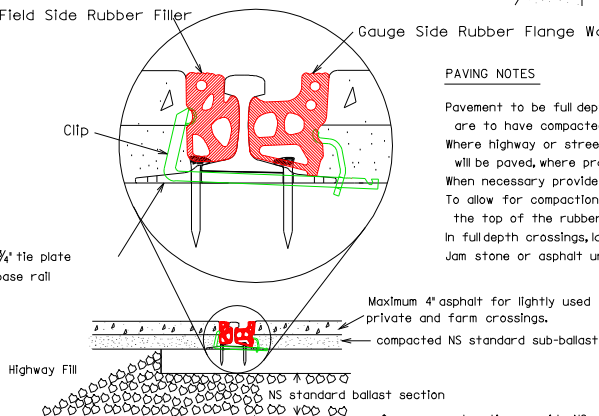
All spikes for 110" thru 141" rail shall be driven in holes as shown below.



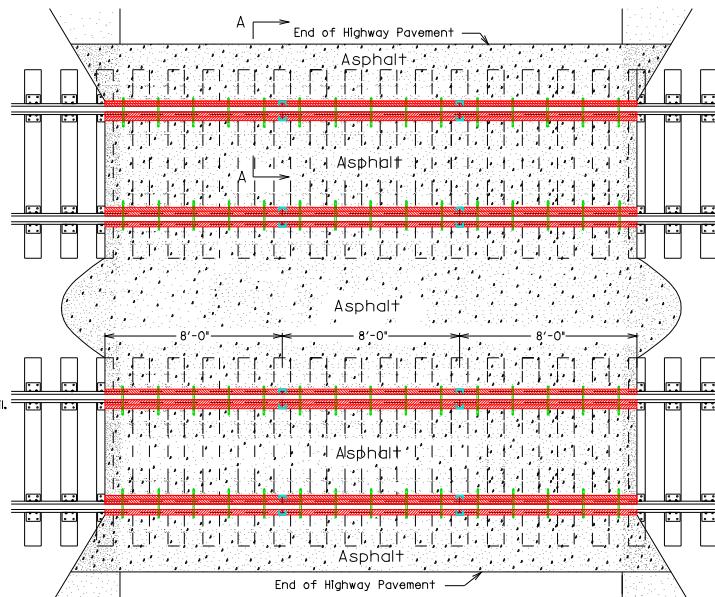
Field Side Rubber Filler

Gauge Side Rubber Flange Way

Clip



SECTION A-A



RIGHT ANGLE CROSSING

PAVING NOTES

Pavement to be full depth asphalt, except lightly used private crossings and farm crossings. These type crossings are to have compacted NS standard sub-ballast with 4" maximum asphalt.
Where highway or street have separate sidewalks, the entire width of crossing to the outside edge of sidewalk, will be paved, where practical.
When necessary provide drainage between tracks.
To allow for compaction of paving under vehicular traffic, the surface of the asphalt paving shall be raised $\frac{3}{8}$ " above the top of the rubber flange ways for the width of the roadway.
In full depth crossings, lay asphalt in two lifts.
Jam stone or asphalt under rubber flange way between ties - both field and gauge sides. FILL ALL VOIDS.

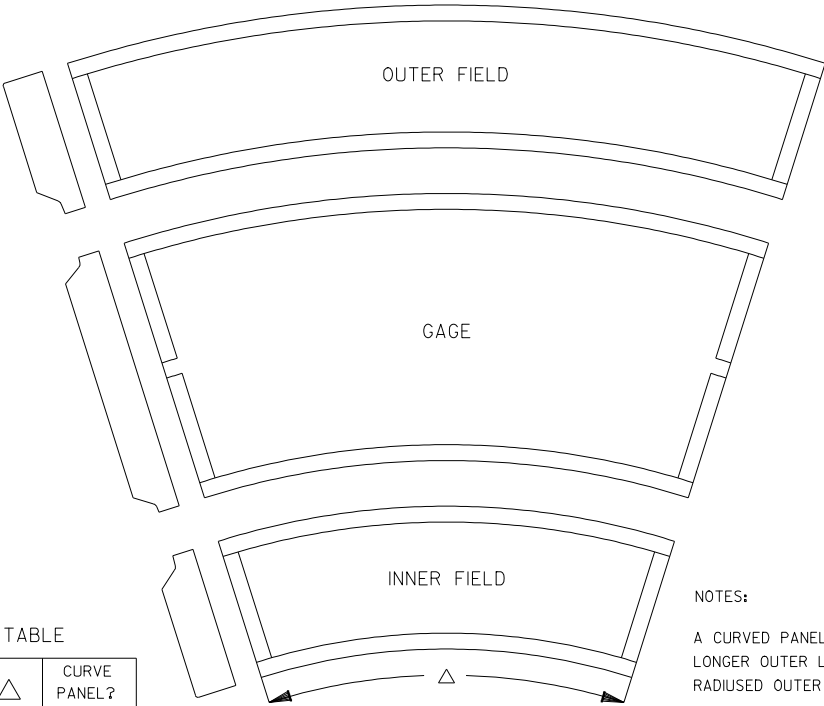
NORFOLK SOUTHERN RAILWAY COMPANY HIGHWAY GRADE CROSSING ASPHALT PAVING WITH RUBBER FLANGE WAY

OCTOBER 2003

Atlanta, Georgia

DATE	REVISION
11-18-03	ADD CLASS & ITEM NUMBER FOR 100-LB RAIL





CURVATURE TABLE

DEGREE OF CURVE	RADIUS IN FEET	Δ	CURVE PANEL ?
3° OR LESS	1,910	0.24°	NO
4°	1,433	0.32°	YES
5°	1,146	0.40°	YES
6°	955	0.48°	YES
7°	819	0.56°	YES
8°	717	0.66°	YES
9°	637	0.74°	YES
10 °	574	0.82°	YES
11 °	522	0.90°	YES
12 °	478	0.98°	YES
13 °	442	1.06°	YES
14 °	410	1.14 °	YES

NOTES:

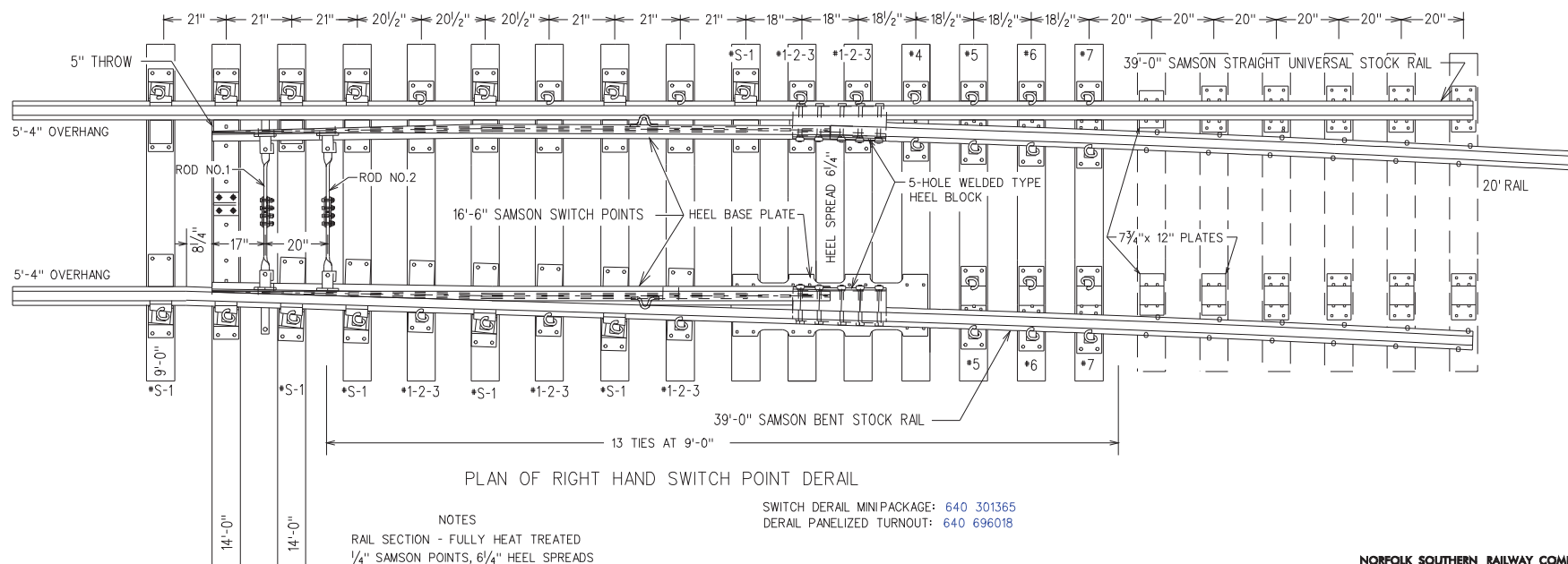
A CURVED PANEL IS A PANEL THAT IS PIE SHAPED WITH A LONGER OUTER LENGTH THAN INNER LENGTH WITH A TRUE RADIUSUED OUTER AND INNER STEEL.

CURVED PANELS USE STANDARD REINFORCEMENT SIMILAR TO TANGENT PANEL STANDARD REINFORCEMENT.

LAG HOLES MUST LINE UP WITH THE CENTERLINE OF THE TIES.

NORFOLK SOUTHERN RAILWAY COMPANY
CURVED CONCRETE PANELS

DATE	REVISION



PLAN OF RIGHT HAND SWITCH POINT DERAIL

NOTES

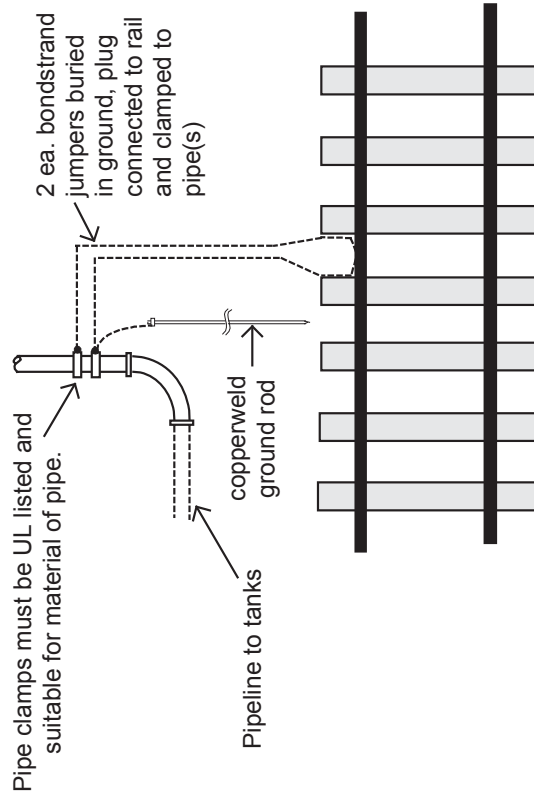
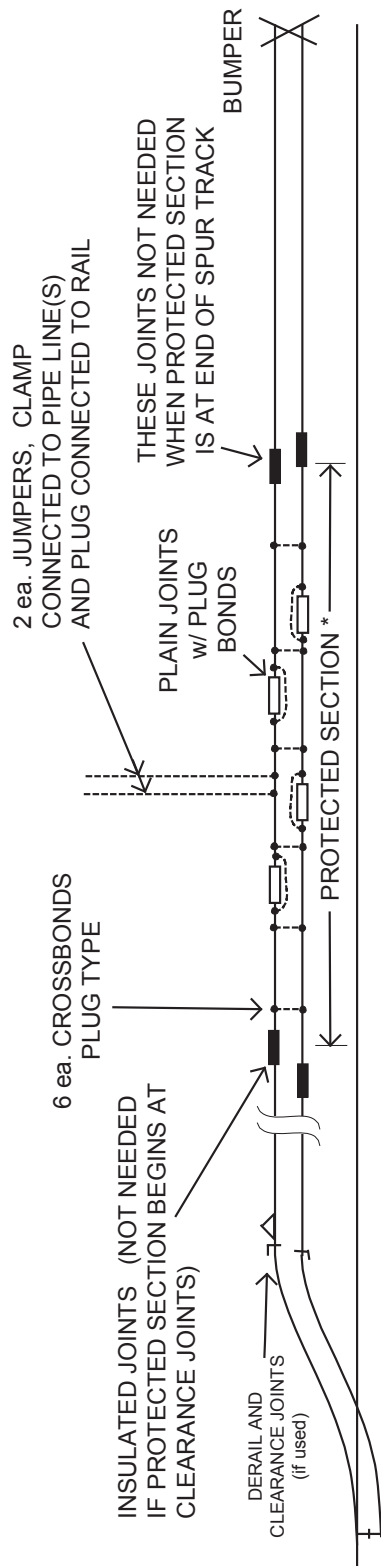
RAIL SECTION - FULLY HEAT TREATED
 1/4" SAMSON POINTS, 6 1/4" HEEL SPREADS
 RAIL ENDS BEVELED PER AREMA PLAN 1005-40
 GAGE - 4'-8 1/2" THRU SWITCH

SWITCH DERAIL MINI PACKAGE: 640 301365
 DERAIL PANELIZED TURNOUT: 640 696018

NORFOLK SOUTHERN RAILWAY COMPANY
132RE SWITCH POINT DERAIL
 JUNE 2003
 Atlanta, Georgia

DATE	REVISION

STANDARDS AND PROCEDURES
OIL, GAS or OTHER FLAMMABLES
LOADING / UNLOADING SPURS
PROTECTION FROM STRAY ELECTRIC CURRENTS
Initial date 4/19/93 – Revised 3/18/03



NOTES:

1. * Protected Section - To be of sufficient length to hold car(s) connected to tanks for loading/unloading.
Cars spotted for loading/unloading must not bridge insulated joints or be coupled to cars outside of protected section during loading/unloading operations.
2. Protected Section insulated joints must be of approved type and must be painted with yellow paint.
3. No connections or bonding using any welding process permitted in Protected Section due to fire hazard.
4. Holes for web bond connections must be at least 8" horizontally from any thermite web weld.
5. Loading/unloading pipe to be connected to rails as shown in drawing to right. Ground clamps to be UL listed type and suitable for material that pipe is made from.

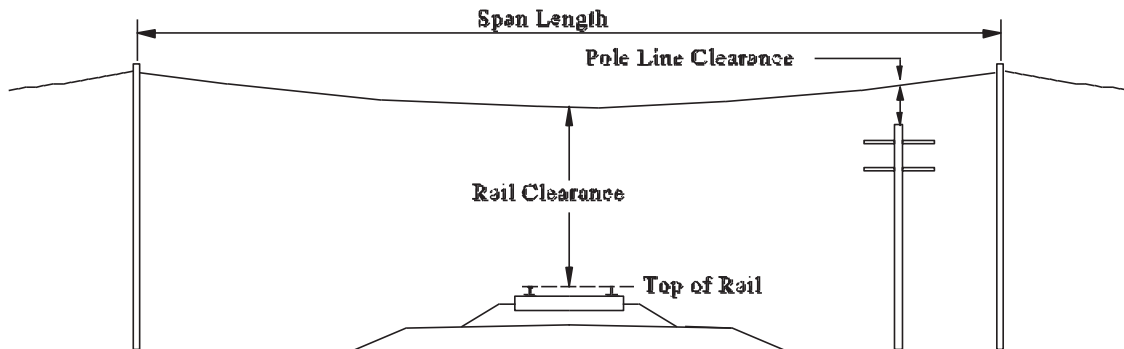
STANDARDS AND PROCEDURES

CLEARANCE REQUIREMENTS FOR CABLE AND WIRE CROSSINGS

Initial date 9/1/93 - Revised 3/24/06

Note: All power and communication lines constructed over, under or parallel to the railroad shall meet or exceed the requirements of the National Electric Safety Code (NESC), latest revision.

OVERHEAD CLEARANCE



In no case shall crossings have less vertical clearance than the following at a final unloaded sag at 60 °F, or for span lengths greater than the standard span lengths for the appropriate geographic loading district, at the maximum conductor temperature for which the supply line is designed to operate.

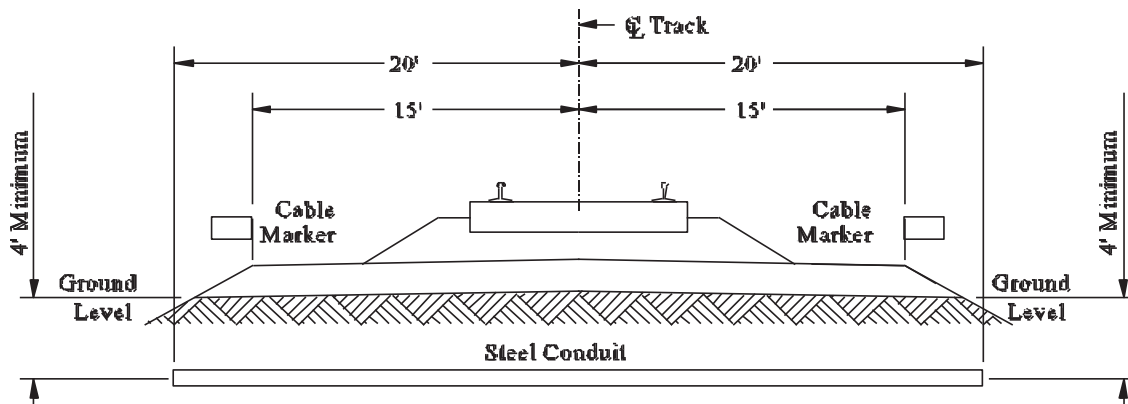
Distance Above	Guys, Messenger, and Communications Spans	Open Supply Line or any Neutral (phase to ground voltage)		
		0 to 750 V	over 750 V to 15 KV	over 15 KV to 50 KV *
Rail	27 feet	30 feet	31 feet	33 feet
Pole Line	2 feet	2 feet	4 feet	6 feet

* Add 1/2 inch for each 1000 volts (phase to ground) above 50 KV.

Loading District	Standard Span Lengths
Heavy	175 feet
Medium	250 feet
Light	350 feet

Note - The applicant will furnish line design final sag data.

UNDERGROUND CLEARANCE



Power and communications underground wire and cable crossings must be buried a minimum 5 1/2 feet below base of rail and 4 feet below ground level for entire width of right-of-way and must be installed in steel conduit beneath the track, extending a minimum of 20 feet from the centerline of nearest track. Cable marker signs must be installed 15 feet from centerline of nearest track on both sides of right-of-way entry/exit. Signs must indicate cable owner, depth buried and voltage.



Quality Assurance Specifications for Ties and Timbers

Revised

May 1, 2017

2.0 NORFOLK SOUTHERN SPECIFICATIONS FOR WOODEN INDUSTRIAL GRADE CROSSTIES

SCOPE

This specification cancels and supersedes all previous specifications for Norfolk Southern Corporation covering the purchase of solid wooden industrial grade crossties.

GENERAL

Industrial grade crossties are standard crossties that do not meet all of the requirements of grade ties, but are suitable for industrial leads, yards, sidings, and other low-impact tracks. Only the following defects are considered acceptable for ties down-graded to industrial grade: splits, checks, shake, twist, bow, and failed end-plates.

No green, dry, or treated industrial grade crossties shall be bought unless explicitly specified by an NS purchase order. If a purchase order is issued, then this specification will detail the classifications and defect limitations.

Normally industrial grade crossties will accumulate in the Norfolk Southern inventory only after degrading in the air-drying or treating processes at a plant where NS owns the dry tie or the treated tie. Full service plants will absorb all degraded ties into their inventories and ship only grade crossties to NS; unless storage time limitations for treated crossties are approved.

2.1 Species of Acceptable Woods

Mixed oak and mixed hardwoods are acceptable. Poplar, cottonwood, willow and basswood are not acceptable.

2.2 Classification and Design

The following sizes, lengths, and minimum faces are allowed in industrial grade crossties:

- 6" IG 6" x 8" x 8'0" - 8'7" 6" face on top or bottom
- 7" IG 7" x 8" x 8'0" - 8'7" 6" face on top or bottom
- 7" IG 7" x 9" x 8'0" - 8'7" 6" face on top or bottom.

The above minimum face requirements apply to the rail-bearing areas, which are the areas between 20" and 40" from the middle (11"-31" from the end) of the industrial grade crosstie. Outside the rail-bearing areas, wane will be limited to half the face width on the top or bottom of the tie. The grade of each tie shall be determined at the point of most wane, on the top or bottom, within the rail-bearing areas. The top is defined as the wide face farthest from the pith center.

Dry or treated ties may be 1" narrower or 1/2" thinner than the specified sizes. Thickness and width may not vary more than 1" from end to end. The tie body may be out of square by no more than 1" throughout the length. Tie length may vary from 8'-0" to 8'-6".

End squareness should be reasonably flat to accept end plates.

2.3 Definitions of Defects

- 2.3.1 Wane: Wane is defined as bark or the lack of wood (see Section 2.2 for allowance).
- 2.3.2 Bark Seam: Bark seams will not be acceptable if more than 2" deep or more than 10" long anywhere in the industrial grade crosstie.
- 2.3.3 Decay: A decayed knot greater than 3/4" in diameter will be rejected within the rail-bearing area. Also, slight incipient decay may be allowed outside the rail-bearing area, if the decayed area does not exceed 2" in diameter. Ties with decay appearing in both ends will be rejected.
- 2.3.4 Splits: A split is a separation of the wood extending from one surface to an opposite or adjacent surface --not counting the end as a surface. Seasoned or treated ties with a split greater than 1/2" wide or 15" long will be rejected with or without an end-plate.
- 2.3.5 Check: A check is a separation of wood due to seasoning which appears on one surface only - not counting the end as a surface. Season checks greater than 2" deep or 3/4" wide shall be rejected.
- 2.3.6 Shakes: Industrial grade crossties with shakes (ring separations) having a width on the cross-section greater than 4" or extending to more than one surface shall be rejected.
- 2.3.7 Holes: Ties having holes on any surface within the rail-bearing areas that are greater than 1" in diameter or greater than 3" deep will be rejected. Ties having holes on any surface outside the rail-bearing areas which are greater than 3" in diameter or deeper than 4" will be rejected.

- 2.3.8 Knots: A knot greater than 4" in diameter will not be permitted in industrial grade crossties.
- 2.3.9 Cross or Spiral Grain: Except in species with interlocking grain, ties having cross, slant, or spiral grain greater than 2" in 15" of length will be rejected.
- 2.3.10 Manufacturing Defects: All ties must be straight and have top and bottom parallel. Ties will be rejected for any of the following:
- Lack of Straightness - A straight line from a point on one end to a corresponding point on the other end is no more than 2" from the surface at any point.
 - Not Well-Sawn - Surfaces are cut with score marks more than 1" deep.
 - Out of Parallelism - If any difference in width or thick at the sides or ends exceeds 1".

2.4 Seasoning and Conditioning

- 2.4.1 Air Seasoning - Prior to air seasoning, ties shall be incised, separated by size and species, and stacked promptly upon receipt at the treating plant. Hickory shall be air stacked with the oaks.

Each completed run of green industrial grade crossties will be dated on the front of the run, conforming to the fiscal or status month in which it was completed. No longer than 30 days will be allowed for the construction, completion, and dating of any given run of ties. Each completed run of ties will be scheduled for treatment when moisture contents fall to specified levels.

For air-dried runs, 7 of the 20 borings required for moisture assessment shall be taken from the hacks on the ends of the runs. Sufficient runs must be sampled to yield a representative moisture content that will allow proper creosote penetration in all of the ties that finished drying that month. A solid 3" boring shall be taken midway between the ends and midway from top to bottom of each tie sampled. All species within a run should be included in the moisture content determination.

The whole 3" borings shall be dried, and the finished moisture content percentage shall not exceed the following limits:

Oak-hickory 50% moisture content
Mixed hardwood 40% moisture content.

Use the stacking method that normally produces the best results for your particular locality. However, regardless of stacking method, all stacks must be supported on treated, or non-decaying sills. The first layer of ties shall be off the ground 12" or more. Space between stacks or runs shall be dictated by site and climate. Horizontal and vertical alignment of ties within a stack or run must be equal to provide for good air circulation within and between stacks or runs of ties. When stickers are used for air-drying, they must be treated and at least 1 1/2" thick.

All air seasoning yards shall be so located and constructed to provide for free, unobstructed flow of prevailing air currents, and complete water drainage away from stacks of seasoning ties. Seasoning yards will be kept free and clear of grass, weeds, decayed wood, and other such objects that inhibit good seasoning.

- 2.4.2 Artificial Seasoning (Boultonizing) - Industrial grade crossties scheduled for Boultonizing shall be separated by size and species, incised, then sent to the tramming station and handled as outlined in Section 2.5 before the drying process begins. Hickory ties must be Boultonized with the oaks. Each layer of ties on the tram shall be separated with one 3/4" steel spacer placed on alternate ends as layers are built.

Moisture contents shall be determined in accordance with **current** AWPA procedures using twenty - 3" borings from each charge, prior to drying. Water removal is acceptable when target moisture content of 50% for oak-hickory charges and 40% for mixed hardwoods are obtained. A preheating period of 3 hours without any vacuum applied will be initiated after filling the cylinder and heating the oil to a minimum of **180°** F. This period must be shown on charge reports as "Heated in oil at **180-210°** F". After this heating period, the Boulton cycle is initiated as described below with temperatures of 170-210° F and vacuums sufficient to boil the water at the desired rate. The Boulton cycle will continue until the required amount of water is removed, or the minimum water flow rate is achieved. If a plant elects to control the Boulton vacuum times based on flow rates alone, then the above initial moisture content borings and water removal calculations are not required. If flow rates are used alone, then the target amount of gallons to be removed will be an amount equal to the cubic foot volume of ties in the cylinder, i.e. 3500 cubic feet would require a target amount of 3500 gallons of water be removed.

The Boulton cycle may be stopped before the calculated amount of water is removed, if the following conditions have all been met during the previous 2 out of 3 consecutive hours:

- The temperature of the oil bath was **180°**F or more.
- A vacuum of 20" or more mercury existed in the cylinder.
- Not more than 0.30 lbs. water/cubic ft. of wood in the cylinder was recovered.

Moisture content after treatment shall be taken on one charge per week and shall not exceed the following averages from 20 - 3" cores:

Oak-hickory 50% moisture content
Mixed hardwood 40% moisture content.

2.5 Processing and Handling

2.5.1 TSO Tie Orders

Prior to being loaded on trams for preservative treatment and/or Boultonizing, all ties shall be double end-trimmed square to 8'6" length, inspected, graded and end-branded with the letters 'NS', plant location, and year treated. Letters shall be a minimum of 1" high, ½" wide, and 1/8" deep. Letter designations for plant locations are as follows:

A – Koppers, Glenvar, VA	R – Stella-Jones, McAlisterville, PA
B – Stella-Jones, DuBois, PA	S – Koppers, Susquehanna, PA
C – Stella-Jones, Cordele, GA	V – Stella-Jones, Goshen, VA
G – Koppers, Guthrie, KY	W – Stella-Jones, Winslow, IN
K – Cahaba, Brierfield, AL	X – Stella-Jones, Montevallo, AL
M – Mellott, Needmore, PA	

2.5.2 Black Tie Orders

Prior to being loaded on trams for preservative treatment and/or Boultonizing, all ties shall be double end-trimmed square to 8'6" length, inspected, graded and end-branded/plated with an approved letter(s) to identify the plant location, and year treated. Letters shall be a minimum of 1" high, ½" wide, and 1/8" deep.

Inspection and grading shall consist of the examination of all four surfaces and both ends of the tie. Acceptance is based on the requirements of this specification.

2.5.3 Incisor heads must be well-maintained to assure an average penetration depth of 1/2" minimum for each tooth for the full length of the tie. A bar will be replaced when any two adjacent teeth are missing or damaged or more than three teeth are missing from the entire length of the bar.

2.6 Treatment and Preservatives

The methods, requirements, and specifications to insure proper handling, conditioning and treatment of ties shall be governed first by NS Specifications and supplemented secondly with current AWP Standards, with the following exceptions:

Treatment shall be by the empty cell method with a creosote/coal tar solution in accordance with AWP Standard P-2. The preservative solution shall be tested monthly according to current AWP Standard with a copy of the results maintained for a representative of Norfolk Southern Corp to review.

Net retention shall not be less than 8 lbs. / cubic ft. in oak-hickory and 10 lbs. / cubic ft. in mixed hardwoods by gauge or until refusal.

Net retention of creosote for creosote-borate dual treated ties shall not be less than 6 pcf in oak-hickory and 6 pcf in mixed hardwoods by gauge or until refusal, with a 0.28 pcf DOT of borate retention.

2.6.3 Air-Dry Treatment – All air-dried charges of ties shall be held in 180-210°F oil for a minimum of 6 hours. This time will be a combination of pressure and preheating in oil to achieve sterilization and deeper distribution of creosote in air-dried material. Preheating time will begin only after 180°F is attained. These preheats will have only the “initial air” pressure applied and will be 1 hour minimum for both oak-hickory and mixed hardwood. Pressure periods will include only the time at 200 psi or more, and will be sufficient to meet desired retentions. Each layer of ties on the tram shall be separated with one ¾” steel spacer placed on alternate ends as the layers are built.

2.6.2 Boulton Treatment -Pressure periods will include only the time at 200 psi or more, and will be sufficient to meet desired retentions. Each individual charge or “lot” of treated ties must have process records retained for review by Norfolk Southern Corp. representatives. These records shall be maintained for a minimum of 7 years.

All tie treatment facilities shall certify on invoices that treated ties meet the appropriate Norfolk Southern specifications and AWPA standard treating requirements.

2.7 Inspection After Treatment

Except as hereinafter provided, all after-treatment inspection tests shall be made in accordance with requirements stipulated in current AWPA Standards. Each treated charge of ties will be tested for penetration of preservative after removal from the treating cylinder or retort. This visual test shall consist of at least 20 borer cores taken randomly throughout the charge of material to be representative of the charge as a whole. All borings made for the penetration test shall be made on the 6” or 7” side of the tie midway between the ends and midway between the top and bottom to a minimum depth of 3 ½”. All holes made during boring shall be plugged with tight fitting, treated plugs. If 80% of the test cores in any charge meet the annual ring penetration requirements, that charge shall be accepted.

Minimum penetration requirements for DOT will be per current AWPA standards. Spray all dual treated borings with 2 part curcumin solution to visually check for borate penetration. These should be the same borings used for the visual determination of creosote penetration.

Dual treated crossties shall bear a 1/8” wide by 1/8” deep kerf mark across the top and bottom face of one end positioned approximately 9” from the end.

2.7.1 Minimum penetration requirements for oak-hickory charges are as follows:

White Oak 95% of sapwood annual rings

Red Oak 65% of annual rings in a 3 ½" test core
Hickory 90% of sapwood annual rings

Bore only the red oak and hickory to assess the penetration results of oak-hickory charges.

If the average red oak and hickory penetration of the 20 test cores meets the penetration requirements, the charge shall be accepted.

Charges of white oak with less penetration may be accepted, if the wood is conditioned properly, and treatment continued to refusal.

2.7.2 Minimum penetration requirements for mixed hardwoods are as follows:

Blackgum 2 ½" solid or 90% of sapwood rings
Mixed Hardwood 90% of sapwood rings

2.7.3 Assay extractions by zone (0-1", 1-2", 2-3") on a 3" core, as per AWP A-6 shall be done weekly, or more often as required by any of the following; the supplier's Quality Assurance representative, treating supervisor or Norfolk Southern representative.

Only red oak and hickory ties shall be assayed to determine if adequate retention levels are being obtained in the oak – hickory charges, but any of the mixed hardwoods may be assayed. Assay results should be at least 70% of gauge retentions. Assays for DOT shall be done regularly as dictated by the dual-treatment section of this specification and the plants written procedure.

No charge shall be pulled from the cylinder for refusal with less than the specified amount of treating solution injected **absorbed in each of any two consecutive half-hours is not more than 2% of the amount already injected.**

All treated borings must be stored in sealed zip-loc plastic bags with the charge number, tie size, species, date, and retention clearly marked on the bag. These bags must be kept in date order until inspected by the NS representative.

Treatment to refusal does not, however, constitute an acceptable alternative to minimum penetration and/or retention requirements specified under results of treatment except as specifically listed.

2.8 Retreatment

Treated industrial grade ties not conforming to the minimum requirements for retention and/or penetration may be retreated and re-offered for acceptance in accordance with **current** AWP A Standards and the following conditions:

- Industrial Grade tie charges to be retreated will be heated in **180-210°F** oil for 3 hours before applying pressure. A pressure period of 2 hours at 200 psi will be required to improve penetration.
- When a charge is retreated, the total retention as a result of all treatments must be sufficient to satisfy the requirements for both net retention and penetration.

-Ties may not be retreated more than twice.

2.9 Inspection, Care and Handling after Treatment

Treated ties shall be inspected for all of the defects outlined in Section 2.4. Soft areas can be probed for soundness as well.

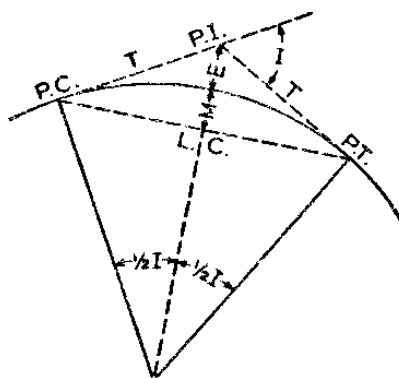
Ties that are to be plated, or re-worked in any way must be separated and marked for re-work. All rejects shall be separated and marked as rejects.

All treated ties not handled directly from tram to car must be carefully and neatly stored. Different size classifications must be kept separate, and all bundles or stacks must be marked with 'NS', grade, and treatment date. All ties must be stacked to ensure that tie straightness is not impaired during temporary storage. Treated stringers must be placed underneath all stacks of treated ties. No loose windrows of NS treated ties will be allowed. Shipments are to be made from the oldest stacks first. If any ties become excessively bleached during storage, they will be retreated or replaced by the vendor if not properly rotated. Yard drainage conditions must provide rapid drainage of water from beneath stacks of treated ties. Storage areas must be kept free of grass and weeds to aid in the free flow of air and to minimize the possibility of fire. The vendor shall be liable for all fire damage while NS crosstie inventory is located on the property of the vendor. Care must be exercised in the handling of NS crossties for storage or shipment to prevent damage which affects the utility of the crosstie in service.

For shipments already delivered, compliance with Section 2.4 of the specification shall be deemed satisfactory if no more than 5% of the ties in any given shipment are considered borderline compliant. This 5% allowance is only for subjective variation in the judgment of the inspectors. NS reserves the right to refuse any obvious rejects.

CURVE AND REDUCTION TABLES

Published by Eugene Dietzgen Co.



CURVE FORMULAS

1. Radius : $R = \frac{50}{\sin D/2}$
2. Degree of Curve: $D = 100 \frac{I}{L}$ Also, $\sin D/2 = \frac{50}{R}$
3. Tangent : $T = R \tan \frac{1}{2} I$. Also, $T = \frac{T \text{ for } 1^\circ \text{ curve}}{D} + C$.
4. Length of Curve: $L = 100 \frac{I}{D}$
5. Long Chord : $L.C. = 2R \sin \frac{1}{2} I$.
6. Middle Ordinate: $M = R (1 - \cos \frac{1}{2} I)$
7. External : $E = \frac{R}{\cos \frac{1}{2} I} - R$. Also, $E = T \tan \frac{1}{4} I$.

EXPLANATION AND USE OF TABLES

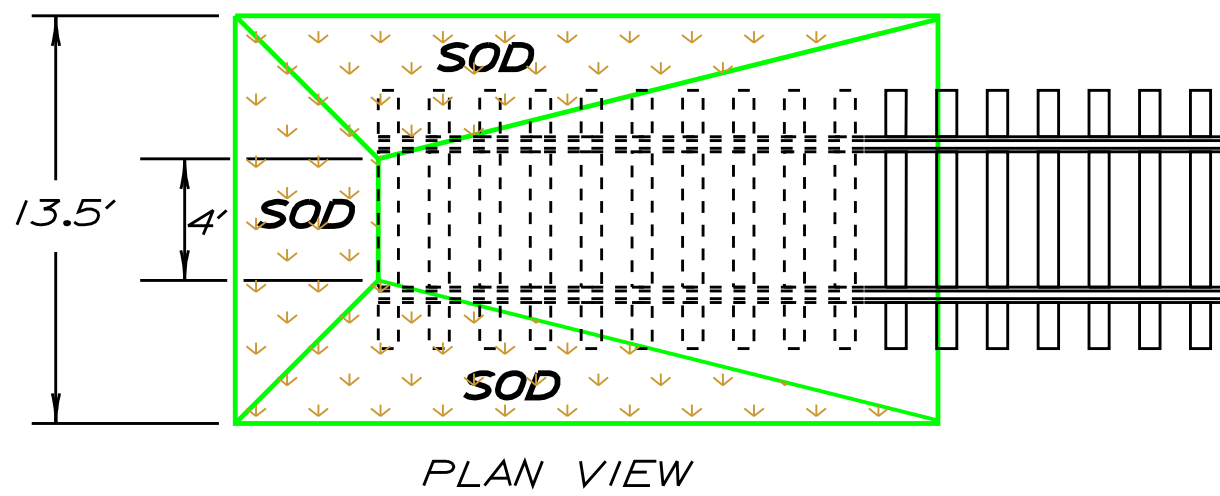
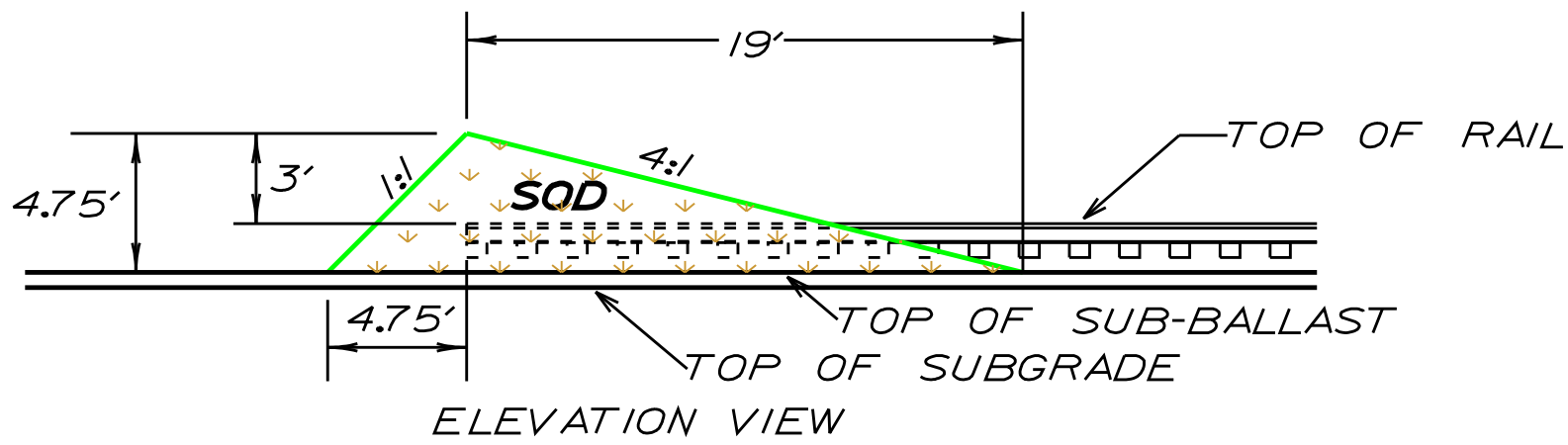
Given P.I. Sta. 83+40.7, $I = 45^\circ 20'$ and $D = 6^\circ 30'$ find:

Stations—P.C. = P.I. — T. $T = \frac{T \text{ for } 1^\circ \text{ Curve}}{D} + C$. From Tables V and VI
 $T = \frac{2392.8}{6.5} + .197 = 368.32 = 3 + 68.32$. Sta. P. C. = 83+40.7 — (3+68.32) = 79+72.38.
 P. T. = P. C. + L, and $L = 100 \frac{I}{D} = 100 \frac{45.33}{6.5} = 697.38$ Therefore, P. T. = (79+72.38) + (6+97.38) = 86+69.76.

Offsets—Tangent offsets vary (approximately) directly with D and with the square of the distance. From Table III Tangent Offset for 100 feet = 5.669 feet. Distance = 80 — Sta. P. C. = 27.62. Hence offset = $5.66 \times \left(\frac{27.62}{100}\right)^2 = .432$ ft. Also, square of any distance, divided by twice the radius equals (approximately) the distance from tangent to curve. Thus $(27.62)^2 \div (2 \times 881.95) = .432$ ft.

Deflections—Deflection angle = $\frac{1}{2} D$ for 100 ft., $\frac{1}{4} D$ for 50 ft., etc. For "X" ft., Deflection Angle (in minutes) = $.3 \times X \times D$. For Sta. 80 of above curve Deflection Angle = $.3 \times 27.62 \times 6.5 = 53.86'$. Also Deflection Angle = dfl. for 1 ft. from Table III $\times X = 1.95 \times 27.62 = 53.86'$. For Sta. 181 Deflection Angle = $53.86' + \frac{6^\circ 30'}{2} = 4^\circ 8.86'$.

Externals—From Table V for 1° curve, with central angle of $45^\circ 20'$, $E = 479.6$. Therefore, for $6^\circ 30'$ curve, $E = \frac{479.6}{6.5} + \text{Correction from Table VI} = 7.378 + .039 = 7.417$.



NORFOLK SOUTHERN RAILWAY COMPANY

EARTH MOUND DETAIL

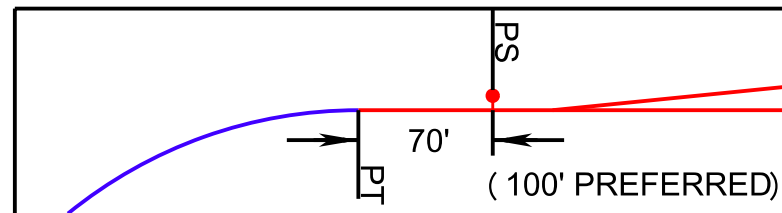
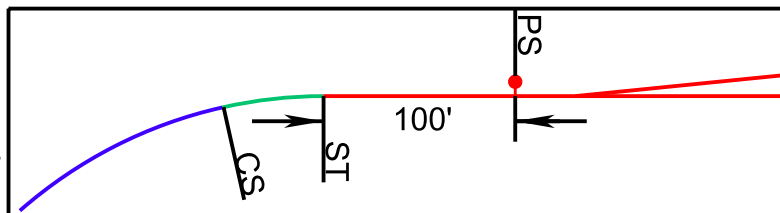
AUGUST 2000
Atlanta, Georgia

PLACEMENT OF INDUSTRY TURNOUTS

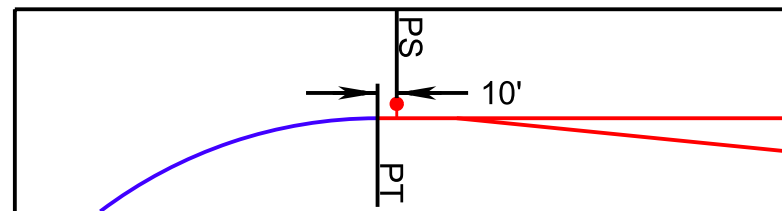
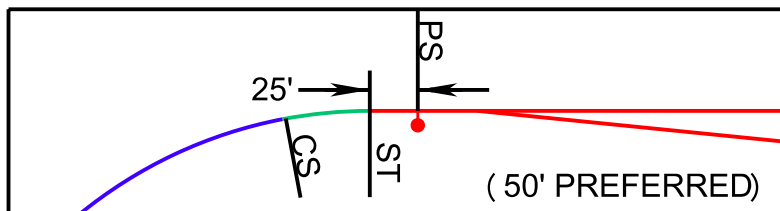
MAIN TRACKS

ALL OTHER TRACKS

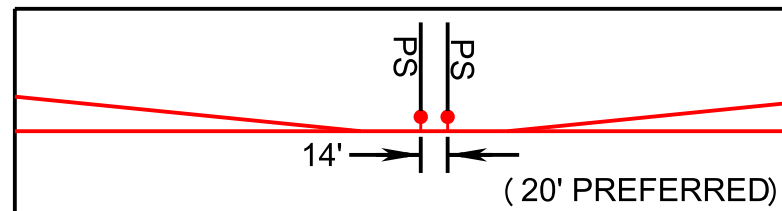
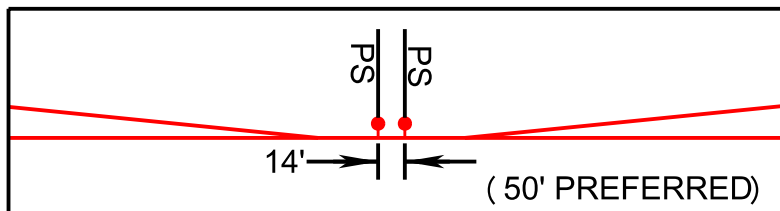
TURNOUT
ON OPPOSITE SIDE
OF PRECEDING CURVE



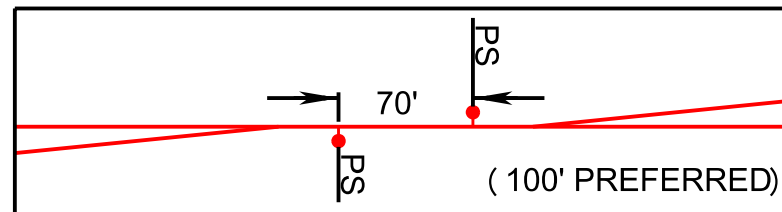
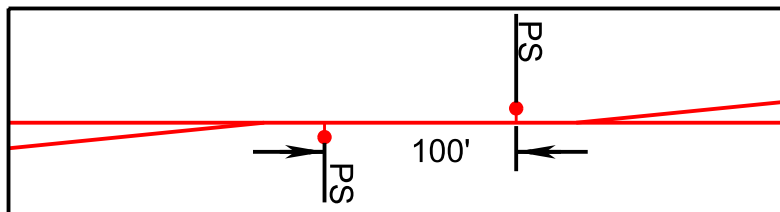
TURNOUT
ON SAME SIDE
AS PRECEDING CURVE



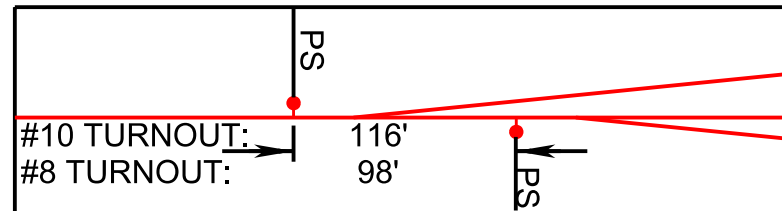
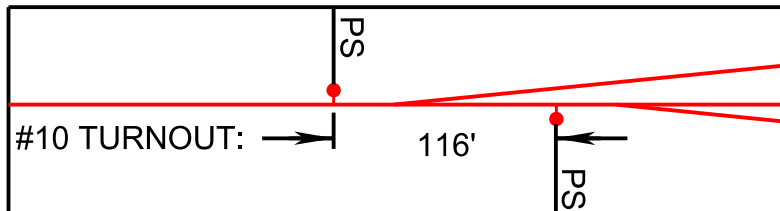
FACING TURNOUTS
ON THE SAME SIDE



FACING TURNOUTS
ON OPPOSITE SIDES



TURNOUTS ONE
BEHIND THE OTHER
OPPOSITE SIDE



TURNOUTS ONE
BEHIND THE OTHER
SAME SIDE

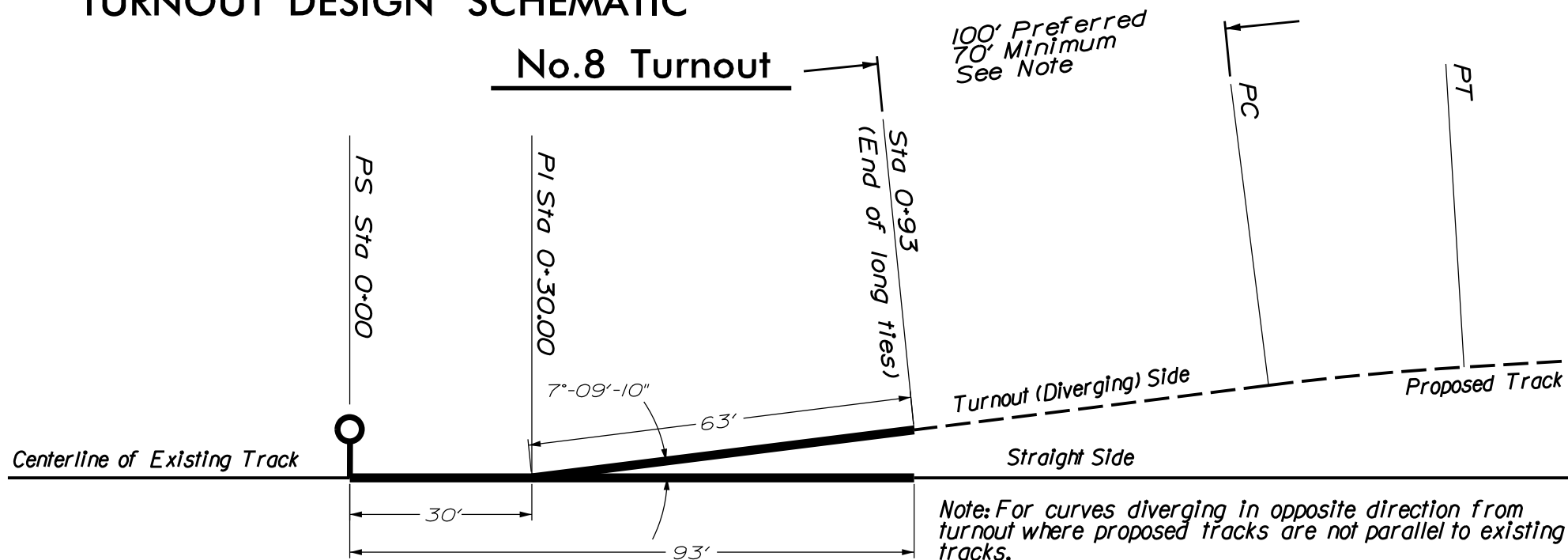


NOTE: DISTANCES SHOWN ARE MINIMUMS

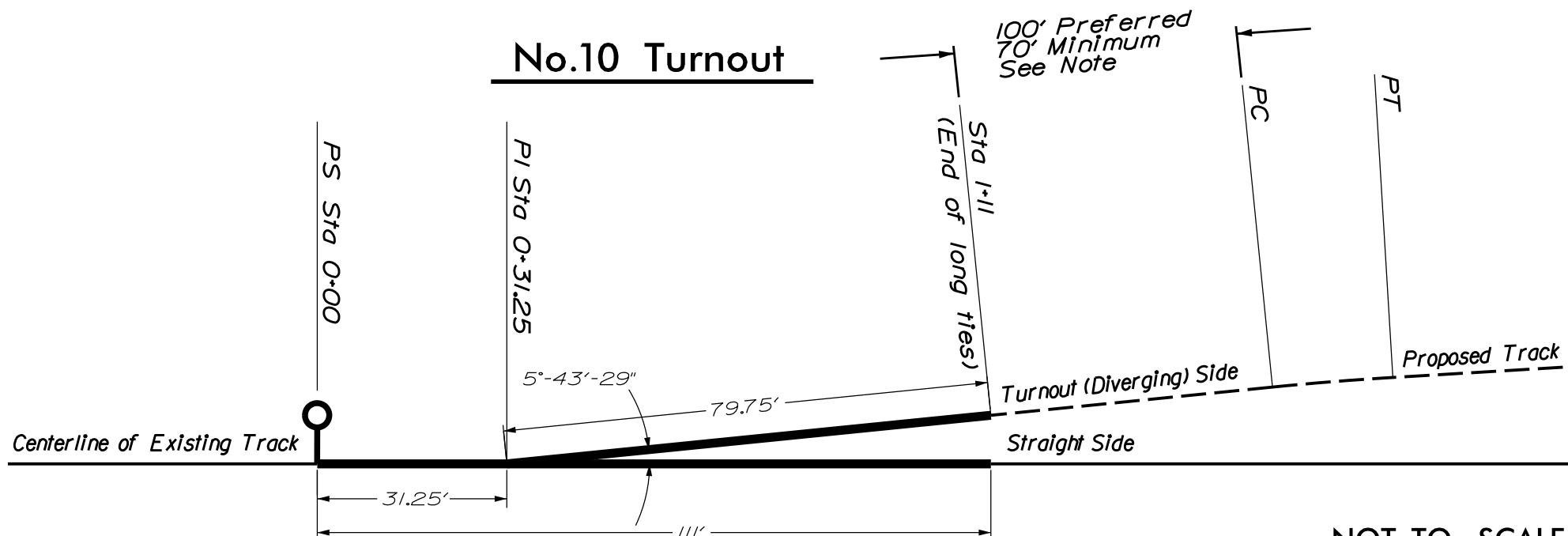
NORFOLK SOUTHERN RAILWAY CO. TURNOUT DESIGN SCHEMATIC

DETAIL

No.8 Turnout



No.10 Turnout

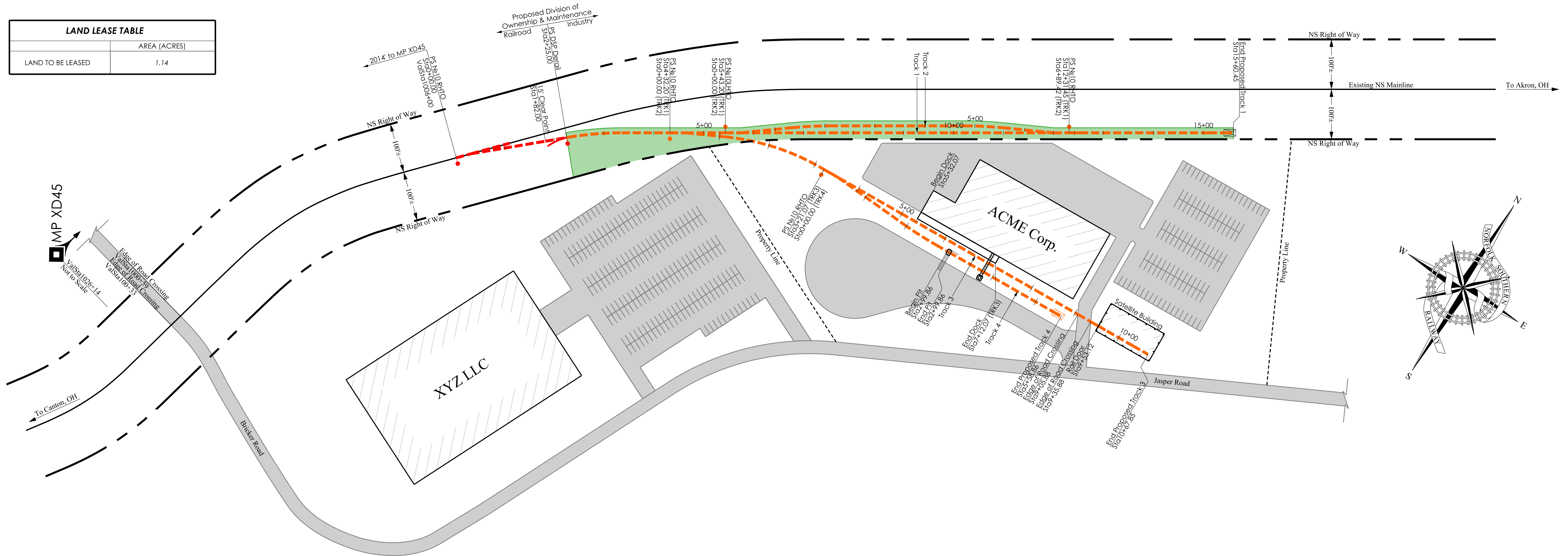


NOT TO SCALE

TRACK LEASE TABLE				COORDINATE SYSTEM = UTM83-17F / OH83 NF			
	TRACK #1		TRACK #2		TRACK #3		LEASE SUMMARY
BEGIN LEASE	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	
	N/A	N/A	N/A	N/A	N/A	N/A	
END LEASE	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	
	N/A	N/A	N/A	N/A	N/A	N/A	
LEASE LENGTH	N/A		N/A		N/A		N/A

SIDE TRACK AGREEMENT TABLE				COORDINATE SYSTEM = UTM83-17F / OH83 NF				
BEGIN TRACK	TRACK #1		TRACK #2		TRACK #3		TRACK #4	
	STATION				STATION		STATION	
	0+00				0+00		0+00	
DIVISION OF OWNERSHIP & MAINTENANCE	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES
	2+25	-81.602277, 40.895395						
END TRACK	STATION				STATION		STATION	
	15+60.45		6+89.42		10+67.85		5+58.86	
CLEAR TRACK CAPACITY	550 TF				300 TF		240 TF	

LAND LEASE TABLE	
	AREA (ACRES)
LAND TO BE LEASED	1.14



1289 Brookwood Park Drive Akron, Ohio 44322 The office of John Doe, PE
Drawing Number: 02387 Drawing Date: 05/15/2020 Customer: ACME Corp. Project Location: Canal Fulton, OH

☐ PLAN PREPARED BY OUTSIDE PARTY - SUBMITTED TO NS D&C FOR REVIEW.
☐ PLAN PREPARED BY NS D&C USING INFORMATION PROVIDED BY OTHERS.
☐ PRELIMINARY PLAN - APPROVED BY NS TRANSPORTATION CO. 04/01/2020
☐ APPROVED PLAN - ACCEPTED FOR CONSTRUCTION BY NS D&C ON:



NORFOLK SOUTHERN

NORFOLK SOUTHERN RAILWAY CO.

CHIEF ENGINEER

DEARBORN DIVISION

OPERATING DIVISION

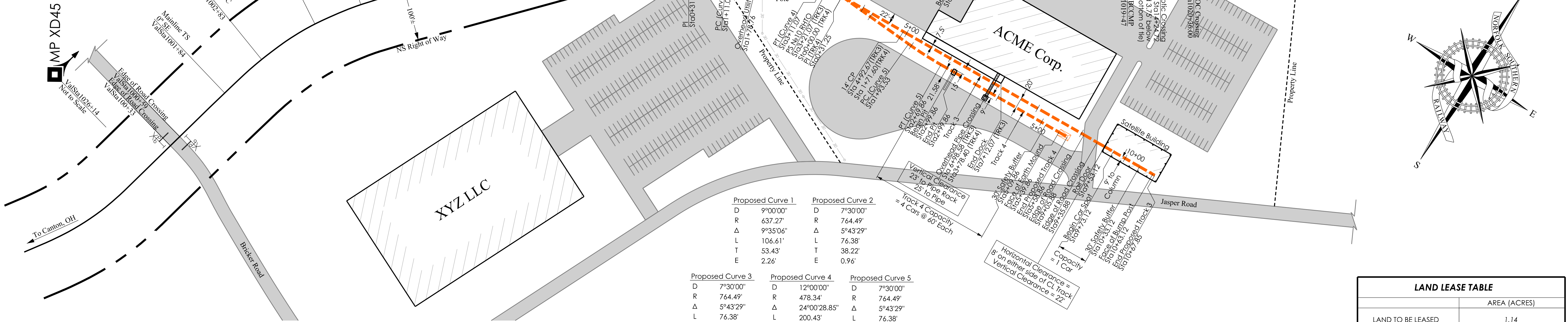
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA

REV.	BY	DATE	DESCRIPTION
REVIEWED BY	TMH		LOCATION CANAL FULTON, OH
PROJ#	ID24613	TITLE	PROPOSED TRACK TO SERVE ACME CORP. AGREEMENT PLAN
DRN	10385	DATE	05/15/2020
VAL SEC / WAP	17 OH / 23	FILE	TRK0103594
MILE POST	XD45.38	DATE	05/15/2020

DRAWING NUMBER
AD-2020-58A

Legend

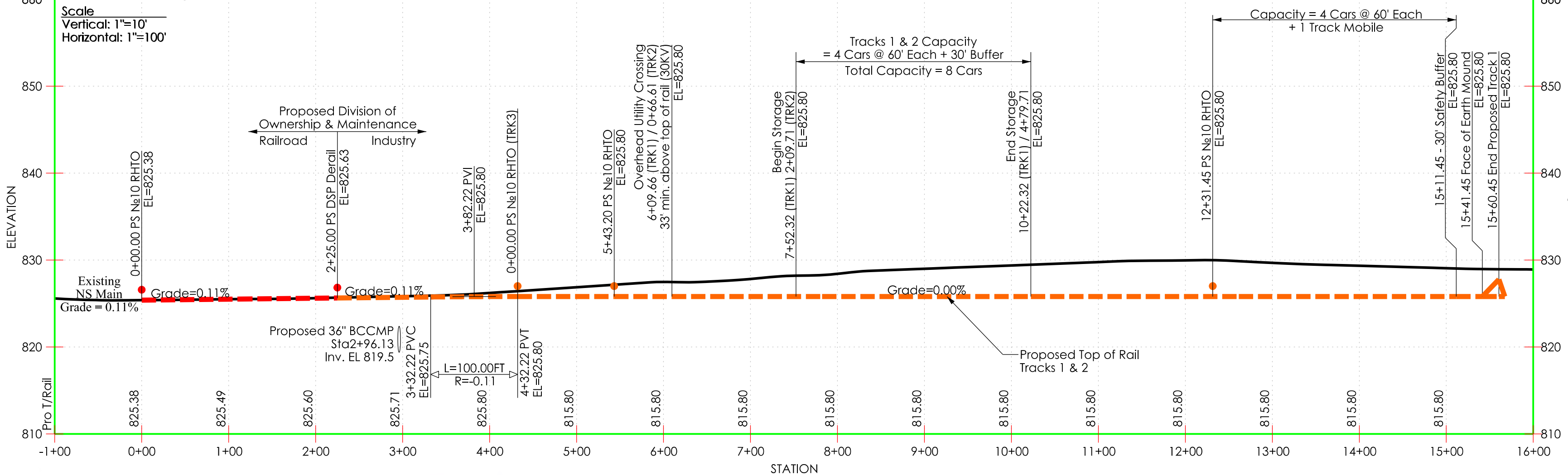
Existing NS Track	—
Existing Industry Track	—
Proposed NS Track	- - -
Proposed Industry Track	- - -
Track to be Removed	- - -
Ex. Property Line	- - -
Ex. NS ROW	- - -
Ex. Overhead Wire	- - -
Ex. Fiber Optic Cable	- - -
Ex. Pavement or Concrete	■
Ex. Buildings	■
Lease of ROW	■



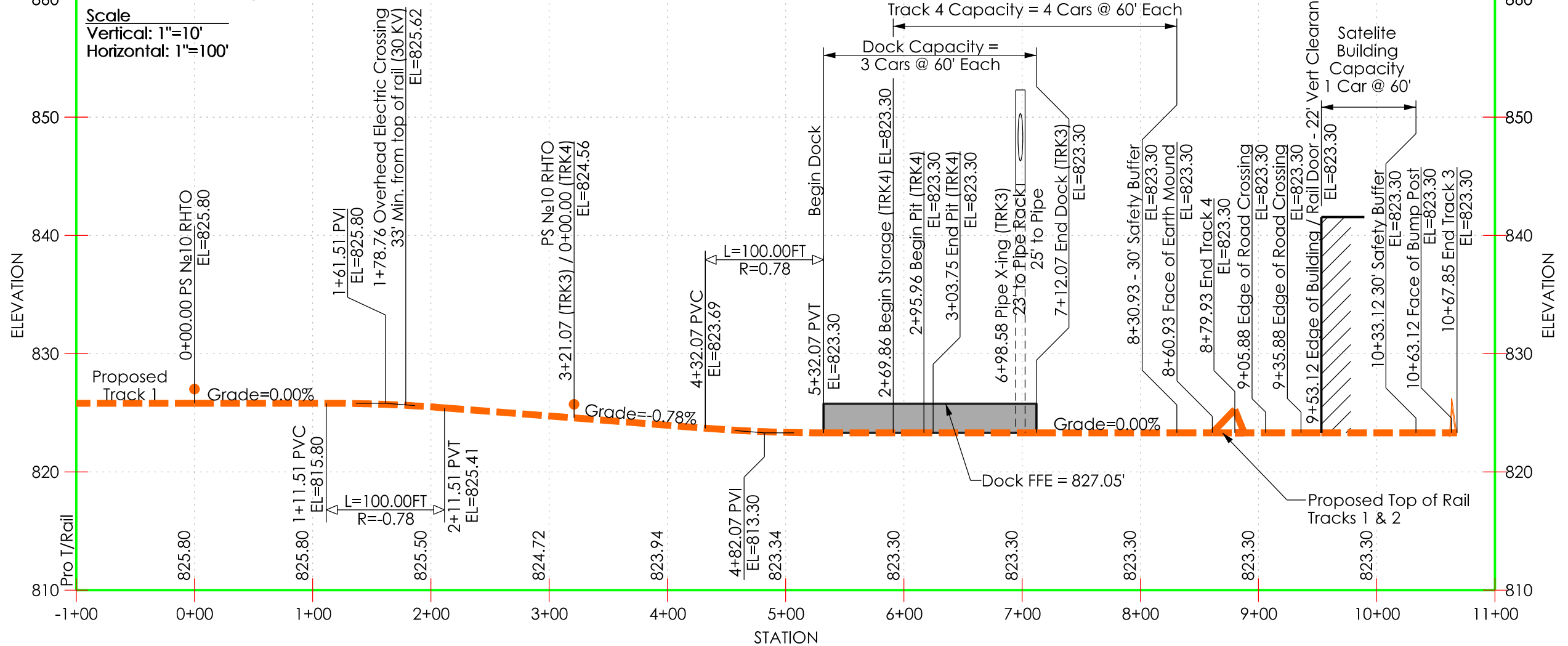
Proposed Curve 1		Proposed Curve 2		Proposed Curve 3		Proposed Curve 4		Proposed Curve 5	
D	9°00'00"	D	7°30'00"	D	7°30'00"	D	12°00'00"	D	7°30'00"
R	637.27'	R	764.49'	R	764.49'	R	478.34'	R	764.49'
Δ	9°35'06"	Δ	5°43'29"	Δ	5°43'29"	Δ	24°00'28.85"	Δ	5°43'29"
L	106.61'	L	76.38'	L	76.38'	L	200.43'	L	76.38'
T	53.43'	T	38.22'	T	38.22'	T	101.71'	T	38.22'
E	2.26'	E	0.96'	E	0.96'	E	10.69'	E	0.96'

LAND LEASE TABLE	
	AREA (ACRES)
LAND TO BE LEASED	1.14

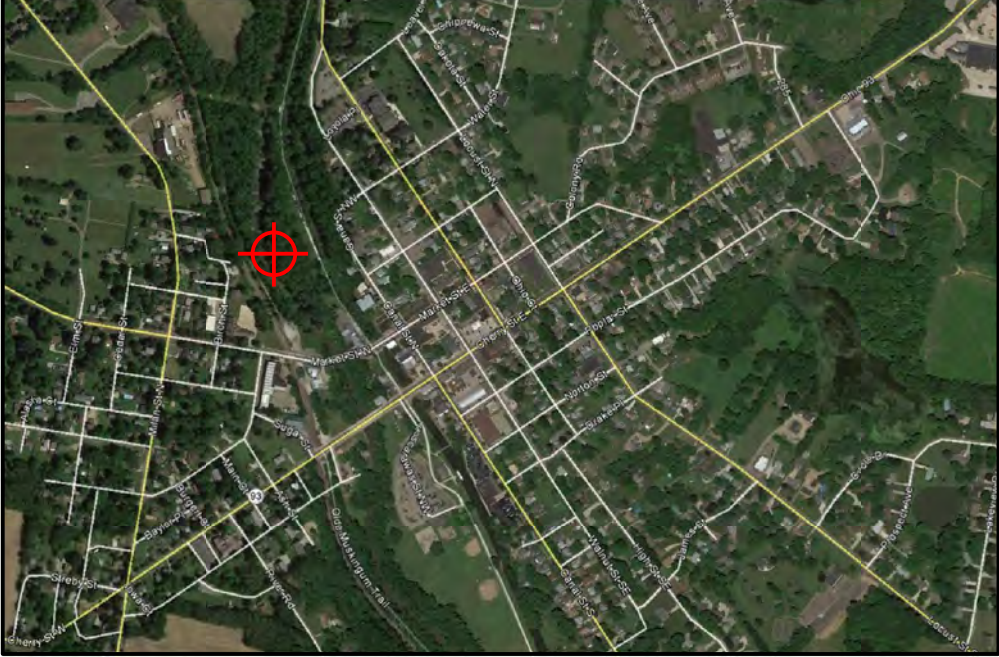
Profile - Proposed Tracks 1 & 2



Profile - Proposed Tracks 3 & 4



Location Map



Notes

- Grading, drainage and placement of sub-ballast for the entire project to be performed by the applicant at their expense.
- Proposed drainage structures to be extended and/or installed must meet A.R.E.M.A. Part 5 Specifications and be of sufficient length to comply with NS standards.
- Existing and/or proposed utilities are to be relocated, adjusted and/or protected by the applicant at their expense and must meet NS minimum clearance standards.
- Clearances to existing or proposed structures must adhere to NS standard plans 7-1 and SP-1621.
- Detail plans of the proposed loading and/or unloading facilities, including horizontal and vertical clearances, are to be approved by the railway before construction.
- All plans for unloading/loading structures, extensions of railway drainage structures, or retention ponds which empty into railway drainage structures must be approved by the NS Bridge and Structures Department prior to any construction.
- Bonding of tracks (if required) shall adhere to NS standard plan SP-701.
- A bow handled throw is required for all switches.
- This plan was not prepared or intended for use as a real estate title map.
- Valuation stationing based on existing NS Culvert (ValSta1019+47)
- Track plan based on Xenos Rail Consulting survey (January 14th, 2017)
- Tie and rail at clear points without a derrick are to be painted fluorescent green.

Critical PTC Coordinates

Location	Y (N)	X (E)	Latitude	Longitude
Mainline Switch	568974.844	2240679.483	40.895809	-81.602202
DSP Derail	569125.449	2240846.465	40.895395	-81.602277
End Track 1	569834.478	2241977.663	40.894730	-81.601880
End Track 3	569340.566	2242065.179	40.895273	-81.603211
End Track 4	569366.933	2241877.158	40.895765	-81.602084

Operations

Car Type	Car Size	Commodity	Loading/Unloading
Box Car	60'	Food Products	NS will bring full cars and spot them directly on track 3, or store them on tracks 1 & 2 to later be switched by the industry. Dock and satellite building will be used to unload.
Hopper	60'	Grain	NS will bring full cars and spot them directly on Track 4, or store them on tracks 1 & 2 to later be switched by the industry. A rail pit will be used to unload.

Control Points (NAD83 OH N)

Point Number	North	East	Elevation	Description
1	568015.576	2241789.567	936.025	Rebar w/ cap
2	569304.326	2241365.784	938.158	PK Nail in file
3	567814.387	2240684.364	935.741	Rebar w/ cap
4	569457.628	2240876.124	929.189	Rebar w/ cap
5	568749.842	2240012.389	932.267	Rebar w/ cap
6	570841.856	2241361.589	940.325	Monument Found
159	571375.986	2240786.819	928.249	

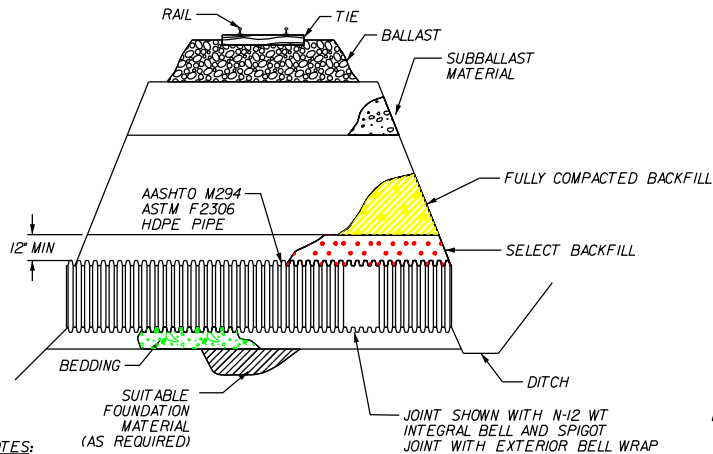
SCALE: 1"=100'



1289 Brookwood Park Drive
Akron, Ohio 44322
The office of John Doe, PE
Drawing Number: 02387
Drawing Date: 05/15/2020
Customer: ACME Corp.
Project Location: Canal Fulton, OH

PLAN PREPARED BY OUTSIDE PARTY - SUBMITTED TO NS D&C FOR REVIEW.	
PLAN PREPARED BY NS D&C USING INFORMATION PROVIDED BY OTHERS.	
PRELIMINARY PLAN - APPROVED BY NS TRANSPORTATION ON: 04/01/2020	
APPROVED PLAN - ACCEPTED FOR CONSTRUCTION BY NS D&C ON:	
NS NORFOLK SOUTHERN	
NORFOLK SOUTHERN RAILWAY CO.	
OWNING COMPANY	
DEARBORN DIVISION	
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA	
REV	BY DATE DESCRIPTION
1	TMH
2	TMH
3	TMH
4	TMH
5	TMH
6	TMH
7	TMH
8	TMH
9	TMH
10	TMH
11	TMH
12	TMH
13	TMH
14	TMH
15	TMH
16	TMH
17	TMH
18	TMH
19	TMH
20	TMH
21	TMH
22	TMH
23	TMH
24	TMH
25	TMH
26	TMH
27	TMH
28	TMH
29	TMH
30	TMH
31	TMH
32	TMH
33	TMH
34	TMH
35	TMH
36	TMH
37	TMH
38	TMH
39	TMH
40	TMH
41	TMH
42	TMH
43	TMH
44	TMH
45	TMH
46	TMH
47	TMH
48	TMH
49	TMH
50	TMH
51	TMH
52	TMH
53	TMH
54	TMH
55	TMH
56	TMH
57	TMH
58	TMH
59	TMH
60	TMH
61	TMH
62	TMH
63	TMH
64	TMH
65	TMH
66	TMH
67	TMH
68	TMH
69	TMH
70	TMH
71	TMH
72	TMH
73	TMH
74	TMH
75	TMH
76	TMH
77	TMH
78	TMH
79	TMH
80	TMH
81	TMH
82	TMH
83	TMH
84	TMH
85	TMH
86	TMH
87	TMH
88	TMH
89	TMH
90	TMH
91	TMH
92	TMH
93	TMH
94	TMH
95	TMH
96	TMH
97	TMH
98	TMH
99	TMH
100	TMH

UNDER PROPOSED TRACK



NOTES:

1. ALL PIPE SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D2321, "STANDARD PRACTICE FOR UNDERGROUND INSTALLATION OF THERMOPLASTIC PIPE FOR SEWERS AND OTHER GRAVITY FLOW APPLICATIONS", LATEST EDITION

2. MEASURES SHOULD BE TAKEN TO PREVENT MIGRATION OF NATIVE FINES INTO OPEN GRADED MATERIAL.

3. FOUNDATION: WHERE THE TRENCH BOTTOM IS UNSTABLE, THE CONTRACTOR SHALL EXCAVATE UNSUITABLE MATERIAL TO THE REQUIRED DEPTH AND REPLACE WITH SUITABLE MATERIAL AS SPECIFIED BY THE DESIGN ENGINEER. DEPTH OF FOUNDATION IMPROVEMENT MAY BE REDUCED BY USE OF GEOTEXTILE FABRIC AND GRID. REQUIRED TRENCH WIDTH MAY INCREASE WHEN FOUNDATION MATERIALS ARE MODIFIED.

4. BEDDING: BEDDING MATERIAL SHALL CONFORM TO CATEGORY B DENSE GRADED AGGREGATE IN ACCORDANCE WITH SECTION GA - GRADED AGGREGATE OF THE NS STANDARD SPECIFICATIONS UNLESS STATED OTHERWISE BY THE DESIGN ENGINEER OR PLANS. MINIMUM BEDDING THICKNESS SHALL NOT BE LESS THAN 12 INCHES. THE MIDDLE THIRD OF THE BEDDING SHALL BE LOOSE AND UNIFORM IN DEPTH AND CONSISTENCY. AFTER PIPE IS IN PLACE, COMPACT BEDDING TO SELECT BACKFILL STANDARDS. BEDDING SHALL BE COMPACTED TO A DENSITY OF NOT LESS THAN 95 PERCENT IN ACCORDANCE WITH AASHTO T 99.

5. SELECT BACKFILL: SELECT BACKFILL MATERIAL SHALL CONFORM TO CATEGORY B DENSE GRADED AGGREGATE IN ACCORDANCE WITH SECTION GA - GRADED AGGREGATE OF THE NS STANDARD SPECIFICATIONS UNLESS STATED OTHERWISE BY THE DESIGN ENGINEER OR PLANS. MINIMUM COMPACTION SHALL BE TO A DENSITY OF NOT LESS THAN 95 PERCENT IN ACCORDANCE WITH AASHTO T 99. BACKFILL MATERIAL SHALL BE PLACED ALONGSIDE THE PIPE IN UNIFORM LAYERS AND COMPACTED. WHEN VIBRATORY COMPACTION EQUIPMENT IS USED IN CONJUNCTION WITH OTHER METHODS OF COMPACTION, THE COMPACTED DEPTH OF A SINGLE LAYER OF BEDDING MATERIAL SHALL NOT EXCEED 6 INCHES (6-9 INCHES LOOSE). WHEN NO VIBRATORY COMPACTION EQUIPMENT IS USED, THE MAXIMUM COMPACTED THICKNESS OF ONE LAYER SHALL NOT EXCEED 3 INCHES (3-6 INCHES LOOSE). IF A HAND TAMPER IS USED, IT SHALL WEIGH NOT LESS THAN 20 POUNDS AND HAVE A TAMPING FACE NOT LESS THAN 6 INCHES X 6 INCHES.

6. THE CONTRACTOR SHOULD PROVIDE DOCUMENTATION FOR MATERIAL SPECIFICATIONS TO DESIGN ENGINEER. WHERE BACKFILL VERIFICATION IS NOT PROVIDED OR WHERE BACKFILL MAY BECOME SATURATED AFTER PLACEMENT, ONLY ASTM CLASS I OR II (CLEAN) BEDDING AND BACKFILL SHOULD BE USED.

7. BEDDING MATERIAL SHALL BE PLACED AND COMPACTED UNDER THE HAUNCHES OF THE PIPE EXTENDING FROM THE BOTTOM OF PIPE UP TO A DISTANCE EQUAL TO 1/3 OF THE PIPE'S DIAMETER UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

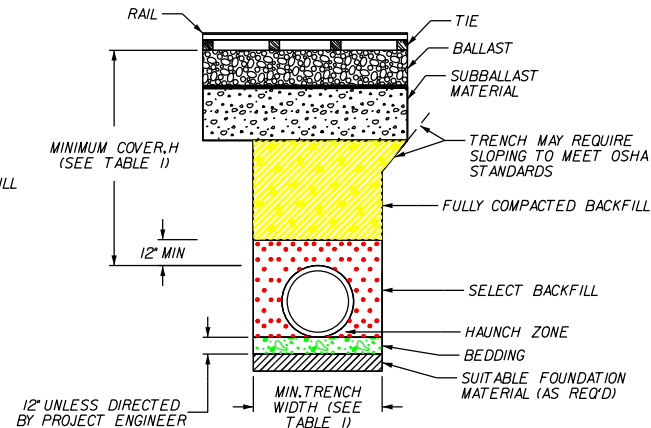
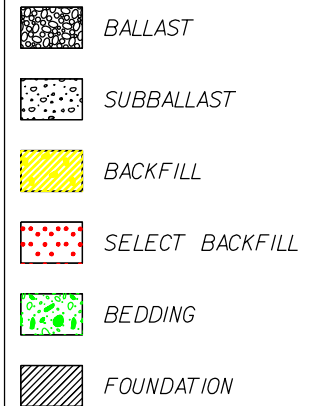


TABLE 1
RECOMMENDED MINIMUM TRENCH WIDTHS,
MIN. COVER ^{1,2,3,4,5} AND MAX. COVER ^{1,2,3,4,5}

PIPE DIA.	MIN. TRENCH WIDTH	MINIMUM COVER	MAX. COVER CLASS I	MAX. COVER CLASS II
12"	30"	2'	25'	20'
15"	34"	2'	25'	20'
18"	39"	2'	25'	20'
24"	48"	2'	25'	20'
30"	56"	3'	25'	15'
36"	64"	3'	25'	15'
42"	72"	4'	25'	15'
48"	80"	4'	25'	15'
54"	88"	4'	25'	15'
60"	96"	4'	25'	15'

- COVER IS MEASURED FROM TOP OF PIPE TO BOTTOM OF RAILWAY TIE.
- LOADS GREATER THAN E-80 LOAD MAY REQUIRE ADDITIONAL COVER.
- MINIMUM COVER MAY BE INCREASED TO PREVENT PIPE DAMAGE DUE TO ROUTINE TRACK MAINTENANCE.
- MANUFACTURER NEEDS TO VERIFY ALLOWABLE FILL HEIGHTS PER DESIGN LOADS.
- FILL HEIGHT CALCULATIONS DO NOT TAKE IN TO CONSIDERATION GROUND WATER. WHERE GROUND WATER IS ENCOUNTERED HAVE THE MANUFACTURER VERIFY FILL HEIGHTS.



SCALE: NTS

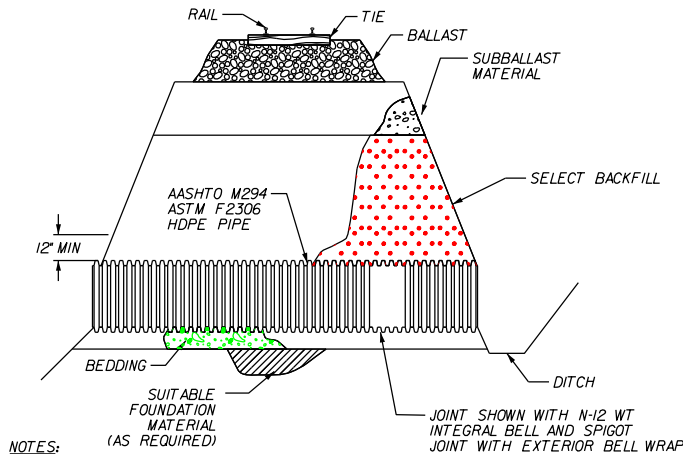
DO NOT SCALE THIS DRAWING FOR DIMENSIONS NOT GIVEN



REV	BY	DATE	DESCRIPTION
LOCATION			
SYSTEMWIDE			
TITLE HDPE PIPE TYPICAL TRENCH DETAIL PROPOSED TRACK APPLICATIONS			
DGN	PID No.	VRN	MILE POST
DWN	FILE No.	DRAWING NUMBER	
CHK	DATE	APRIL 18, 2017	
		DR-HDPE-1	

CADD FILE:

UNDER EXISTING TRACK



NOTES:

1. ALL PIPE SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D2321, "STANDARD PRACTICE FOR UNDERGROUND INSTALLATION OF THERMOPLASTIC PIPE FOR SEWERS AND OTHER GRAVITY FLOW APPLICATIONS", LATEST EDITION

2. MEASURES SHOULD BE TAKEN TO PREVENT MIGRATION OF NATIVE FINES INTO OPEN GRADED MATERIAL.

3. FOUNDATION: WHERE THE TRENCH BOTTOM IS UNSTABLE, THE CONTRACTOR SHALL EXCAVATE UNSUITABLE MATERIAL TO THE REQUIRED DEPTH AND REPLACE WITH SUITABLE MATERIAL AS SPECIFIED BY THE DESIGN ENGINEER. DEPTH OF FOUNDATION IMPROVEMENT MAY BE REDUCED BY USE OF GEOTEXTILE FABRIC AND GRID. REQUIRED TRENCH WIDTH MAY INCREASE WHEN FOUNDATION MATERIALS ARE MODIFIED.

4. BEDDING: BEDDING MATERIAL SHALL CONFORM TO CATEGORY B DENSE GRADED AGGREGATE IN ACCORDANCE WITH SECTION GA - GRADED AGGREGATE OF THE NS STANDARD SPECIFICATIONS UNLESS STATED OTHERWISE BY THE DESIGN ENGINEER OR PLANS. MINIMUM BEDDING THICKNESS SHALL NOT BE LESS THAN 12 INCHES. THE MIDDLE THIRD OF THE BEDDING SHALL BE LOOSE AND UNIFORM IN DEPTH AND CONSISTENCY. AFTER PIPE IS IN PLACE, COMPACT BEDDING TO SELECT BACKFILL STANDARDS. BEDDING SHALL BE COMPACTED TO A DENSITY OF NOT LESS THAN 95 PERCENT IN ACCORDANCE WITH AASHTO T 99.

5. SELECT BACKFILL: SELECT BACKFILL MATERIAL SHALL CONFORM TO CATEGORY B DENSE GRADED AGGREGATE IN ACCORDANCE WITH SECTION GA - GRADED AGGREGATE OF THE NS STANDARD SPECIFICATIONS UNLESS STATED OTHERWISE BY THE DESIGN ENGINEER OR PLANS. MINIMUM COMPACTION SHALL BE TO A DENSITY OF NOT LESS THAN 95 PERCENT IN ACCORDANCE WITH AASHTO T 99. BACKFILL MATERIAL SHALL BE PLACED ALONGSIDE THE PIPE IN UNIFORM LAYERS AND COMPACTED. WHEN VIBRATORY COMPACTION EQUIPMENT IS USED IN CONJUNCTION WITH OTHER METHODS OF COMPACTION, THE COMPACTED DEPTH OF A SINGLE LAYER OF BEDDING MATERIAL SHALL NOT EXCEED 6 INCHES (6-9 INCHES LOOSE). WHEN NO VIBRATORY COMPACTION EQUIPMENT IS USED, THE MAXIMUM COMPACTED THICKNESS OF ONE LAYER SHALL NOT EXCEED 3 INCHES (3-6 INCHES LOOSE). IF A HAND TAMPER IS USED, IT SHALL WEIGH NOT LESS THAN 20 POUNDS AND HAVE A TAMPING FACE NOT LESS THAN 6 INCHES X 6 INCHES.

6. THE CONTRACTOR SHOULD PROVIDE DOCUMENTATION FOR MATERIAL SPECIFICATIONS TO DESIGN ENGINEER. WHERE BACKFILL VERIFICATION IS NOT PROVIDED OR WHERE BACKFILL MAY BECOME SATURATED AFTER PLACEMENT, ONLY ASTM CLASS 1 OR II (CLEAN) BEDDING AND BACKFILL SHOULD BE USED.

7. BEDDING MATERIAL SHALL BE PLACED AND COMPACTED UNDER THE HAUNCHES OF THE PIPE EXTENDING FROM THE BOTTOM OF PIPE UP TO A DISTANCE EQUAL TO 1/3 OF THE PIPE'S DIAMETER UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

SCALE: NTS

DO NOT SCALE THIS DRAWING FOR DIMENSIONS NOT GIVEN

NORFOLK SOUTHERN

NORFOLK SOUTHERN RAILWAY COMPANY

OWNING COMPANY

SYSTEMWIDE

OPERATING DIVISION

OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

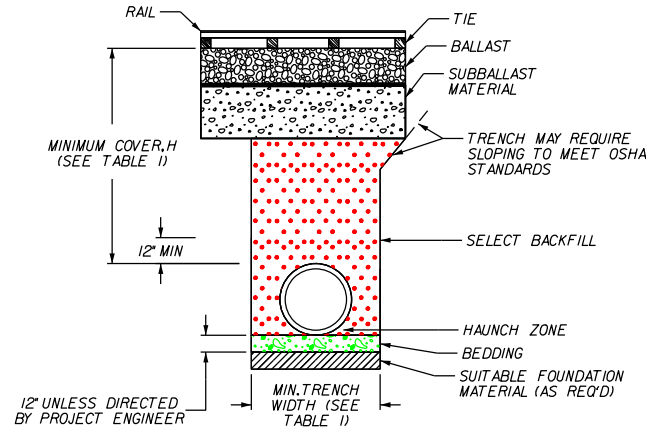


TABLE 1
RECOMMENDED MINIMUM TRENCH WIDTHS,
MIN. COVER ^{1,2,3,4,5} AND MAX. COVER ^{1,2,3,4,5}

PIPE DIA.	MIN. TRENCH WIDTH	MINIMUM COVER	MAX. COVER CLASS I	MAX. COVER CLASS II
12"	30"	2'	25'	20'
15"	34"	2'	25'	20'
18"	39"	2'	25'	20'
24"	48"	2'	25'	20'
30"	56"	3'	25'	15'
36"	64"	3'	25'	15'
42"	72"	4'	25'	15'
48"	80"	4'	25'	15'
54"	88"	4'	25'	15'
60"	96"	4'	25'	15'

- COVER IS MEASURED FROM TOP OF PIPE TO BOTTOM OF RAILWAY TIE.
- LOADS GREATER THAN E-80 LOAD MAY REQUIRE ADDITIONAL COVER.
- MINIMUM COVER MAY BE INCREASED TO PREVENT PIPE DAMAGE DUE TO ROUTINE TRACK MAINTENANCE.
- MANUFACTURER NEEDS TO VERIFY ALLOWABLE FILL HEIGHTS PER DESIGN LOADS.
- FILL HEIGHT CALCULATIONS DO NOT TAKE IN TO CONSIDERATION GROUND WATER. WHERE GROUND WATER IS ENCOUNTERED HAVE THE MANUFACTURER VERIFY FILL HEIGHTS.

LEGEND

- BALLAST
- SUBBALLAST
- SELECT BACKFILL
- BEDDING
- FOUNDATION

REV	BY	DATE	DESCRIPTION
LOCATION			
SYSTEMWIDE			
TITLE			
HDPE PIPE TYPICAL TRENCH DETAIL EXISTING TRACK APPLICATIONS			
DGN	PID No.	VRN	MILE POST
DWN	FILE No.	DRAWING NUMBER	
CHK	DATE	APRIL 18, 2017	
		DR-HDPE-2	

CADD FILE:

SHEET 1 OF 1

CORRUGATED METAL CULVERT GAGE SELECTION AND INSTALLATION UNDER NS-OWNED TRACKS

CORRUGATED METAL PIPE GAGE TABLE FOR 2 2/3" X 1/2" CORRUGATIONS											
AREA (SQ.FT.)	DIA. (IN.)	HEIGHT OF COVER (FEET)									
		1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
1.8	18										
2.4	21									10	10
3.1	24								10	10	10
4.9	30					10	10	10	8	8	8
7.1	36				10	8	8	8	8	8	8
9.6	42			10	8	8					
12.6	48										
13.9	54										
19.6	60										
23.8	66										
28.3	72										

12 GAGE

USE ELONGATED CORRUGATED
METAL PIPE FOR THESE
TABULAR VALUES

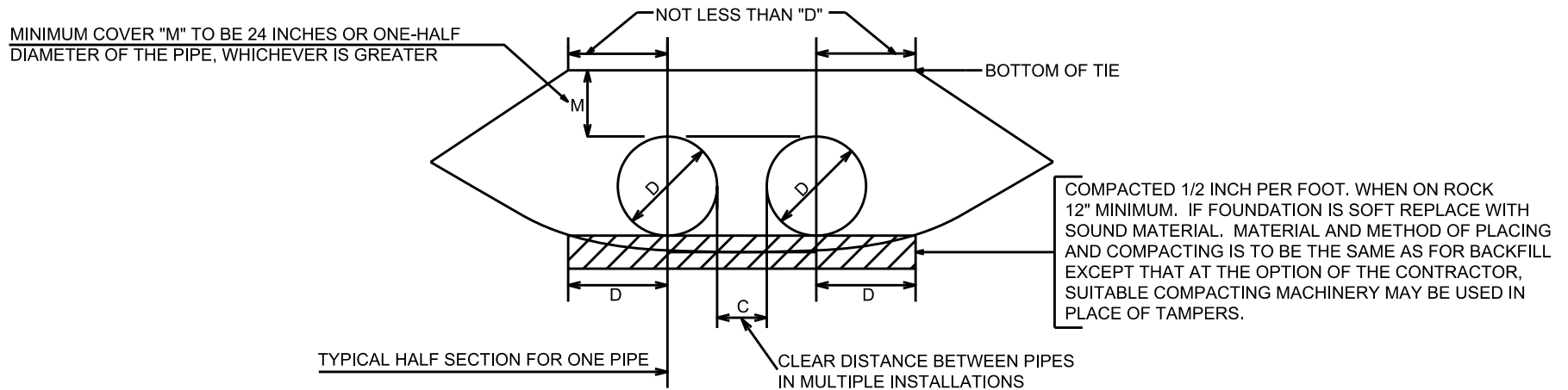
ELONGATED CORRUGATED METAL PIPE GAGE TABLE FOR 2 2/3" X 1/2" CORRUGATIONS											
DIA. (IN.)	HEIGHT OF COVER (FEET)										
	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	
18											
21											
24											
30											
36											
42											
48	10	10	8	8	8	8	8	8	8	8	
54	8	8	8	8	8	8	8	8			
60	8	8	8	8	8						
66	8	8	8								
72	8	8									

USE ROUND CORRUGATED METAL
PIPE FOR THESE TABULAR VALUES

NOTES

1. **MINIMUM DIAMETER** : TO BE 36" UNLESS APPROVED BY BRIDGE OFFICE.
2. **MATERIAL** : TO BE GALVANIZED STEEL, ASTM A760 TYPE 1 PIPE, WITH 2 2/3" X 1/2" ANNULAR CORRUGATION.
3. **COATING** : PIPE AND BANDS TO BE FULLY ASPHALT COATED, CONFORMING TO AASHTO M190 TYPE A.
4. **CONNECTING BANDS** : MAY BE ONE GAGE LIGHTER THAN CULVERT MATERIAL. ALL BANDS UNDER COMPANY OWNED TRACKS ARE TO BE ONE PIECE, TWO FEET WIDE. CULVERTS 48" DIAMETER AND LARGER TO USE TWO FOOT BAND WITH FOUR - 1/2" DIAMETER RODS AND SILO LUGS.
5. **INSTALLATION** : WHERE CULVERTS ARE INSTALLED IN OPEN CUT TO REPLACE FAILED CULVERTS, BEDDING AND BACKFILL TO BE DENSE GRADED AGGREGATE.
6. **ELONGATED PIPE** : SHALL NOT HAVE LESS THAN 5% VERTICAL ELONGATION. ELONGATED PIPE 42" IN DIAMETER AND LARGER SHALL BE SHOP WIRE STRUTTED.
7. **EXCEPTIONS** : THE GAGE TABLES ARE TO PROVIDE ADEQUATE STRENGTH. EXCEPTIONS MUST BE CLEARED BY BRIDGE OFFICE. WHERE KNOWN CONDITIONS WILL AFFECT THE SERVICE LIFE OF THE CULVERT, ADDITIONAL GAGE REQUIREMENTS WILL BE FURNISHED BY THE BRIDGE OFFICE.
8. **MINIMUM COVER** : SHALL BE 24" OR 1/2 PIPE DIAMETER, WHICHEVER IS GREATER, AS MEASURED BETWEEN BOTTOM OF TIE AND TOP OF PIPE. EXCEPTIONS TO THIS CRITERIA WILL BE CONSIDERED ON AN INDIVIDUAL BASIS.

PLACE MATERIAL (6" LAYERS ONLY) EVENLY ON EACH SIDE OF PIPE. STONES LARGER THAN 2" SHALL NOT BE USED



DETAILS FOR BEDDING AND BACKFILLING PIPE

INSTALLATION INSTRUCTIONS FOR CORRUGATED METAL DRAINAGE STRUCTURES

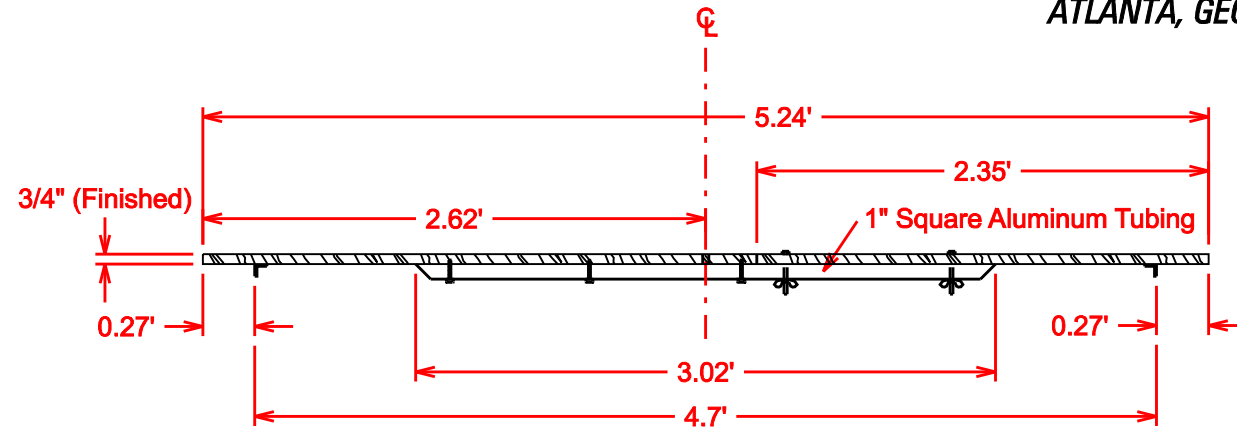
PROTECTION:	A REASONABLE AMOUNT OF CARE MUST BE TAKEN IN HANDLING CORRUGATED METAL DRAINAGE PRODUCTS TO PROTECT AGAINST CRACKING OR BREAKING THE PIPE OR DAMAGING THE GALVANIZED AND/OR OTHER COATING. HEAVY CONSTRUCTION EQUIPMENT MUST NOT BE RUN DIRECTLY OVER STRUCTURE UNTIL IT HAS BEEN BACKFILLED AND EMBANKMENT PLACED TO THE MAXIMUM HEIGHT ABOVE TOP OF PIPE AS SHOWN ON THIS DRAWING.	ASSEMBLY OF STRUCTURE:	CORRUGATED METAL PIPES MUST BE PLACED WITH INSIDE CIRCUMFERENTIAL LAPS POINTING DOWNSTREAM. THE LONGITUDINAL LAPS SHOULD BE AT THE SIDES OR QUARTER POINTS BUT NOT IN THE BOTTOM. STRUCTURAL PLATE PIPES WILL BE ASSEMBLED FROM DETAILED ERECTION INSTRUCTIONS WHICH ACCOMPANY EACH PIPE WHEN SHIPPED.
STRUTTING:	PIPES SHOWN TO BE SHOP STRUTTED WILL HAVE TWISTED WIRE OR ROD STRUTS. STRUTS SHALL BE HORIZONTAL WHEN PIPE IS PLACED.	BEDDING AND BACKFILLING:	BEDDING AND BACKFILL MATERIAL SHALL BE DENSE GRADED CRUSHED STONE MAXIMUM SIZE 2 INCHES TO DUST. BACKFILL IS TO BE PLACED IN LAYERS NOT LESS THAN 4" OR MORE THAN 6" AND COMPACTED WITH MECHANICAL TAMPERS TO NOT LESS THAN 95% MODIFIED PROCTOR. HEAVY EARTH COMPACTING EQUIPMENT SHALL NOT BE USED OVER THE PIPE UNTIL BACKFILL HAS BEEN COMPLETED AS SHOWN AND SPECIFIED ON THE PLAN. CARE MUST BE TAKEN NOT TO STRIKE THE PIPE WITH THE TAMPER.
CAMBER:	UNDER HIGH FILLS, WHERE THE FOUNDATION IS SUBJECT TO SUBSIDENCE, THE GRADE LINE WILL BE CAMBERED TO PRODUCE A STRAIGHT GRADE AFTER SUSIDENCE.	MULTIPLE LINES OF PIPE:	PIPE DIAMETERS MINIMUM CLEARANCE "C" UP TO 72" ONE HALF DIAMETER OF THE PIPE 72" TO 180" 36"
HAND TAMPED:	WHEN APPROVED BY THE ENGINEER, A HAND TAMPER SHALL WEIGH NOT LESS THAN TWENTY (20) POUNDS AND HAVE A TAMPING FACE NOT LESS THAN 6" X 6".		

NORFOLK SOUTHERN RAILWAYS

INSTALLATION INSTRUCTIONS
CORRUGATED METAL PIPE CULVERTS
REVISED 5/2/2017

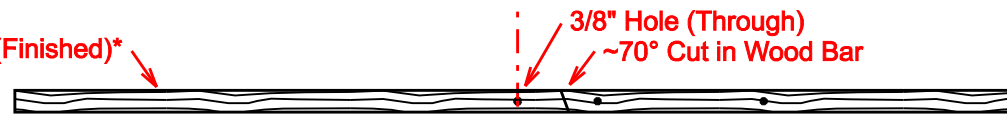
ATLANTA, GEORGIA

SIDE VIEW



TOP VIEW

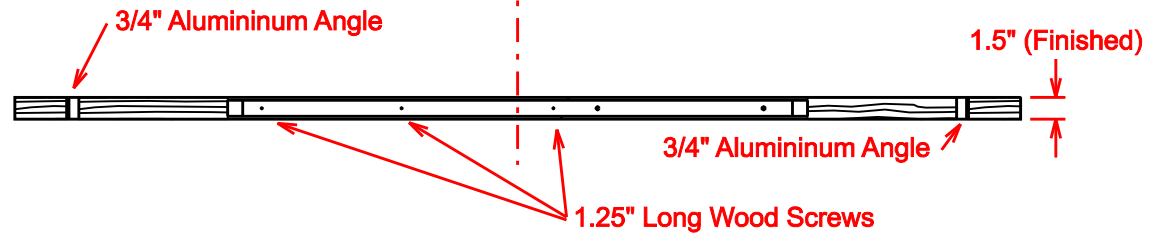
5.25' x 1 1/2" x 3/4" Wood (Finished)*



1/4" x 2" Reg. Thread Bolt w/ Wingnut

1/4" x 2" Reg. Thread Bolt w/ Wingnut

BOTTOM VIEW



*Wood type selection - Experience has shown that pine is light, but Red Oak is more durable.

SCALE: NONE



DO NOT SCALE THIS DRAWING FOR DIMENSIONS NOT GIVEN



NORFOLK SOUTHERN

OWNING COMPANY

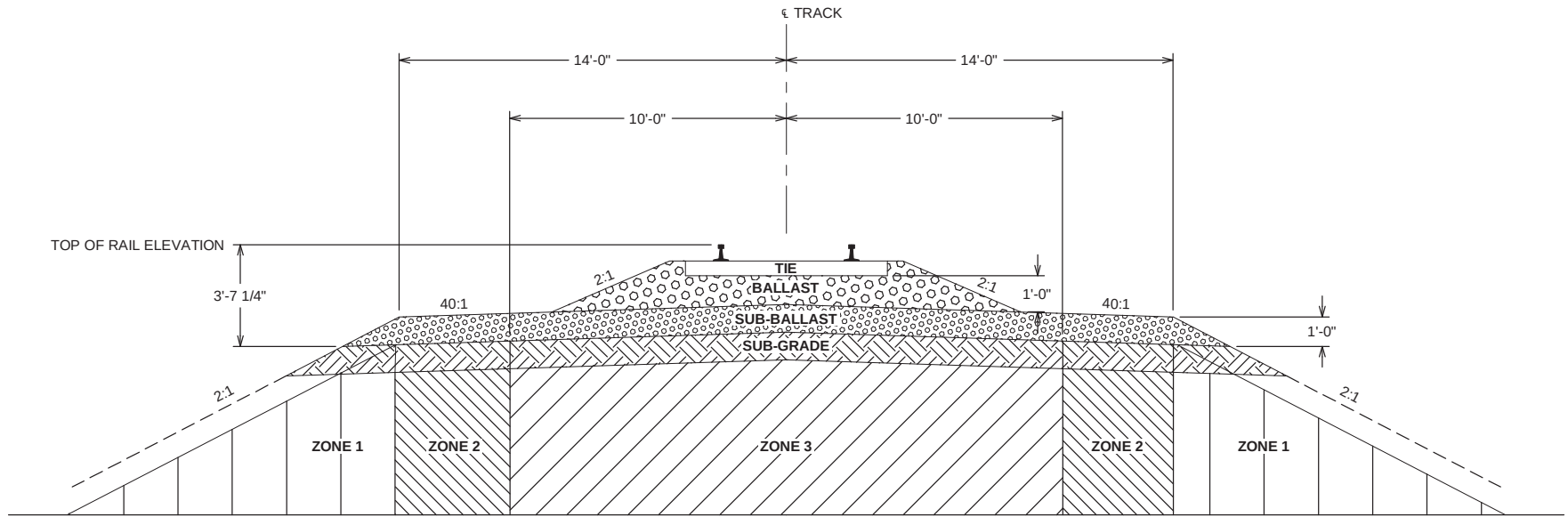
OPERATING DIVISION

OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

DESIGNED BY	JRT	DATE	3/28/05	ADDED DIMENSIONING AND MATERIAL TYPES
REVIEWED BY		DATE		DESCRIPTION
LOCATION	ATLANTA, GEORGIA			
TITLE	NON-SHUNTING TRACK SURVEY BAR			
DGN	CJF	PTD No.		VAL MAP REC. No.
DWN	AD	FILE No.		MILE POST
CHK		DATE		DRAWING NUMBER
				NONE

CADD FILE*

Filename: P:\6260400 - TECHNICAL\33 - PUBLIC PROJECTS MANUAL\STANDARD DRAWINGS\SHORING DESIGN GUIDE - SHORING REQUIREMENTS.DWG



ROADBED PROFILE - SHORING REQUIREMENTS (NTS)

- ZONE 1 EXCAVATION WITHIN ZONE 1 WILL REQUIRE SHORING FOR THE PROTECTION OF THE RAILROAD
- ZONE 2 EXCAVATION WITHIN ZONE 2 WILL REQUIRE SHORING CONSISTING OF INTERLOCKING SHEETING FOR THE PROTECTION OF THE RAILROAD
- ZONE 3 NO EXCAVATIONS WILL BE ALLOWED IN ZONE 3

NOTES:

- EXCAVATIONS OUTSIDE OF ZONE 1 MAY REQUIRE SHORING FOR SAFETY. LATERAL PRESSURES DUE TO TRAIN LOADINGS DO NOT AFFECT SHORING DESIGN OUTSIDE OF ZONE 1.
- REFER TO PUBLIC PROJECTS MANUAL APPENDIX H, SECTION H.1.6.A. (OVERHEAD BRIDGE) OR SECTION H.2.8.A (UNDERPASS BRIDGE) AND APPENDIX H FOR ADDITIONAL SHORING LOCATION REQUIREMENTS.

REVISIONS		
DATE	LTR.	DESCRIPTION
9/23/2013	1	REVISE ZONE 2 DIMENSION AND AREA
1/1/15	2	REVISED NOTE 2



NORFOLK SOUTHERN
PUBLIC PROJECTS MANUAL
TYPICAL DRAWINGS

SHORING DESIGN GUIDE
SHORING REQUIREMENTS

REF. NO.: SEC 1 - OHB - 5 - SHT 4

DATE: AUGUST 1, 2015 DRAWING NO.: 4

LATERAL PRESSURES FROM COOPERS E-80 TRAIN LOADS

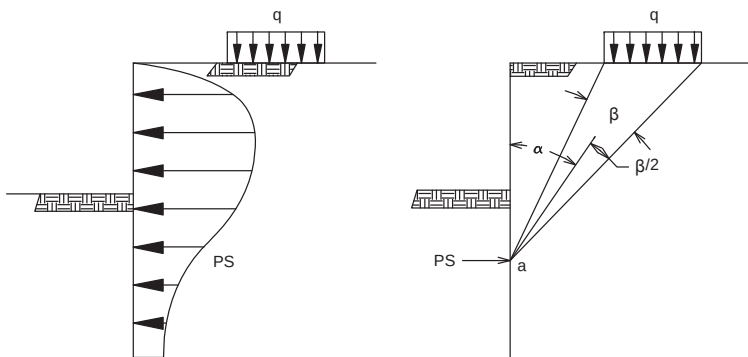
THE BOUSSINESQ EQUATION FOR STRIP LOADS IS SHOWN IN THE AREMA MANUAL FOR RAILWAY ENGINEERING, CHAPTER 8, SECTION 20.3.2.2

BOUSSINESQ EQUATION:

$$PS = (2q/\pi) * (\beta - (\sin(\beta) * \cos(2\alpha)))$$

WHERE:

- PS = ACTIVE PRESSURE FROM SURCHARGE LOADING
 β = $\text{ATAN}((\text{CLT} + \text{TL}/2) / \text{HS}) - \text{ATAN}((\text{CLT} - \text{TL}/2) / \text{HS})$ IN RADIANS
 α = $\beta/2 + \text{ATAN}((\text{CLT} - \text{TL}/2) / \text{HS})$ IN RADIANS
q = UNIFORM SURCHARGE LOAD FROM TRAINS = 80 KIPS/ (5) (TL)
CLT = DISTANCE FROM FACE OF RETAINING WALL TO CENTERLINE OF TRACK
TL = TIE LENGTH = 8.5' STANDARD
HS = DEPTH BELOW APPLIED SURCHARGE LOADING



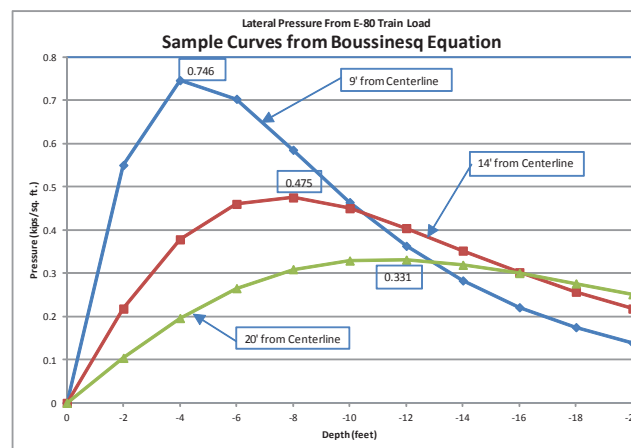
NOTES:

- TABLE 1 PROVIDES THE RESULTANT LATERAL PRESSURES FOR VARIOUS DEPTHS AND DISTANCES FROM THE CENTERLINE OF TRACK. THREE REPRESENTATIVE PRESSURE CURVES ARE ALSO SHOWN ON THE PROVIDED SAMPLE CURVES FROM BOUSSINESQ EQUATION.
- FOR A SIMPLIFIED ENGINEERING ANALYSIS, THE RAILROAD LOADING SURCHARGE PRESSURE MAY BE ASSUMED RECTANGULAR WITH WIDTH (P) EQUAL TO 0.8 OF THE MAXIMUM PRESSURE ORDINATE AS GIVEN BY THE APPROPRIATE RAILROAD CURVE.
- WORK THIS DRAWING WITH PUBLIC PROJECTS MANUAL APPENDIX H, SECTION H.1.6 (OVERHEAD BRIDGE) OR SECTION H.2.8 (UNDERPASS BRIDGE).

Table 1 - Lateral Pressure from E-80 Train Loads
(From Boussinesq Equation)

		0	-2	-4	-6	-8	-10	-12	-14	-16	-18	-20
"CLT" (Distance From Centerline of Track in Feet)	8	0	0.7	0.846	0.732	0.576	0.439	0.333	0.253	0.195	0.152	0.12
	9	0	0.55	0.746	0.703	0.585	0.464	0.363	0.283	0.221	0.175	0.139
	10	0	0.44	0.65	0.659	0.579	0.478	0.385	0.307	0.245	0.196	0.158
	11	0	0.36	0.565	0.608	0.561	0.482	0.399	0.326	0.265	0.215	0.176
	12	0	0.301	0.492	0.556	0.536	0.477	0.406	0.339	0.281	0.232	0.192
	14	0	0.218	0.378	0.46	0.475	0.45	0.404	0.352	0.302	0.257	0.218
	16	0	0.165	0.297	0.38	0.413	0.411	0.386	0.35	0.311	0.272	0.236
	18	0	0.13	0.239	0.315	0.357	0.369	0.36	0.338	0.309	0.278	0.247
	20	0	0.104	0.196	0.265	0.309	0.329	0.331	0.319	0.3	0.276	0.251
	23	0	0.078	0.15	0.208	0.25	0.276	0.287	0.287	0.279	0.265	0.247
	26	0	0.061	0.118	0.166	0.205	0.232	0.248	0.255	0.254	0.247	0.237
	29	0	0.049	0.095	0.136	0.17	0.196	0.214	0.224	0.228	0.227	0.222
	32	0	0.04	0.078	0.113	0.143	0.167	0.185	0.197	0.205	0.207	0.206
	35	0	0.034	0.066	0.095	0.122	0.144	0.161	0.174	0.183	0.188	0.189
	39	0	0.027	0.053	0.078	0.1	0.119	0.135	0.148	0.158	0.164	0.168
	43	0	0.022	0.044	0.064	0.083	0.1	0.115	0.127	0.137	0.144	0.149
	47	0	0.019	0.037	0.054	0.07	0.085	0.098	0.11	0.119	0.127	0.133
	51	0	0.016	0.031	0.046	0.06	0.073	0.085	0.095	0.104	0.112	0.118
	55	0	0.014	0.027	0.04	0.052	0.063	0.074	0.084	0.092	0.099	0.105

All pressures shown are in kips per sq. ft.
 Boxed values represent the maximum pressure ordinate for each value of "CLT".



REVISIONS		
DATE	LTR.	DESCRIPTION



NORFOLK SOUTHERN

PUBLIC PROJECTS MANUAL
TYPICAL DRAWINGS

SHORING DESIGN GUIDE
LATERAL PRESSURES FROM
TRAIN LOADS

REF. NO.: SEC 3 - MISC 1

DATE: AUGUST 1, 2015 DRAWING NO.: 5

SECTION 35 20 20

MISPLACED MATERIAL

PART 1 – GENERAL

1.01 SCOPE

This Section covers the requirements regarding any misplaced material by the Contractor.

1.02 RELATED SECTIONS

A. 01 57 20 – “Protection of Environment”

1.03 IN WATER

A. Should the Contractor, during the progress of the Work, lose, dump, throw overboard, sink, or misplace any material, plant, or Equipment, which in the opinion of the Owner and Engineer may be dangerous to, or obstruct navigation, or may cause negative impact to the environment, the Contractor shall recover and remove the same with the utmost dispatch at no expense to the Owner. The Contractor shall give immediate notice, with description and location of such obstructions to the Owner and Engineer, and if required to the United States Coast Guard (USCG), and when required, mark or buoy such obstructions until the same are removed. In the event of refusal, neglect, or delay in compliance with the above requirements, such obstructions may be removed by the Owner, and the cost of such removal may be deducted from any money due or to become due to the Contractor or may be recovered under his/her bond. The liability of the Contractor for removal of a vessel wrecked or sunk without fault or negligence shall be limited to that provided in Sections 15, 19, and 20 of the Rivers and Harbors Act of March 3, 1899 (33 U.S.C. 410 et seq.).

1.04 ON LAND

- A. Should the Contractor, during the progress of the Work misplace any material, plant, Equipment, or other Materials outside of what is authorized within the Work Area without the approval of the Owner or Engineer, the Contractor shall recover and remove the same with the utmost dispatch. The Contractor shall give immediate notice, with description and location of such misplaced Materials to the Owner and Engineer.
- B. Misplaced Materials shall be removed at the Contractor's expense. Additionally, the Contractor will be responsible for restoring unauthorized disposal areas to pre-construction conditions at his/her own expense as specified in Section 01 57 20, “Protection of the Environment”. In the event of refusal, neglect, or delay in compliance with the above requirements, such obstructions may be removed by the Owner, and the cost of such removal may be deducted from any money due or to become due to the Contractor or may be recovered under his/her bond.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION

SECTION 35 59 13

ELASTOMERIC FENDER SYSTEM

PART 1 – SCOPE OF WORK

1.01 GENERAL

- A. The work under this Section consists of the design, fabrication, testing, shipping, and installation of new fender systems. Design includes the design of the anchorages into the new concrete pier deck.
- B. The Contractor shall furnish all components, hardware, fasteners, anchors, and appurtenances required for the fender systems. All like components of the fender system shall be supplied by a single manufacturer and shall be identical.
- C. The complete assembly for the fender system shall include, but not be limited to the following components:
 - 1. Rubber fender unit: cone fender
 - 2. Frontal frame and front rubbing pads
 - 3. Weight support chains
 - 4. Shear and tension chains
 - 5. Chain Tensioners and Shackles
 - 6. Anchor bolts and brackets
 - 7. Stool: steel stool for connecting the fender to the frontal frame or wharf
- D. Materials and methods of construction not specifically covered in the Contract Drawings and Specifications shall conform to the ALDOT Standard Specifications for Highway Construction (2022).

1.02 REFERENCE TECHNICAL STANDARDS AND SPECIFICATIONS

- A. Fabrication shall be in accordance with the following U.S. specifications. The edition shall be the latest edition as of one month before the bid date.
- B. If other standards are used, a copy of the proposed standard shall be submitted.

ASTM A 572	Structural Steel	
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products	H-8641
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware	H-8641
ASTM A 193	Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature Service	
ASTM A 307	Carbon Steel Bolts and Studs 60,000 psi Tensile Strength	
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength	
ASTM A 413	Carbon Steel Chain	F-3303
ASTM D 395	Test Methods for Rubber Property-Compression Set	K-6301
ASTM D 412	Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension	K-6301
ASTM D 573	Test Method for Rubber- Deterioration in an Air Oven	K-6301
ASTM D 624	Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers	K-6301
ASTM D 638	Test Method for Tensile Properties of Plastics	K-7113
ASTM D 648	Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position	K-7207
ASTM D 785	Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials	K-7202
ASTM D 792	Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement	K-7112
ASTM D 1044	Test Method for Resistance of Transparent Plastics to Surface Abrasion	K-7204
ASTM D 1149	Test Method for Rubber Deterioration-Surface Ozone Cracking in a Chamber	
ASTM D 1894	Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheet	
ASTM D 2000	Classification System for Rubber Products in Automotive Applications	
ASTM D 2240	Test Method for Rubber Property-Durometer Hardness	K-6301
AWS D1.1	Structural Welding Code	Z-3605
AISC	Design, Fabrication and Erection of Steel for Building Specifications and Bridges.	
AISC	Steel Buildings and Bridges Standard Practice	
API RP 2A	Planning, Designing, and Constructing Fixed Offshore Platforms – Working Stress Design	

Manual of the Steel Structures Painting Council (SSPC), Volumes 1 and 2

Guidelines for the Design of Fender Systems: 2002, Report of Working Group 33 of the Maritime Navigation Commission, PIANC, 2002.

1.03 SUBMITTALS

A. The following submittals shall be in accordance with Section 01 33 00 – Submittals

- B. Bid Submittal shall include bid drawings that include at least the following: system arrangement with dimensions, descriptions of proposed system components, materials, quantities, and rated capacities.
- C. Design Submittals after Award: Copies of the following shall be submitted to the Port and reviewed by a person to be designated by the Port for technical review of submittals and the fender systems. The review and/or approval by the Engineer does not relieve the Contractor of responsibility for compliance with the applicable standards and specifications.
 - 1. Manufacturer Qualifications
 - 2. Design calculations shall be submitted for all fender components, hardware, frontal frame, steel support frame (for Temporary Dolphins), concrete anchorage for chain bracket connections, etc., in the U.S. Customary System of Units. These calculations shall be signed and sealed by a Specialty Engineer licensed in the state of Florida.
 - 3. Assembly drawings showing the complete assembly of the fender units, rubbing pads, chain assemblies, pad eyes, anchor bolts, and any other inserts. All dimensions and units shall include U.S. Customary System of Units.
 - 4. Shop drawings showing the material, size, method of assembly, fabrication details, welding details, and list of material parts for the complete assembly.
 - 5. Welding procedures in accordance with AWS D1.1.
 - 6. Fender unit physical properties and performance curves showing energy and reaction load versus deflection for axial compression and range of angular loading. Reduction factors for horizontal deflection at 6-degree approach angle and 8-degree bow flare. Velocity correction factor shall be based on 0.33 feet per second.
 - 7. Mill test certificate of all materials supplied.
 - 8. Safe working load, proof load, and breaking load of the chain assemblies and other hardware.
 - 9. Documentation of maximum coefficient of friction between rubbing pads and steel
 - 10. Product data sheets for coating system
 - 11. List standards and specifications of each material such as ferrous, elastomeric, plastic, and coating.
 - 12. Manufacturer's procedures for installation, and Operation and Maintenance.
 - 13. Welder Certification: All welders shall be qualified by AWS D1.1 or approved equivalent welding code.
 - 14. Warranty Certificate

15. Test reports shall include the following information as a minimum:
 - a. Serial number of the tested fender.
 - b. Date, time, and location of the fender performance test
 - c. Test procedure, including test speed.
 - d. Factory performance test data values for Velocity Correction, Temperature Correction, Angular Correction (if used).
 - e. Signature of the Quality Manager.
16. Coating Applicator
 - a. Proposed Applicator's name, address, contact name, phone number and qualifications, verifying that the company is in compliance with the specifications.
 - b. Application Equipment

1.04 WARRANTY

- A. The Contractor shall furnish a written warranty to the Port certifying that the fender systems furnished are free of defects and installed in accordance with the manufacturer's recommendations. The warranty shall guarantee to the Port that the Contractor will remove and replace, without cost to the Port, any materials that develop defects within five (5) calendar years from the date of acceptance by the Port.

1.05 MANUFACTURER'S QUALIFICATION

- A. Manufacturer of marine fender systems shall provide a reference list demonstrating that it has been in the business of manufacturing molded/bonded, elastomeric element fenders for at least five (5) years and show proof of ten (10) element and foam-filled fender installations plus ten (10) reference letters from customers.

1.06 QUALITY CONTROL

- A. Quality Control under this Section shall be performed as determined necessary by the CONTRACTOR to ensure the in progress and completed work meets the requirements of the plans and specifications.

1.07 QUALITY ASSURANCE

- A. Fender elements shall be molded of rubber, shall be generally free from cracks, burrs, warpage, checks, chips, or blistered surfaces, and shall have a smooth surface.
- B. Steel Fabrication: The steel used in fabrication shall be free from kinks, burrs, sharp bends, and other conditions which would be detrimental to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately. Make bends by controlled means to ensure uniformity of size and shape
- C. Welding: AWS D1.1: Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

- D. Delivery, storage, and handling:
1. Fenders shall be undamaged when delivered and shall be handled and stored so as to prevent damage such as bending or abrading end fittings or cutting of skin.
 2. Protect fenders from exposure to damaging liquids, oils, and greases.
- E. Rejection
1. Fenders that are delivered to the site in a damaged condition or that are not in conformance with this specification are subject to rejection. Any rejected materials shall be replaced with suitable materials, at no additional cost to the Port.
- F. Coating Applicator
1. Unless otherwise approved by the Port, the Coating Applicator's shop shall be located in the United States and shall be easily accessible by Port's Inspector(s) and Manufacturer's Representative(s).
 2. The Coating Applicator shall be regularly engaged in the application of similar coatings and structures for at least five years immediately prior to this work. Applicator shall identify and furnish references for five (5) similar projects involving coating of marine fender steel frames with the methods proposed for the work of this Section.
 3. Foreman and workers in the shop and on the project, site shall be experienced and knowledgeable in preparation for and application of high-performance industrial coatings.
 4. Workmanship shall conform to standards and recommendations of Society of Protective Coatings SSPC Vol. 1.
 5. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- G. Coating Manufacturer's Representative
1. At Contractor's expense, a qualified technical representative from the coating manufacturer shall be made available to provide on-site technical assistance. The representative is to evaluate the prepared surface and periodically throughout the coating process as required to ensure that the product has been applied satisfactorily, and to resolve problems related to the coating system or the application of the system. At minimum, the Coating Manufacturer's Representative shall provide the following:

- a. After surface has been prepared, prior to the application of prime coating, the manufacturer shall provide written approval that the surface preparation meets the manufacture's recommendations.
- b. During application, the representative shall provide written approval that the surface, atmospheric conditions, drying, mixing safety, etc., and application method meets the manufacturer's recommendations.
- c. After the coating system has been fully applied, the representative shall submit a final report to the Engineer with observations and conclusions, and written approval that the coating system was applied per manufacturer recommendations.

1.08 ACCEPTANCE TESTING

- A. The Port may opt to perform independent acceptance testing, verification observation(s), inspections, validate sampling(s), and witness testing(s) of the system(s), solely for the purpose of verifying Contractor's conformance with the requirements and Contract Documents.
- B. Independent verification under this section shall in no way replace, augment, or relieve the Contractor from quality control, quality assurance, or any contractual responsibilities.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Structural steel shapes and plates shall conform to ASTM A 572 Gr. 50.
- B. Chain shall be of welded steel conforming to ASTM A 413.
- C. Heavy-Hex, Stainless Steel Anchors:
 1. Anchors: ASTM F193, Type 316
 2. Nuts: ASTM A194, Type 316
 3. Washers: ASTM A436-1
- D. Stainless steel plate: ASTM A240, Type 316L.
- E. Cast-In-Place Anchor with Threaded Socket, Type 316L
- F. The rubbing pads for single unit fender shall consist of standard sizes, engineered synthetic resin material (UHMW polyethylene), optimized for minimum friction, abrasion, and gouging. The UHMW shall have the following properties:

Property	Testing Standard	Condition
Density	ASTM D792	0.034 lb/in ³
Coefficient of Friction – UHMW-PE to Steel, UV stabilized	ASTM D1894	0.1 – 0.25
Tensile Strength	ASTM D1894	2760 – 3190 psi
Ultimate Strength	ASTM D638	4790 – 5080 psi
Elongation at Break	ASTM D638	400 – 500%

2.02 FENDER COMPONENTS

A. General

1. The waterside face of the fontal frame shall align with the outer face of all the other fenders horizontally, i.e., the distance between outer face of the frontal frames and wharf face shall be approximately 5' - 7" $\pm$ 2 in.
2. The top of the fontal frame shall be at or below the elevation of the concrete deck.
3. Fender and pad eye mounting bolts shall be designed and located to avoid conflict with cap reinforcing.
4. The Contractor shall design the anchorages for the fender system in accordance with ACI 318.
5. The requirements for various fender components follow. These requirements are organized by component for clarity. Requirements that affect multiple components apply to those affected components, e.g., the frontal frame loading conditions are presented in the "Frontal Frame" section but apply to the entire fender system.
6. Loads specified in this specification are working or ASD loads. A load factor of 1.6 should be used if LRFD design is used.

B. Elastomeric Component

1. The elastomeric component shall be one elastomeric fender units of "cone" type with a minimum rated performance (RPD) energy of 663 foot-kips at a maximum rated reaction of 295 kips (ASD). The energy shall be based on a test with initial berthing velocity of 0.33 ft/s and decreasing to no more than .017 ft/s at test end.
 - a. The elastomeric component size selection shall be based on the energy capacity at the rated deflection with the appropriate corrections for the combined effect of up to 6-degree horizontal angle for angular berthing, up to 8-degree vertical angle for bow flare, and horizontal deflection of the fender unit.
 - b. The rated deflection, energy, and reaction of the elastomeric component shall be as specified in the manufacturer's catalog. The fender shall be within $\pm 10\%$ of the rated energy and reaction specified in section 2.02B regardless of the tolerance specified in the catalog.

- c. The rubber material from which the elastomeric component is molded shall meet the following requirements:

Property	Testing Standard	Condition	Requirement
Tensile Strength	ASTM D412 Die C	Original	2.32 ksi (Min)
		Aged for 96 hours at 158° F	1.86 ksi (Min)
Elongation at Break	ASTM D412 Die C	Original	400% (Min)
		Aged for 96 hours at 158° F	320% (Min)
Hardness	ASTM D2240	Original	78° (Max) Shore A Original Value
		Aged for 96 hours at 158° F	+ 6° Points increase
Compression Set	ASTM D395	Aged for 22 Hours at 158° F	30% (Max)
Tear Resistance	ASTM D624	Die B	0.399 k/in (Min)
Ozone Resistance	ASTM D1149	1ppm at 20% Strain at 104° F for 100 Hours	No cracking visible by eye.

- C. Fender system shall be manufactured and supplied by the vendors listed in this Specification, unless otherwise approved by the Engineer. Pre-approved vendors include the following:

1. Trelleborg Marine Systems North America, Inc.,

10375 Richmond Ave. Ste# 1725
Houston, TX 77042
Ph. 713-800-7640
E-mail TMS.Americas@trelleborg.com

- D. Frontal Frame and Front Rubbing Pads

1. Design and fabrication of the frontal frame shall conform to the AISC Specification and Code.
2. The flat area of the frontal frame shall be sized such that when in full contact with the ship, the average hull pressure will not exceed 4.0 ksf (ASD).
3. The fender system frontal frame shall be designed to withstand the maximum reaction developed by the fender unit including the simultaneous application of a friction force (25 percent of the maximum reaction) in any direction in the plane of the fender face and the design hull pressure at the basic allowable stress levels as specified in AISC. No increase in allowable

stresses is permitted. As a minimum, the frame shall be designed for the maximum reaction applied as:

- a. Uniform pressure over the face of the frontal frame.
 - b. Horizontal line load from a ship rub rail at any location across the frontal frame.
4. The frontal frame shall consist of structural steel shapes and plates seal welded at all exterior joints, “closed box” type. All welding and welded joint details shall conform to AWS D1.1. All joints shall be seal welded. Drain holes shall be provided to eliminate water collection on open frames.
 5. The frontal frame shall be beveled at a minimum 3:1 slope along the perimeter as follows:
 - a. Sides (vertical edges) at least a bevel of 3” deep by 9” wide
 - b. Top and bottom (horizontal edges) at least a bevel of 3” deep by 9” wide
 6. Pad-eyes shall be provided for lifting and chain attachment and shall be designed in accordance with the requirement of API RP2A and AISC. Sufficient lifting pad-eyes shall be provided to allow easy handling and the padeye and frame shall have sufficient rigidity and strength to avoid damage during handling and installation.
 7. Structural steel shall have a minimum thickness of 3/8-inch. Exposed steel (frontal frame) shall have an additional 1/8” of thickness as a corrosion allowance (each face). This additional thickness shall not be considered in the calculations.
 8. Frontal frame shall include front rubbing pads to be attached to the frame by stainless steel bolts, nuts and washers as follows:
 - a. Bolt nuts shall be welded all around at the backside of the steel face. Stud welding is not permitted.
 - b. Bolt head shall be countersunk a minimum of 3/4” from the face of the pad. The pads shall be drilled, and counter bored for the studs or mounting bolts. The counter bored hole shall leave a minimum of 1/2” of material between the panel and the washer. The wear surface shall be a minimum of 3/4”. All mounting studs (or bolts) shall be a minimum of 5/8” in diameter. All studs, bolts, washers, and nuts shall be 316 stainless steel. All exposed edges of the UHMW shall include 3/4” x 3/4” chamfers.
 - c. Rubbing pads at the perimeter of the frame shall be chamfered. The size of the rubbing pad sections shall be such that they can be handled easily by one worker for future replacement.
 - d. If a closed, watertight panel assembly is used, a water sealant

compound shall be applied on all bolt thread connections.

E. Shear, Tension, and Weight Chains

1. Shear, tension, and weight chains shall be provided in accordance with the recommendations of the fender manufacturer and the following.
2. The chain assemblies shall consist of shackles, adjustable links, and chain. The Contractor shall furnish all hardware required for attaching the chain assemblies to the fender frontal frame and into the wharf. The anchors into the wharf shall have an ultimate (breaking) strength exceeding 125 percent of the ultimate strength of the weakest link in the chain system, i.e., the chain system shall fail before the cap anchorage. Anchors shall be of undercut type and shall include installation instructions that include preloading to at least the design working tensile load.
3. Chain assemblies shall be designed to satisfy the following requirements:
 - a. Working loads shall be within the rated capacities for safe working loads or within allowable AISC stresses. No increase in AISC allowable stress is permitted. The proof load of the chains shall be greater than 2 times the required working load. The breaking strength shall be greater than 3 times the required working load.
 - b. The working load of each pair of weight chains shall be designed to support the design loads described above and, at a minimum, the sum of the following:
 - i. half the weight of the fender unit
 - ii. full weight of the frontal frame with all attachments
 - iii. the most severe of the shear and torsion caused by friction equal to 25 percent of the maximum reaction at the most severe location and direction on the frontal frame.
 - c. The working load of each shear chain shall be designed to the design conditions described above and, at a minimum, at the most severe of the shear and torsion caused by friction equal to 25 percent of the maximum reaction at the most severe location and direction on the frontal frame. Shear chains shall be arranged such that they will limit the excessive horizontal deflection of the fender unit when subjected to horizontal friction load parallel to the ship at 6-degree approach angle.
 - d. Tension chains shall be designed to support the design loads described above and, at a minimum considering a partial deflection of the fender from a vessel rolling into the panel, at 5 degrees from vertical and 5 degrees from horizontal berthing angles and the ship rub rail line loading anywhere along the height of the frontal frame.

- e. The Contractor shall verify that chains, pad eyes, bolts, pins, and shackles are consistent and compatible.
- F. Anchors shall be Heavy-Hex, Stainless Steel Anchors
- G. Padeyes shall be stainless steel plate.
- H. Other Hardware
 - 1. Anchor bolts shall be designed to remain undamaged when any other component fails.
 - 2. Anchors shall not interfere with the wharf reinforcing steel or other attachments. The anchors shall be designed to meet ACI 318 and be located to maintain a minimum clearance of 6" from the nearest edge of the concrete. Contractor shall consider ACI 318 edge distance requirements.

2.03 PROTECTIVE COATING

- A. Hardware (Galvanizing)
 - 1. All hardware including chain assemblies and stools, except stainless steel items, shall be hot dip galvanized to ASTM A 123 or ASTM A 153, except that threaded parts may be mechanically galvanized in accordance with the materials standard for the part.
 - 2. Welded assemblies shall be galvanized after welding. Bolted assemblies shall have all components galvanized separately prior to assembly.
- B. Frontal Frame (Paint)
 - 1. Coating system shall be per Section 09 97 12 – Marine Coatings. See pre-approved coating systems.
 - 2. All exposed surfaces of the frontal frame shall be grit blasted in accordance with SSPC-SP10 (near white). All surfaces, at the time of coating, shall be free from dust, oil grease, moisture, and any other contaminants. Coating system shall consist of a minimum of 2 to 3 mils DFT of inorganic zinc primer followed by two coats of epoxy paint for a total DFT of 24 mils. The final coat should produce a surface that is smooth, uniform, and free from sags and voids.
 - 3. Interfaces between differing materials shall be isolated if necessary to avoid accelerated corrosion of a particular component due to galvanic action.

2.04 SOURCE QUALITY CONTROL

- A. All fender units shall have a unique serial number that can be traced back to manufacturing and testing records.
- B. Elastomeric Units
 - 1. The elastomeric units shall be tested in accordance with the manufacturer's standard practice and in accordance with the Appendix A, Report of Working Group 33, PIANC, prior to shipment. Contractor shall bear the cost of all sampling and testing. Test results shall conform to the catalog

data within plus or minus 10 percent. The Engineer reserves the right to witness the tests.

- C. Welder Certification
 - 1. All welders shall be qualified by AWS D1.1 or approved equivalent welding code. The Engineer may require evidence of the qualifications of welders.
- D. Inspection
 - 1. The Engineer reserves the right to perform inspection during shop fabrication and galvanizing.

PART 3 - EXECUTION

3.01 INTALLATION

- A. Installation methods shall be in accordance with the fender supplier's recommendations. Use templates to locate all items embedded in the concrete.
- B. Canvas slings, wood cradles, or other protective devices, as recommended by the fender manufacturer, shall be used.
- C. Hoisting and slinging by the rubber section may be permitted only when approved by the fender manufacturer. Caution is required to avoid cutting or wearing the rubber.

3.02 REPLACEMENT OF DAMAGED UNITS

- A. Any unit damaged shall be replaced at the Contractor's expense. Repair of torn rubber is not permitted.

3.03 FENDER SUPPLIER'S FIELD SERVICES

- A. A representative from the fender supplier shall perform the following work at the job site:
 - 1. Provide technical direction to workers on proper installation techniques and procedures, during or just prior to installation of the first fender units.
 - 2. Provide visual inspection of completed installations for conformance with installation procedures.
 - 3. Within five (5) working days after the completion of fender installation, submit written documentation to certify that all fender system and components have been installed in accordance with all contract documents and to the satisfaction of the supplier.
- B. The Contractor shall bear the cost of transportation, meals, lodging, and other associated costs of providing these field services.

END OF SECTION

SECTION 35 59 33
MOORING BOLLARDS

PART 1 – SCOPE OF WORK

1.01 SUMMARY

- A. This Section details the requirements for the supply and installation of the cast steel mooring bollards and embedded anchors as shown on the drawings. Installation includes grouting of base, filling bollard with concrete, and painting.
- B. Materials and methods of construction not specifically covered in the Contract Drawings and Specifications shall conform to the ALDOT Standard Specifications for Highway Construction (2018).

1.02 RELATED SECTIONS

- A. Technical Specification Section 01 33 00 – Submittal Procedures
- B. Section 03 62 13 – Non-Metallic Non-Shrink Grouting

1.03 APPLICABLE PUBLICATIONS

- A. All work performed and materials installed by the Contractor, unless otherwise specified herein, are to be in strict accordance with the latest version of the following Codes and Standards. In the event of a conflict between these specifications and the referenced standards, the more stringent requirement shall govern.

American Institute of Steel Construction (AISC)

AISC 325 Steel Construction Manual

American Society of Testing and Materials (ASTM)

ASTM A27	Standard Specification for Carbon Steel Castings for General Application
ASTM A123	Standard Specification for Zinc Coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc Coating on Iron and Steel Hardware
ASTM C920	Standard Specification for Elastomeric Joint Sealants

1.04 SUBMITTALS

A. The following submittals shall be in accordance with Section 01 33 00 – Submittals

1. Drawings

- a. Submit for approval the shop drawings and specifications for bollard, inclusive of anchor hardware and all related mounting hardware.
- b. All shop drawings for the mooring bollard system shall be signed and sealed by a Professional Engineer

2. Product Data

- a. Steel Hardware: Include Manufacturer's product data for all bollard hardware, including bolts, anchor bolts, inserts, nuts, washers, dimensions, material specifications, working loads and ultimate loads, as applicable. For anchor bolts and inserts, include methods and materials for installation.
- b. Mooring Bollard: Coating system data sheets, mill test certificates for each heat number, mill certificates for all mounting hardware, certificate of conformance for line pull rating, record showing heat numbers and serial numbers.
- c. Coating System
- d. Elastomeric sealant data sheet.

3. Calculations

- a. Submit design calculations, signed, and sealed by a Professional Engineer, demonstrating that the bollard and hardware for anchorage system meets the rated bollard capacity with required factor of safety.

4. Manufacturer's Instructions

- a. Submit the manufacturer's installation instructions for each bollard type.

5. Coating Manufacturer's Approval

- a. Submit the Letter of Acceptance from coating manufacturer's representative.

6. Independent Inspector Reports

- a. Submit inspection reports performed by qualified independent inspector.

7. Coating Applicator Qualifications

1.05 DELIVERY, HANDLING, AND STORAGE

- A. Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.
- B. Handling Coated Material
 - 1. Store, handle and place coated (or painted) material in a manner that will minimize damage to the coating and will not reduce its effective protective value. Repair damaged surfaces as directed and per the Manufacturer's recommendations. Handle coated work which is flexible in a manner that will prevent flexing sufficient to crack coating, especially when temperature is below 40 degrees F. Do not place coated surfaces on strips or skids until coating has hardened thoroughly. Wide fabric slings used for lifting, and strips, slings, blocks, skids, cradles, and other supports shall provide ample bearing areas. In transporting, fasten and protect coated materials in a manner that will prevent movement and preclude chafing and rubbing, and when unloading, do not dump or drop. Place coated material in position carefully on suitably prepared beds and with a minimum of handling.

1.06 QUALITY ASSURANCE

- A. The manufacturer shall have an in-house Quality Assurance Program.
- B. Quality Assurance of Work in this Section shall be the contractor's responsibility. Quality Control and Quality Assurance testing and observation include, though are not restricted to, the following, and as specified elsewhere in this Section:
 - 1. Submittals
 - 2. Visual Inspections
- C. Quality assurance activities performed by the contractor shall be recorded and submitted to the engineer for record and conformance with Contract Documents.
- D. Coating Applicator
 - 1. The Coating Applicator shall be regularly engaged in the application of similar coatings and structures for at least five years immediately prior to this work. Applicator shall identify and furnish references for five (5) similar projects involving coating of marine bollards with the methods proposed for the work of this Section.
 - 2. Foreman and workers in the shop and project site shall be experienced and knowledgeable in preparation for and application of high-performance industrial coatings.
 - 3. Workmanship shall conform to standards and recommendations of Society of Protective Coatings SSPC Vol. 1.
 - 4. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of

the work of this Section.

E. Coating Manufacturer's Representative

1. At contractor expense, a qualified technical representative from the coating manufacturer shall be made available to provide on-site technical assistance. The representative is to evaluate the prepared surface and periodically throughout the coating process as required to ensure that the product has been applied satisfactorily, and to resolve problems related to the coating system or the application of the system. At minimum, the Coating Manufacturer's Representative shall provide the following:
 - a. After surface has been prepared, prior to the application of prime coating, the manufacturer shall provide written approval that the surface preparation meets the requirements.
 - b. During field application, prior to the application of the intermediate coating, the representative shall provide written approval that the surface, climate, and application method meets the requirements.
 - c. After the coating system has been fully applied, the representative shall submit a final report to the engineer with observations and conclusions, and written approval that the coating system was applied per manufacturer recommendations.

PART 2 – PRODUCTS

2.01 MOORING BOLLARDS

- A. Provide mooring bollards as shown on the Drawings, including installation of anchor bolt, bolting of bollard to embedded cast-in-place anchors, grouting of base, filling bollard with concrete, and filling of bolt holes with elastomeric sealant.
- B. Bollards shall be manufactured and supplied by the vendor shown on the drawings, or by the vendors listed in this Specification, unless otherwise approved by the Engineer. Acceptable vendors include the following:
 1. Trelleborg Marine Systems
 2. Schoellhorn-Albrecht Marine Co.
- C. Bollards shall be designed against yielding with a minimum factor of safety of 2.0 and against breaking with a minimum factor of safety of 3.0.
- D. Bollards shall have a hole through the top through which concrete will be deposited and placed after bolting the bollards.
- E. Bollards shall be cast steel conforming to the requirements of ASTM A27, Grade 65-35.
- F. Anchor hardware shall be designed in accordance with AISC 325 and supplied by the manufacturer.

- G. Anchors shall be UNC-2A threaded rod, ASTM F1554, Grade 105.
- H. Equivalent bollards shall be of similar dimension and not result in conflict between anchors and concrete-embedded elements.

I. Performance Requirements

- 1. Each of the mooring bollards shall have the following performance characteristics:

Bollard Location	Bollard type	Bollard rated capacity
Elevated concrete pedestal, recessed base	Single Bitt	75 Metric Tons

J. Cleaning and Painting

- 1. Bollard shall be blasted to SSPC-SP6 and cleaned of any grease or other foreign matter with suitable degreaser before applying any coating. Prior to applying primer, the Coating Manufacturer's representative and Independent Inspector shall inspect the area to be coated. Independent Inspector to inspect and approve all prepared bollards prior to primer application.
- 2. Bollards shall be primed at the shop with 3.0 mils Dry Film Thickness (DFT) minimum, to 5.0 mils, Carbozinc 859 Primer. Independent Inspector to inspect and approve all primed bollards and protection provided for transport prior to shipping. Certification by coating manufacturer's representative is acceptable.
- 3. After installation of the bollards to their final position, bollards shall be finished with a 3-coat paint system (SAFETY YELLOW in color) in accordance with manufacturer's instructions and recommendations. Prior to application of each coat, contractor shall request approval from the Independent Inspector or coating system manufacturer's representative. If corrections are necessary as directed by the Independent Inspector, the contractor shall bring the surfaces to compliance.
- 4. A pre-approved paint system is as follows:
 - a. Primer: Blast and re-prime with 3.0 mils DFT (minimum) Carbozinc 859
 - b. Intermediate Coat: 10 mils DFT (minimum) Carboguard 1209
 - c. Topcoat: 6.0 mils DFT (minimum) Carbothane 134 HG

K. Tolerance for Coating Thickness:

- a. Minimum: As Specified
- b. Maximum: Unrestricted, other than maximums recommended by manufacturer.

2.02 CONCRETE AND LEVELING GROUT

- A. Concrete fill and leveling grout shall conform to section 03 62 13 Non-Metallic Non-Shrink Grouting
- B. Fill and grout shall comply with manufacturer's recommendations.

2.03 ELASTOMERIC SEALANT

- A. Provide elastomeric sealant meeting ASTM C920, Type S or M, Grade P, Class 12.5 or 25, Use NT. Acceptable products include the following:
 - a. Sikasil 728 RCS
 - b. WABOCrete SiliconeSeal
 - c. Pecora 322FC

2.04 GALVANIZED HARDWARE

- A. All anchor bolts, washers, heavy hex nuts, and plate washers shall be ASTM A123 or ASTM A153 hot-dipped galvanized steel, as applicable. All bolts shall be coated with a liberal coating of anti-seize compound prior to installation.

PART 3 - EXECUTION

3.01 SUPPLY AND INSTALLATION

- A. All bollards must have their serial numbers, name of manufacturer and bollard capacity stenciled onto the surface of the bollard.
- B. To prevent damage to vessel mooring lines and prior to painting, all exterior edges to be ground to 1/8-inch minimum radius to avoid sharp edges after installation.

3.02 INSTALLATION

- A. Mooring bollard anchor bolts shall be cast in. Anchor bolts and sleeves shall be held in place with templates that match bollard manufacturers bolt pattern. Templates shall ensure proper location of bolts during placement of concrete.
- B. Bollard base shall be leveled on top of a grout bed. Nuts shall be hand tight before grouting of base. After grouting has cured for seven (7) days, nuts shall be tightened to the snug tight condition in accordance with manufacturer's instructions.
- C. All countersunk bolt holes in the base shall be filled with an elastomeric sealant with good adhesion to base material with no voids or air pockets.
- D. Bollard shall be painted after installation is complete, unless otherwise recommended by the manufacturer and approved by the Engineer.

3.03 CONNECTIONS

- A. Coat threads of bolts with an anti-seize compound prior to applying washers and nuts. Recoat bolt thread projection beyond nut after tightening.

3.04 WARRANTY

- A. The Contractor shall furnish a written warranty to the Port certifying that the bollard systems furnished are free of defects and installed in accordance with the manufacturer's recommendations. The warranty shall guarantee to the Port that the Contractor will remove and replace, without cost to the Port, any materials that develop defects within five (5) calendar years from the date of acceptance by the Port.

END OF SECTION