Addendum #2 to SJPC-22-49 (BMT Rail Rehabilitation): August 4, 2022

Please see attached revised Technical Specifications.

BALZANO MARINE TERMINAL
RAIL INFRASTRUCTURE REHABILITATION

Technical Specifications

South Jersey Port Corporation
101 Joesph A, Balzano Blvd.
Camden, NJ 08103

Issued For Bid
7/2/2022
REV 1 - 8/3/22

Urban Engineers, Inc.
Project # : 2021500064.000

SCHEDULE OF QUANTITIES, PRICES, AND TOTAL BID

Item No.	Quantity	Units	Bid Item	Unit Price	Total
1	1	LS	MOBILIZATION / DEMOBILIZATION	$	$
2	1	LS	SURVEY & LAYOUT	$	$
3	1	LS	MISCELLANEOUS DEMOLITION	$	$
4	1	LS	REMOVAL OF EXISTING PAVEMENT, CONCRETE AND RR TRACK FOR CONSTRUCTION OF NEW RR TRACK ON SOIL	$	$
5	1	LS	SELECT CONCRETE DEMOLITION AND REMOVAL OF RAIL TRACK ON DOCK	$	$
6	1	LS	EXCAVATION AND GRADING FOR PLACEMENT OF NEW TRACK ON SOIL	$	$
7	1	LS	PLACEMENT OF NEW RR TRACK ON SOIL, INCLUDING SUB-BALLAST, BALLAST, TIES & NEW RAILROAD TRACK	$	$
8	1	LS	PLACEMENT OF NEW RR TRACK ON DOCK EMBEDDED IN CONCRETE	$	$
9	4	EA	NO. 8 DOUBLE TONGUE TURNOUT	$	$
10	1	LS	TRACK CONCRETE TRANSITION SLAB AND ENCASEMENT	$	$
11	1	LS	PRECAST GRADE CROSSING	$	$
12	2	EA	CRANE RAIL CROSSING FROGS	$	$
13	1	EA	RAIL TRACK BUMPER RELOCATION	$	$
14	2	EA	RAIL DERAILS	$	$
15	1	LS	REMOVE & ABANDONED STORM WATER INFRASTRUCTURE	$	$
16	1	LS	STORMWATER INFRASTRUCTURE INCLUDING EXCAVATION, INLETS, STORM PIPING AND ASSOCIATED WORK	$	$
17	2	EA	REMOVE AND RELOCATE EXISTING FIRE HYDRANTS & NEW BOLLARDS	$	$
18	1	LS	PAVING, INCLUDING GRADING, SUB-BASE, BASE COURSES AND WEARING COURSE	$	$
19	1	LS	REMOVE EXISTING LOADING DOCK & CONSTRUCT NEW LOADING DOCK AT SHED 1	$	$
20	1	EA	ROLL UP DOORS, INCLUDING REQUIRED DEMOLITION FOR NEW DOORS	$	$
21	1	LS	ELECTRICAL AT SHED 1 FOR DOORS AND LIGHTS	$	$
22	1	LS	CONCRETE SLABS AT DOORS IN SHED 1	$	$
23	1	LS	REMOVAL OF ROOF DECKING AT SHED 1	$	$

TOTAL BID	**$**

SCHEDULE OF QUANTITIES, PRICES, AND TOTAL BID

NOTES:

1. All Bid Items shall include the descriptions as defined within Section 012000 - Price and Payment Procedures.
2. The total of the Items above shall constitute the Total Bid for the Contract.
3. The following Suplementray Bid Items are only applicable for changes to the Scope of Work and to not constitute part of the Total Bid amount.

ADDITIONS AND DELETIONS					
Item No.	**Quantity**	**Units**	**Supplementary Bid Item**	**Unit Price**	**Total**
A	--	LS	NEW TRACK ALIGNMENT TO BUILDING A, INCLUDING IMPROVEMENTS IN BUILDING A	$	$
B	2	EA	ROLL UP DOORS, INCLUDING REQUIRED DEMOLITION FOR NEW DOORS AT BUILDING A	$	$
C	2	EA	CANOPY AT BUILDING A	$	$
D	1	LS	ELECTRICAL AT BUILDING A FOR DOORS AND LIGHTS	$	$
E	1	LS	CONCRETE SLABS AT DOORS IN BUILDING A	$	$
F	1	EA	RAIL TRACK BUMPER RELOCATION AT BUILDING A	$	$
G	1	LS	CREDIT FOR NOT EMBEDDING TRACK IN ASPHALT	- $	- $
H	1	LS	EMBED TRACK IN PCC PAVEMENT RATHER THAN ASPHALT	$	$

SECTION 000110 - TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS:

- END OF SECTION -

SECTION 011000 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by S.J.P.C.
5. Future work not part of this Project.
6. S.J.P.C.-furnished/Contractor-installed (OFCI) products.
7. Contractor's use of site and premises.
8. Coordination with occupants.
9. Work restrictions.
10. Specification and Drawing conventions.

B. Definitions:

1. Substantial Completion – “The stage in the progress of the Work where the Work or designated portion is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.”

C. Related Requirements:

1. ~~Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.~~
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 PROJECT INFORMATION

A. Project Identification: Balzano Marine Terminal Rail Improvements.

Project Location: 101 Joseph A. Balzano Blvd, Camden, NJ 08103.

B. Owner: South Jersey Port Corporation, 2 Aquarium Drive, Suite 100, Camden NJ 08103.

Owner's Representative: Mr. Chris Perks, Director of Engineering,

C. Engineer: Urban Engineers, Inc., 530 Walnut Street, Philadelphia, PA 19106

Engineer's Representative: Mr. Michael Wagner, PE

D. Construction Manager: To Be Named.

1. Construction Manager will be engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and Contractor, according to a separate contract between Owner and Construction Manager.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of his Project is divided into two distinct categories defined as those items that comprise the BASE BID work and those items that comprise the ALTERNATE ADDITIONAL BID.

B. The items identified as those to be included in the BASE BID is defined by the Contract Documents and includes, but is not limited to, the following:

1. Removal of existing track in concrete or bituminous pavement located on land side and on the reinforced pile supported concrete deck of the riverside docks including lawful disposal of all demolition debris so removed as indicated on the drawings.
2. Removal of seven (7) existing "Tongue and Mate" turnouts embedded in pavement.
3. Removal of two (2) Double Point Split Switch" turnouts embedded in pavement.
4. Removal and return to Owner of one (1) Hayes type Track Bumper located on track to be removed under this contract.
5. Removal of two 135CR/115RE crossing frogs at the location of the crossing of one dockside STS crane runway rail with an existing railroad sidetrack.
6. Supply and installation of fully welded track complete including new 136RE standard rail on timber crossties, or steel crossties, embedded in concrete or bituminous pavement or as embedded as the direct fixation sections located on the pile supported reinforced concrete deck portion of the riverside ship berths as indicated on the drawings.

7. Supply of and installation of four (4) new 136RE cast manganese steel #8 Double Tongue type manually operated railroad turnouts for installation in concrete pavement, including all components to provide a complete installation.

8. Design, fabrication, supply and installation of two new Flange Bearing Solid Manganese Steel 132RE to 135CR rail crossing frogs for direct fixation installation to replace those removed as noted in Item 4 above.

9. Drainage infrastructure improvements including video camera inspection of a portion of the existing stormwater drainage system between point of connection of new work to outfall at the Delaware River bulkhead.

10. Water supply system infrastructure modifications.

11. Renewal of one existing Bituminous Concrete at-grade single track railroad crossing of the Marine Terminal Main Entrance Gate Road, including removal of existing railroad track, pavement and other excavated materials and their removal from SJPC property including lawful disposal of all materials so removed and supply and installation of a new full depth, heavy duty, precast reinforced concrete grade crossing, eighty (80) total feet in length (measured along the centerline of track) including new 136RE CWR with all necessary field rail welding, restoration of pavement, application of pavement markings and signage in accordance with the requirements State and Federal regulations, supply of temporary traffic control measures and all other ancillary work required to complete the installation.

12. Milling and removal of portions of the existing bituminous paving located within designated areas and by sequential Phases as defined by the Project Documents

13. Removal of two (2) existing loading dock roll-up doors and the supply and installation of two (2) motor operated steel coiling type roll up doors, including supply of the electrical supply and control system, to be located as shown on the plans for work at Shed 1.

14. Selective demolition and removal of portions of the existing concrete floor and sections of the existing loading dock of Shed 1 and the supply, installation and finishing of new reinforced concrete floor and sections of the loading dock as shown on the plans for work at Shed 1.

15. Restoration of painted traffic directional pavement markings removed or otherwise rendered illegible by the construction activities performed under the scope of this project.

16. Other ancillary work in connection with the Base Bid portion as described and as indicated in the Project Documents.

17. Lawful disposal of all materials so removed not otherwise designated for reinstallation or rejected by the Engineer as unsuitable for reuse.

C. The ALTERNATE ADDITIONAL BID work of the Project is defined by the Contract Documents as “Building A Improvements” and includes the following

1. Supply and installation of 875 feet of fully welded track complete including new 136RE standard rail on timber or steel crossties and embedded in bituminous pavement and connection to the portion of track installed under the BASE BID portion as described above. Work shall include all necessary excavation, grading, compaction, supply of all required materials. Work will also include reinstallation of one existing Hayes Type railroad track bumper removed from existing track performed under work comprising the BASE BID items.
2. Removal of two (2) existing loading dock roll-up doors and the supply and installation of two (2) motor operated steel coiling doors including electrical supply and control system for installation in Building A.
3. Selective demolition of a portion of the existing concrete floor of Building A including removal of demolition debris from SJPC property and lawful disposal of all demolition materials removed in connection therewith.
4. Supply of all material and labor required to form and place reinforcing steel and concrete including the finishing of the surface including any ancillary work necessary to complete the installation of the section of floor of Building A removed as described above and as defined by the Project Documents.
5. Supply of all materials and the fabrication and installation of two (2) new exterior weather canopies and exterior lighting in connection with the installation of the two (2) railcar loading doors of Building A as noted above, and in accordance with that shown on the plans and as defined by the Project Documents.

D. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 PHASED CONSTRUCTION

A. The Work comprising the BASE BID items shall be conducted in five (5) phases to enable an orderly, uninterrupted transfer of Owner's operations to new facilities, with each phase substantially complete as indicated below:

1. Phase 1: Within the limits as designated on drawing #CP-1 of the Project Documents.
2. Phase 2: Within the limits as designated on drawing #CP-1 of the Project Documents.
3. Phase 3: Within the limits as designated on drawing #CP-1 of the Project Documents.
4. Phase 4: Within the limits as designated on drawing #CP-1 of the Project Documents.
5. Alternate Extra Item #1: Within the limits as designated on drawing #CP-1 of the Project Documents.

B. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule, showing the sequence, commencement, and completion dates for all phases of the Work.

1.6 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide access to Owner-furnished products at location where products are currently stored, at a time or times as agreed upon by Owner and Contractor.
2. Inspect and inventory, with Contractor present, Owner-furnished items prior to loading for transport.
3. Inform Contractor of earliest available date for access to storage location for loading of Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate dates required for access to Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available dates.
2. Receive, unload, handle, store, protect, and install Owner-furnished products.
3. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
4. Repair or replace Owner-furnished products damaged following receipt.

C. Owner-Furnished/Contractor-Installed (OFCI) Products:

1. One hundred and fifty (150) each, 7” x 9” x 8’-6” treated timber railroad crossties with “Pandrol” type rail plates pre-installed.

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site:

1. Contractor shall submit a location plan indicating area(s) required for the support of Contractors work including “laydown or temporary materials and equipment storage, staging of work, and Contractor Project Office as defined in the Project Documents. Confine support construction operations to the area(s) depicted on the plan approved by Engineer.
2. Limit Work in areas as designated for each Phase of work as noted in Article 1.5 and as indicated on Drawing CP-1 of the Project Documents. Do not disturb portions of Project site beyond areas in which the Work is indicated until substantial completion of the work within that Area as is approved by Engineer.
3. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
4. Schedule deliveries to minimize use of driveways and entrances by construction operations.
5. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Buildings: Maintain portions of existing buildings affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

D. Condition of Existing Grounds: Maintain portions of existing grounds affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.8 COORDINATION WITH OCCUPANTS

A. Full SJPC Occupancy: SJPC will occupy Project site and existing building(s) during entire construction period. Cooperate with SJPC during construction operations to minimize conflicts and facilitate SJPC usage. Perform the Work so as not to interfere with SJPC's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, vehicle corridors, and other adjacent occupied or used facilities. Do not close or obstruct

roadways, walkways, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.

2. The Contractor shall minimize the use of the Project site to the Phases of work areas indicated on the drawings. The Contractor's presence on and the use of the areas outside of the indicated work areas shall be at the approval and discretion of the Construction Manager. Do not disturb portions of the Project site beyond areas in which the Work is indicated. Additional work and/or storage areas or parking for the Contractor's and sub-tier contractors that is beyond those provided by SJPC shall be provided by the Contractor at no additional cost to SJPC. Contractor shall make off-site provisions for parking and storage areas not explicitly depicted on the documents. There is no guaranteed on-site parking for the Contractor.

3. Notify Owner not less than 72 hours in advance of activities that will affect SJPC's operations.

B. Partial Owner Occupancy: SJPC will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with SJPC during construction operations to minimize conflicts and facilitate SJPC usage. Perform the Work so as not to interfere with SJPC's operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from SJPC and authorities having jurisdiction.

2. Provide not less than 72 hours notice to SJPC of activities that will affect SJPC's operations.

C. SJPC Limited Occupancy of Completed Areas of Construction: SJPC reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1.9 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

2. Work located in the area defined as lying between the east wall of Shed 1 and west wall of Building A and from the northern most walls of aforesaid buildings to the southern most walls of aforesaid buildings may not be performed between the December 1st and April 30th of any year.

B. On-Site Work Hours: The proposed Contractor work hours shall be coordinated with SJPC and will minimize impacts to SJPC employees, facilities and Port operations. If at all possible, Contractor work hours should coincide with normal business working hours, Monday through Friday, except as limited by local ordinances or permits or as otherwise indicated outages may require night/early morning and/or weekend work.

C. No work shall be scheduled on observed holidays: New Year's Day, Martin Luther King Day, President's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving, Christmas, and other special events specified by SJPC.

D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by SJPC or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.

2. Obtain Owner's written permission before proceeding with utility interruptions.

E. Employee Identification: All Contractors employees must obtain a valid Transport Worker Identification Credential (TWIC) and present such identification to gain entry to the Port Facilities or upon demand, by any SJPC Personnel or its Security Contractors, uniformed personnel of the U.S. Coast Guard, U.S. Customs and Border Protection or Transportation Security Administration at any time. Contractor personnel must display TWIC identification badging at all times.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

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

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION 011000 -

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

PART 1 : GENERAL

1.01 REFERENCE

A. The provisions of this section are applicable to the Bid Items as listed within the Schedule of Quantities, Prices, and Total Bid form.

B. The cost of all elements as described under each Bid Item shall be included within the price prosed for that Item.

C. The total of all items in Part 2 of this Section shall comprise the Total Value of the Contract. The Total Value of the Contract may be amended using these unit prices for additions or deletions in the scope of work.

D. The amount(s) bid on the supplementary item(s) in Section 3 shall only be paid if the indicated modifications to the work become necessary. The Total Value of the Contract will be amended using these rates for additions or deletions in the scope of work.

1.02 INCIDENTAL ITEMS

A. The scope of work for each pay item shall include providing all associated equipment, materials, labor, utilities, transportation, taxes and all other services and expenses as may be necessary to complete the work described.

B. Each bid item, where applicable, shall include the procurement, storage, handling, and installation of all materials described within the item.

C. Tasks that are incidental to the completion of the payment items shall be included in the cost of the associated item, unless specifically identified under another payment item(s).

D. The description of work in this section may not be exhaustive of all tasks necessary for completion of the overall payment item, and the omission of such tasks does not indicate that they are extra to the contract.

E. Where the Contractor deems that items in the scope of work are not incidental to the payment items, or additional work is required to complete the project scope, a request for clarification must be submitted with the Bid.

1.03 UNIT ABBREVIATIONS

A. CY = Cubic Yard

B. EA = Each

C. LF = Linear Feet

D. LS = Lump Sum

E. SF = Square Feet

PART 2 : BID ITEM DESCRIPTION

2.01 MOBILIZATION / DEMOBILIZATION

A. The amount of this item shall be limited to ten percent (10%) of the total lump sum price of the Contract Bid.

B. The Contractor shall mobilize all equipment, personnel, materials and supplies necessary for completing the work to the project site.

C. Notify the state One Call Center.

D. Notify the Coast Guard and local mariner's committee, as necessary. Make required notifications to the Army Corps and other permit agencies, as required.

E. Obtain necessary permits.

F. Comply with the Owner's site safety and security requirements.

G. Prepare and transmit submittals to the Engineer and/or Owner as required.

H. Attend meetings as required.

I. Transport material, equipment and tools to accommodate the Owner's operations when provided with at least 18 hours of notice.

J. Provide the Owner and Engineer access to the construction site during the work.

K. Prepare and submit As-Built Drawings.

L. Cleanup and dispose of material off-site.

M. Address items on project closeout punch list.

N. Demobilize.

2.02 SURVEYS

A. Provide all layout, and other surveys required to complete the project.

B. Field verification of existing conditions and geometry.

C. Prepare and transmit associated reports and drawings.

2.03 MISCELLANEOUS DEMOLITION

A. Demolish and dispose of all miscellaneous items and materials as indicated within the Contract.

B. Elements included in this pay item are the existing conc island, existing flag pole, existing utility pole and any other miscellaneous items that need to be demolished or removed in order to construct the project.

C. Include any falsework or temporary supports as may be required.

D. All work included within the following Technical Specifications sections shall be included, unless specifically included within another pay item.

2.04 REMOVAL OF EXISTING PAVEMENT AND RR TRACK FOR CONSTRUCTION OF NEW RR TRACK

A. Remove existing track and associated pavement in the areas that new track will be installed

2.05 SELECT CONCRETE DEMOLITION AND REMOVAL OF RAIL TRACK ON DOCK

A. Perform selected demolition of concrete on dock only as required to remove existing track and plates and provide room for new track construction.

2.06 EXCAVATION AND GRADING FOR PLACEMENT OF NEW TRACK

A. Perform all excavation necessary to the subgrade elevation for track and turnout construction

2.07 PLACEMENT OF NEW RR TRACK ON SOIL, INCLUDING SUB-BALLAST, BALLAST, TIES & NEW RAILROAD TRACK

A. Construct new track on soil

B. Include all compaction, sub-ballast, ballast, timber ties, plates and new track

2.08 PLACEMENT OF NEW RR TRACK ON DOCK EMBEDDED IN CONCRETE

A. Construct new track on dock that is to be embedded in concrete

2.09 NO. 8 DOUBLE TONGUE TURNOUT

A. Supply and construct new No. 8 double tongue turnouts.

2.10 TRACK CONCRETE TRANSITION SLAB AND ENCASEMENT

A. Provide necessary concrete transition slabs and encasements for construction of turnouts.

2.11 PRECAST GRADE CROSSING

A. Supply and construct new precast grade crossing at the main entrance to the terminal

2.12 CRANE RAIL CROSSING FROGS

A. Supply and install new manganese steel rail crossing frogs

2.13 RAIL TRACK BUMPER RELOCATION

A. Remove one rail track bumper and install bumper at the end of the track along Building A

2.14 RAIL DERAILS

A. Supply and install new rail derails.

2.15 REMOVE & ABANDONED STORM WATER INFRASTRUCTURE

A. Remove all stormwater infrastructure that interferes with new construction

B. Any stormwater infrastructure that does not interfere with new construction can be abandoned in place and filled with flowable fill.

2.16 STORMWATER INFRASTRUCTURE INCLUDING EXCAVATION, INLETS, STORM PIPING AND ASSOCIATED WORK

A. Supply, excavate, install and backfill all new stormwater infrastructure.

2.17 REMOVE AND RELOCATE EXISTING FIRE HYDRANTS & NEW BOLLARDS

A. Remove and relocated existing fire hydrants

B. Supply and install new bollards to protect hydrants

2.18 PAVING, INCLUDING GRADING, SUB-BASE, BASE COURSES AND WEARING COURSE

A. Grade, install subbase and asphalt & compact as required to finish all paving

2.19 REMOVE EXISTING LOADING DOCK & CONSTRUCT NEW LOADING DOCK AT SHED 1

A. Demolish existing loading dock in the vicinity of the new loading dock at Shed 1.

B. Construct new loading dock at Shed 1.

2.20 ROLL UP DOORS, INCLUDING REQUIRED DEMOLITION FOR NEW DOORS

A. Demolish existing doors or walls as required to construct new doors at Shed 1 and Building A

B. Supply and install new motor operated doors at Shed 1 and Building A

2.21 CANOPY AT BUILDING A

A. Perform selective demolition of the brick facing at Building A to access the building columns.

B. Notify the Engineer if the existing building columns can not accept the canopy members as indicated on the drawings.

C. Supply and install steel and decking for the canopies at Building A.

2.22 ELECTRICAL AT BUILDING A & SHED 1 FOR DOORS AND LIGHTS

A. Supply and install all electrical infrastructure necessary for the operation and control of the new lights and doors at Building A and Shed 1.

2.23 CONCRETE SLABS AT DOORS IN BUILDING A

A. Demolish existing floor to the limits of the new slabs at Building A.

B. Compact and install subbase under slab.

C. Pour and finish concrete slab at Building A.

2.24 CONCRETE SLABS AT DOORS IN SHED 1

A. Demolish existing floor to the limits of the new slabs at Shed 1.

B. Compact and install subbase under slab.

C. Pour and finish concrete slab at Shed 1.

2.25 REMOVAL OF ROOF DECKING AT SHED 1

A. Remove roof decking at Shed 1 in all areas except for the areas over the existing and new loading docks.

PART 3 : ADDITIONS AND DELETIONS ITEM DESCRIPTION

3.01 TURNOUT REMOVAL AND TRACK RECONSTRUCTION ON CLINTON ST SHED 5

A. Remove and reconstruct track embedded in asphalt along Clinton Street and to the east of Shed 5.

B. Includes the removal of the turnout on the west side of Clinton Street.

3.02 TRACK RECONSTRUCTION NORTH OF BUILDING F

A. Remove and reconstruct track embedded in asphalt to the North of Building F.

3.03 EMBED TRACK IN PCC PAVEMENT RATHER THAN ASPHALT

A. Provide cost to embed reconstructed track in PCC pavement rather than asphalt, refer to details on drawings.

3.04 TURNOUT REMOVAL AND TRACK RECONSTRUCTION IN PCC PAVEMENT ON CLINTON ST SHED 5

A. Provide cost to construct 3.01 in PCC pavement rather than asphalt, refer to details on drawings.

3.05 TRACK RECONSTRUCTION IN PCC PAVEMENT NORTH OF BUILDING F

A. Provide cost to construct 3.02 in PCC pavement rather than asphalt, refer to details on drawings.

- END OF SECTION -

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule.
2. Construction schedule updating reports.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

C. Construction Schedule Updating Reports: Submit with Applications for Payment.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Activities: Treat each phase of construction as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.

2. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.

3. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
4. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

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

D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.

E. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 013300 – SUBMITTAL PROCEDURES

PART 1: GENERAL

1.01 SCOPE

A. The provisions of this section apply to the submittal of all information by the Contractor to the Engineer / Owner.

PART 2: PRODUCTS

Not used.

PART 3: SUBMITTALS

As specified in related sections.

PART 4: QUALITY ASSURANCE

Not used.

PART 5: EXECUTION

5.01 SUBMITTAL PROCEDURES

A. It is the Contractor's responsibility to make timely Submittals. The Contractor shall not initiate a construction activity prior to receiving ALL the submittals, reviewed by the Engineer, related to the construction activity, indicating an authorization to proceed with the construction activity. Any construction activity performed without this authorization shall be at Contractor's risk and cost. Delays arising due to the failure in making timely submittals shall be at Contractor's cost. The Contractor shall not be compensated for construction activities performed without the authorization of the Engineer.

B. The Contractor shall submit a Submittal Log, documenting the list of submittals to be made during the project, prior to mobilization.

C. Transmit each submittal with a letter of transmittal indicating the content of the submittal, quantity of submitted items and any special instructions.

D. Submittals are to be sequentially numbered. Mark revised submittals with original number and sequential alphabetic suffix.

E. Identify Project, Contractor, Subcontractor and Supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

F. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

G. Schedule submittals to expedite Project. All materials shall be submitted electronically either through email. The Contractor shall coordinate with the Engineer and Owner as to the preferred submission procedures for the project.

I. For each submittal, allow for a 10-working-day review period excluding delivery time to and from Contractor.

J. Identify with highlighter and/or red ink variations from Contract Documents and product or system limitations, which may alter or be detrimental to successful performance of completed Work. Contractor shall provide an estimated cost for any proposed alternates.

K. Allow space on submittals for Contractor and Engineer review stamps.

L. When revised for resubmission, identify changes made since previous submission.

M. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

N. Submittals not requested will not be recognized or processed.

O. No materials, supplies, equipment or labor shall be ordered for an item until the Engineer has reviewed the submittal.

P. Contractor shall update the submittal log and submit to the Engineer every month at a minimum.

5.02. SUBMITTAL DATA

A. Product Data: Submit to the Engineer, for the purpose of review and checking the conformance with information given and design concept expressed in Contract Documents. Provide appropriate number of copies and distribute in accordance with the section “Submittal Procedures”.

B. Mark each copy to identify applicable products, models, options, and other

data. Supplement manufacturers' standard data to provide information specific to this Project. Record this information in the submittal matrix.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1: GENERAL

1.1 SCOPE

A. Quality control and control of installation.

B. Tolerances.

C. References.

D. Examination.

E. Operations.

PART 2: PRODUCTS

Not used.

PART 3: SUBMITTALS

The Contractor shall submit a quality assurance / quality control plan for the project.

PART 4: QUALITY ASSURANCE

As specified in related sections.

PART 5: EXECUTION

5.1. QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Prior to ordering any material, the Contractor is responsible to verify all material quantities and dimensions in the field.

B. The contractor shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of Contract-specified quality.

C. The Contractor shall comply with all manufacturers' instructions, including performing all tasks in the instructed sequence.

D. When manufacturers' instructions conflict with Contract Documents, a

request of clarification shall be submitted to the Engineer 5 business days prior to the need.

E. The Contractor shall have a minimum of five (5) years of experience in performing similar work. The Contractor shall use qualified employees to produce the Contract-specified quality.

F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

5.2. TOLERANCES

A. Fabrication and installation tolerances shall be governed by the tolerances specified in applicable codes, standards, and the Contract Documents. Monitor fabrication and installation tolerance control of products to produce acceptable work. Tolerances are non-additive.

B. When tolerances mentioned in the Contract Documents conflict with codes and standards, request a written clarification from the Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

D. For items found to be installed or manufactured out of tolerance, the Contractor shall remove and install an acceptable replacement at no additional cost to the Owner.

5.3. REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified by this Contract or are required by applicable codes.

B. Obtain copies of standards where required by product and contract specification sections.

C. When specified reference standards conflict with the Contract Documents, request clarification from the Engineer before proceeding.

D. Neither the contractual relationships, duties, nor responsibilities of the parties to the Contract, shall be altered from the Contract Documents by mention or inference in reference documents. All changes, alterations and requirements of others shall be presented to the Engineer prior to initiation.

5.4. EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

5.5. OPERATIONS

A. The Contractor shall submit a schedule of work to the Owner as required by the Contract. Daily time sheets including men, equipment, and material received shall be presented at the conclusion of each working day.

B. Construction and testing are to be scheduled to accommodate the Owner's operations.

C. Weekly Construction Progress Update meetings will be held to discuss and document the status of the project. It is mandatory that the Contractor or Contractor's representative, empowered to engage in Contract binding decisions, attend each meeting.

D. The Contractor shall submit to the Owner and the Engineer a copy of the updated work progress 1-week look-ahead schedule for review and comments 24 hours prior to each Construction Progress Update meeting.

E. Continuous coordination with the Owner / Engineer / Project Construction Inspector and other Contractors is the responsibility of the Contractor. Failure to coordinate will not relieve the Contractor from his responsibilities.

F. The Engineer will record and distribute meeting minutes for each Construction Progress Update meeting.

- END OF SECTION -

SECTION 017000 – EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1: GENERAL

1.1 SCOPE

The work shall consist of the mobilization and demobilization of the Contractor's forces, equipment, and materials necessary for performing the work required under the contract.

PART 2: PRODUCTS

The Contractor shall provide all equipment, materials, and labor required for this item.

PART 3: SUBMITTALS

Not used.

PART 4: QUALITY ASSURANCE

As specified in related sections.

PART 5: EXECUTION

5.1 Mobilization shall include all activities and associated costs for transportation and assembly of the Contractor's personnel, equipment, and operating supplies to the site; establishment of offices and other necessary general facilities for the Contractor's operations at the site as may be required by the Specifications, as well as by Federal, State and/or local law and regulation. The determination of the adequacy of the Contractor's facilities, except for those required by government laws and regulations, shall be made by the Engineer. The cost of required bonds, insurance, permits and/or any other initial expenses required for the start of the work shall be included in this item.

5.2 The Owner has available a small unoccupied trailer on site that is available if the contractor elects to use it. SJPC will not pay an extra if the contractor arrives and feels it does not meet his needs sufficiently.

5.3 Demobilization shall include all activities and costs for transportation of personnel, equipment, and supplies not required or included in the Contract from the site; including the disassembly, removal and site clean up of offices, buildings, and other facilities assembled on the site specifically for this contract. In addition, all storage areas and work areas shall be cleaned of all rubbish and discarded

materials. Storage and work areas must be left in a manner satisfactory to the Owner & Engineer. Any damage to the Owner's property and/or any other property of the project site shall be repaired to the satisfaction of the Owner & Engineer at no additional cost to the Owner. The project will not be considered complete until the above work has been completed and accepted by the Owner & Engineer.

5.4 This work includes mobilization and demobilization required by the contract at the time of award. If additional mobilization and demobilization activities and costs are required during the performance of the contract as a result of changed, deleted, or added items of work for which the Contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

- END OF SECTION -

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Product Data.

B. Related Requirements:
1. Section 017000 "Execution & Closeout Requirements"

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Submittal:
1) Submit PDF electronic files of scanned Record Prints.
2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made following Engineer’s written orders.
    k. Details not on the original Contract Drawings.
    l. Field records for variable and concealed conditions.
    m. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.

2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect and Construction Manager.
e. Name of Contractor.

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in

good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 024117 – PAVEMENT REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. The contractor shall furnish all plant, tools, materials, equipment, labor and supervision and perform all tasks to demolish, remove and lawfully dispose of bituminous concrete materials and/or asphalt pavements at the locations and to the elevations and/or depths as shown on, or required by, the drawings, as specified herein, and/or as directed by the engineer.

B. Demolition shall consist of the careful removal of pavements with such equipment as to leave undamaged adjacent pavements, utilities, etc.

1.2 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

1.3 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of capped utilities, subsurface obstructions, and end of track locations.

1.4 QUALITY ASSURANCE

A. Conform to applicable building code for demolition of structures, safety of adjacent structures, dust control, runoff control, and disposal.

B. Conform to applicable building code for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.

1.5 QUALIFICATIONS

A. Demolition Firm: Company specializing in performing work of this section with minimum five years documented experience.

B. Design shoring, bracing, and underpinning under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State where the project site is located.

1.6 PRE-INSTALLATION MEETINGS

A. Section 013100 – Project Management & Coordination: Pre-installation Conferences.

B. Convene minimum one week prior to commencing work of this section.

1.7 SEQUENCING

A. Section 011000 - Summary: Phased construction.

1.8 SCHEDULING

A. Section 013200 – Construction Progress Documentation: Contractor's Construction Schedule

B. Describe demolition removal procedures and schedule.

1.9 PROJECT CONDITIONS

A. Notify the Engineer upon discovery of hazardous materials.

B. Do not sell demolished materials on-site.

C. Maintain existing roadways to the greatest extent possible.

PART 2 - PRODUCTS

A. Not used

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not close or obstruct roadways, sidewalks and hydrants without prior authorization from the Project Engineer.

B. Erect, and maintain detours, temporary barriers and security devices at locations indicated, including warning signs and lights, and similar measures, for protection of the Owner, and existing improvements indicated to remain.

C. Protect existing appurtenances, and structures indicated to remain.

D. Prevent movement or settlement of adjacent structures, tracks and paving.

3.2 DEMOLITION

A. Pavements shall be removed to its full depth unless otherwise directed by the engineer.

B. The contractor shall use suitable equipment, tools and methods for cutting and trimming as well as removing the pavement materials to the neat lines

set by the engineer and shall not in any manner disturb or damage the sections of base and/or pavement to remain.

C. All active underground utilities shall be braced and shored adequately and shall not be removed. If active piping is to be covered or backfilled, adequate precautions must be taken as to not cause damage to the existing service. After construction is complete, the active piping shall be left in a condition that will ensure proper function of the service.

D. Damage done by the contractor's equipment or methods to those areas of pavement designated to remain shall be repaired and restored at the contractor's sole expense.

E. Unless otherwise authorized by the engineer in writing, all pavement materials, resulting refuse and debris from the demolition will become the property of the contractor and must be properly and lawfully disposed of off site.

F. Rough grade and compact areas affected by demolition to maintain site grades and contours.

G. Continuously clean-up and remove demolished materials from site. Do not allow materials to accumulate in building or on site.

H. Do not burn or bury materials on site. Leave site in clean condition.

3.3 DISPOSAL

A. All demolition material is to be lawfully disposed of offsite by the contractor.

- END OF SECTION -

SECTION 024119 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

2. Demolition and removal of selected site elements.

3. Salvage of existing items to be reused or recycled.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.3 INFORMATIONAL SUBMITTALS

A. 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.

2. Interruption of utility services. Indicate how long utility services will be interrupted.

3. Coordination for shutoff, capping, and continuation of utility services.

4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

1.4 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.5 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.

2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

B. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.

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.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project Site.

1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

- END OF SECTION -

SECTION 031000 – CONCRETE FORMS & ACCESORIES

PART 1: GENERAL

1.01 SCOPE

A. All labor, materials, services, and equipment necessary for furnishing, installing, and removing all formwork for cast-in-place concrete.

PART 2: PRODUCTS

2.01 MATERIALS

A. Plywood: Exterior-type softwood plywood, PS 1-66.

B. Glass Fiber Fabric-Reinforced Plastic Forms: Shall be matched, tight fitting, stiffened to support the weight of wet concrete without deflections that exceed the structural tolerances or that are detrimental to the appearance of the finished concrete.

C. Lumber: Softwood framing lumber, PS 20-70. Grade markings shall be clearly visible and marked by grading rules approved by the American Lumber Standards Committee.

D. Steel: Minimum 16 gauge sheet, well matched, tight fitting, stiffened to support the weight of wet concrete without deflections that exceed the structural tolerances or that are detrimental to the appearances of the finished concrete.

A. Void Forms: Shall be moisture-resistant treated paper faces, seamless, laminated fiber material as approved by the Construction Manager. The forms shall be structurally sufficient to support the weight of a wet concrete mix and any construction or consolidation vibrations until the initial set.

2.02 FORMWORK ACCESSORIES

A. Form ties shall be left in place and equipped with swaged (waterproofing) washers or other approved devices to prevent seepage of moisture along the tie.

1. Minimum 1-inch depth of breakback.

B. Form release agent shall be a colorless material which will not stain concrete; absorb moisture; or impair finish, bonding, or color characteristics of coating intended for use on concrete.

C. Fillets shall be used for all exposed vertical and horizontal corners.

PART 3: SUBMITTALS

3.01 GENERAL

The Contractor shall submit the following items in accordance with Section 013300, Submittal Procedures.

A. Shop Drawings shall be prepared and submitted, and shall meet the requirements of ACI 315 “Details and Detailing of Concrete Reinforcement”

B. Shop Drawings must be submitted that show in detail the items of the form system affecting the appearance of architectural concrete surfaces such as joints, tie holes, liners, patterns, and textures. Items must be shown in relation to the entire form system.

C. Manufacturers’ literature must be submitted with descriptions and recommended installation instructions for form ties, spreaders, corner formers, form liners, and form coatings.

D. Submittals shall indicate pertinent dimensions, materials, and arrangement of joints and ties.

E. The following field samples shall be submitted, upon request:

1. Field samples of formed concrete must be submitted when the surface of the concrete is to receive a special architectural treatment.

2. Construct and erect a sample formwork panel for architectural concrete surfaces receiving special treatment or finish as a result of formwork. Formwork shall include a vertical and a horizontal form joint.

PART 4: QUALITY ASSURANCE

4.01 REFERENCES

The publications listed below form a part of these Specifications to the extent referenced. The publications are referred to in text by the basic description only.

A. American Concrete Institute (ACI) 301 - Specifications for Structural Concrete for Buildings.

B. ACI 347 - Recommended Practice for Concrete Formwork.

C. ACI 306R - Cold Weather Concreting

D. Product Standard (PS) 1 - Construction and Industrial Plywood.

4.02 QUALITY CONTROL

A. The Contractor shall be responsible for designing and constructing suitable and adequate false work which shall be designed in accordance with ACI 347 “Recommended Practice for Concrete Formwork.” When requested by the Owner or Engineer, formwork shall be designed and sealed by a Professional Engineer.

B. The design of forms will take into account the effect of construction loads during and after placement of concrete.

C. The forms shall be substantial, unyielding, and constructed mortar-tight and of sufficient rigidity to prevent distortion due to the pressures of concrete and other loads incidental to the construction operations.

D. Concrete shall not be cast against surfaces of existing structures, nor formwork be supported on existing structures, unless specifically indicated on the Drawings or approved by the Engineer.

PART 5: EXECUTION

5.01 SYSTEM DESCRIPTION

A. Design, engineer, and construct formwork, shoring, and bracing to meet design and all applicable code requirements so that the resultant concrete conforms to the required shapes, lines and dimensions as shown on the Drawings.

5.02 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials with care to prevent damage to or contamination of formwork.

5.03 INSPECTION

A. Verify lines, levels, and measurements before proceeding with formwork.

B. Notice shall be given 24 hours in advance of pour so that an inspection can be scheduled.

C. Forms shall be inspected by the Construction Manager prior to concreting.

D. No concreting shall be done in the absence of the Construction Manager without the written permission of the Construction Manager.

5.04 PREPARATION

A. Conform to ACI 347, expect as specified herein.

B. Initially and before re-use, forms shall be cleaned and a coat of non-staining form release agent applied per the manufacturer's instructions.

1. Care shall be taken to avoid splashing oil on reinforcing steel or existing concrete.

2. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes which may be affected by agent.

5.05 ERECTION

A. Provide bracing to ensure stability of formwork. Strengthen all formwork liable to be overstressed by construction loads.

B. Camber slabs and beams to achieve ACI 301 tolerances.

1. ¼-inch in 15 feet of span.

C. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

D. All form joints shall be backed up to assure that the edges of abutting panels are in the same plane, straight and true, and forced tightly together to minimize fins. The quality of the form contact surfaces shall be subject to the approval of the Construction Manager.

E. If installing void forms, protect them from moisture before concrete placement and protect from crushing during concrete placement.

F. Do not displace or damage vapor barriers previously placed.

G. Forms for exposed concrete shall be given special attention to provide a surface free from defects and form marks so that rubbing and finishing shall be kept to a minimum.

H. Construct formwork to maintain tolerances in accordance with ACI 301.

5.06 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for Work embedded in or passing through concrete.

B. Coordinate Work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

5.07 COLD WEATHER CONCRETING

A. The Contractor shall adhere to the requirements of ACI 306R "Cold Weather Concreting".

B. All materials that are to come into contact with freshly cast concrete must have a temperature above freezing at the time of concrete pour. The Contractor shall make a pertinent effort to schedule the concrete pour on a day with temperatures in excess of 40 degrees Fahrenheit, based on the weather forecast. When not possible to schedule the pour when ambient temperatures are above freezing, it may be required to preheat the formwork, reinforcement & inserts immediately prior to pouring concrete.

5.08 FORM REMOVAL

A. Do not remove forms and shoring or bracing until concrete has sufficient strength to support its own weight, and construction and design loads which may be imposed upon it.

B. The following schedule shall be considered the minimum period before formwork can be removed under normal conditions with the use of Type II cement. Its use shall not relieve the Contractor of responsibility for the safety and appearance of the structure.

Type of Form	Above 60°F	50-60°F	40-50°F
Columns 5' high	24 hours	36 hours	72 hours
Columns 5'-10' high	3 days	5 days	7 days
Columns 10' high	5 days	7 days	10 days

Walls 5'	24 hours	36 hours	72 hours
Walls 5-10'	3 days	5 days	7 days
Walls 10'	5 days	7 days	10 days
Beam Side Forms	24 hours	36 hours	72 hours
Beam Bottom Forms	14 days	18 days	21 days
Slabs 6' Span*	5 days	7 days	14 days
Construction Joint	24 hours	36 hours	72 hours
Bulk Heads	24 hours	36 hours	72 hours

* For slabs of more than 6-foot span, add 12 hours for each additional foot over 5 feet.

1. When the temperature to which the forms or concrete surfaces are exposed to falls below 40 degrees F, the forms shall remain in place an additional time equal to the time of the sub-40 degrees F exposure. If form insulation is used, concrete surface temperature shall apply.

2. The Construction Manager may modify the form removal schedule if compressive tests indicate that the in-place concrete is of sufficient strength. Methods of field curing the cylinders shall simulate that of the concrete and shall be approved by the Construction Manager. All such tests shall be at the option and expense of the Contractor at no additional cost to the Owner.

3. When Type III cement or retarders are used, the form removal schedule above does not apply and may be modified by the Construction Manager.

C. Immediately following the removal of the forms, the projecting ties shall be removed and all holes filled with grout flush with the wall. Care shall be taken to use the same brand of cement and same mix proportions used in the wall to prevent color differences.

5.09 CLEANING

A. Clean forms to remove foreign matter as erection proceeds.

B. Ensure that water and debris drain to exterior through clean-out ports.

C. During cold weather, remove ice and snow from forms. Do not use deicing salts. Do not use water to clean out completed forms unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

- END OF SECTION -

SECTION 032000 – CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 WORK SPECIFIED

A. Provide all labor, materials, equipment, and services necessary for furnishing and installing all steel reinforcement, welded steel wire fabric, and accessories for concrete required for the completion of the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel:

a. General Applications: ASTM A615, 60 ksi yield grade billet-steel deformed bars, uncoated finish.

b. Welding Applications: ASTM A706, 60 ksi yield grade billet-steel deformed bars, uncoated finish,

B. Welded Steel Wire Fabric: ASTM A185 plain type; in flat sheets, coiled rolls, uncoated finish.

B. Stirrup Steel: ASTM A82.

C. Fiber Reinforcement
a. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 long.
b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
i. Euclid Chemical Company; an RPM company.
ii. FORTA Corporation.
iii. Grace Construction Products; W.R. Grace & Co. -- Conn.
iv. Nycon, Inc.
v. Propex.
vi. Sika Corporation.

2.02 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete, including load bearing pad on bottom to prevent vapor barrier puncture.

C. Chairs, Bolsters, Bar Supports, Spacers Adjacent to Architectural Concrete Surfaces: Plastic tipped-type, sized and shaped as required.

2.03 FABRICATION

A. Unless otherwise shown or directed, the following minimum concrete cover shall be provided for reinforcement.

		Minimum Cover (inches)
1.	Concrete cast against and permanently exposed to earth	3
2.	Concrete exposed to earth or weather:	
	No. 6 through No. 18 bar	2
	No. 5 bar and smaller	1-1½
3.	Concrete not exposed to weather or in contact with ground	
	Slabs, nails, joists:	
	No. 14 and No. 18 bars	1½
	No. 11 and smaller	¾
	Beams, columns:	
	Primary reinforcement, ties, stirrups, spirals	1½
4.	Concrete exposed to water or sewerage slabs, walls	2
5.	Concrete hooks or development bars	2½

D. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate the proposed location of splices on the Shop Drawings for approval. Splices shall be staggered such that adjacent bars located in the same plane of reinforcement are not lapped at the same location. The projecting ends of horizontal bars that extend across construction joints shall be furnished at different lengths, such that in no place will laps in adjoining bars occur in the same plane.

E. Unless noted otherwise, longitudinal reinforcing shall be closed off at end faces and cold joints of all concrete elements by 90 degree bends, U-stirrups, or some other engineer-approved method such that the faces of the element normal to the longitudinal reinforcing are laterally reinforced against cracking. In all cases, the lateral reinforcement shall be adequately developed or lapped with the longitudinal reinforcement. This provision may

not apply where longitudinal reinforcing is continued across the plane of construction joints.

PART 3: SUBMITTALS

3.01 GENERAL

The Contractor shall submit the following items, in accordance with Section 013300:

A. Shop Drawings that indicate sizes, spacings, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting, and spacing devices.

B. Mill test certificates of supplied concrete reinforcing indicating physical and chemical analysis.

3.02 WELDING

A. Only AWS (American Welding Society) qualified welders shall be employed for welding. Submit a Welding Personnel Qualification Record (WPQR), containing all variables listed in AWS Table 6.2, to the Engineer for review at least three (3) weeks prior to using the welder. If the qualification test listed on the WPQR is more than six (6) months old, a detailed employment history and letter must accompany the WPQR to certify that the welder has been engaged in the welding process in question since the date of original qualification.

B. For each anticipated class of weld, submit Weld Procedure Specifications, containing joint geometries and all variables listed in AWS Table 4.12, to the Engineer for review at least three (3) weeks prior to welding. In general, only Welding Procedures that are prequalified, or have been qualified in accordance with AWS, shall be used.

PART 4: QUALITY ASSURANCE

4.01 REFERENCES

A. American Concrete Institute (ACI)

1. 301 Specifications for Structural Concrete for Buildings.

2. 315 Details and Detailing of Concrete Reinforcement.

3. 315R Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.

4. 318 Building Code Requirements for Reinforced Concrete.

B. American Society for Testing and Materials (ASTM)

1. A185 Welded Steel Wire Fabric for Concrete Reinforcement.

2. A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

3. A706 Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

3. E329 Recommended Practice for Inspection Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

C. Concrete Reinforcing Steel Institute (CRSI)

1. CRSI Manual of Practice.

2. 63 Recommended Practice for Placing Reinforcing Bars.

3. 65 Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.

D. American Welding Society (AWS)

1. D1.4 Reinforcing Steel Welding Code for Reinforcing Steel.

4.02 QUALITY CONTROL

A. Perform concrete reinforcement Work in accordance with referenced Standards.

B. Welders and Weld Procedure Specifications shall be qualified in accordance with AWS D1.4. Note that personnel qualification to AWS D1.1 alone does not satisfy this requirement.

PART 5: EXECUTION

5.01 INSTALLATION

A. Before placing concrete, clean reinforcement of foreign particles or coatings.

B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.

C. Do not displace or damage vapor barrier, if required.

D. The Contractor shall follow the requirements of ACI 306R “Cold Weather Concreting” when applicable.

F. Do not flame-cut rebar.

5.02 WELDING

A. All welds shall be performed in accordance with AWS D1.4 in accordance with a prequalified or approved qualified Weld Procedure Specification.

B. Except for tack welding, GMAW shall not be used for welding. When GMAW is used for tack welding, the electrode shall not be deposited by short circuit transfer.

C. All welding shall be in accordance with AWS D1.4, using low-hydrogen E80XX electrodes, unless noted otherwise on Contract Drawings or specifically approved by the Engineer.

D. In general, electrodes shall be new, or reconditioned, at the start of each work shift. The Contractor shall strictly adhere to the atmospheric exposure and baking requirements of Table 5.3 of AWS D1.4, and shall provide suitable holding and conditioning ovens onsite, as necessary.

E. Welds shall not be water quenched.

F. Field welds shall be permitted only at air temperatures above zero (0) degrees F. When welding, surfaces of pile within 3 inches, laterally and in advance of weld shall be preheated and maintained to the temperature recommended by AWS D1.4. Welding shall not be permitted during rain or snow, or when surfaces are wet.

G. The Contractor shall be responsible for the adequacy of welds in addition to the service life of the weld. The Contractor shall be responsible for visual inspection and necessary correction of all weld deficiencies in material and workmanship in conformance with AWS D1.4. The Contractor shall maintain records of these visual inspections and submit if requested by the Engineer.

H. All connections shall be welded unless noted otherwise on the Contract Drawings. Field fabricated members shall be cut to within 1/4” of required dimensions, fitted and welded completely along the perimeter of intersecting members on both sides using a 3/8” filet weld, unless shown otherwise on the Contract Drawings. No separate measurement or payment will be made for this work.

I. The Owner, at his own discretion, may perform visual and ultrasonic testing of up to 20 percent of the welds on the project, using an independent agency. The contractor shall not be compensated for any delays due to the testing of welds. Contractor shall cooperate and provide access to the welds to the testing agency. The Contractor shall correct the deficient welds at no cost to the Owner.

- END OF SECTION -

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.01 SCOPE

A. Provisions of this section apply to furnishing and placing all cast-in-place cement concrete indicated on the Drawings, described in these Specifications or otherwise required for proper completion of the Work.

B. This section does not include pre-cast, post-tensioned or pre-stressed concrete work.

PART 2: PRODUCTS

2.01 MATERIALS

A. Cement & Cementitious Materials

1. ASTM C 150, Portland Cement - Type II except as modified herein. The blended cement shall consist of a mixture of ASTM C 150, Type II, and ASTM C 618 Type F or C pozzolan or fly ash. The pozzolan or fly ash content shall not exceed 25% by weight of the total cementitous material. Use one manufacturer for each type of cement, fly ash, and pozzolan.

B. Admixtures

1. When required or permitted, use admixtures conforming to the following specifications:

a. Air Entertaining - ASTM C260

b. Water Reducing, Retarding and Accelerating - ASTM C494.

2. When concrete is to be placed underwater, whether by tremie or another method, an anti-washout admixture shall be included in the concrete mix design to minimize material loss and segregation.

C. Water

1. Water used in the mix shall conform to the requirements specified in ASTM C1602.

D. Aggregates

1. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size: ¾ inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

E. Curing Materials

1. Waterproof Sheets

a. Conform to the requirements specified in ASTM C171.

2. Liquid Membrane Forming Compounds

a, Conform to the requirements specified in ASTM C309.

F. Expansion Joint Filler

1. Conform to the requirements specified in ASTM D1751.

PART 3: SUBMITTALS

3.01 The Contractor shall submit the following for approval in accordance with the Contract:

A. Submit shop drawings of proposed construction two (2) weeks prior to fabrication of reinforcement. Shop drawings shall contain the following:

1. Meet requirements of applicable portions of “Details and Detailing of Concrete Reinforcement” by ACI 315, latest edition.

2. Show bending, assembly, splicing, sizes, bar lengths, and marking of bars. Indicate bar spacing by dimension.

3. Show reinforcing with necessary details in elevations, sections and plans. Locate sleeves, holes, accessories, and anchors by dimensions.

4. Furnish prints of approved shop drawings to trades that have items to be embedded in, or connected to concrete work.

B. Submit a plan showing the location and details of proposed construction joints two (2) weeks prior to fabrication of reinforcement.

C. Submit data on proposed concrete admixtures thirty (30) days before concrete placement.

D. Submit Samples of materials as requested by the Engineer, including names, sources, and descriptions.

E. Submit a brief plan stating the proposed method of pouring and testing concrete, providing details on site access for delivery trucks, staging area, means of conveyance, washout locations, testing and cylinder curing locations, and proposed curing procedures thirty (30) days before concrete placement.

F. Submit proposed concrete mix design and supporting laboratory test reports for concrete materials and mix design test for approval thirty (30) days before concrete placement. Provide materials certificates in lieu of materials laboratory test reports. Materials certificates shall be signed by the manufacturer and contractor, certifying that each material item complies with, or exceeds specified requirements.

G. Submit results of strength tests for samples taken at site within ten (10) days after test is completed

PART 4: QUALITY ASSURANCE

4.01 CODES, STANDARDS & PROVISIONS

A. Comply with the provisions specified in the latest revision of the following ASTM standards, including all supplements and addenda:

1. C31 - Standard Method of Making and Curing Concrete Test Specimens in the Field

2. C33 - Standard Specification for Concrete Aggregates.

3. C39 - Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens.

4. C94 - Standard Specification for Ready-Mixed Concrete

5. C138 - Standard Method of Test for Unit Weight, Yield, and Air Content (Gravi-metric) of Concrete.

6. C143 - Standard Method of Test for Slump of Portland Cement Concrete.

7 C150 – Portland Cement.

8. C171 - Standard Specification for Sheet Materials for Curing Concrete.

9. C172 - Standard Method of Sampling Fresh Concrete.

10. C173 - Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.

11. C192 - Standard Method of Making and Curing Concrete Test Specimens in the Laboratory.

12. C231 - Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.

13. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

14. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

15. C494 - Standard Specification for Chemical Admixtures for Concrete.

16. C618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolans for Use in Portland Cement Concrete.

17. C685 - Specifications for Concrete Made by Volumetric Batching and Continuous Mixing.

18. C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

19. C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

20. D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

21. E329 - Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

B. Comply with the provisions specified in the latest revision of the following publications of the American Concrete Institute (ACI):

1. Committee 212 Report - Guide for Use of Admixtures in Concrete.

2. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete.

3 ACI 301 - Specifications for Structural Concrete for Buildings.

4. ACI 302 - Recommended Practice for Concrete Floor and Slab Construction.

5. Committee 303 Report - Guide to Cast-In-Place Architectural Concrete Practice, 1974.

6. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.

7. Committee 304 Report - Placing Concrete by Pumping Methods.

8. Committee 305 Report - Hot Weather Concreting.

9. Committee 306 Report - Cold Weather Concreting.

10. ACI 308 - Recommended Practice for Curing Concrete.

11. ACI 309 - Recommended Practice for Consolidation of Concrete

12. ACI 318 - Building Code Requirements for Reinforced Concrete.

13. ACI 347 - Guide to Formwork for Concrete.

14. ACI 357R - Design and Construction of Fixed Offshore Concrete Structures

15. ACI 546.2R - Guide to Underwater Repair of Concrete

16. SP-19 - Cement and Concrete Terminology (Report of ACI Committee 116).

C. Comply with the provisions specified in the following:

1. Concrete Plant Manufacturers Bureau: "Concrete Plant Mixer Standards of the Plant Mixer Manufacturers Division", 1970.

2. National Ready Mixed Concrete Association: Check List for Certification of Ready Mixed Concrete Production Facilities, 1967.

3. American Association of State Highway and Transportation Officials, "Standard Specification for Transportation Materials and Methods of Sampling and Testing". (AASHTO T260-78).

PART 5: EXECUTION

5.01 HANDLING

A. Storage

1. Store cement in weathertight buildings, bins or silos which will exclude moisture and contaminants.

2. Arrange and utilize aggregate stockpiles in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates. To insure that this condition is met, perform any test for determining conformance to requirements for cleanness and grading on samples taken from the aggregates at the point of batching. Do not use frozen or partially frozen aggregates.

3. Allow stockpiles of natural or manufactured sand to drain to ensure a relatively uniform moisture content throughout the stockpile.

4. To prevent excessive variations in moisture content, allow predampened aggregates to remain in the stockpiles for a minimum of 12 hours before use.

5. Store admixtures in such a manner as to avoid contamination, evaporation or damage. For those used in the form of suspensions or non-stable solutions, provide agitating equipment to assure thorough distribution of the ingredients. Protect liquid admixtures from freezing and from temperature changes which would adversely affect their characteristics.

5.02 CONCRETE MIX

A. General

1. Concrete for all parts of the work shall be of the specified quality capable of being placed without excessive segregation and, when

hardened, of developing all characteristics required by these specifications.

B. Strength

1. The minimum compressive strength of the concrete shall be as indicated on the drawings.

C. Durability

1. Concrete shall be air-entrained and shall conform to the air content limits of the following table as measured by ASTM C 138 or ASTM C 173 or ASTM C231.

Nominal maximum size of coarse aggregate, in	Size number	Total air content percent by volume
3/8 ½ ¾ 1	8 7 67 57	6 - 10 5.5 – 7.5 5 - 7 4.5 – 6.5
Nominal maximum size of coarse aggregate, in	Size number	Total air content percent by volume
1-1/2 2 3	467 357 -	4.5 - 6 4 - 5.5 3.5 - 4.5

2. Concrete of normal weight shall have a water-cement ratio not exceeding 0.40.

3. For all concrete in which aluminum or galvanized metal is to be embedded, demonstrate by tests that the mixing water of the concrete, including that contributed by the aggregates and admixture used, will not contain a deleterious amount of chloride ion.

D. Slump

1. Except as specified for floors, proportion and produce concrete to have a slump of 4 in. or less if consolidation is to be by vibration, and 5 in. or less if consolidation is to be by methods other than vibration. A tolerance of up to 1 in. above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may

be used provided it is properly placed and consolidated. The slump shall be determined by ASTM C 143.

2. If concrete slabs are used, proportion and produce concrete to have a slump of 3 inches or less.

3. A slump of 6 to 9 inches is typically used for concrete that will be pumped or tremie-poured.

E. Aggregate

1. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
3. The nominal maximum size of the aggregate shall be ¾ inch but shall not exceed one fifth of the narrowest dimension between sides of forms, one third of the depth of slabs, or three fourths of the minimum clear spacing between reinforcing bars.

F Fiber Reinforcement

1. Synthetic Micro-Fiber: Shall be included in all concrete utilized in construction of embedded track
2. Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.0 lb/cu. yd.

G. Admixtures

1. Except for air-entraining admixtures, or anti-washout admixtures for underwater placement, do not use admixtures unless specifically approved by the Engineer.

2. When its use is allowed by the Engineer, the amount of calcium chloride shall not exceed 2 percent by weight of cement. Determine the amount of calcium chloride by the method described in AASHTO T260-78.

3. When their use is permitted, use all admixtures in accordance with the manufacturer's instructions except as otherwise specified herein.

H. Proportions

1. Proportion the ingredients so as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement by the methods of placing and consolidation employed on the work, but without permitting the materials to segregate or excessive free water to collect on the surface.

2. Use of the proposed mixture proportions shall be subject to approval by the Engineer based on their demonstrated ability to produce concrete meeting all requirements of the specifications. Determine ability to produce the required average strength on the basis of the strength test record of 30 or more tests made during the past 24 months from a similar mix, representing similar materials and conditions to those expected, in accordance with section 5.3 of ACI 318.

   The strength test history used to determine standard deviation will be considered to comply with the above requirement for 30 consecutive strength tests if the tests represent either a group of 30 consecutive batches of the same class of concrete or the statistical average for two groups totaling 30 or more batches. The tests used in establishing the standard deviation shall represent concrete produced for a specified strength or strengths within 1000 psi of that required for the proposed work; changes in materials and proportions within the population of background tests shall not have been more closely restricted than will be the case for the proposed work.

H. Temperature

1. The temperature of concrete to be placed shall not exceed 90 degrees F.

2. The temperature of concrete to be placed in cold weather shall conform to the requirements of the following table.

Nominal Section Size, in	Minimum Concrete Temperature, as placed, F
<12	55
12-36	50
36-72	45
>72	40

3. The temperature of ready-mix concrete shall be determined in accordance with ASTM C 1064.

5.03 PRODUCTION OF CONCRETE

A. Batch, mix and transport ready-mixed concrete in accordance with ASTM C94, except as otherwise specified herein. Plant equipment and facilities shall conform the "Check List for Certification of Ready Mixed Concrete Production Facilities" of the National Ready Mixed Concrete Association.

B. Batch and mix concrete produced by on-site volumetric batching and continuous mixing in accordance with and conforming to all requirements of ASTM C 685.

C. Charge air-entraining admixtures, calcium chloride, and other chemical admixtures into the mixer as solutions and measure by means of an approved mechanical dispensing device. Consider the liquid a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer.

D. If two or more admixtures are used in the concrete, add them separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.

E. Complete the addition of retarding admixtures within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first.

F. Mix concrete only in quantities for immediate use. Do not re-tamper concrete which has partially set.

G. When concrete arrives at the project with slump below that suitable for placing, as indicated by the specifications, water may be added only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. Incorporate the water by additional mixing equal to thirty revolutions or more, if necessary, at mixing speed. Water shall not be added to the batch at any later time.

H. Cold Weather

1. Comply with the applicable requirements of “Cold Weather Concreting”, ACI 306.

2. Do not place concrete if temperature is below 40 degrees F, except with specific approval. For concrete placed or cured below 40 degrees F, provide heat, insulation and moisture to maintain concrete temperature and curing conditions as recommended by ACI 306.

3. Do not use frozen materials, or materials containing ice. Do not allow concrete to come into contact with frost.

I. Hot Weather

1. Comply with the applicable requirements of “Hot Weather Concreting”, ACI 305.

2. Cool the ingredients before mixing.

3. Flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered.

4. Reduce concrete temperatures to prevent rapid evaporation of water in hot weather.

5.04 PREPARATION BEFORE PLACING

A. Remove hardened concrete and foreign materials from the inner surfaces of the conveying equipment.

B. Complete the formwork and remove snow, ice, frost, water, dirt or other foreign materials.

C. All material that is to come in contact with the fresh concrete, including formwork, reinforcement and inserts, must be at a temperature above 32 Degrees Fahrenheit at the time the concrete is poured, in accordance with ACI 306 “Cold Weather Concreting”.

D. Place all sleeves, inserts, anchors and embedded items including reinforcing bars. Approved bar chairs shall be used where required to vertically position reinforcing bars. The use of large aggregate or brick will not be permitted to provide clearance between the formwork and reinforcing steel.

E. Give ample notice and opportunity to Engineer before starting to place concrete in any unit of the structure to permit proper inspection of forms and reinforcement by the Engineer.

F. Give ample notice and opportunity to all other contractors whose work is related to or supported by the concrete to furnish embedded items before the concrete is placed.

G. Sprinkle semiporous subgrades sufficiently to eliminate suction, and seal porous subgrades in a manner approved by the Engineer.

H. Do not place concrete on frozen ground or fill material, or on subgrades containing frost.

5.05 CONVEYING

A. Convey concrete from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will assure that the required quality of the concrete is maintained.

B. Use conveying equipment which is approved by the Engineer and of a size and design such that detectable setting of the concrete does not occur before adjacent concrete is placed.

C. Clean conveying equipment at the end of each operation or work day.

D. For truck mixers, agitators and non agitating units, conform to the applicable requirements of ASTM C94.

E. For belt conveyors, use units which are horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Protect concrete against undue drying or rise in temperature. Use an arrangement approved by the Engineer at the discharge end to prevent apparent segregations. Do not allow mortar to adhere to the return length of the belt. Discharge long runs into a hopper or through a baffle.

F. For chutes, use metal or metal lined equipment having a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 ft. long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.

G. For pumping or pneumatic conveying, use equipment of suitable kind with adequate pumping capacity, and pump the concrete directly to the structure with no intermediate transfer points.

1. Do not convey concrete through pipe made of aluminum or aluminum alloy.

2. Control pneumatic placement so that segregation is not apparent in the discharged concrete.

3. When concrete is being conveyed to the pump by delivery trucks, the Contractor shall test the slump and entrained air of the first batch of concrete on each shift in which concrete will be poured. Tests will be conducted on the concrete being discharged from the truck into

the pump, and on the concrete being discharged from the end of the pumping line at the point of final placement. These tests shall be performed at no additional cost to the Owner.

a. The loss of slump due to the pumping or pneumatic conveying of concrete shall not exceed 3 inches. Concrete exhibiting larger slump losses, or a resulting slump outside the specified range shall not be accepted.

b. The loss of entrained air due to the pumping or pneumatic conveying of concrete shall not exceed 5%. Concrete with a resulting air entrainment below the specified range shall not be accepted.

4. The Contractor shall ensure that pump and pipeline washout-blowout procedures are performed safely and cleanly to prevent personnel injury and to prevent concrete contact with river water or other natural environments.

5.06 PLACING CONCRETE

A. Deposit concrete continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, locate construction joints as shown on the drawings or as approved by the Engineer.

B. Deposit concrete at such a rate that the concrete which is being integrated with fresh concrete is still plastic.

C. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.

D. Remove temporary spreaders in forms when the concrete placing has reached an elevation rendering their service unnecessary. They may remain embedded in the concrete only if made of metal or concrete, and if prior approval has been obtained from the Engineer.

E. Do not begin placing of concrete in supported elements until the concrete previously placed in columns and walls is no longer plastic and has been in place at least two hours.

F. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not subject the concrete to any procedure which will cause segregation.

1. Do not allow concrete to drop free more than four feet. Where greater drops are required use a tremie or "elephant's trunk". Control the discharge of such devices so that the concrete can effectively be compacted in horizontal layers not more than 12 inches thick. Space the devices such that excessive segregation does not occur.

G. Consolidate all concrete by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Use international vibrators of the largest size and the most powerful that can be properly used in the work, as described in Table 5.1.4 of ACI 309. They shall be operated by competent workmen. Do not use vibrators to transport concrete within forms. Insert vibrators and withdraw at points approximately 18 in. apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not sufficient to cause segregation, generally from 5 to 15 seconds. Keep a spare vibrator on the job site during all concrete placing operations. Where the concrete is to have an as-cast finish, bring a full surface of mortar against the form by the vibration process, supplemented if necessary by spading to work the coarse aggregate back from the formed surface.

H. Unless adequate protection is provided, do not place concrete during rain, sleet or snow.

I. Do not allow rainwater to increase the mixing water or damage the surface finish.

J. The temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 90F. When the temperature of the concrete exceeds 90 F, use precautionary measures approved by the Engineer. When the temperature of steel forms is greater than 120 F, spray steel forms and reinforcement with water just prior to placing the concrete.

K. When required or permitted, deposit concrete underwater by an approved method in such a way that the fresh concrete enters the mass of previously placed concrete from within, causing water to be displaced with minimum disturbance at the surface of the concrete.

A tremie pipe (8 to 12 inches in diameter) shall be used to deposit the concrete. The tremie pipe shall be water tight. No water shall be allowed to enter the tremie pipe. The tremie pipe shall be sealed and lowered into the base of the formwork and filled with concrete. The tremie shall be raised no more than 6 inches off the bottom to break the seal and initiate the flow of concrete. The end of the tremie pipe shall remain embedded in the fresh concrete from 3 to 5 feet after pouring is started. The tremie pipe shall be

lifted slowly to avoid disturbance to the concrete. Concrete placement shall be as continuous as possible through each tremie.

The tremie pipe must remain fixed horizontally while concrete is flowing. Horizontal movement of the pipe will damage the surface of concrete already in place. Horizontal distribution of the concrete is accomplished by halting placement, moving the pipe, reestablishing the seal and resuming placement. A tremie pipe injection point spacing of 2 to 3 times the depth of concrete shall be used.

L. After the introduction of the mixing water to the cement and aggregates, each batch of concrete will be discharged within 1.5 hours, or before the mixing drum has completed 300 revolutions, whichever comes first.

1. These limitations may be waived by the Owner, or Engineer, if, after the limits stated above, the concrete slump remains sufficient to allow it to be placed without the addition of water to the batch.

2. These limitations may reduced by the Owner, or Engineer, if hot weather, or other conditions that may contribute to rapid stiffening of the concrete mix, are present.

M. Provide all material, manpower and equipment necessary for the safe washout and cleaning of all concrete-related equipment, including trucks, pumps, pipes, and forming tools. Dispose of all hardened washout concrete. Rivers and other aquatic environments shall not be used for washout or cleaning.

5.07 CONSTRUCTION JOINTS

A. Make construction joints only as shown on the Drawings, or as approved by the Engineer.

B. Locate joints not shown on the Drawings only as approved by the Engineer. Locate those joints as least to impair the strength of the structure. In general, locate construction joints near the middle of the spans of slabs, beams and girders. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at the tops of footings or floor slabs. Place beams, girders, brackets, column capitals, haunches and drop panels at the same time as slabs. Make joints perpendicular to the main reinforcement.

C. Continue reinforcement across joints unless shown otherwise on the drawings.

D. Provide keys and inclined dowels as directed by the Engineer.

E. For all transverse and longitudinal construction joints, provide a keyway 2 inches deep by 4 inches wide with a rubber dumbbell-type waterstop.

F. Clean the surface of concrete at all joints and remove all laitance before placing adjoining concrete.

G. Immediately before new concrete is placed, all construction joints shall be wetted and standing water removed.

H. Obtain bond by one of the following methods:

1. The use of an approved adhesive. Prepare and apply adhesive to joints receiving an adhesive in accordance with the manufacturer's recommendations.

2. The use of an approved chemical retarder which delays but does not prevent setting of the surface mortar. Remove mortar within 24 hours after placing to produce a clean exposed aggregate bonding surface. Prepare surfaces of joints to be treated in accordance with the manufacturer's recommendations.

3. Roughening the surface of the concrete in an approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

4. Dampen (but do not saturate) the hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all others not mentioned below immediately prior to placing of fresh concrete.

5. For horizontal construction joints in exposed work; horizontal construction joints in the middle of beams, girders, joists and slabs; and horizontal construction joints in work designed to contain liquids, dampen (but do not saturate) the hardened concrete and thoroughly cover the joint with a coat of cement grout of similar proportions to the mortar in the concrete. Place the fresh concrete before the grout has attained its initial set.

5.08 EMBEDDED ITEMS

A. Expansion Joints - Do not extend reinforcement or other embedded metal items bonded to the concrete (except dowels in slabs bonded on only one side of joints) continuously through any expansion joint.

B. Position expansion joint material, waterstops and other embedded items accurately, and support them against displacement. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent the entry of concrete into the voids.

5.09 SLABS

A. Set edge forms and intermediate screed strips accurately to produce the designated elevations and contours of the finished surface, and construct them sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment. Align the concrete surface to the contours of screed strips by the use of strike-off templates or approved compacting type screeds.

B. Carefully coordinate mixing and placing with finishing. Do not place concrete on the subgrade or forms more rapidly than it can be spread, straightened, and darbied or bull floated. These operations must be performed before bleeding water has an opportunity to collect on the surface.

C. To obtain good surfaces and avoid cold joints, plan the size of finishing crews with due regard for the effects of concrete temperature and atmospheric conditions on the rate of hardening of the concrete.

D. If saw-cut joints are required or permitted, time cutting properly with the set of the concrete: start cutting as soon as the concrete has hardened sufficiently to prevent aggregates being dislodged by the saw, and complete before shrinkage stresses become sufficient to produce cracking.

E. Thoroughly consolidate concrete in slabs. Use internal vibration in beams and girders of framed slabs and along the bulkheads of slabs on grade. Obtain consolidation of slabs with vibrating screeds, roller pipe screeds, internal vibrators, or other approved means.

5.10 FINISHES

A. Provide the following finishes as applicable and in accordance with ACI 301 unless specified otherwise herein or shown otherwise on the Drawings:

1. Smooth Form Finish - for all formed concrete surfaces.

2. Broom or Belt Finish - for sidewalks, driveways, ramps and exterior platforms.

3. Provide smooth form finish where type of finish is not certain from above.

B. Smooth Form Finish - Use form facing materials which produce a smooth, hard, uniform texture on the concrete. it may be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. Support it with studs or other backing capable of preventing excessive deflection. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface. Patch tie holes and defects. Completely remove all fins.

C. Broom or Belt Finish - First, float finish the surface as described above. Do not trowel. Give the surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

5.11 TOLERANCES

A. Tolerance in finished elevation shall be ¼ inch per 100 feet of length. This tolerance is non additive.

B. Produce formed surfaces which result in concrete outlines within the tolerances of applicable standards.

C. Depressions in slabs between high spots shall not be greater than 3/16 in. below a 10 ft. long straightedge.

5.12 CURING

A. Beginning immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury, and maintain the concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete.

B. For concrete surfaces not in contact with forms, apply one of the following procedures immediately after completion of placement and finishing:

1. Ponding or continuous sprinkling.

2. Application of absorptive mats or fabric kept continuously wet.

3. Application of sand kept continuously wet.

4. Continuous application of steam (not exceeding 150F) or mist spray.

5. Application of waterproof sheet materials conforming to ASTM C171.

6. River water and other non-potable water sources shall not be acceptable for use in curing.

7. Application of a curing compound conforming to ASTM C309. Apply the compound in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Do not use on any surface against which additional concrete or other material is to be bonded unless it is proved that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications. Minimize moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun by keeping the forms wet until they can be safely removed. After form removal, cure the concrete for at least seven days.

C. Cold Weather - When the mean daily outdoor temperature is less than 40 F, maintain the temperature of the concrete between 50 and 70 F for seven days. When necessary, make arrangements for heating, covering, insulating, or housing the concrete work in advance of placement and maintain the required temperature without injury due to concentration of heat. Do not use combustion heaters during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.

D. Hot Weather - When necessary, make provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material in advance of placement, and take such protective measures as quickly as concrete hardening and finishing operations will allow.

E. Rate of Temperature Change - Keep changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period as uniform as possible and do not exceed 5 F in any 1 hour or 50 F in any 24 hour period.

F. During the curing period, protect the concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. Protect all finished concrete surfaces from damage by construction equipment, materials, or methods, by application of curing procedures, and by rain or running water. Do not load self-supporting structures in such a way as to overstress the concrete.

G. Proper curing methods shall be maintained, including curing methods for side faces once forms are stripped, for a minimum of seven (7) days.

H. No external loads shall be applied to the concrete until seven (7) days after concrete is cast.

I. No piles shall be driven or vibrated within fifty feet (50 ft) of new concrete until seven (7) days after concrete is cast.

5.13 REPAIR OF SURFACE DEFECTS

A. Repair surface defects, including tie holes immediately after form removal.

B. Remove all honeycombed and other defective concrete down to sound concrete. If chipping is necessary, form the edges perpendicular to the surface or slightly undercut. No featheredges will be permitted. Dampen the area to be patched and an area at least 6 in. wide surrounding it to prevent absorption of water from the patching mortar. Prepare a bonding grout using a mix of approximately 1 part cement to 1 part fine sand passing a No. 30 mesh sieve, mixed to the consistency of thick cream, and then well brushed into the surface.

C. Make the patching mixture of the same materials and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2 1/2 parts sand by damp loose volume. Substitute white portland cement for a part of the gray portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete as determined by a trial patch. Use no more mixing water than necessary for handling and placing. Mix the patching mortar in advance and allow it to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

D. After surface water has evaporated from the area to be patched, brush the bond coat well into the surface. When the bond coat begins to lose the water sheen, apply the premixed patching mortar. Consolidate the mortar.

E. After cleaning and thoroughly dampening the tie holes, fill them solid with patching mortar.

F. If permitted or required, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Use such compounds in accordance with the manufacturer's recommendations.

5.14 TESTING

A. Concrete materials and operations will be tested and inspected as the work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such a defect is discovered, nor shall it obligate the Engineer for final acceptance.

B. Additional testing and inspection required by failure to meet specification requirements or by changes in materials or proportions requested by the Contractor shall be paid for by the Contractor.

C. Testing of concrete for mix design purposes shall be paid for by the Contractor.

D. All testing agencies shall meet the requirements of ASTM E 329.

E. Contractor shall engage an independent field and laboratory testing agency to perform all test required by the Contract Documents.

F. To facilitate testing and inspection,

1. Furnish any necessary labor to assist the designated testing agency in obtaining and handling samples at the project or other sources of materials.

2. Advise the designated testing agency sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.

3. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test cylinders on the project site for the first 24 hours as required by ASTM C 31.

G. The first batch of concrete to be poured during a shift shall have its air content, slump and temperature tested, prior to initiating a pour, and will be rejected if values outside accepted ranges are obtained.

H. One strength test sampling shall be randomly taken from each 50 cu. yds. of concrete poured in a given shift. A minimum of five (5) strength test samplings shall be performed on randomly selected batches for each class of concrete on the project. If fewer than five (5) batches of concrete are used, strength test sampling shall be performed on each batch. If the total quantity of a given class of concrete is less than 50 cu. yds., strength tests may be waived at the engineer’s discretion.

I. A strength test sampling shall consist of enough cylinders to perform a minimum of two strength tests, as defined below in 5.14.I.1. All strength

test sampling shall be performed in accordance with ASTM C-172. Cylinders will be made and cured in accordance with ASTM C-31 and tested in accordance with ASTM C-39.

1. A valid strength test shall consist of the breaking of a minimum of two (2) 6”x12” concrete cylinders, or three (3) 4”x8” concrete cylinders. At a minimum, strength tests shall be performed after seven (7) days and twenty-eight (28) days.

2. Additional test cylinders may be taken at the time of sampling, at the Engineer’s or Contractor’s discretion, in order to:

    a. Perform an additional strength test after less than seven (7) days for consideration of form removal.

        i. Forms shall not be removed until the concrete has achieved at least 70% of the design strength.

    b. Perform an additional strength test after fourteen (14) days for evaluation of strength gain.

    c. Perform an additional strength test after either seven (7) days or twenty-eight (28) days to confirm those strength tests results.

    d. Perform an additional strength test after forty-five (45) days should the twenty-eight (28) day strength test results be below the specified strength.

    e. Allow for the discarding of outlying strength results for any strength test, in accordance with ACE 214R.

    f. Perform strength tests of cylinders cured under field conditions to demonstrate the adequacy of the curing and protection undertaken in the field.

        i. The strength test results of field-cured cylinders will not be used for evaluation and acceptance of the concrete strength. However, a field-cured strength test that results in less than 85% of the strength of companion laboratory-cured cylinders will necessitate the improvement of field protection and curing procedures. This 85% limitation will not apply if the field-cure strength exceeds the specified compressive strength by more than 500 psi.

ii. No additional compensation will be allowed to accommodate the requirement to perform the additional sampling and testing under this prevision, and to improve field curing and protection procedures as necessary.

J. The air content, temperature, and slump of the concrete shall be measured for each strength test sampling performed. All sampling shall be performed in accordance with ASTM C 172.

1. These properties tests may be conducted more frequently than the test strength sampling, and may be performed on every arriving batch prior to its placement, at the Engineers discretion.

2. If the measured slump, or air content, or both are found to be *above* the specified upper limit, a check test shall be immediately performed on a fresh sample. If the check test fails, the concrete shall be considered to have failed the requirements of this specification, and shall be rejected.

3. If the measured slump, or air content, or both are found to be *below* the specified upper limit, adjustments shall be permitted in accordance with ASTM C 94. If the adjusted concrete subsequently fails, a check test shall be immediately performed on a fresh sample. If the check test fails, the concrete shall be considered to have failed the requirements of this specification, and shall be rejected.

K. All concrete testing, whether properties testing or strength test sampling, shall be conducted on concrete at the point of placement. The Contractor shall take all necessary measures to efficiently and safely allow the representative of the testing agency to take samples at the point of placement. No additional compensation will be allowed to accommodate this requirement.

L. Representatives of the testing agency will inspect, sample and test the materials and the production of concrete as required by the Engineer. When it appears that any material furnished or work performed by the Contractor fails to fulfill specification requirements, the testing agency will report such deficiency to the Engineer and the Contractor.

M. The testing agency will report all test and inspection results to the Engineer and Contractor immediately after they are performed. All test reports will include the exact location in the work at which the batch represented by a test was deposited. Reports of strength tests will include detailed information on storage and curing of specimens prior to testing.

N. The testing agency and its representatives are not authorized to revoke, alter, relax, enlarge or release any requirement of the contract documents, nor to approve or accept any portion of the work.

5.15 EVALUATION AND ACCEPTANCE

A. Test results for standard molded and standard cured test cylinders will be evaluated separately for each portion of the structure.

B. The strength level of the concrete will be considered satisfactory so long as the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi, or one tenth the specified strength, whichever is greater.

C. Completed concrete work which meets all applicable requirements will be accepted without qualification.

D. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring into compliance will be accepted without qualification.

E. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance as determined by the Engineer may be accepted or rejected. Remove and replace (at Contractor's expense) all concrete work rejected by the Engineer.

F. Formed surfaces resulting in concrete outlines smaller than permitted by the allowable tolerances shall be considered potentially deficient in strength and subject to the requirements stated below for concrete of deficient strength.

G. Formed surfaces resulting in concrete outlines larger than permitted by the allowable tolerances may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance.

H. Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected or misplaced items interfere with other construction.

I. Inaccurately formed concrete surfaces exceeding the limits of applicable standards and which are exposed to view, may be rejected and shall be repaired or removed and replaced if required.

J. Finished slabs exceeding the tolerances of this section may be repaired provided that strength, durability or appearance is not adversely affected. High spots may be removed with a terrazzo grinder, low spots filled with a patching compound or other remedial measures performed as permitted.

K. Concrete with defects which adversely affect the appearance of the specified finish may be repaired, if possible. If, in the opinion of the Engineer, the defects cannot be repaired, the concrete may be either accepted or rejected.

L. Concrete not exposed to view is not subject to rejection for defective appearance, except in those cases where concrete finish is specified.

M. The strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements which control the strength of the structure, including but not necessarily limited to the following conditions.

1. Low concrete strength.

2. Reinforcing steel size, quantity, strength, position, or arrangement at variance with the requirements of the contract drawings.

3. Concrete which differs from the required dimensions or location in such a manner as to reduce the strength.

4. Curing less than that specified.

5. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.

6. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.

7. Poor workmanship likely to result in deficient strength.

N. Structural analysis and/or additional testing may be required when the strength of the structure is considered potentially deficient.

O. Core tests may be required when the strength of the concrete in place is considered potentially deficient.

P. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be required and their results evaluated in accordance with Chapter 20 of ACI 318.

Q. Concrete work judged inadequate by structural analysis or by results of a load test shall be reinforced with additional construction if so directed by the Engineer, or shall be replaced at the Contractor's expense.

- END OF SECTION -

SECTION 036000 - GROUTING

PART 1: GENERAL

1.01 SCOPE

A. Provide all labor, materials, equipment, and services necessary to furnish and place all grout as shown and specified in the contract documents or otherwise required for proper completion of the Work.

B. This specification covers the requirements for the furnishing and installation of non-shrink epoxy grout, sand-cement poured grout and sand-cement drypack grout, unless shown otherwise on the design drawings. The work shall include, but not be limited to the following:

1. Concrete surface preparation.

2. Furnishing and installation of all leveling plates, shims, wedges, and other approved adjusting materials.

3. Furnishing and installation of all grout.

PART 2: PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Application of grout types shall be as follows unless noted otherwise on the drawings:

1. Non-shrink Epoxy Grout

a. Compressors, generators, blowers, pumps, motors and all other rotating equipment, including grout inside equipment bases.

b. Equipment with cast bases.

c. Equipment on base frames or skids up to base of skid (space between beams shall be filled with sand-cement grout)

d. Anchor bolts and structural elements, especially those mounted into existing concrete elements.

2. Sand-Cement Poured Grout

a. Vessels, heat exchangers and other miscellaneous equipment

b. Anchor bolts and structural elements subjected to static loading only.

3. Dry-pack Grout

a. Structural column base plates

b. Small equipment with flat plate bases

B. Manufacturer's printed instructions accompanying epoxy grout containers and the installation instructions given on vendor equipment drawings shall be reviewed together with this specification prior to commencing any grouting. Any conflict among these three sources of information will be resolved by the Engineer. The Construction Manager will issue a revision to this specification, documenting the resolution.

C. Work Prior to Setting Base Plates

1. Concrete foundations shall be at least 7 days old prior to surface preparation.

2. Concrete surfaces shall be prepared for grouting or drypacking by chipping back to sound concrete or to a dimension specified by the Engineer. The surface shall be clean with all laitance, grease, oil, dirt or loosened aggregate removed prior to setting the leveling plate and/or equipment to be grouted.

3. Water for surface soaking, mixing and curing cement-based grout or drypack shall be potable.

4. All leveling plates shall be set to the proper elevation prior to grouting. The number and type of leveling plates will be determined by the Construction Manager in accordance with the recommendations of the equipment manufacturer and other project documents. On subcontracted work, the number and type of leveling plates shall be submitted by the Equipment Installation Subcontractor to the Engineer for review two weeks prior to use. Leveling plates shall be removed after grout hardening and before tightening the anchor bolt nuts.

5. Concrete surfaces on which cement-based grout or drypack is to be placed shall be thoroughly soaked with water for 24 hours. Just prior to grouting, the water shall be removed. All standing water shall be removed from anchor bolt sleeves.

6. Concrete surfaces on which epoxy grout is to be placed shall be completely dry before grouting.

7. Metal surfaces in contact with the grout or drypack shall be clean and free of oil and grease, and foreign substances not associated with the grouting process.

D. Grout Formwork

1. Form work shall be provided for grout and shall be compatible with the method of placing grout specified herein.

2. Forms shall be designed for rapid, continuous and complete filling of space to be grouted. Forms shall be of adequate strength to withstand the forces of the fluid grout, and shall be caulked or sealed with tape to prevent excessive leakage. The forms shall be coated with form oil or heavy wax to prevent grout adherence and absorption.

3. For other than epoxy grout applications, form placement shall allow at least 1 inch (25 mm) of space all around base plates or equipment bases. The top of the forms shall be a minimum of 1 inch (25 mm) above the bottom of the adjacent base plate. Forms shall have a chamfer strip attached to form a chamfered edge at all corners.

4. For all epoxy grout applications, form placement shall be such that the epoxy grout extends 1 ½ inch (38 mm) beyond the outside edge of the foundation, and 4 inches (100 mm) below the top of the poured concrete surface. Grout thickness below the equipment base shall be a minimum of 1 ½ inch (38 mm) for foundations 3 feet (.9m) in width and less, increasing by 1 inch for each additional 3 feet in foundation width. Forms shall have a chamfer strip attached to form a chamfered edge at all corners.

5. For rotating equipment, leveling and alignment shall be performed and witnessed by the Engineer on the same day that the grout is placed.

E. Grout Material Storage

1. Epoxy grout materials shall be stored and handled in accordance with the manufacturer’s printed instructions.

2. Cement-based grouting materials which becomes damp or air-set, prior to use, shall not be used.

3. Epoxy grout aggregate shall be delivered to the jobsite in sound, dry bags and epoxy grout liquids in sealed hardener and resin containers. The Contractor shall be responsible for storing the grout in a dry, weatherproof shelter.

2.02 REQUIREMENTS FOR EPOXY GROUT

A. Materials

Nonshrink epoxy grout shall be a proportioned, factory packaged product consisting of specially formulated resin, hardener and aggregate. Approved epoxy grouts are HILTI, Carter Waters, Five Star, Sika, and Escoweld. Substitutes shall not be permitted unless specifically approved by the Engineer. Epoxy grout shall be designed for injection in anchor bolt applications.

B. Performance Characteristics

1. Epoxy grout shall have a minimum compressive strength of 5000 psi (350 kg/cm ^{2}) at 24 hours when tested in accordance with ASTM C579.

2. Epoxy grout shall have a minimum working time of 45 minutes at 75^o F (24 ^{o} C).

3. The grout shall show no shrinkage (0.0 percent) and a maximum of 2.5 percent expansion at all ages when tested in accordance with ASTM C827 (modified). The volume change test of epoxy grout, ASTM C827 (modified), requires an indicator ball with a specific gravity between 0.9 and 1.1.

4. The grout shall be flowable, or injectable, depending on the application.

2.03 REQUIREMENTS FOR SAND-CEMENT POURED GROUT

A. Materials

1. Grout is a mixture of cement and sand with pouring consistency. The mix shall consist of 1 part of Portland cement and 2 parts of sand by volume.

The water-cement ratio shall be limited to 0.45 by weight.

2. Portland cement shall conform to ASTM C150, Types I, II, IV, or V.

3. Sand shall conform to ASTM C33.

2.04 REQUIREMENTS FOR DRYPACK GROUT

A. Materials

1. Drypack shall be a mixture of one part cement and 2 ½ parts of sand by volume proportioned at the jobsite and mixed thoroughly with just enough water to produce a consistency such that when a sample is tightly squeezed in the hand only enough moisture will come to the surface to moisten the hand.

2. Portland cement shall conform to ASTM C150, Types I, II, IV or V.

3. Sand shall conform to ASTM C33.

PART 3: SUBMITTALS

3.01 Contractor shall submit the following in accordance with the Contract:

A. Submit with the bid, if not otherwise directed, copies of laboratory test reports, including all test data certifying that the selected products will produce grouts of the qualities specified herein. These certification documents shall be forwarded to the Engineer for review and authorization to proceed.

B. Certify that the grout conforms to the test reports submitted with the bid.

PART 4: QUALITY ASSURANCE

4.01 REFERENCE

Comply with the requirements of the latest edition of the following standards.

A. ASTM Standards

1. C33 Specification for Concrete Aggregates

2. C150 Specification for Portland Cement

3. C191 Test for Time of Setting Hydraulic Cement by Vicat Needle

4. C579 Test Method for Compressive Strength of Chemical-resistant Mortars and Monolithic Surfacing

5. C827 Test Method for Early Volume Change of Cementitious Mixtures

B. U.S. Army Corp. of Engineers (CRD) Standards

1. CRD-C79-77 Test Method for Flow of Grout Mixtures (Flow Cone Method)

PART 5: EXECUTION

5.01 EPOXY GROUT

A. Mixing

1. All epoxy grout components shall be conditioned to a temperature range between 70° F to 85° F (21° C to 30° C) prior to mixing. The entire hardener component shall then be added to the entire resin component and thoroughly mixed for 2 to 3 minutes with a low speed mixer. Mixed resin and hardener shall then be put into a clean mortar mixer or wheelbarrow and the entire bag of aggregate added. The combination shall be mixed until aggregate is completely wetted. Nothing else shall be added to the mixture.

2. Mixing shall be adjacent to area being grouted, with sufficient manpower and equipment available for rapid and continuous mixing and placing.

3. Grout shall not be mixed in quantities larger than that which can be placed during the working time specified herein.

B. Placing

1. Epoxy grout has a limited working time after mixing. This working time shall be specified by the grout manufacturer. The placing of grout shall be performed only during this specified working time and any unused grout remaining beyond this time shall be discarded.

2. Epoxy grout shall be injected for anchor bolt applications. In top-down vertical anchor bolt applications, grout may be gravity-poured with the Engineer's approval. Anchors shall be temporarily supported to prevent sagging until the grout is fully cured.

3. When placing epoxy grout, the temperature of the foundation, base plate and grout material shall be within the temporary range of 40° F

to 90° F (5° C to 32° C) or as recommended by the manufacturer, determined by a surface thermometer.

4. Epoxy grout shall be placed from one long side of an equipment base to the other, in one direction only. The grout shall be poured into movable head box having an inclined plane to direct the grout beneath the equipment base in a manner which minimizes trapped air and bubble formation. The head box should be about a 3 foot (1 m) cube to allow large volumes of grout to be poured continuously. The use of vibrators is not permitted. The use of steel straps is permitted to move grout into position but chaining is not permitted because of air entrapment between the links.

5. Pumping epoxy grout is permitted and may eliminate the requirement for a head box.

6. Epoxy grout placing shall be continued until it oozes out along the entire perimeter and up through every interior air relief hole and grout hole. An exception occurs when grouting such equipment as pumps having an elevated interior base plate. In these situations, grout shall be placed under the entire equipment base to the top of the exterior base plate and then the grouting stopped for a short period of time to allow the grout to seal the periphery and then the grouting completed through one of the interior grout holes.

7. Expansion joints shall be in stalled as indicated on the design drawings for epoxy grout placements of long length or large area. In no case shall the poured length in any direction exceed 10 feet (3m) without an expansion joint.

C. Finishing and Curing

1. Finishing and curing shall be in strict accordance with the manufacturer's printed instructions.

2. Epoxies cannot be trimmed after set. They must be left at the finished level with required chamfer strips built into the forms. Top surfaces may be trowelled with a steel trowel moistened with oil. Further finishing will require grinding.

3. The epoxy grout shall be maintained within the placing temperature range for a minimum of 24 hours after placing.

4. Epoxy grout shall not be wet-cured.

5. After 24 hours, the juncture between the equipment base or sole plate and the epoxy grout, and between the epoxy grout and the concrete foundation shall be sealed with a silicon such as R.T.V., as approved by the Engineer.

5.02 SAND-CEMENT POURED GROUT

A. Mixing

1. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 to 5 minutes.

2. Batches shall be sized to allow continuous placement of freshly mixed grout. Grout not used within one hour or in accordance with manufacturer's recommendation, whichever is less, after mixing, shall be discarded.

B. Placing

1. When placing grout the temperature of the foundation, base plate and grout shall be within the temperature range of 40° F to 90° F (5° C to 32° C) or as recommended by the manufacturer, determined by a surface thermometer. This temperature shall be maintained for 3 days following grouting. Preparations for maintaining this temperature shall be submitted to the Engineer.

5.03 DRYPACK GROUT

A. Mixing

1. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 to 5 minutes. Batches shall be sized to allow continuous placement of freshly mixed drypack. Drypack grout not used within one hour , or in accordance with manufacturer's recommendation whichever is less, after mixing shall be discarded. Re-tampering will not be allowed.

B. Placing

1. The space between the top of the flange of steel beam and the bottom of the concrete slab shall be filled with drypack grout by tamping with a bar until the voids are eliminated.

2. When placing drypack grout, the temperature of the concrete, steel, and drypack grout shall be within the temperature range of 40° F to

90° F (5° C to 32° C) or as recommended by the manufacturer, determined by a surface thermometer. This temperature shall be maintained for 3 days following grouting.

5.04 INSPECTION AND QUALITY CONTROL

A. For epoxy grouts, a manufacturer's technical representative shall be called to the field office for a pre-grouting conference to assure that all grouting steps are followed in accordance with the manufacturer's instructions. The representative should remain at the jobsite until the Construction Manager is assured that the correct procedures are being followed and the warranty is not in jeopardy. The Structural Engineer shall be advised if the manufacturer's representative recommends anything contrary to this specification.

B. The Construction Manager and Contractor shall implement contract document procedures for inspection, testing, and documentation. These procedures shall define the documentation that will be employed to assure that the certifications, examinations, tests and approvals required by the contract specifications are accomplished.

C. Vertical support for equipment having a structural steel base frame and a stiffened cover plate is provided by grouting under the base frame. Compliance with the installation procedure established herein will preclude unacceptable voids. Incidental voids under the cover plate may not be detrimental or witnessed and approved by the construction engineer. It is important that the cover plate is sealed by grout against foreign elements.

- END OF SECTION -

SECTION 039320 - CONCRETE REPAIR

PART 1: GENERAL

1.1 SCOPE

The work specified in this section consists of repairs to portions of the existing concrete surfaces as shown on the Contract Drawings and additional work as may be determined by the Owner on a unit price basis. Types of repairs to be made include but are not limited to:

A. Repair of existing cracks.

B. Removal and replacement of deteriorated structural concrete.

C. Repair of surface spalls and delaminations on existing concrete.

D. Removal of existing steel materials present on and within deteriorated concrete for the purpose of repairing the deteriorated concrete.

E. Existing track switches.

1.2. RELATED SECTIONS

A.	Submittal Procedures	Section 013300
B.	Quality Control	Section 014500
C.	Reinforcing Bars	Section 032100
D.	Cast-In-Place Concrete	Section 033000

1.3 JOB CONDITIONS

A. Do not perform any repair work without prior approval of the Owner for the location, limits and type of the repair.

B. Reinforcement may be encountered upon removal of deteriorated concrete.

C. When using water or abrasive blasting equipment, shield all work for the protection of the public and workers on the site.

PART 2: PRODUCTS

2.1 CONCRETE CRACK REPAIR

The Crack Repair Method shall be used to repair cracks wider than one-sixteenth

inch (1/16”) and less than one-quarter inch (1/4”).

A. Bond Breaker Tape: 502A clear polyethylene tape or approved equal or a recommended by the sealant manufacturer to suit application.

B. Crack Sealant: A cold-applied single-component type, polyurethane, non-sag elastomeric sealant, meeting the requirements of ASTM C920 and Federal Specifications, TT-S-00230C, Type II, Class A such as SikaFlex 15LM or approved equal which allows ± 25% joint movement.

2.2 TYPE 1 AND TYPE 2 CONCRETE REPAIR

A. Repair Concrete: Use a polymer-modified cementitious, component, self-consolidation concrete such as Sikaorete 211 SCC or approved equal.

2.3 REINFORCEMENT

A. Conform to Section 032100 - Reinforcing Bars

PART 3: SUBMITTALS

3.1 The Contractor shall submit the following for approval:

A. Product Data: Submit manufactures' product data and current specifications for materials proposed for the work of this section.

PART 4: QUALITY ASSURANCE

A. Manufacture’s Representative Services: The Contractor shall arrange for, and provide, the services of the product manufacture’s technical representative for the initial concrete repair operations. Services shall include detailed instruction to the Contractor’s personnel on the use of the concrete repair materials and witness the first application for each system. Services of the Manufacture’s Representative during construction for consultation, as needed, shall be arranged.

B. Perform mock-ups if required by the Scope of Work:

1. Provide a mock-up at each structure of the required concrete repairs and products.

2. A manufacture’s technical representative for proprietary products shall be present during the execution of the work on mock-ups.

3. The mock-ups at each structure or wall shall include as a minimum:

   a. 10 square feet each of Type 1 and 2 concrete repairs.

   b. 5 linear feet each of surface preparation crack repairs and sealant repairs.

4. Demonstration of work on mock-ups shall be completed prior to beginning production of the work represented by the mock-up.

5. Mock-ups will be used to judge the quality and finish of completed work. Preparation of mock-ups and work performed for demonstration of product application shall be observed by a representative of the product manufacture and Engineer to review and advise on proper application procedures and techniques.

6. Preparation of concrete repairs shall be in accordance with these specifications and the product manufacture's recommendations.

7. Selected mock-up locations shall be representative of typical repair conditions determined by the Engineer.

PART 5: EXCUTION

5.1 REPAIR OF EXISTING CRACKS

A. The Crack Repair Method shall be used to repair cracks wider than one-sixteenth inch (1/16") and less than one-quarter inch (1/4"). Perform surface preparation and placing in conformance with manufacture's specifications and recommendations. Also conform to the following as specifically applicable to this project:

1. Surface Preparation: Rout cracks to be sealed by sawing or grinding. Use oil-free compressed air or water under pressure as approved by the Engineer to remove all dirt, grease, and loose or other bond inhibiting material from inside the cracks.

2. Insert a bond breaker tape along the bottom of the slot.

3. Fill the slot with an Engineer approved polyurethane elastomeric sealant.

5.2 TYPE 1 CONCRETE REPAIRS

A. General: This work consists of the removal of unsound concrete and the

repair of spalled and delaminated concrete surfaces generally over an area of five square feet and two inches and less in depth, with no reinforcing bars exposed, using polymer-modified repair concrete. Surfaces preparation, mixing, and placement shall be in accordance with manufacturer's recommendations.

B. Repair Procedure:

1. Inspection: In the presence of the Engineer, inspect concrete surfaces to be repaired under work for this section to determine the exact limits and locations of all areas to be repaired as work of this section.

2. Make a minimum one inch deep saw cut around the perimeter of the repair area. Remove spalled, scaled, loose and deteriorated concrete to sound concrete. Use maximum 30 pound size pneumatic hammer or other approved method to remove deteriorated concrete. Thoroughly blast or pressure water clean and vacuum the newly exposed area prior to installing repair concrete.

3. Place the polymer-modified repair concrete. Restore the concrete surface to its original lines and finish to match the surrounding concrete surfaces.

4. Render all surfaced of exposed concrete free of oil solvent, grease, dirt, dust, bitumen, rust, loose particles and foreigner matter.

5.3 TYPE 2 CONCRETE REPAIRS

A. General: This work consists of the removal of unsound concrete and the repair of spalled and delaminated concrete surfaces in areas greater than or equal to five square feet and/ or greater that two inches deep where reinforcing bars may be present within the repair area limits. Surfaces preparation, mixing, and placement shall be in accordance with manufacturer's recommendations.

B. Repair Procedure:

1. Inspection: In the presence of the Engineer, inspect concrete surfaces intended to be repaired under work for this section to determine the exact limits and locations of all areas to be repaired as work of this section.

2. Make a minimum one inch deep saw cut around the perimeter of the repair area. Remove spalled, scaled, loose and deteriorated concrete to sound concrete. Use maximum 30 pound size pneumatic

hammer or other approved method to remove deteriorated concrete. Thoroughly blast or pressure water clean and vacuum the newly exposed area prior to installing repair concrete.

3. Remove unsound concrete material in a manner to facilitate uniform placement of fresh concrete; slope upper area of excavated voids evenly to within one inch of the face of the concrete to preclude entrapping air and forming hollow spots on the freshly placed concrete. Within an inch of the surface, the upper outline shall be essentially normal (perpendicular) to the surface.

4. Render all surfaced of exposed concrete free of oil solvent, grease, dirt, dust, bitumen, rust, loose particles and foreigner matter.

5. Use caution where reinforcing steel is uncovered so as not to damage the steel or is bond in the surrounding concrete. Do not use pneumatic tools in direct contact with reinforcing steel. Use maximum 30 pound size hammer for chipping behind reinforcing steel. Clean exposed reinforcing steel in accordance with SSPC-SP-6, Commercial Blast Cleaning, to remove all contaminants, rust and rust scale and coat with epoxy bonding compound.

    a. In areas where reinforcing steel is found to be surrounded by deteriorated concrete or has at least one-half its surface area exposed or has less than 1 inch cover, the depth of removal shall be such as to include all deteriorated concrete but not less than 1 inch below or behind the reinforcing steel.

    b. Where the existing reinforcing steel is severely corroded or damaged, cut out reinforcing steel and replace with new reinforcing steel or the same size and spacing. Where existing steel is determined by the Engineer to have insufficient cover. Either replace reinforcing or adjust as directed. Attach new steel behind existing steel with a minimum lap of 15 inches. Remove concrete a minimum depth of 1 inch behind the new steel.

    c. Provide and tie welded wire fabric to the existing reinforcement or concrete where existing bar spacing exceeds 12 inches.

6. Apply bonding compound to existing surfaces with brush or roller. Place fresh concrete while bonding compound is still tacky. If coating becomes glossy or loses tackiness, remove any surface contaminates then recoat. Follow manufacturer’s instructions for application. Observe all limitations and cautions.

7. Use forms on repair areas of vertical and overhead surfaces of concrete members. Coat forms with a plastic coating or similar type film. Do not use form release agents. Design forms so that placement access will be at the top of each formwork assembly for vertical surfaces.

    a. Prior to forming, install reinforcement as indicated on the Contract Drawings or as required and directed by the Engineer.

8. Use bonding compounds prior to placement of polymer-modified repair concrete.

    a. Place concrete in the maximum height lift possible and consolidate during placement with adequately sized vibrators.

    b. Small holes may be drilled into forms to permit air to escape during pouring and consolidation.

    c. Overhead repairs shall be made by the form and pump method. Design forms so that placement access will be by pumping through ports. Seal joints in the formwork to prevent leakage. Provide holes or vent tubes to prevent the entrapment of air during the pumping process. Support formwork adequately to resist expansive forces of concrete. Details of the pumping sequencing shall be submitted by the Contractor and approved by the Engineer prior to commencing work.

9. After curing and stripping of forms, blend the patched area to match the physical appearance of the adjacent area as close as possible.

    a. The Engineer will sound the patched areas to detect the presence of hollow spots. Remove and repair such defects to the satisfaction of the Engineer and at no additional cost to the Owner.

- END OF SECTION -

SECTION 051200 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications and general provisions of the Contract, including General and Supplementary Conditions, all documents included within this contract and Division 00, 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes fabrication and erection of structural steel work, as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.

1. Structural steel is that work defined in American Institute of Steel Construction (AISC) “Code of Standard Practice” and as otherwise shown on drawings.
2. Refer to Division 3 for anchor bolt installation in concrete.
3. Refer to Division 9 for touch-up and repair painting.

B. Related Sections:

1. Section 055000 – Metal Fabrications
2. Section 099113 – Exterior Painting
3. Section 099123 – Interior Painting
4. Section 033000 – Cast-In-Place Concrete

1.3 REFERENCES

A. American Institute of Steel Construction:

1. Steel Construction Manual.
2. AISC 303 – Code of Standard Practice for Steel Buildings and Bridges.

B. American Society for Testing Materials (ASTM):

1. ASTM C150 - Standard Specification for Portland Cement.
2. ASTM A6/A6M – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling
3. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
4. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
5. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 1020/105 ksi Minimum Tensile Strength

6. ASTM A500/A500M – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
7. ASTM A572/A572M – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
8. ASTM F959 – Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
9. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

C. American Welding Society (AWS)

1. AWS D1.1 – Structural Welding Code – Steel.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.
2. High strength bolts (each type), including nuts and washers, including certified copy of mill reports.

a. Include Direct Tension Indicators.

C. Shop drawings prepared under supervision of a Structural Engineer licensed in the **State of New Jersey**, including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.

1. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.
2. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.

D. Certified copies of each survey conducted by a licensed Land Surveyor, showing elevations and locations of leveling plates and anchor bolts to receive structural steel and final elevations and locations for major members. Indicate discrepancies between actual installation and contract documents.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:

1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges", (AISC 303).

2. AISC "Specifications for Structural Steel Buildings," including "Commentary."
3. "Specifications for Structural Joints Using High-Strength Bolts" approved by the Research Council on Structural Connections.
4. American Welding Society (AWS) D1.1 "Structural Welding Code Steel."
5. ASTM A6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

B. Qualifications for Welding Work: Qualify welding procedures and welding operators in accordance with AWS "Qualification" requirements.

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
2. If recertification of welders is required, retesting will be Contractor's responsibility.

C. High Strength Bolts:

1. High-strength bolts shall be preassembled and supplied directly by the manufacturer. Boxes shall be marked so that bolts may be traced to mill certificates.

1.6 INSPECTION

A. Material or workmanship will be subject to inspection in the shop and field.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast in place concrete or masonry, in ample time so as not to delay work.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. If bolts and nuts become dry or rusty, clean and relubricate before use.

1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: For fabrication of work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes.

B. Structural Steel Shapes, Plates, and Bars: ASTM A 36. High-Strength Structural Steel Shapes, Plates, and Bars: ASTM A 572, Grade 50.

C. Cold Formed Steel Tubing: ASTM A 500, Grade B (Round, Fy=46 ksi), Grade C (Square and Rectangular, Fy=50 ksi.)

D. Anchor Bolts: ASTM F 1554; Grade 36, non-headed type with double nuts and washer at each end unless otherwise indicated.

E. Concrete Anchors: Adhesive Anchors, unless noted otherwise on Contract Documents.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. HVA with HAS SS rods as manufactured by Hilti.
    b. EPCON Ceramic 6 as manufactured by ITW Ramset/Redhead with stainless steel rod.

F. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low carbon steel bolts and nuts.

1. Provide hexagonal heads and nuts for all connections.

G. High Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

1. Quenched and tempered medium carbon steel bolts, nuts, and washers, complying with ASTM A 325.

H. Direct Tension Indicators: ASTM F 959, type as required.

1. Shall be installed with each bolt.

I. Electrodes for Welding: Comply with AWS Code, E 70 Series.

J. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.

K. Nonmetallic Shrinkage Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with COE CRD C621.

1. Products: Subject to compliance with requirements, provide one of the following:
2. Products: subject to compliance with requirements, provide one of the following:

a. 100 Non Shrink Grout (Non Metallic); Conspec, Inc.
b. Supreme Grout; Cormix, Inc.
c. Sure Grip Grout; Dayton Superior.
d. Euco N.S.; Euclid Chemical Co.
e. Crystex; L & M Construction Chemicals, Inc.
f. Masterflow 713; Master Builders.
g. Sealtight 588 Grout; W. R. Meadows.
h. Propak; Protex Industries, Inc.
i. Set Non Shrink; Set Products, Inc.
j. Five Star Grout; U.S. Grout Corp.
k. Owner Approver Equal.

2.2 FABRICATIONS

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.

1. Properly mark and match mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections, as indicated.

C. Bolt field connections, except where welded connections or other connections are indicated.

1. Provide high strength threaded fasteners for all bolted connections, except where unfinished bolts are indicated.

D. High Strength Bolted Construction: Install high strength threaded fasteners in accordance with AISC "Specifications for Structural Joints Using High-Strength Bolts".

E. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

F. Assemble and weld built up sections by methods that will produce true alignment of axes without warp.

G. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.

H. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.

I. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 FINISH

A. Surface Preparation: After inspection and before shipping, clean steel work to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:

1. SP 1 "Solvent Cleaning."
2. SP-6 "Commercial Blast Cleaning."

B. Galvanize all structural steel members to ASTM A123/A123M. Furnish minimum 1.25 oz/sq ft galvanized coating.

C. General: Shop paint structural steel as much as possible to reduce field painting. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.

1. Do not paint surfaces to be welded or high strength bolted with slip critical-type connections.

2. Do not paint surfaces scheduled to receive sprayed on fireproofing.
3. Apply 2 coats of paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.4 SOURCE QUALITY CONTROL

A. Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

1. Promptly remove and replace materials or fabricated components that do not comply.

B. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

1. Promptly notify Engineer whenever design of members and connections for any portion of structure are not clearly indicated.

PART 3 - EXECUTION

3.1 ERECTION

A. Surveys: Employ a surveyor for accurate erection of structural steel. Check elevations of concrete bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Engineer. Do not proceed with erection until corrections have been made or until compensating adjustments to structural steel work have been agreed upon with Owner’s Representative.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.

D. Grout under column baseplates using a shrinkage resistant cement grout. Grout inside anchor bolt sleeves using a flowable nonshrink grout.

E. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
4. For proprietary grout materials, comply with manufacturer's instructions.

F. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

G. Level and plumb individual members of structure within specified AISC tolerances.

H. Splice members only where indicated and accepted on shop drawings.

I. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts or fill with weld metal, grind smooth and field drill.

J. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to Engineer. Finish gas cut sections equal to a sheared appearance when permitted.

K. Touch Up Painting: Cleaning and touch up painting of field welds, bolted connections, and abraded areas of shop paint and galvanizing on structural steel is included in Division 9 under painting work.

3.2 QUALITY CONTROL

A. Contractor will engage an independent testing and inspection agency to inspect high strength bolted connections and welded connections and to perform tests and prepare test reports.

B. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.

C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

D. Testing agency may inspect structural steel at plant before shipment.

E. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.

F. Shop Bolted Connections: Inspect or test in accordance with AISC specifications.

1. Verify that gaps of installed Direct Tension Indicators are less than gaps specified in ASTM F 959, Table 2.

G. Shop Welding: Inspect and test during fabrication of structural steel assemblies, as follows:

1. Certify welders, conduct inspections and tests and have testing agency submit reports. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
2. Perform visual inspection of all welds.
3. Perform non-destructive testing in accordance with the following:

a. 10 percent of fillet welds.
b. 25 percent of partial and full penetration welds.

H. Field Bolted Connections: Inspect in accordance with AISC specifications.

1. All Direct Tension Indicators, comply with requirements of ASTM F 959. Verify that gaps are less than gaps specified in Table 2.

I. Field Welding: Is prohibited.

END OF SECTION 051200

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Standard Contract Requirements, Special Provisions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Electric-motor operated overhead coiling doors, operators, controls and accessories.

1.3 REFERENCES

A. A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. American Society for Testing and Materials (ASTM):
   1. 1. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized).

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance:
   1. 1. System must meet or exceed applicable minimum wind load requirements.

1.5 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer’s product data and installation instructions.

C. Shop Drawings: Provide drawings indicating guide details, head and jamb conditions, clearances, anchorage, accessories, finish colors, patterns and textures, operator mounts and other related information.

D. Quality Assurance Submittals: Submit the following:
   1. Submit manufacturer's certificate that products meet or exceed specified requirements.
   2. Submit installer qualifications.

E. Closeout Submittals: Submit the following:
   1. Warranty documents.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity, and trained and authorized by the door dealer to perform the work of this section.

B. Manufacturer Qualifications: Company with a minimum of five-year experience in producing the specified type of doors.

C. Coordination: Verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

1.7 DELIVERY, STORAGE & HANDLING

A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.8 WARRANTY

A. Manufacturer shall provide a minimum of one (1) year warranty against defects in material and workmanship.

B. Manufacturer shall provide a minimum of two (3) year warranty on electrical operator and its component parts against defects in material and workmanship.

1.9 MAINTENANCE

A. Extra Materials: Provide additional material for use by owner in building maintenance. Package products with protective covering and identify with

descriptive labels. Comply with Closeout Submittals (Maintenance Materials) Section. Service and repair should be performed by an authorized supplier / installer.

B. Maintenance Service: Submit for Owner's consideration and acceptance maintenance service agreement for products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Raynor DuraCoil Door, model FP or Engineer approved equal.

2.2 DOOR OPERATORS

A. Provide doors designed for electric motor operation.
   1. Drive Orientation: For electric motor operated doors, coordinate installation conditions for drive orientation via shop drawing.

2.3 GUIDES

A. Guide Assemblies: To consist of three structural steel angles, minimum 3 inches by 2 inches by 3/16 inch and fitted with removable curtain stops. Steel guides to be provided with one coat of rust-inhibitive primer.

B. Weather Seal: Guide brush seal.

2.4 COUNTERBALANCE SYSTEM

A. Headplates: 3/16 inch steel plate, attached to wall angle of guide assembly with 1/2 inch diameter class 5 case hardened bolts. Inside of drive bracket fitted with sealed ball bearing. Provide head plates with one coat of rust-inhibitive primer

B. Barrel: Minimum 4-1/2 inches O.D. and 0.120 inch wall thickness structural steel pipe. Deflection of pipe under full load shall not exceed 0.03 inch per foot of span.

C. Counterbalance: Provide torsion counterbalance mechanism as follows: Torsion Spring: Oil-tempered, helical torsion springs, grease packed and mounted on a continuous steel torsion shaft.

2.5 ENCLOSURES

A. Hood: Round Hood: 24 gauge steel, finish-painted to match curtain.

B. Hood Baffle: With EPDM seal to inhibit air infiltration through hood cavity.

2.6 HARDWARE

A. Locks: Furnish door system with interlock switch with locking bar.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions and recommendations of door manufacturer.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify through direct observation and field measurement all site conditions for installation of doors, operators, controls and accessories. Ensure that opening is square, flush and plumb.

3.3 INSTALLATION

A. General: Install door, guide and operating equipment complete with all necessary accessories and hardware according to shop drawings and manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide manufacturer's field service consisting of product installation and use recommendations, and adequate site visits to observe and ensure product installation is done in accordance with manufacturer's recommendations.

3.5 ADJUSTING

A. General: Lubricate bearings and sliding parts and adjust doors for proper operation, balance, clearance and similar requirements.

3.6 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Repair or replace installed products damaged prior to or during installation.

B. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove and legally dispose of construction debris from project site.

- END OF SECTION -

SECTION 099000 – PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation and field application of paints, and other coatings.

B. Related Requirements:

1. Section 321723 - Pavement Markings: For traffic paint used for parking area stall delineations and other pavement marking.

2. Section 323913 – Bollards and Bollard Covers: For paint used on steel pipe protection bollards for yard hydrants and fire hydrants.

3. Section 331419 – Valves and Hydrants for Water Utility Service: Color coding and painting of Fire Hydrants and Yard Hydrants.

1.2 DEFINITIONS

A. Refer to ASTM D16 for definitions of terms used in this Section.

1.3 REFERENCE STANDARDS

A. American Society of Testing Materials (ASTM): Conform to ASTM D16 for interpretation of terms used in this Section.

B. National Paint and Coatings Association (NPCA): Guide to U.S. Government Paint Specifications.

C. Painting and Decorating Contractors of America (PDCA): Painting - Architectural Specifications Manual.

D. Steel Structures Painting Council (SSPC): Steel Structures Painting Manual.

E. ANSI A13.1: Scheme for Identification of Piping System.

F. OSHA safety color regulation.

1.4 SEQUENCING

A. Section 011000 - Summary: Requirements for sequencing.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

1.6 QUALITY ASSURANCE

A. MPI Standards:

1. Comply with indicated MPI standards.

2. Products: Listed in MPI - Approved Products List.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Schedule delivery of materials at the site at such time as required for proper coordination of the work. Receive materials in manufacturer's unopened packages and bearing manufacturer's label.

B. Storage:

1. General: Store materials in a dry and properly ventilated separate structure not less than 50 feet - 0 inch from any other structure on the site. Adequately protect from damage and exposure to the elements.

2. Temperature: Maintain minimum of 45 degrees F and a maximum of 90 degrees F.

3. Fire Prevention: Take necessary precautions to prevent fire; remove paint-soiled rags and waste from building each day or store in metal containers with covers in the paint storage structure.

1.8 AMBIENT CONDITIONS

A. Section 015000 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

B. Storage Conditions:

1. Minimum Ambient Temperature: 45 degrees F.
2. Maximum Ambient Temperature: 90 degrees F

C. Application Conditions:

1. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint manufacturer.
2. Do not apply exterior coatings during rain or snow, when relative humidity is outside humidity ranges, or when moisture content of surfaces exceeds those required by paint manufacturer.
3. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors and 50 degrees F for exteriors, unless otherwise indicated by manufacturer instructions.

PART 2 - PRODUCTS

A. PAINT, GENERAL

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Materials:

1. Coatings:

a. Ready mixed, except field-catalyzed coatings.

b. Capable of drying or curing free of streaks or sags.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Requirements for application examination.

B. Verify that surfaces are ready to receive Work as recommended by product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of Work, and report conditions capable of affecting proper application to Architect/Engineer.

D. Test shop-applied primer for compatibility with subsequent cover materials.

3.2 PREPARATION

A. Section 017300 - Execution: Requirements for application preparation.

B. Prepare coatings as follows:

1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.

2. For smooth flow and brushing properties.

C. Defects:

1. Correct defects and clean surfaces capable of affecting Work of this Section.

D. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint application:

1. Remove foreign particles to permit adhesion of finishing materials.

E. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish:

1. Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter.

2. Remove oil and grease with solution of tri-sodium phosphate, rinse well, and allow to dry.

3. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water, and allow to dry.

F. Uncoated Steel and Iron Surfaces:

1. Remove grease, mill scale, weld splatter, dirt, and rust.

2. If heavy coatings of scale are evident, remove by wire brushing or by sandblasting.

3. Clean by washing with solvent.

4. Apply treatment of phosphoric acid solution, ensuring that weld joints, bolts, and nuts are similarly cleaned.

5. Spot-prime paint after repairs.

G. Shop-Primed Steel Surfaces:

1. Sand and scrape to remove loose primer and rust.

2. Feather edges to make touch-up patches inconspicuous.

3. Clean surfaces with solvent.

4. Prime bare steel surfaces.

H. Existing Work:

1. Extend existing paint and coatings installations using materials and methods compatible with existing installations and as specified.

3.3 APPLICATION

A. Comply with MPI - Architectural Painting Manual.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform appearance.

D. Apply each coat of paint slightly darker than preceding coat, unless specified otherwise.

E. Finishing Protection Bollards

1. Section 323913 – Bollards and Bollard Covers includes requirements for paint and primer used on concrete filled steel pipe protection bollards for installation at yard hydrants and fire hydrants.

F. Restoration of Traffic Markings

1. Section 321723 - Pavement Markings, includes requirements for traffic paint used for restoration or replacement of pavement markings removed or rendered illegible as a direct or indirect result of Contractors activities.

2. Restore existing pavement markings following the completion of water line installation, including testing, backfill, compaction and repaving where installation occurred through existing pavements. Restoration shall include pavement markings on areas immediately

adjacent to excavations or where existing pavement markings have been rendered illegible as a result of contractor's activities.

G. Fire Hydrants and Sanitary Yard Hydrants

1. Section 331419 – Valves and Hydrants for Water Utility Service includes requirements for paint and color coding of Fire Hydrants and Sanitary Yard Hydrants.

2. Paint shop-primed hydrants.

3. Where manufacturer applied finishes have been damaged during handling or installation, repaint as follows;

a. Where manufacturers applied finish color complies project specifications, prepare damaged surface area(s), reapply primer and paint affected area to match original finish color.

b. Where manufacturer applied finish color does not meet specified color(s), prepare damaged surface area(s), apply primer to affected area, and apply finish color(s) to entire hydrant complying with project specifications.

4. Color-Coding:

a. Color-code equipment according to indicated requirements.

3.4 FIELD QUALITY CONTROL

A. Section 017300 - Execution: Requirements for testing, adjusting, and balancing.

B. Inspecting and Testing: Comply with MPI - Architectural Painting Manual.

3.5 CLEANING

A. Section 017300 - Execution: Requirements for cleaning.

B. Collect waste material that may constitute fire hazards, place in closed metal containers, and remove daily from Site.

- END OF SECTION -

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
2. Grout.
3. Common electrical installation requirements.

1.3 DEFINITIONS

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

1.5 SHOP DRAWING SUBMITTALS AND PRODUCT SUBSTITUTION

A. The following shall be considered an amendment to Specification section 012500 – SUBSTITUTION PROCEDURES.

B. If the Contract Documents state "basis of design product shall be used" the Contractor shall provide the specified or scheduled material or equipment.

C. If the Contract Documents list two or more acceptable products for an item of work, the choice shall be up to the contractor. However, should any product other than the specified or scheduled "Basis of Design" be submitted, the contractor shall be responsible for making any and all changes to the project required to accommodate that product. He shall also be responsible for paying all associated costs necessitated by the change including the costs incurred by other trades on the project, the fees for the Design Professionals for reviewing the product and performing any design work necessitated by the change, and for costs caused by schedule delays caused by the change.

D. If a Contractor intends to substitute an "or equal" that is not listed by name on the documents, he must do so at the time of bid. If the required notice is not provided and an "or equal" substitution is requested, the Design Professional and Owner, at their sole discretion, may refuse to consider the substitution unless the product specified is no longer commercially available. If the Design Professional and Owner allow the substitution to be proposed despite the lack of proper notice, the Contractor will be back-charged the professional fees incurred by the Design Professional and Owner in reviewing the proposed substitution.

E. Whenever in the Contract Documents any specific article, device, equipment, product, material, fixture, patented process, form, method, or type of construction is indicated or specified by name, make, trade name, or catalogue number, with or without the words "or equal", such specifications shall be used for the purpose of facilitating description of material, process, or article desired, and shall be deemed to be followed by the words "or equal". Contractor may, unless it is specifically stated that the basis of design shall be used, offer any material, process, or article which shall be substantially equal or better in every respect to that so indicated or specified, which will completely accomplish the purpose of the Contract Documents.

F. The Owner shall not incur additional responsibilities, including but not limited to, additional compensation to the Design Professional for redesign and evaluation services, increased cost of other construction to the Owner, or similar considerations as all such costs shall be borne by the Contractor proposing the change.

G. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

2. Name file with submittal number or other unique identifier, including revision identifier.
3. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number. Resubmittals shall include an alphabetic suffix after another decimal point.
4. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Design Professional.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

PART 2 - PRODUCTS

2.1 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non staining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

- END OF SECTION -

SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Mineral-insulated cable, Type MI, rated 600 V or less.
4. Fire-alarm wire and cable.
5. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Encore Wire Corporation.
2. General Cable Technologies Corporation.
3. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type USE-2 and Type SE: Comply with UL 854.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Encore Wire Corporation.
2. General Cable Technologies Corporation.
3. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.

4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Steel, interlocked.

I. Jacket: PVC applied over armor.

2.3 MINERAL-INSULATED CABLE, TYPE MI

A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. KME America, Inc.
2. Pentair.
3. Watlow Electric Manufacturing Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. UL 2196 for fire resistance.

3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper.

E. Insulation: Compressed magnesium oxide.

F. Sheath: Copper.

2.4 FIRE-ALARM WIRE AND CABLE

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 Wire & Cable Inc.
2. CommScope, Inc.
3. Superior Essex Inc.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.5 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. 3M Electrical Products.
2. Hubbell Incorporated, Power Systems.
3. Ideal Industries, Inc.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

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. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type USE, single conductor in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type XHHW, THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type XHHW, THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type XHHW, THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 INSTALLATION OF FIRE-ALARM WIRING

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted.
3. Signaling Line Circuits: Power-limited fire-alarm cables may be installed in the same cable or pathway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

D. Comply with requirements in 284621.13 “Conventional Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 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.

3.7 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."

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.

3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

- END OF SECTION -

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

    a. Slotted support systems, hardware, and accessories.
    b. Clamps.
    c. Hangers.
    d. Sockets.
    e. Eye nuts.
    f. Fasteners.
    g. Anchors.
    h. Saddles.
    i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

1.4 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. Suspended ceiling components.
2. Ductwork, piping, fittings, and supports.
3. Structural members to which hangers and supports will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

a. Luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

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. ABB (Electrification Products Division).
    b. Atkore International (Unistrut).
    c. Eaton (B-line).

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

- END OF SECTION -

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, inner duct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

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. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

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. Atkore International (Allied Tube & Conduit).
    b. Southwire Company.
    c. Wheatland Tube Company.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. EMT: Comply with ANSI C80.3 and UL 797.
5. FMC: Comply with UL 1; zinc-coated steel.
6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

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. Atkore International (Allied Tube & Conduit).
    b. Southwire Company.
    c. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:

    a. Material: Steel.

b. Type: Setscrew.

7. 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.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for GRC: 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 AND FITTINGS

A. Nonmetallic Conduit:

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. Atkore International (AFC Cable Systems).
   b. Cantex Inc.
   c. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fiberglass:

   a. Comply with NEMA TC 14.
   b. Comply with UL 2515 for aboveground raceways.
   c. Comply with UL 2420 for belowground raceways.

4. ENT: Comply with NEMA TC 13 and UL 1653.
5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
6. LFNC: Comply with UL 1660.

7. Rigid HDPE: Comply with UL 651A.
8. Continuous HDPE: Comply with UL 651A.
9. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.

B. Nonmetallic Fittings:

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. Atkore International (AFC Cable Systems).
    b. Cantex Inc.
    c. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

    a. Fittings for LFNC: Comply with UL 514B.

4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

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. ABB (Electrification Products Division).
2. Eaton (B-line).
3. Schneider Electric USA (Square D).

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 12 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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 unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

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. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
2. Hubbell Incorporated.
3. Wiremold; Legrand North America, LLC.

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. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

J. Gangable boxes are allowed.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 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. Oldcastle Enclosure Solutions.
   c. Quazite; Hubbell Incorporated, Power Systems.

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, "ELECTRIC."
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 and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

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: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
   a. Maintenance Areas.
   b. Storage Room.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC.
6. Boxes and Enclosures: NEMA 250, Type 12, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. 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.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches of enclosures to which attached.

L. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch 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 intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor.

M. Stub-Ups to Above Recessed Ceilings:

1. Use EMT or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. 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.

O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

R. 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.

S. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

U. 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.

V. 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 an underground service raceway enters a building or structure.
2. Conduit extending from interior to exterior of building.
3. Conduit extending into pressurized duct and equipment.
4. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
5. Where otherwise required by NFPA 70.

W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

X. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Z. 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.

AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces

to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

CC. Locate boxes so that cover or plate will not span different building finishes.

DD. 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.

EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

FF. Set metal floor boxes level and flush with finished floor surface.

GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches 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 from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

- END OF SECTION -

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Round sleeves.
2. Rectangular sleeves.
3. Sleeve seal systems.
4. Grout.
5. Pourable sealants.
6. Foam sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Wall Sleeves, Steel:

1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

2.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Description:

a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness must be 0.052 inch.
2) For sleeve cross-section rectangle perimeter not less than 50 inches or with one or more sides larger than 16 inches, thickness must be 0.138 inch.

2.3 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.5 POURABLE SEALANTS

A. Description: Single-component, 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.

2.6 FOAM SEALANTS

A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. 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 space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed.
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.

C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch

annular clear space between pipe and sleeve for installing mechanical sleeve seals.

F. Underground, Exterior-Wall and Floor Penetrations:

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install conduits and cable with no crossings within the sleeve.

B. Fill opening around conduits and cables with expanding foam without leaving voids.

C. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS

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.

- END OF SECTION -

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70.

B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

C. Comply with ANSI Z535.4 for safety signs and labels.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service conductors.

1. Color shall be factory applied.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 240-V Circuits:

a. Phase A: Black.
b. Phase B: Red.

4. Colors for 480/277-V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

5. Color for Neutral: White.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

E. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

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. Brady Corporation.
    b. Panduit Corp.
    c. Seton Identification Products; a Brady Corporation company.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

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. Brady Corporation.
    b. Panduit Corp.
    c. Seton Identification Products; a Brady Corporation company.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

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. Brady Corporation.
    b. Ideal Industries, Inc.
    c. Seton Identification Products; a Brady Corporation company.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels:

    a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

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. Brady Corporation.
b. Ideal Industries, Inc.
c. Panduit Corp.

2. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

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. Brady Corporation.
b. HellermannTyton.
c. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

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. Brady Corporation.
b. HellermannTyton.
c. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

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. HellermannTyton.
b. Ideal Industries, Inc.
c. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

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. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.

C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.

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. HellermannTyton.
b. LEM Products Inc.
c. Seton Identification Products; a Brady Corporation company.

D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

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. HellermannTyton.
b. Carlton Industries, LP.
c. Seton Identification Products; a Brady Corporation company.

E. Underground-Line Warning Tape:

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. Brady Corporation.
    b. Ideal Industries, Inc.
    c. Seton Identification Products; a Brady Corporation company.

2. Tape:

    a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
    b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

    a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
    c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

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. Brady Corporation.
    b. emedco.
    c. Seton Identification Products; a Brady Corporation company.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

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. Brady Corporation.
    b. emedco.
    c. Seton Identification Products; a Brady Corporation company.

2. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags:

    a. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

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. Carlton Industries, LP.
    b. emedco.
    c. Marking Services, Inc.

2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

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. Brady Corporation.
    b. emedco.
    c. Marking Services, Inc.

2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

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. Brady Corporation.
   b. emedco.
   c. Marking Services, Inc.

2. Engraved legend.
3. Thickness:

   a. For signs up to 20 sq. in., minimum 1/16 inch thick.
   b. For signs larger than 20 sq. in., 1/8 inch thick.
   c. Engraved legend with black letters on white face.
   d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

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. HellermannTyton.
2. Ideal Industries, Inc.
3. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

L. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

N. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

V. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

W. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using cable ties.

X. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using cable ties.

Y. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using cable ties.

Z. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

AA. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

BB. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

CC. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive

labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

E. Auxiliary Electrical Systems Conductor Identification: Marker tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

F. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

G. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

H. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

I. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.

- END OF SECTION -

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 15 A.
2. GFCI receptacles, 125 V, 20 A.
3. Twist-locking receptacles.
4. Toggle switches, 120/277 V, 20 A.
5. Decorator-style devices, 20 A.
6. Wall plates.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

G. Device Color:
1. SPD Devices: Blue.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

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. Leviton Manufacturing Co., Inc.
b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 15 A

A. Duplex Receptacles, 125 V, 15 A:

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. Leviton Manufacturing Co., Inc.
b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Standards: Comply with UL 498 and FS W-C-596.

2.4 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

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. Leviton Manufacturing Co., Inc.
b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

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. Leviton Manufacturing Co., Inc.
    b. Pass & Seymour; Legrand North America, LLC.
    c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Type: Feed through.
5. Standards: Comply with UL 498 and UL 943 Class A.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.5 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20A, 30A, 50A, 60A:

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. Leviton Manufacturing Co., Inc.
    b. Pass & Seymour; Legrand North America, LLC.
    c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Configuration: NEMA WD 6, Configuration L5-20R, L5-30R, L5-50R, L5-60R.
3. Standards: Comply with UL 498.

B. Twist-Lock, Single Receptacles, 250 V, 20A, 30A, 50A, 60A:

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. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
    b. Leviton Manufacturing Co., Inc.
    c. Pass & Seymour; Legrand North America, LLC.

2. Configuration: NEMA WD 6, Configuration L6-20R, L6-30R, L6-50R, L6-60R.
3. Standards: Comply with UL 498.

C. Twist-Lock, Single Receptacles, 277 V:

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. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.

2. Configuration: NEMA WD 6, Configuration L7-20R, L7-30R, L7-50R, L7-60R.
3. Standards: Comply with UL 498.

D. Twist-Lock, Isolated-Ground, Single Receptacles, 125 V, 20 A:

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. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.

2. Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
3. Configuration: NEMA WD 6, Configuration L5-20R, L5-30R, L5-50R, L5-60R.
4. Standards: Comply with UL 498.

2.6 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

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. Leviton Manufacturing Co., Inc.

b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Standards: Comply with UL 20 and FS W-S-896.

B. Three-Way Switches, 120/277 V, 20 A:

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. Leviton Manufacturing Co., Inc.
b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Comply with UL 20 and FS W-S-896.

C. Four-Way Switches, 120/277 V, 20 A:

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. Leviton Manufacturing Co., Inc.
b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Standards: Comply with UL 20 and FS W-S-896.

D. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:

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. Leviton Manufacturing Co., Inc.
b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Factory-supplied key in lieu of switch handle.
3. Standards: Comply with UL 20 and FS W-S-896.

2.7 DECORATOR-STYLE DEVICES, 20 A

A. Decorator Single-Pole Switches, 120/277 V, 20 A:

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. Leviton Manufacturing Co., Inc.
b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Comply with UL 20.

B. Decorator Three-Way Switches, 120/277 V, 20 A:

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. Leviton Manufacturing Co., Inc.
b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Comply with UL 20 and FS W-S-896.

C. Decorator Four-Way Switches, 120/277 V, 20 A:

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. Leviton Manufacturing Co., Inc.
b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Standards: Comply with UL 20 and FS W-S-896.

2.8 OCCUPANCY SENSORS

A. Wall Switch Sensor Light Switch, Dual Technology:

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. Leviton Manufacturing Co., Inc.
b. Pass & Seymour; Legrand North America, LLC.
c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
3. Standards: Comply with UL 20.
4. Rated 10 A at 277 V ac for LED lighting.
5. Adjustable time delay of 20 minutes.
6. Able to be locked to Automatic or Manual-On mode.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

B. Wall Sensor Light Switch, Passive Infrared:

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. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.

2. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
3. Standards: Comply with UL 20.
4. Rated 10 A at 277 V ac for LED lighting.
5. Adjustable time delay of 20 minutes.
6. Able to be locked to Automatic or Manual-On mode.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

C. Wall Sensor Light Switch, Ultrasonic:

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. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.

2. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using ultrasonic technology.
3. Standards: Comply with UL 20.
4. Rated 10 A at 277 V ac for LED lighting.

5. Adjustable time delay of 20 minutes.
6. Able to be locked to Automatic or Manual-On mode.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

2.9 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

D. Antimicrobial Cover Plates:

1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Tarnish resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

- END OF SECTION -

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Luminaire-mounted photoelectric relays.
2. Luminaire types.
3. Materials.
4. Finishes.
5. Luminaire support components.

1.2 DEFINITIONS

A. Fixture: See "Luminaire."

B. Lumen: Measured output of lamp and luminaire, or both.

C. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens), and energy-efficiency data.

a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

5. Wiring diagrams for power, control, and signal wiring.
6. Photoelectric relays.
7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps, use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Structural members to which luminaires will be attached.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of the following:

1. Luminaire.

D. Product Test Reports: For each luminaire, for tests performed.

E. Source quality-control reports.

F. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts.: Furnish at least one of each type.
3. Diffusers and Lenses: Furnish at least one of each type.
4. Globes and Guards: Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:

1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.9 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with ANSI C81.61.

F. Internal driver.

G. Nominal Operating Voltage: 277 V ac

H. Lamp Rating: Lamp marked for outdoor use

I. Source Limitations:

1. Obtain luminaires from single source from a single manufacturer.

2.2 LUMINAIRE TYPES

ions.

A. Canopy:

1. Manufacturers: Lithonia Model CNYLEDP240KMVOLTDDBM4
2. Shape: Square.
3. Dimensions: 10 inches square
4. Housings:

a. Cast-aluminum housing and heat sink.
b. polyester powder-coat finish.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

E. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

F. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage and coating.
c. CCT and CRI for all luminaires.

2.4 FINISHES

A. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2.5 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.

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 electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Install lamps in each luminaire.

C. Fasten luminaire to structural support.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
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.

E. Wiring Method: Install cables in raceways. Conceal raceways and cables.

F. Coordinate layout and installation of luminaires with other construction.

G. Adjust luminaires that require field adjustment or aiming.

H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533.13 "Conduits for Electrical Systems" for wiring connections and wiring methods.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533.13 "Conduits for Electrical Systems."

C. IDENTIFICATION

D. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. 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.

    a. IES LM-79.
    b. IES LM-80.test standards apply.

C. Luminaire will be considered defective if it does not pass tests and inspections.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

- END OF SECTION -

SECTION 310516 - AGGREGATES FOR EARTHWORK

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. Coarse aggregate materials.
2. Fine aggregate materials.

B. Related Sections:
1. Section 312316.13 - Trenching

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO M6 - Standard Specification For Fine Aggregate For Hydraulic Cement Concrete.
2. AASHTO M29 - Standard Specification For Fine Aggregate For Bituminous Paving Mixtures.
3. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
4. AASHTO T96 - Standard Method Of Test For Resistance To Degradation Of Small-Size Coarse Aggregate By Abrasion And Impact In The Los Angeles Machine.
5. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
1. Chapter 1, Part 2 - Ballast

C. ASTM International:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).

3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3).
4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
5. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D. New Jersey Department of Transportation (NJDOT)
1. Standard Specifications for Road and Bridge Construction, 2019.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Supplier currently approved by New Jersey Department of Transportation

C. Manufacturer's Certificate: Submit materials certifications from suppliers stating materials meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

PART 2 - PRODUCTS

2.1 AGGREGATE FOR SUBGRADE

A. Comply with the requirements of NJDOT Specifications, Section 901.11.

2.2 DENSE GRADED AGGREGATE MATERIALS

2.3 Comply with the requirements of NJDOT Specifications, Section 901.10.

2.4 BACKFILLING PIPE TRENCHES

A. Comply with the requirements of NJDOT Specifications, Section 901.03.01.F.

2.5 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Testing and inspection services.

B. Aggregate materials shall meet the requirements of NJDOT Specifications, Section 106..

PART 3 - EXECUTION

3.1 STOCKPILING

A. Stockpile materials on site at locations designated by Engineer.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

E. Stockpile unsuitable or hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.2 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

- END OF SECTION -

SECTION 311000 – SITE CLEARING

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. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities abandoning site utilities in place.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. ~~Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.~~

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project Site.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises in a location to be specified by the owner. Retain one option in "Utility Locator Service" Paragraph below. First option is a generic term that is known in various states by different names listed in the other options.

C. Utility Locator Service: Notify Pennsylvania One Call for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

F. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner’s Representative not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Only remove trees, shrubs, and other vegetation indicated as to be removed or relocated on the Drawings.
2. Grind down stumps and remove roots, obstructions, and debris to a full depth below exposed subgrade. Use only hand methods or air spade for grubbing within protection zones.
3. Chip removed tree branches and dispose of off-site .

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches .
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.

1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1. Limit height of rock stockpiles to 36 inches .
2. Do not stockpile rock within protection zones.
3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus rock to allow later use by the Owner.

3.8 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

- END OF SECTION -

SECTION 312000 – EARTH MOVING

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. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade,walks, pavements, turf and grasses and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks and pavements.
6. Subbase course and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.
9. Excavating well hole to accommodate elevator-cylinder assembly.
10. Geotextiles and Geogrids

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" Section 013233 "Photographic Documentation" for recording preexcavation and earth-moving progress.
2. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
3. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
4. Section 312319 "Dewatering" for lowering and disposing of ground water during construction.
5. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner's Representative. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner's Representative. Unauthorized excavation, as well as remedial work directed by Owner's Representative, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofoam.
4. Warning tapes.
5. Geogrids.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches.
2. Warning Tape: 12 inches long; of each color.
3. Geogrids: 12 by 12 inches.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 1557.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

B. Pre-excavation Conference: Conduct conference at Project Site.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify NJ One Call for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in ~~Section 015000 "Temporary Facilities and Controls"~~ and Section 311000 "Site Clearing" are in place.

D. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

E. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 , or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 , or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33/C 33M; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polypropylene fibers; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Grab Tensile Strength: ≥ 120 lbs; ASTM D 4632.
2. Mullen Burst Strength: ≥ 225 psi; ASTM D 3786.
3. Flow Rate: ≥95 gal/min/ft^2; ASTM D 4491.
4. UV Resistance: 70% after 500 hours; ASTM D 4355.
5. Heat-Set or Heat-Calendared fabrics are not permitted.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 GEOGRID

A. Utility Trench Geogrid: Punched polypropylene geogrid, oriented in three substantially equilateral directions manufactured to provide a mechanically stabilized layer at the bottom of utility trenches; complying with ASTM D4759-02.

1. Junction Efficiency: 93% (as a percentage of ultimate tensile strength).
2. Aperature Stability, kg-cm/deg @ 5.0 kg-cm: 3.0
   Radial Stiffness at Low Strain, kN/m @ 0.5% Strain: 225 (ASTM D6637-01) lb/ft @ 0.5% Strain: 15,430
3. Resistance to chemical degradation: 100% (in accordance with EPA 9090).

4. Resistance to ultra-violet light and weathering: 10% (in accordance with ASTM D4355-05).

2.4 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Refer to Section 312319 Dewatering.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Shall consist of excavation and disposal of material, regardless of its nature.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: As indicated.

C. Trench Bottoms: Excavate trenches deeper than bottom of pipe and conduit elevations to allow for bedding course and/or pile caps as indicated on the Drawings. Retain "Trenches in Tree- and Plant-Protection Zones" Paragraph below if required.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

A. Notify Geotechnical Engineer when excavations have reached required subgrade.

B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade at the bottom of excavation with a self-propelled 20-ton vibratory compactor used in conjunction with a large pad roller to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner's Representative, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Owner's Representative.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 98 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 98 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1/2 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Section 334600 "Subdrainage."

B. Install as indicated on the drawings.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as indicated on the Drawings as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement as indicated on the Drawings.
3. Shape subbase course and base course (if required per Drawings) to required crown elevations and cross-slope grades.
4. Place subbase course and base course (If required per Drawings) 6 inches or less in compacted thickness in a single layer.
5. Place subbase course and base course (If required per Drawings) that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase course and base course (If required per Drawings) at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 1557.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place and compact drainage course as indicated on the Drawings. Revise percentage of compaction in subparagraph below and change compaction

test from ASTM D 698 to ASTM D 4254 or ASTM D 1557 if required. Replace the term "unit weight" with "density" if preferred. See Evaluations.

3. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material classification and maximum lift thickness comply with requirements.
3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

- END OF SECTION -

SECTION 312316.13 - TRENCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities from 5 feet outside building to undergrade water, sewer, wastewater, electrical, communication, fuel gas, compressed air or other services.
2. Protection of excavation including sheeting and shoring where required.
3. Compacted fill from top of utility bedding to subgrade elevations.
4. Backfilling and compaction.
5. Restoration of Paving where trenching passes through existing paved areas.

B. Related Sections:
1. Section 310516 - Aggregates for Earthwork
2. Section 321216 – Asphalt Paving

1.2 REFERENCES

A. American Railway Engineering and Maintenance of Way Association.

1. Manual for Railway Engineering – Chapter 1, Parts 3 & 4

B. ASTM International:
1. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3).
3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. New Jersey Department of Transportation (NJDOT)
1. Standard Specifications for Road and Bridge Construction, 2019

D. Occupational Safety and Health Administration:
1. 29 CFR Part 1929 - Safety and Health Regulations for Construction

SECTION 312316.13 - TRENCHING

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Submit Site Specific Work Plan (SSWP) to Engineer for review seven (7) days in advance of scheduled commencement of each area of work under this section.

C. Excavation Protection Plan: Support trenches more than 5 feet deep in accordance with applicable OSHA requirements. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation. Submit sheeting and shoring plans and calculations prepared by a Professional Engineer, licensed in the State of New Jersey, for Engineer's review and approval at least 60 days prior to performing the work.

D. Where work will interfere with 45 degree bearing splay of foundations, catenary support structures or the Live Load Influence Line of adjacent railroad tracks comply with the requirements of the State of New Jersey. Submit sheeting and shoring plans and calculations prepared by a Professional Engineer, licensed in the State of New Jersey, for Engineer's review and approval at least 60 days prior to performing the work.

E. Product Data: Submit data for geotextile fabric indicating fabric and construction.

1.5 QUALIFICATIONS

A. Prepare required sheeting and shoring plans under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of New Jersey.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to commencing work.

1.7 COORDINATION

A. Section 013100 - Administrative Requirements: Coordination.

B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. As specified in:

1. Section 310516 - Aggregates for Earthwork

PART 3 - EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.

1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

A. Coordinate with Engineer not less than five working days before performing work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

2. Progress work in accordance with approved Site Specific Work Plan.

B. Identify required lines, levels, contours, and datum locations.

C. Protect bench marks, existing structures, fences, sidewalks, paving, railroad tracks and curbs from excavating equipment and vehicular traffic.

D. Maintain and protect above and below grade utilities indicated to remain.

E. Establish temporary traffic control and detours when trenching is performed in vehicular circulation roadways. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

A. Excavate subsoil required for utilities to locations of connections with existing facilities or as otherwise indicated on the plans.

B. Do not advance open trench more than 50 feet ahead of installed pipe.

C. Cut trenches to width indicated on Drawings or no more than necessary to enable installation and allow inspection of the installed utility. Remove water or materials that interfere with Work.

D. Saw cut a clean neat edge of trench through paved areas.

E. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.

F. Do not interfere with 45 degree bearing splay of foundations, support structures or the Live Load Influence Line of railroad tracks as defined in these specifications.

G. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.

H. When subsurface materials at bottom of trench are loose or soft, notify Engineer, and request instructions.

I. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Aggregate and compact to density equal to or greater than requirements for subsequent backfill material.

J. Trim excavation;
   1. Hand trim for bell and spigot pipe joints.
   2. Provide required additional excavated area for Clay Trench Plugs in accordance with the dimensions shown in the construction detail drawings.
   3. Remove loose matter.

K. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

L. Remove excess subsoil not intended for reuse, from site.

M. Stockpile excavated material in area designated on site in accordance with Section 310516 - Aggregates for Earthwork

3.4 SHEETING AND SHORING

A. Install sheeting and shoring in accordance with plans previously submitted to, and approved by Engineer in accordance with Section 1.5 above.

B. Design sheeting and shoring to be removed at completion of excavation work.

C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Pipe shall be installed on a Class B bed of compacted graded aggregate or sand bedding as indicated. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

D. After laying pipe and insuring that the pipe is properly placed and supported by the bedding, unless other material is specified, backfill shall be placed in 6 inch lifts and compacted, to 12 inches above the top of pipe. The backfill shall be thoroughly rodded and tamped for compaction. Install warning tape 12 inches above the pipe, except 6 inches below subgrade under pavements and slabs. The remainder of the trench backfill shall be well graded clean granular soil having less than 20% by dry passing No. 200 US STD sieve. Maximum aggregate shall be size shall be ½”. Backfill shall be paced in uniform layers not to exceed 8" loose depth, each lift to be compacted to a minimum of 95 percent of Standard Density at within 2% of the optimum moisture content as determined in accordance with ASTM D15557. All earth backfill to be placed the next day or later after the pipe is laid.

E. Detectable Warning Tape:
   1. Install detectable warning tape directly above all piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
   2. If multiple pipes occur in common trench, locate tape above centerline of trench.

F. Employ placement method that does not disturb or damage, utilities in trench, and adjacent structures or railroad tracks.

G. Maintain optimum moisture content of fill materials to attain required compaction density.

H. Do not leave more than 50 feet of trench open at end of working day.

I. Protect open trench to prevent danger to personnel.

J. Where trenching has been progressed through asphalt paved areas, restore pavement in accordance with the plans and Section 321216.00 – Asphalt Paving.

K. Where trenching has been progressed through concrete paved areas, restore concrete paving in accordance with the plans and Section 033000 - Cast-In-Place Concrete.

3.6 TRENCH PLUGS

A. Where shown on the plans, trenches must have either a bentonite granular clay, or lean concrete, approved controlled strength material, plug, installed in accordance with the detail drawings, to reduce the transmission of ground water along the pipe.

B. The plug must extend 18” beneath utility trench into undisturbed soil. This portion of the clay plug must be installed prior to the installation of the utility pipe.

C. The plug must extend across the entire trench width and extend 18” into undisturbed soil beyond the trench width. Install bentonite clay plug and the utility pipe at the same time.

D. The plug must extend to within 12” of finished grade. A clay plug cap consisting of material with a plasticity index greater than 15 and a liquid limit in excess of 30 shall be placed on top of the bentonite granular clay plug. This clay plug cap shall fill the remaining 12” up to finished grade.

3.7 CONTAMINATED SOIL

A. Contractor shall remove, and segregate all soil removed from the ground that appears to be contaminated by petroleum parameter constituents. Clean and moderately contaminated soils shall be segregated and separated from heavily contaminated soils, impervious material, and from each other.

B. Stockpiled soil, possible for petroleum hydrocarbons but determined to be acceptable both structurally and environmentally should be considered for replacement back into an excavation.

C. Stockpiled soils deemed unsuitable as fill due to contamination shall be stockpiled and protected by barrier as directed by the Engineer. Material deemed suitable as backfill and not contaminated but not required for fill should be graded to promote drainage, seeded and mulched as directed by the Engineer.

D. The Owner shall be responsible for the final handling and disposal of all contaminated materials.

3.8 TOLERANCES

A. Section 014000 - Quality Requirements.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.9 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Quality Assurance, Quality Control, Special Tests and Inspection.

B. Perform laboratory material tests in accordance with ASTM D1557.

C. Perform in place compaction tests in accordance with the following:

1. Density Tests: ASTM D2922.
2. Moisture Tests: ASTM D3017.

D. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

E. Frequency of Tests:
1. Under railroad tracks, structures, building slabs and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.

3.10 PROTECTION OF FINISHED WORK

A. Section 017700 - Closeout Procedures: Repair of the work.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

- END OF SECTION -

SECTION 312319 - DEWATERING

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 provisions for pumping out stormwater and site dewatering during excavation and construction on the site. Dewatering consists of lowering and controlling groundwater and runoff levels and hydrostatic pressures to permit excavation and construction to be performed in near-dry conditions. This includes treatment to comply with any and all environmental requirements and the legal disposal of the collected materials during construction.

B. The altering or diversion of existing site surface stormwater runoff patterns will be necessary by the construction of berms, ditches, grading and piping as shown on the plans and approved by the Engineer or Owner's Representative. The maintenance of the dewatering system is required to be in accordance with the requirements of the Specification Section "Pollution Prevention and Environmental Requirements".

C. The contractor is required to pump the groundwater and stormwater flows to the outfall on the Delaware River in accordance with the Stormwater and/or Groundwater Discharge Permit.

1.3 DEWATERING OF THE CONSTRUCTION SITE

A. Subject to approval by the NJDEP, the Contractor may discharge pumped stormwater and/or ground water directly to the Delaware River. The owner will provide an applicable Stormwater Discharge Permit and/or Groundwater Discharge Permit.

1.4 SUBMITTALS

A. The Contractor shall submit to the Engineer or Owner's Representative a dewatering plan that includes working plans and specifications that identify the type of dewatering system proposed. The material to be submitted shall include, but not necessarily be limited to, the following:

1. Type and description of system.
2. Description of equipment and materials proposed.
3. Installation procedures.
4. Maintenance procedures.
5. Standby equipment and power supply.
6. Discharge locations.
7. Collection methods.
8. Storage methods.
9. Treatment methods.
10. Discharge method and location.
11. Method and measures for surface water control.
12. Sump layouts, pumps, piping and controls.

B. Prior to implementation, the Contractor shall obtain approval from both the Engineer or Owner's Representative and the City of Camden. Approval does not relieve the Contractor of the responsibility for adequacy of the system or providing equipment required to perform the operation. Should the Contractor's method of treatment prove to be ineffective in eliminating or significantly minimizing pollutants, the Contractor will be required to change the dewatering system to achieve an acceptable quality of discharge.

1.5 DOCUMENTATION

A. The Contractor shall provide the equipment manuals, documentation of equipment warranties and maintenance records for all dewatering system components.

1.6 CODE COMPLIANCE

A. Comply with the following Codes and Regulations:

1. International Building Code (IBC)
2. City of Camden Building Code.
3. Occupational Safety and Health Administration (OSHA) – As required by the state and federal regulations.
4. NJDEP requirements for erosion and sedimentation control.
5. City of Camden, New Jersey Department of Transportation, NJDEP and USEPA standards.
6. New Jersey Department of Transportation Soil and Erosion and Sediment Control Standards.

B. Comply with all local, state, and Federal laws, codes, and regulations applicable to the work specified in this Section including, but not limited to, the Federal Occupational Safety and health Act and the Construction Safety Act.

C. The more stringent provisions shall govern where provisions of pertinent codes and regulations are in conflict.

1.7 DESIGN CRITERIA

A. The Contractor shall provide a dewatering system that will remove rainfall and surface runoff and groundwater inflow for safe and proper execution of the work that will result in a stable, substantially dry base or subgrade for the execution of subsequent work.

B. The dewatering system shall be designed for continued operation through the contract.

C. The Contractor shall maintain adequate supervision and control to ensure that stability of excavated and constructed slopes are not adversely affected by water, erosion is controlled, and flooding of excavation or damage to structures does not occur.

1.8 PROJECT CONDITIONS

A. Permits.

1. Prior to discharging water, the Contractor shall obtain permits from the City and State as required.
2. The Contractor shall control the discharge of water with the General Requirements.

B. Responsibilities.

1. Design and install the dewatering system to perform removal of surface and groundwater and treatment as specified.
2. Monitor discharge from the dewatering system to determine that it meets the requirements identified in this specification. Modify the dewatering system as necessary during construction to meet the requirements.
3. Take all necessary measures to prevent damage to buildings, structures, utilities, pavements and other contractor work areas.
4. Repair and maintain the dewatering system during operation in accordance with the dewatering system plan and working drawings. Submit periodic maintenance records to the Engineer or Owner’s Representative.

PART 2 - PRODUCTS

2.1 PUMPING SYSTEMS.

A. All electrical components, equipment and installations shall meet the requirements of the NEC, NEMA and shall be UL listed.

B. All electrical control equipment shall be provided with and connected to a backup power source.

C. All pumping system shall be duplex type pumps. The pumping equipment shall be such that if one pump is not in service, the other pumps are capable of pumping the design flow and provide an ability to maintain a dry project site.

D. The pumping system controls and power sources shall be housed in a weatherproof structure with access in accordance with OSHA 29CFR, Parts 1910 and 1926.

E. Pumps shall be located to facilitate access for maintenance, removal and reinstallation.

F. Sumps, well points, and wet wells shall be constructed to provide unrestricted access for cleaning and maintenance.

G. The Contractor shall make his own assessment of existing conditions including adjacent activities and shall select and design such dewatering systems, methods and details and surface water control system as will assure safety to the public, adjacent activities, existing buildings, structures, and the competed work.

H. The cofferdam, sheet piling, and dewatering shall work as a system to provide a safe work area, dewater the project site, and permit the flow of the combined sewer to the river, passing the 550 cfs noted during storm events.

I. All excavations shall be kept continually free of water or mud from any source, including leaking utilities.

J. Leaking Utilities: Dewatering system shall accommodate all inflows of water into the excavation from whatever source, including any existing underground piping or utilities which may be leaking. If contractor notes leaking utilities, contact Engineer or Owner’s Representative immediately defining type and extent of leaking utility.

PART 3 - EXECUTION

3.1 DEWATERING

A. Coordinate dewatering installation with other construction activities to prevent conflicts with construction operations.

B. Provide and install a dewatering system to control stormwater runoff and lower and control groundwater in order to permit excavation, construction of support of excavation and future structures, and placement of fill materials under dry conditions. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of structure foundations, drains, sewers, and other excavations.

C. Install the dewatering system in accordance with the approved plans, procedures and documentation.

D. Prior to excavation, place system into operation to lower water levels as required and then operate it continuously 24 hours a day, 7 days a week.

E. Dispose of water removed from excavations in a manner approved by the Engineer or Owner's Representative and the City. Provide sumps, sedimentation tanks, and other flow control devices as required by NJDEP requirements.

F. Provide standby equipment for immediate operation if required to maintain dewatering on a continuous basis in event any part of system becomes inadequate or fails.

G. Monitor system and modify system to maintain dewatering on the site and meet the requirements of the specifications.

H. Maintain the dewatering system and submit periodic maintenance records to the Engineer or Owner's Representative.

I. The dewatering system shall be maintained in good working condition throughout the life of the contract.

3.2 SURFACE DRAINAGE AND DEWATERING

A. The contractor shall divert surface drainage by means of berms, dikes, curbs and ditches. Surface drainage shall be separated from the dewatering as possible during construction by the Contractor's grading and layout on the site.

B. The surface drainage system shall be designed to prevent erosion.

C. All surface drainage shall meet the requirements of Specification Section “Pollution Prevention and Environmental Requirements”.

PART 4 - CONTRACTOR’S QUALITY CONTROL REQUIREMENTS

4.1 GENERAL

A. Comply with applicable provisions of Division 01 Section "Quality Requirements".

B. The Contractor shall provide quality control for the dewatering in accordance with the Contractor Quality Control Program. In addition, the Contractor supplied quality control shall consist of:

1. Shop Drawings. Verify shop drawings are prepared as specified herein by or under the supervision of a qualified Professional Engineer registered in the State of New Jersey.
2. Verify qualifications of firms and persons specified in “Quality Assurance”.
3. Monitor dewatering activities and provide a weekly report to the Engineer or Owner’s Representative as specified herein.
4. Reports. Provide documentation and reports of the dewatering system as specified herein.

C. The Contractor or the Contractor’s quality control testing service shall take all samples and perform all tests required for quality control sampling and testing to be performed by the Contractor or the testing service and all quality assurance samples to be tested by the Owner’s Representative. All costs for all quality control and quality assurance sampling and quality control testing shall be included in the Contractor’s cost for the project. Unless otherwise noted, the number of samples for quality control testing and sampling shall be the same for quality assurance testing.

D. All of the Contractor’s or testing agency test results shall be provided to the Owner or Owner’s Representative.

- END OF SECTION -

SECTION 321216 - ASPHALT PAVING

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. Asphalt materials.
2. Aggregate materials.
3. Asphalt paving base course and wearing course.
4. Hot-mix asphalt paving.
5. Asphalt paving restoration for utilities installation.

B. Related Requirement:
1. Section 312316.13 – Trenching
2. Section 321723 – Pavement Marking.
3. Section 330130.86 – Manhole, Inlet or Valve Box Rim Adjustment
4. Section 330597 - Identification and Signage For Utilities
5. Section 331419 – Valves and Hydrants

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M17 - Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
2. AASHTO M29 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
3. AASHTO M140 - Standard Specification for Emulsified Asphalt.
4. AASHTO M208 - Standard Specification for Cationic Emulsified Asphalt.
5. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
6. AASHTO M320 - Standard Specification for Performance-Graded Asphalt Binder.
7. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
8. AASHTO MP1a - Standard Specification for Performance-Graded Asphalt Binder.

B. Asphalt Institute:

1. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot- Mix Types.
2. AI MS-19 - Basic Asphalt Emulsion Manual.
3. AI SP-2 - Superpave Mix Design.

C. ASTM International:

1. ASTM C1371-15 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
2. ASTM C1549-16 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
3. ASTM D242 - Standard Specification for Mineral Filler For Bituminous Paving Mixtures.
4. ASTM D692 - Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
5. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
6. ASTM D977 - Standard Specification for Emulsified Asphalt.
7. ASTM D1073 - Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
8. ASTM D1188 - Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
9. ASTM D2027 - Standard Specification for Cutback Asphalt (Medium-Curing Type).
10. ASTM D2397 - Standard Specification for Cationic Emulsified Asphalt.
11. ASTM D2726 - Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
12. ASTM D2950 - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.
13. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
14. ASTM D3515 - Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
15. ASTM D3549 - Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
16. ASTM D3910 - Standard Practices for Design, Testing, and Construction of Slurry Seal.
17. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
18. ASTM E408-13 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
19. ASTM E903-12 - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.

20. ASTM E1918-16 - Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
21. ASTM E1980-11 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

D. State of New Jersey, Department of Transportation (NJDOT)

1. Standard Specifications for Road and Bridge Construction, 2019

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit product information for asphalt and aggregate materials.
2. Submit mix design with laboratory test results supporting design.

C. Manufacturer's Certificate: Certify Products and Hot Mix Asphalt mix designs meet or exceed specified requirements.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.
2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

B. Material Certificates: For each paving material. Include a statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix supplier registered with and approved by NJDOT.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of following NJDOT Specifications:
   1. Section 105 - Control of Work
   2. Section 401 – Hot Mix Asphalt (HMA) Courses
   3. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.9 FIELD CONDITIONS

A. Environmental and Weather Limitations:

   1. Comply with requirements of NJDOT Specifications, Section 401.03.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Comply with requirements of NJDOT Specifications, Section 901.

B. Coarse Aggregate: Comply with requirements of NJDOT Specifications, Section 901.05.01.

C. Fine Aggregate: Comply with requirements of NJDOT Specifications, Section 901.05.02.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: Comply with requirements of NJDOT Specifications, Section 901.01.01.

B. Asphalt Cement: Comply with requirements of NJDOT Specifications, Section 902.

C. Cutback Prime Coat: Comply with requirements of NJDOT Specifications, Section 401.03.06.

D. Emulsified Asphalt Prime Coat: Comply with requirements of NJDOT Specifications, Section 902.

E. Tack Coat: Comply with requirements of NJDOT Specifications, Section 401.03.05

F. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Not applicable.

2.4 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes complying with the following requirements:
   1. Base Course: Hot Mix Asphalt 12.5M Base Course
   2. Surface Course: Hot Mix Asphalt 12.5M Surface Course

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Requirements for examination of existing conditions.

B. Verify following:
   1. Utilities indicated under paving are installed with excavations and trenches backfilled and compacted in accordance with project specifications.
   2. Subgrade is dry and in suitable condition to begin paving.
   3. Gradients and elevations of base are correct.
   4. Inspect elevation of inlet frames and grates, valve boxes, trace wire test boxes, cleanouts and manhole frames and adjust to meet final pavement elevations and provide proper drainage upon completion of repaving.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Joints:
   1. General: Comply with NJDOT Specifications, Section 401.03.04.
   2. Saw cut perimeter of utility trench openings and excavate existing pavement section extending 6 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
   3. Remove excavated material.

B. Apply Tack Coat:
   1. Before placing asphalt material, apply tack coat uniformly to vertical asphalt surfaces abutting the area. Apply at a rate of 0.05 to 0.15 gal./sq. yd.
   2. The contact surfaces of manholes, catch basins, valve boxes or other appurtenant structures shall be painted thoroughly with a thin uniform coating of tack coat just before any mixture is placed against them.
   3. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   4. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings.
   5. Remove spillages and clean affected surfaces.

3.3 INSTALLATION

A. General: Comply with NJDOT Specifications, Section 401.03.

B. Joints: Seal joints with existing sound pavement in accordance with NJDOT Specifications, Section 401.03.04.

C. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

D. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

E. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

F. Re-apply or restore existing pavement markings that have been removed, destroyed or rendered illegible either directly or indirectly as a result of work under scope of the project.

3.4 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

C. In-Place Density: Testing agency will test compacted pavement density and depths according to NJDOT Specifications, Section 401.03.07.C.

D. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.6 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan.

- END OF SECTION -

SECTION 321723 - PAVEMENT MARKINGS

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. Painted markings applied to asphalt paving.
2. Painted markings applied to concrete surfaces.

B. Related Requirements:

1. Section 014000 “Quality Requirements” for Quality Assurance requirements.
2. Section 099000 "Painting and Coating" for painting exterior and interior concrete surfaces other than pavement markings.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. NTPEP PMM-17-01 – Field Testing and Evaluation Procedures for Permanent Pavement Marking Materials

B. ASTM International:

1. ASTM D 93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
2. ASTM D 562 - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
3. ASTM D 869 - Standard Test Method for Evaluating Degree of Settling of Paint

C. United States:

1. Federal Spec TT-P-85 – Paint, Traffic, and Airfield Markings, Solvent Based
2. Federal Test Method Standard – Adhesives: Methods of Testing

D. United States Environmental Protection Agency (EPA):

1. EPA Method 24 – Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

1.4 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.

1. Pavement-marking paint, acrylic.

B. Shop Drawings:

1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.

1.5 QUALITY ASSURANCE

A. The paint shall not contain any hazardous material listed in the Environmental Protection Agency Code of Federal Regulations (CFR) 40, Section 261.24, Table 1.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 60 deg F for water-based materials.

PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint, Acrylic: White and yellow paint material shall be a fast drying water based, nonleaded, acrylic resin paint suitable for use on both asphalt and Portland Cement Concrete surfaces.

2.2 PERFORMANCE REQUIREMENTS

A. Hiding Power: Paint shall show a dry hiding quality that will give a contrast ratio of at least 0.96 at 15 mil wet film thickness.

B. Settling Properties: Settling shall be no less than a rating of 8 when tested in accordance with ASTM D 869.

C. Freeze-Thaw and Heat Stability: Paint shall show no coagulation or change in viscosity greater than ± 5 KU.

D. Water Resistance: Paint shall show no:

1. Blistering
2. Peeling or wrinkling
3. Softening or loss of adhesion.

E. VOC: The Volatile Organic Compound (VOC) content shall be no greater than 150 grams/liter when tested in accordance with EPA Method 24.

F. Flash Point: Paint shall have a flash point of at least 140 deg F.

G. Total Solids: Total solids shall be a minimum of 70 percent by weight when tested in conformance with Federal Test Method 4041.1, Volatile and Nonvolatile Content (ordinary lab oven).

H. Color

1. Production: The color of the dry paint film of the production sample shall essentially match Federal Standard 595, color chips Nos. 37886 (white) or 33538 (yellow), when compared instrumentally
2. Control: Control sample color matching determinations will be made using a color machine and the CIE Chromaticity Coordinate Color Matching System under light source Illuminate C, with the following tolerances permitted between the standard chip and the dry paint film sample:

	WHITE Color No. 37886		YELLOW Color No. 33538	
	X	Y	X	Y
Standard Chip	0.32	0.33	0.49	0.44
Delta Tolerance	± 0.02	± 0.02	± 0.03	± 0.03

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to any work survey the identified work zone for all existing pavement markings and document location, size, and color of existing pavement markings so that any removed pavement markings can be reapplied after construction is complete.

B. At the end of each construction stage, verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.

C. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.

B. Allow asphalt paving or concrete surfaces to age for a minimum of 15 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

- END OF SECTION -

SECTION 323913 – BOLLARDS AND BOLLARD COVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel Pipe Bollards
2. Thermoplastic Bollard Covers.

B. Related Requirements:

1. Section 033000 - Cast-in-Place Concrete.
2. Section 099000 - Painting and Coating.

1.2 REFERENCE STANDARDS

A. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

1.3 DESCRIPTION

A. The contractor shall furnish permanent bollards at the locations as shown on the plans.

1.4 SUBMITTALS

A. Product data for all products.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PIPES

1. The permanent pipe bollards shall be concrete filled steel pipes. The pipes shall be six (6) inch nominal diameter steel pipe, round, and free of dents and of other irregularities above the ground line. Cuts at the ends shall be clean, free of burrs and made square to the longitudinal axis of the pipe.

B. CONCRETE

1. The concrete shall be 2000 p.s.i. Portland cement with a maximum aggregate size of two (2) inches.

C. FINISHES

1. PAINTS

a. The primer and finish paint shall be designed for outside use and for application to steel. Refer to Specification Section 099000 “Painting and Coating”.
b. Finish paint color shall be OSHA Yellow.

2. RETROREFLECTIVE TAPE

a. Retroreflective Tape: 2 strips of 3M Scotchlite® Reflective Sheeting Series tape, applied to bollard or bollard cover.
b. Color: White

D. THERMOPLASTIC BOLLARD COVERS

1. Materials:

a. High Density Polyethylene (HDPE).
b. Ultraviolet (UV) protection additive.
c. Thickness: Nominal wall thickness minimum 0.125 inch
d. Flexural modulus: 200,000 psi.
e. Tensile Strength: 4,000 psi.
f. Color: Solid color throughout.

2. Color:

a. OSHA Yellow

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine paving or other substrates for compliance with manufacturer’s requirements for placement and location of embedded items, condition of substrate, and other conditions affecting installation of bollards.

B. Identify and markout all underground utilities at proposed bollard locations prior to auguring holes for bollard installation. If the location of underground utilities results in conflicts which require adjustment of bollard location(s), install

bollards to avoid interference with clear access for fire hose connection to fire hydrant nozzles.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Apply primer and finish coat(s) of paint to bollards and allow to fully dry before installing Bollards.

B. Install Bollards at the locations and in numbers as indicated on the plans, and at distance from adjacent structure or fixture as indicated.

C. Install Bollards in pre-augured holes, at depth indicated and adequately braced to remain plumb during placement and curing of concrete fill and concrete footing. Do not install damaged, cracked, chipped, deformed or marred bollards.

D. Field touch-up minor imperfections in accordance with manufacturer’s instructions. Replace bollards that cannot be field repaired.

E. Plastic Bollard Covers: Install over foam strips in pattern indicated in manufacturer's instructions.

F. Retroreflective Tape: Install retroreflective tape on clean, fully dry painted surface or thermoplastic bollard cover cleaned and in accordance with manufacturer’s instructions

- END OF SECTION -

SECTION 330120 - ABANDONMENT OF UNDERGROUND UTILITIES

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. Contractor shall furnish all materials, equipment, and labor necessary to abandon underground utilities in-place as specified herein or indicated on the Drawings. Work specified in this Section includes but is not limited to the abandonment of water mains, valve boxes, valve casings, meter boxes, valve and meter vaults, water service lines, stormwater inlets, and stormwater lines in accordance with the Contract Documents.

B. Related Sections:

1. Section 013100 - Project Management and Coordination: Requirements for coordination.
2. Section 013300 – Submittal Procedures: Requirements for submittals.
3. Section 014000 – Quality Requirements
4. Section 017700 – Closeout Procedures
5. Section 312316.13 – Trenching
6. Section 331413 - Water Distribution Piping
7. Section 334200 – Stormwater Conveyance

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C33: “Standard Specification for Concrete Aggregates”.
2. ASTM C1107: “Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)”.

B. State of New Jersey, Department of Transportation (NJDOT)

1. Standard Specifications for Road and Bridge Construction 2019

C. SUBMITTALS

D. Product Data: Submit manufacturer product data for each product used.

1.4 COORDINATION

A. Coordinate Work of this Section with installation of new water distribution pipe and stormwater conveyance pipe.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of pipe caps or plugs.

1.6 QUALITY ASSURANCE

A. Perform Work according to applicable standards as defined in these specifications.

PART 2 - PRODUCTS

2.1 NON-SHRINK GROUT:

A. Non-shrink grout shall be Cement-based dry-pack grout conforming to ASTM C1107.

2.2 MANUFACTURED PLUG:

A. Commercially available plug or cap specifically designed and manufactured to be used with the pipe being abandoned.

2.3 FLOWABLE FILL:

A. Flowable fill shall be general purpose backfill controlled low-strength material (CLSM)

PART 3 - EXECUTION

3.1 GENERAL:

A. Valve boxes, meter pits, fire hydrant riser pipes, yard hydrants, other water service appurtenances, stormwater inlets, and stormwater conveyance lines that are located at a depth less than three (3) feet below grade and that are a part of the existing water distribution system to be abandoned, shall be removed. Portions more than three (3) feet below subgrade shall be abandoned in

place in accordance with this Section unless noted otherwise on the Contract Drawings.

B. When a water or stormwater pipeline is to be abandoned, Contractor shall ensure that all existing mains and service connections are properly plugged or transferred to the new water or stormwater pipeline prior to decommissioning the existing pipeline.

C. Where indicated on the Contract Drawings, existing water pipelines, conduits, stormwater inlets, and stormwater pipelines, and/or appurtenances shall be removed by the Contractor. Removed materials shall be the property of the Contractor, unless otherwise noted on the Contract Drawings.

D. Existing out of service utilities within the limits of the trench excavation where new water service pipes are being placed shall not be abandoned in-place. In this situation, the existing utilities shall be removed to the limits of the trench and disposed of by the Contractor. The ends of existing utilities that extend beyond the trench limits will be abandoned as specified herein.

E. Existing utilities outside the limits of the trench excavation and shown on the Contract Drawings to be abandoned in-place shall be abandoned in-place in accordance with this Section.

F. During placement of flowable fill in piping being abandoned, protect the open ends of nearby piping that will remain in operation to prevent flowable fill from getting into it.

3.2 WATER SERVICE LINE ABANDONMENT:

A. Water service line abandonment includes water service lines up to and including two (2) inches in diameter.

B. Cut, drain and cap water service lines five (5) feet from the building envelope.

C. Cut, drain and cap water service lines immediately adjacent to the existing main line when the existing main line will remain active.

3.3 PIPELINE ABANDONMENT:

A. Pipelines 16 inches in diameter and smaller shall be drained and abandoned in-place. Except as noted otherwise in this Section and on the Contract Drawings each end shall be cut and plugged.

B. Plugs made of non-shrink grout shall extend into the pipe a minimum of 24 inches and form a solid waterproof plug completely bonded to the pipe.

C. When manufactured plugs are used to plug pipe, install concrete around plug and over pipe to ensure a waterproof plug.

D. All pipes, regardless of size, under structures, waterways, railroad tracks, rail right-of-way shall be abandoned in-place and completely filled with flowable fill, unless noted otherwise on the Contract Drawings.

E. If a utility line to be abandoned terminates in a manhole/vault that will remain in service, the existing main to be decommissioned shall be plugged from within the manhole and clearly marked on the Record Drawings.

F. Installation of flowable fill shall be performed by experienced crews with equipment to monitor the density of flowable fill and control pressure.

3.4 CONCRETE OR MASONRY STRUCTURE ABANDONMENT:

A. Concrete or masonry structures include, but are not limited to Junction Boxes, Regulator or Valve Vaults, Meter Pits, etc.

B. The top of each structure shall be removed to a minimum depth of three (3) feet below grade, or 12 inches below any crossing utility, whichever is greater.

C. The depth of structures removed shall not be deeper than 18 inches above the crown of an abandoned pipeline.

D. Piping or conduit entering a structure shall be plugged.

E. Break and perforate the bottom of the structure to allow water to drain through after installation of backfill material.

3.5 TEES, VALVES, VALVE CASINGS AND BOXES ABANDONMENT:

A. When main line is to remain active and branch connection is to be abandoned, plug mechanical joint tees and remove lead joint tees. Replace lead joint tees with new pipe and sleeve to keep main line active.

B. Remove existing valve casings and valve boxes to be abandoned to a depth of three (3) feet below grade. The remaining portion of the structure shall be filled with No. 57 stone per ASTM C33.

C. For valves that are abandoned in-place on lines that are to remain active, the Contractor shall remove all internal valve parts and install a blank on the valve prior to testing and backfilling.

D. Install plug or cap on abandoned valves when shown on Contract Drawings.

E. Valves abandoned in-place on lines to be abandoned shall be fully opened.

3.6 METER BOXES ABANDONMENT:

A. Water meter boxes shall be removed in their entirety.

3.7 STORMWATER INLETS:

A. Stormwater inlets shall be removed in their entirety.

3.8 BACKFILL, COMPACTION AND RESTORATION:

A. Backfill and compaction for utilities and all appurtenances abandoned in-place, shall be in accordance with the requirements of Division 312316.13 - Trenching.

B. Structures remaining in the ground shall be completely filled with flowable fill, crushed stone, or trench backfill unless otherwise specified or shown on the Contract Drawings.

- END OF SECTION -

SECTION 330130.11 – TELEVISION INSPECTION OF SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipeline flushing and cleaning.
2. Television inspection of sewer pipelines.
3. Audio-video recording of pipeline interior.

B. Related Requirements:

1. Section 334200.00 Stormwater Conveyance: Pipe materials, manholes, and accessories normally encountered with gravity sewerage piping.

1.2 DEFINITIONS

A. DVD: An optical disc storage format, offering higher storage capacity than compact discs (CDs) while having the same dimensions.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Section 012000 - Price and Payment Procedures: Contract Sum/Price modification procedures.

B. Television Inspection of Sewers:

1. Basis of Measurement: Lump Sum.
2. Basis of Payment: Includes pipeline television inspection, and audio-video recording of pipeline.

1.4 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with S.J.P.C..

1.5 PREINSTALLATION MEETINGS

A. Section 013000 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

1.6 SCHEDULING

A. Section 013216 - Construction Progress Schedule: Requirements for scheduling.

B. Schedule Work of this Section to follow Selective Demolition work in affected area and preceding installation of Stormwater System modifications

1.7 SEQUENCING

A. Section 011000 - Summary: Requirements for sequencing.

B. Sequence Work in following order:

1. Define limits of the existing stormwater management system between the point of discharge at the Delaware River and the point(s) of connection of the new stormwater collection system to be installed as part of the Project work.

2. Perform required selective demolition work in the area(s) as defined by the Phase(s) of the project and in accordance with the approved Schedule where portions of the existing stormwater system are located as identified in the above paragraph.

3. Upon completion of selective demolition and any other work that may affect the integrity of the portion(s) of the existing stormwater system slated to remain as identified in the paragraph above, perform video inspection of the pipe network to determine the integrity of the portion(s) of existing stormwater collection system as identified above.

1.8 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. DVDs:

1. Submit three copies of completed narrated color DVDs identified by Project name, and section(s) of pipe(s) comprising and corresponding to that identified in paragraph 1.7B above.
2. DVDs become property of S.J.P.C.

C. Inspection Logs:

1. Submit television inspection logs for each section of line.
2. Include following minimum information:

    a. Stationing and location of lateral services, wyes, or tees.
    b. Date and clock time references.
    c. Pipe joints.
    d. Infiltration/inflow defects.
    e. Cracks.
    f. Leaks.
    g. Offset joints.
    h. Obstructions
    i. Collapsed pipe.

D. Submit spill plan to address any spills that might occur.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.9 QUALIFICATIONS

A. Applicator: Company specializing in performing Work of this Section with minimum three years' documented experience.

PART 2 - PRODUCTS

2.1 DVDs

A. Description: Digital video formatted discs.

B. Audio track containing simultaneously recorded narrative commentary and evaluations of videographer, describing in detail condition of pipeline interior.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for application examination.

B. Verify location of sewer pipelines to be inspected.

3.2 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for application preparation.

B. Flush and clean pipeline to remove sludge, dirt, sand, stone, grease, and other materials to ensure clear view of interior conditions.

C. Debris:

1. Intercept flushed debris at next downstream manhole using weir or screening device.
2. Remove and dispose of debris off Site.

D. Scheduling:

1. The existing stormwater system discharges to the Delaware River and is affected by the rise and fall of the tides. Schedule and perform inspection during period(s) where river elevation is below pipe invert of point of discharge to river for time required to complete television inspection.
2. ~~Provide safety precautions, including barricades, lights, and flaggers as specified in Section 015000 - Temporary Facilities and Controls.~~

3.3 APPLICATION

A. Closed-Circuit Television (CCTV) Camera System:

1. Use cameras specifically designed and constructed for closed-circuit sewer line inspection.
2. Use camera equipment with pan-and-tilt capability to view each lateral connection at multiple angles.
3. Use camera capable of moving both upstream and downstream with minimum 1,000 feet horizontal distance within one setup and using direct-reading cable position meter.

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Pipeline Inspection:

1. Audio-video record sections of sewer pipeline between designated manholes.
2. Identify and record locations of flat grades, dips, deflected joints, open joints, broken pipe, protrusions into pipeline, and points of infiltration.

3. Locate and record service connections.
4. Record locations of pipeline defects, connection horizontal distance in feet, and direction from manholes.
5. Video-record with pipe section plugged to view 100 percent of pipe ID.

- END OF SECTION -

SECTION 330130.86 – MANHOLE, INLET OR VALVE BOX RIM ADJUSTMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Raising manhole, inlet or valve box frames and covers.
2. Replacing manhole, inlet or valve box frames and covers.

B. Related Requirements:

1. Section 033000 – Cast–In-Place Concrete: Execution requirements for concrete and mortar as specified in this Section.
2. Section 321216 - Asphalt Paving: Bituminous paving and pavement rehabilitation.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

B. ASTM International:

1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
3. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
4. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
5. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
6. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

C. State of New Jersey, Department of Transportation (NJDOT)

1. Standard Specifications for Road and Bridge Construction, 2019

1.3 PREINSTALLATION MEETINGS

A. Section 013100 - Project Management and Coordination: Requirements for preinstallation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information for manhole frames and covers, inlet frames and grates, valve boxes and riser rings construction, features, configuration and dimensions.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 017700 - Closeout Procedures: Requirements for submittals.

B. Project Record Documents: Record actual grade-adjusted elevation of manholes.

1.6 QUALITY ASSURANCE

A. Perform Work according to NJDOT standards.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANHOLE FRAMES AND COVERS

1. Furnish materials according to NJDOT standards.

2.2 RISER RINGS

1. Furnish materials according to NJDOT standards.

B. Riser Rings:

1. Thickness of 4 Inches to 6 Inches:

a. Material: Precast concrete.
b. Comply with ASTM C478.

2. Thickness of Less than 4 Inches:

a. Material: Cast iron.
b. Comply with AASHTO M306.

3. Rubber Seal Wraps:

a. Wraps and Band Widths: Comply with ASTM C877, Type III.
b. Cone/Riser Ring Joint: Minimum 3-inch overlap.
c. Frame/Riser Ring Joint: 2-inch overlap.
d. Additional Bands: Overlap upper band by 2 inches.

C. Accessories:

1. Joint Sealant: Comply with ASTM C990.
2. Bolts: Galvanized steel; ASTM F1554.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Requirements for installation examination.

B. Verify and locate manholes, inlets and valve boxes requiring:

1. Grade adjustment.
2. Replacement.

3.2 INSTALLATION

A. General

1. All manholes, covers, inlets, and catch basins shall be reset in accordance with these Specifications when the existing manholes, inlets catch basins or valve boxes are more than one- quarter inch (¼") over or under the grade shown on the Plans for the finished pavement or construction.
2. Cast Iron riser ring heights shall be in one quarter inch (¼") increments from 1 inch through 3 inches and shall be properly sized to afford a snug fit into the existing frame and receive the existing cover or grate.
3. Precast concrete raising rings shall be used where required height adjustment is between 4 and 6 inches.

B. Raising Manhole or Inlet Frames and Covers or Grates:

1. Locate and raise manholes to grade as indicated on Drawings.

2. Use flat or tapered concrete manhole rings or cast-iron riser rings to achieve indicated elevation for frame and cover.
3. Do not adjust elevation greater than 6 inches with concrete manhole rings.
4. Reinstall removed manhole frame and cover.

C. Lowering Manhole or Inlet Covers or Frames and Grates:

1. Remove the manhole or inlet frame and cover and lower the masonry top of the structure and reset on a cushion of cement mortar.

D. Adjust the height of existing two or three section circular valve boxes where a means of adjustment is incorporated into the original design. Where no adjustment is possible, remove and replace the valve box as directed by the Engineer.

E. Replacing Manhole or Inlet Frames and Covers:

1. Locate manholes for replacement of frames and covers as indicated on Drawings.
2. Remove existing manhole frames and covers.
3. Install new frames and covers for manholes as indicated on Drawings.
4. Adjust new frames and covers to match finished grade as indicated on Drawings.
5. Seal joints between manholes and manhole frames.

F. Paving Restoration:

1. Restore bituminous paving areas as specified in Section 321216 - Asphalt Paving.

- END OF SECTION -

SECTION 330509.33 - THRUST RESTRAINT FOR UTILITY PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Tied joint restraint system.
2. HDPE Wall Anchor Force Restraint Collar
3. HDPE Flex Coupling Restraint Device
4. Concrete Thrust Blocks

B. Related Requirements:

1. Section 013100 - Project Management and Coordination
2. Section 013300 - Submittal Procedures
3. Section 017700 - Closeout Procedures
4. Section 033000 – Cast-in-Place-Concrete
5. Section 312316.13 - Trenching
6. Section 331413 - Water Distribution Piping

1.3 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances

B. ASME International:

1. ASME B1.1 - Unified Inch Screw Threads, UN and UNR Thread Form

C. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
5. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
6. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts
7. ASTM A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance
8. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
9. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
10. ASTM D3350 - ASTM D 3350-Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
11. ASTM F436 - Standard Specification for Hardened Steel Washers

D. Plastics Pipe Institute, PPI

1. PPI Handbook of Polyethylene Pipe – 2009 (2nd Edition)

1.4 COORDINATION

A. Coordinate Work of this Section with installation of fittings and joints that require restraint.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer catalog information for restrained joint details and installation instructions.

B. Shop Drawings:

1. Indicate restrained joint details and materials being used.
2. Submit layout drawings showing piece numbers and locations.
3. Indicate restrained joint locations.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Delegated Design Submittals:

1. Submit joint restraint details.
2. Use joint restraint devices specifically designed for applications described in manufacturer information.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of joint restraints.

1.7 QUALITY ASSURANCE

A. Perform Work according to applicable standards as defined in these specifications.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' documented experience and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Provide concrete thrust block at each location of Butt Fusion Tee, Mechanical Joint Branch Tee, Mechanical Tapping Tee or other mechanical connection fittings which result in change of direction of the pipeline or in accordance with Construction Detail drawings.

2.2 TIED JOINT RESTRAINT SYSTEMS

A. Manufacturers

1. American Cast Iron Pipe Co., 1501 31st Avenue North, Birmingham, AL 35207
2. EBAA Iron, Inc.,P.O. Box 877, Eastland, TX 76448
3. Star Pipe Products, 4018 Westhollow Pkwy, Houston, Texas 77082
4. Romac Industries, 21919 20th Avenue SE, Bothell, WA 98021
5. U.S. Pipe, Two Chase Corporate Drive, Suite 200, Birmingham, AL 35244

B. Tie Bolts:

1. Mechanical Joints on 2- and 3-Inch Pipe:

   a. Size:5/8 inch.
   b. Comply with ASTM A588/A588M, Grade B.
   c. Comply with ASTM A325, Type 3, except increase tensile strength of full-body threaded section to 40,000 lb. minimum for 5/8 inch and 60,000 lb. minimum for 3/4 inch by heat-treating (quenching and tempering) to manufacturer's reheat and hardness specifications.

2. Mechanical and Flanged Joints on 4- to 12-Inch Pipe:

   a. Size: 3/4 inch.
   b. Comply with ASTM A588/A588M, Grade B.
   c. Comply with ASTM A325, Type 3, except increase tensile strength of full-body threaded section to 40,000 lb. minimum for 5/8 inch and 60,000 lb. minimum for 3/4 inch by heat-treating (quenching and tempering) to manufacturer's reheat and hardness specifications.

C. Tie Nut:

1. Description: Hex nut for each tie bolt and tie rods.
2. Comply with ASTM A563, Grade C3.
3. Finish: zinc plated, or galvanized.

D. Tiepin:

1. Bends and Hydrants: 3/4-inch round bar stock.
2. Size and Shape: 6-inch hairpin.
3. Comply with ASME B1.1 and ASTM A588/A588M.
4. Finish: zinc plated, or galvanized.

E. Tie Coupling:

1. Description: Extension of continuous-threaded rods.
2. Provide with center stop to aid installation.
3. Comply with ASTM A588/A588M.
4. Finish: zinc plated, or galvanized.

F. Tie Clamp:

1. Description: Retainer clamp for ductile iron, asbestos-cement, and PVC push-on pipe.
2. Location: In front of bell.
3. Comply with ASTM A36/A36M, ASTM A307, Grade A, and ASTM A563, Grade A.
4. Finish: zinc plated, or galvanized.

G. Tie Rod:

1. Description: Continuous-threaded rod for cutting to desired lengths.
2. Comply with ASTM A588/A588M, Grade B, ASTM A325, Type 3, and ASME B1.1.
3. Finish: zinc plated, or galvanized.

H. Tie Bar:

1. Description: Steel bar used to restrain push-in plugs.
2. Comply with ASTM A36/A36M.
3. Finish: zinc plated, or galvanized.

I. Tie Washer:

1. Description: Round flat washers.
2. ASTM A588/A588M, ASTM F436, Type 1.
3. Finish: zinc plated, or galvanized.

2.3 CONCRETE ANCHORS

A. Furnish ready-mixed concrete in accordance with ASTM C 94 and QC-3. Use only Type 1 Portland cement of American manufacture. Use maximum one inch

coarse aggregate (size 5, 56, 57, 6, or 7). Slump shall not exceed 4 inches. No air entrainment. Compressive strength shall be at least 1500 psi after 28 days.

2.4 EXAMINATION

A. Verify that pipe and fittings are ready to receive Work.

B. Field measure and verify conditions for installation of Work.

2.5 PREPARATION

A. Clean surfaces of pipe and fittings that are to receive tied joint restraint systems.

2.6 INSTALLATION

A. According to AWWA C600.

B. Install joint restraint system such that joints are mechanically locked together to prevent joint separation.

C. Form and place concrete for thrust restraints in accordance with the Construction Detail drawings.

- END OF SECTION -

SECTION 330597 - IDENTIFICATION AND SIGNAGE FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Detectable Warning Tape for placement above direct-buried utility.
2. Trace wire for placement above direct-buried utility.
3. Trace Wire Termination Boxes.
4. Signage

B. Related Requirements:

1. Section 013300 – Submittal Procedures
2. Section 017000 – Execution and Closeout Procedures
3. Section 017839 – Project Record Documents: Document actual installed locations of Tracer Wire access (termination) boxes
4. Section 312316.13 –Trenching: Backfilling considerations for installation of underground pipe markers.
5. Section 331413 – Water Distribution Piping: Piping, valves, and appurtenances requiring identification marking.

1.2 REFERENCE STANDARDS

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer catalog information for each specified product.

C. Samples: Submit one pipeline marker post, utility marker, 10 feet of ribbon tape, 10 feet of trace wire and one of each type of trace wire connectors.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Section 017000 – Execution and Closeout Procedures: Requirements for submittals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

PART 2 - PRODUCTS

2.1 DETECTABLE WARNING TAPE

A. Manufacturers:

1. ACP International, Arlington, TX
2. Marking Services Incorporated, Milwaukee, WI
3. Presco Products, Sherman, TX
4. Pro-Line Safety Products Co., West Chicago, IL
5. Reef Industries, Inc., Houston, TX

B. Description:

1. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored in accordance with the American Public Works Association Uniform Color Codes using the ANSI standard Z535.1 Safety Colors as follows:

    a. Red: electric power lines, cables, conduit, and lighting cables.
    b. Orange: telecommunication, alarm or signal lines, cables, or conduit.
    c. Yellow: natural gas, oil, steam, petroleum, or other gaseous or flammable material.
    d. Green: sewers and drain lines.
    e. Blue: potable water.
    f. Purple: reclaimed water, irrigation, and slurry lines.

2.2 TRACE WIRE

A. Manufacturers:

1. Copperhead Industries, LLC, Monticello, MN
2. Kris-Tech Wire, Rome NY

B. Description:

1. Tracer Wire:

a. Open Trench - Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.
b. Directional Drilling/Boring - Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 850 lb. break load, with minimum 30 mil HDPE insulation thickness.
c. Color: In accordance with the APWA Uniform Color Code for Underground Utility Lines.

2.3 TRACER WIRE TERMINATION BOX:

A. Manufacturers:

1. Bingham and Taylor
2. CP Test & Valve products
3. Cott Manufacturing Co.
4. Copperhead Industries
5. Handley Industries
6. Valvco
7. Or approved equivalent.

B. Description:

1. All trace wire termination points must utilize an approved trace wire access box specifically manufactured for this purpose. All tracer wire access boxes must include a manually interruptible conductive/connective link between the terminal for the tracer wire connection and the terminal for the ground rod wire connection. Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.
2. Design:

a. Flush Mount:

1) The Terminal box, or “fink box”, shall be flush mount type for installation at grade level in roadways or paved areas, H-20 highway rated. Terminal box shall be specifically manufactured for such application and shall consist of cast iron collar, tubular housing with flared bottom, terminal board with a minimum of two (2) terminals and removable lockable round lid.

b. Above Grade Mount:

1) The above grade access point s shall be specifically manufactured for such application and shall have a minimum of two (2) terminals, provision for mounting either on conduit, hydrant flange or drive–in ground stake.

C. Construction:

1. Flush mount type: Lid and terminal board material: High strength UV resistant HDPE, ABS or polycarbonate plastic. Lid to be molded in color according to type of service. Collar: Cast Iron ASTM A-48 Class 30. Tubular Housing: ABS or PVC with flared bottom.
2. Above grade type: Body to be UV resistant HDPE, ABS or polycarbonate plastic molded in color according to type of service.
3. Hardware:

   a. Flush Mount type: Locking mechanism with bronze, brass or anodized aluminum pentagon head bolt shall secure lid to base in a closed position.
   b. All types: Fasteners, Terminals and Jumper: All materials of construction shall be impervious to chemicals typically used for snow and ice removal and pavement and hardscape maintenance.
   c. Wire Connections: Separate tracer wire and ground rod wire connection points. Set screws or hex nuts shall secure tracer wire and ground wire to terminals.

4. Marking: All access boxes shall be appropriately identified and be color coded.
5. Color: In accordance with the APWA Uniform Color Code for Underground Utility Lines.

2.4 SIGNAGE

1. Weatherproof signage in shall be fabricated and provided in accordance with example(s) shown on the plans. Free standing signs shall be mounted on durable posts and located over the pipeline centerline.
2. Hydrant Identification Signs shall be fabricated in accordance with the example(s) shown on the plans. Signs shall be affixed to the body of the hydrant by means of aluminum or stainless steel strap and mounting hardware. Attachment hardware shall not require penetration or modification to hydrant body.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pipeline Marker Posts, Utility Markers, and Marking Flags: According to manufacturer instructions.

B. Tracer Wire:

1. All conductive and non-conductive service lines shall include tracer wire. Install HMW-PE jacket coated #12 AWG tracer wire adjacent to pipe prior to backfilling. The tracer wire shall be laid within 6 inches of the plastic pipe where practical and directly above if possible. Do not tape or otherwise attach the trace wire directly to the pipe. The tracer wire shall be installed so that electrical continuity is maintained throughout the pipe system. All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
2. Connections shall be made by:

    a. Direct bury wire connectors – shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.
    b. Non locking friction fit, twist on or taped connectors are prohibited.

3. Termination/Access:

    a. All tracer wire termination points must utilize an approved tracer wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose and installed as follows:

        1) Hydrants - Above-ground tracer wire access boxes will be installed on all fire hydrants. The tracer wire must terminate at the above-ground tracer wire access box, which shall be properly affixed to the hydrant grade flange utilizing 5/8” bolt for hydrants with 5/8” bolts, and ¾” for hydrants with ¾” bolts. Affixing with tape or plastic ties shall not be acceptable.
        2) Service Laterals - Tracer wire on all water service laterals must terminate at an approved at-grade, two-terminal tracer wire access box, color coded blue, and located directly above

the service lateral immediately adjacent to the waterline's entrance to the facility served.

b. At all dead-end mains, service laterals, and curb stops, tracer wire shall go to ground using an approved connection to a drive-in magnesium ground anode rod with a minimum of 20ft of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 1.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.

    1) When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.
    2) When grounding the trace wire in areas where the trace wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire.

c. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.
d. Where the anode wire will be connected to a trace wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

C. Installation Standards:

1. Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
2. Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.

D. Detectable Warning Tape:

1. Install detectable warning tape directly above all piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
2. If multiple pipes occur in common trench, locate tape above centerline of trench.
3. Coordinate with trench Work as specified in Section 31 23 16.13 - Trenching.

E. Prohibited Products and Methods

1. The following products and methods shall NOT be allowed or acceptable:

    a. Uninsulated tracer wire
    b. Stainless steel tracer wire
    c. Tracer wire insulations other than HDPE
    d. Non-locking, friction fit, twist on, or taped connectors
    e. Brass or copper ground rods
    f. Wire connections utilizing taping or spray-on waterproofing
    g. Looped wire or continuous wire installations that have more than one wire laid side-by- side or in close proximity to one another
    h. Tracer wire wrapped around the corresponding utility
    i. Brass fittings with tracer wire connection lugs
    j. Wire terminations within the roadway in valve boxes, cleanouts, manholes, etc.
    k. Connecting tracer wire to existing conductive utilities

3.2 TESTING

A. All new tracer wire installations shall be located using typical low frequency (512 Hz) line tracing equipment, witnessed by the contractor, engineer, and facility owner as applicable, prior to acceptance of ownership.

B. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.

C. Continuity testing in lieu of actual line tracing shall not be accepted.

3.3 RECORD DRAWINGS

A. Record actual locations of all trace wire access boxes on record drawings.

- END OF SECTION -

SECTION 331413 - WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings for potable water line for installation in Utility Trench “A”.
2. Tapping sleeves and valves.
3. Pipe support systems.

B. Related Requirements:

1. Section 033000 - Concrete: Concrete for pipe cradles and encasements and reinforcing steel and required supports for cradles and encasements.
2. Section 312316.13 – Trenching: For excavation and backfill requirements.
3. Section 330509.33 - Thrust Restraint for Utility Piping: Tied joint restraint system to anchor and resist forces developed in underground closed pipeline systems.
4. Section 330597 - Identification and Signage for Utilities: Pipe markers, tracer wire, detectable warning tape and signage for buried piping.
5. Section 331419 - Valves and Hydrants for Water Utility Service: Yard hydrants, valves, and valve boxes for yard hydrant and water main installations.

1.3 REFERENCE STANDARDS

A. American Galvanizers Association (AGA):

1. Inspection of Products Hot-dip Galvanized After Fabrication.
2. The Design of Products to be Hot-dip Galvanized After Fabrication.
3. Recommended Details of Galvanized Structures.
4. Quality Assurance Manual.

B. American Society of Mechanical Engineers:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

C. ASTM International:

1. A36 - Standard Specification for Carbon Structural Steel.
2. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. A143 - Standard Practice for Safeguarding Against Embrittlement of Hot Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
4. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. A384 - Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
6. A385 - Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
7. A563 - Standard Specification for Carbon and Alloy Steel Nuts
8. A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
9. E376 - Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods.
10. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
11. ASTM A395 - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures

D. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
6. AWWA C153 - Ductile-Iron Compact Fittings.
7. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
8. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
9. AWWA C606 - Grooved and Shouldered Joints.
10. AWWA C800 – Underground Service Line Valves and Fittings

E. Federal Specifications

1. DOD-P-21035 Paint, High Zinc Dust Content, Galvanizing Repair
2. MIL-P-26915 Primer Coating, Zinc Dust Pigmented

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves.

G. National Fire Protection Association:

1. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

H. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information regarding pipe materials, pipe fittings, valves, service saddles, pipe supports, hangers and hardware.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

E. Preconstruction Photographs: Submit digital files of color photographs of Work areas and material storage areas, as specified in Section 017000 – Execution Closeout Procedures.

F. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 – Execution and Closeout Procedures: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and centerline elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Valves: Mark valve body with manufacturer's name and pressure rating.

B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

C. Perform Work according to Philadelphia Water Department standards.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience in installation of liner materials.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials according to manufacturer instructions.
2. Block individual and stockpiled pipe lengths to prevent moving.
3. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Section 017000 – Execution and Closeout Procedures: Requirements for warranties.

B. Furnish ten (10) -year manufacturer's warranty for valves.

PART 2 - PRODUCTS

2.1 BACKFILL

A. Furnish Sand Backfill for pipe zone in accordance with ASTM C 33 (fine aggregate) and the following:
   1. Gradation:
      a. Sieve Number 200 100 50 16 4
      b. Percent Passing 0-5 0-8 5-30 50-98 98-100
   2. pH: between 5.5 and 8.5.
   3. Electrical Resistivity: 10,000 ohm-centimeters, minimum.
   4. Character: clean, free from lumps of clay or other deleterious substances.

B. Ordinary Backfill Material may include all material excavated from the trench and free of objectionable matter, unless rejected by the Owner or Owner's Representative. The Contractor shall furnish any deficiency of Ordinary Backfill Material.

C. Furnish Select Backfill Material in accordance with the most recent revision or amendment to PennDOT Publication 408 Specifications, Section 703.3, Select Granular Material-2RC. The use of slag as Select Backfill Material is hereby prohibited.

2.2 DI PIPE

A. Furnish ductile iron push-on joint pipe in accordance with AWWA C151 and C150/A21.50. Furnish gaskets in accordance with AWWA C111. Furnish all pipe with double-thickness cement lining in accordance with AWWA C104.

B. Cast into, stamp or paint on each pipe: the manufacturer's mark; casting number; year of cast; "DI"; class of pipe. Markings shall be clear and legible.

C. Class, wall thickness, and weight per foot of barrel of DI pipe of the various sizes shall be as follows:

Nominal Diameter	Class	Thickness (in.)	Wt. of Barrel per ft. (lbs)
12 inch	56	0.49	59.9
8 inch	56	0.45	37.2
6 inch	56	0.43	26.7
4 inch	54	0.35	15.0

D. Where Polyethylene Encasement is required by the Contract Documents, furnish DI Pipe With Polyethylene Encasememt in accordance with ANSI/AWWA C105/A21.5, American National Standard for Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.

2.3 DI FITTINGS

A. Furnish Compact DI Fittings in accordance with AWWA C153 for Crosses 3” through 16”; and Bends, Tees, Reducers and Sleeves 3" through 24".

B. Furnish DI Fittings (rated at least 350 psi) in accordance with AWWA C110 for Crosses 18” through 24”; Offsets, Caps and Plugs 3” through 12”.

C. Furnish gaskets, glands, nuts and bolts in accordance with AWWA C111. Furnish all fittings with double-thickness cement lining in accordance with AWWA C104 or furnish all fittings coating and lining with a thickness fusion bonded epoxy conforming to the requirements of ANSI/AWWA C550 and C116/A21.16. Bolts shall be high-strength, low-alloy steel.

D. Cast into, stamp or paint on each fitting: the manufacturer's mark; casting number; year of cast; "DI"; weight before cement lining; pressure rating. Markings shall be clear and legible.

E. Furnish fittings with mechanical joint bell ends at all openings unless otherwise directed. Furnish bell and spigot fittings where necessary for connection to existing mains; furnish lead and pure gum rubber scarfed packing gasket acceptable to the Owner or Owner’s Representative.

2.4 CONCRETE ANCHORS

A. Furnish ready-mixed concrete in accordance with ASTM C 94 and QC-3. Use only Type 1 Portland cement of American manufacture. Use maximum one inch coarse aggregate (size 5, 56, 57, 6, or 7). Slump shall not exceed 4 inches. No air entrainment. Compressive strength shall be at least 1500 psi after 28 days.

2.5 WATER SERVICE CONNECTIONS

A. Not Applicable

2.6 COMPOSITION BRONZE CASTINGS

A. Where copper-based component castings are required for fittings, valves, and corporation stop ferrules, furnish castings in accordance with AWWA C 800 and ASTM B 584. Use only Copper Alloy UNS No. C 83600 (Composition Bronze, commercial 85-5-5-5 alloy) in accordance with ASTM B 62 for this work. This alloy consists, nominally, of 85% copper, 5% tin, 5% lead, and 5% zinc. Do not use alloys containing more than 5% lead for castings which will come into contact with potable water.

2.7 ELECTROLYSIS CORROSION CONTROL

A. Furnish corrosion control materials in accordance with Section 331125 and W-23 except as modified below.

B. Attention is directed to the second paragraph of W-23.2.1. Thick-N-Quick Mastic as produced by Utility Products Company and Roskote Mastic R28 Rubberized as manufactured by Royston Laboratories, Inc. are acceptable protective coatings for mechanical joints, miscellaneous iron and steel, etc. However, Bitumastic 50 as manufactured by Koppers Company is no longer acceptable for this use, and Royston Laboratories, Inc. has discontinued production of Roskote A-938.

2.8 PIPE GASKET LUBRICANT

A. Furnish lubricant for lubricating rubber gaskets used in push-on joint or mechanical joint pipe assemblies. Pipe gasket lubricant shall be odorless and suitable for use in potable water systems. Furnish Blue Lube pipe gasket lubricant as manufactured by Whitlam Chemicals, 200 W. Walnut Street, P.O. Box 71, Wadsworth, Ohio 44281-0071 (1-800-321-8358) or approved equal. Alternatives to the Blue Lube lubricant must be approved by the Water Department’s Bureau of Laboratory Services.

2.9 PIPE END PLUGS

A. All DI pipe shall be capped upon delivery. Furnish commercially manufactured plugs for the purpose of plugging the ends of 8”pipe, which awaits installation at the job site. The plugs shall fit tightly so as to be secure in the ends of the pipe. The plug’s design shall prevent over insertion into the pipe.

B. Other sizes of pipe may be capped by securely tapping six-millimeter polyethylene plastic over their ends.

PART 3 - EXECUTION

3.1 MAINTENANCE AND PROTECTION OF TRAFFIC DURING CONSTRUCTION

A. Maintain and protect traffic during construction as required elsewhere in these Contract Documents.

3.2 EXCAVATING

A. Excavate in accordance with the Standard Specifications for Excavation, Refilling, Grading, Landscaping, and Repaving. Excavation will not be classified, whether by type of material encountered, or by type of equipment required.

B. Use sheathing and shoring sufficient to avoid damage to or settlement of adjacent paving and underground structures.

C. Use of a Hydro-Hammer or similar equipment for breaking existing paving is prohibited.

D. Where shown on the plans, remove existing CI water manhole frames and covers and deliver them to Water Department Storage Yard at 28th and Clearfield Streets. Remove existing water manhole structure two feet below surface elevation.

3.3 INSTALLING WATER MAINS

A. Install pipe, fittings, valves, hydrants, anchors, and all appurtenances in accordance with the Contract Documents, and in accordance with AWWA C600 and the manufacturer's recommendations as they apply.

B. Place 6 inches of Sand Backfill in trench before placing pipe, fittings, valves, etc. grade and compact to uniform bearing for full length of each pipe section. Use wood template to assure a straight trench bottom, free of humps and hollows, and at the required grade. Correct all irregularities by leveling, filling, and tamping. Use no blocking. Provide bell groove at each joint, with at least 2 inches clearance below bell.

C. Maintain at least 6 inches clearance between water mains and other underground structures.

D. Cut and plug existing water mains as directed by the Owner or Owner's Representative.

E. Install hydrants in accordance with standard details. At hydrant installations on 6" - 16" mains exclusively, install hydrant anchoring tees so hydrant line valves are near the main. Substitution of mechanical joint tees shall only be permitted if authorized by the Owner or Owner's Representative. After hydrant installation is completed, inspect the hydrant's painted riser surfaces for nicks and scratches and repaint as required to prevent further degradation of the painted surface. Tops of hydrants shall be painted green or red when connected to larger size mains to enable the Fire Department to quickly differentiate them from any others. The bonnets of hydrants shall be color coded as follows:

Main Size	Hydrant Bonnet Color
6" - 8"	Orange
10" - 14"	Green
> 16"	Red

The hydrant bonnets shall be painted with Rust-Oleum 7600 series of VOC industrial enamels. The following is a list of Rust-Oleum's color name and number for each color:

Color	Rust-Oleum Color Name	Number
Orange	Equipment Orange	7656
Green	Safety Green	7633

Do not install any new fire hydrant, nor relocate any existing fire hydrant, until location is approved in field by the Owner or Owner's Representative.

F. Between any two mechanical-joint fittings, use at most one piece of pipe shorter than standard length.

G. Furnish approved pipe gasket lubricant (Blue Lube or approved equal) in sufficient quantities to provide proper fitting for each connection. Apply lubricant to the gasket using a clean applicator brush kept free from soil, grease, coatings, or other potential contaminants.

H. Restrain all pipe joints within 12 feet of a bend, branch of a tee, valve, or hydrant.

I. Place Concrete Anchors in accordance with Standard Details for Water Mains.

J. Where the Corrosion Control plans require Electrolysis Corrosion Control work, perform such work as shown on the plan(s) and in accordance with W-23. Where polyethylene encasement is required by the Contract Documents, install DI Pipe with polyethylene encasement.

K. Disinfect all new water mains in accordance with W-22 and AWWA C651.

L. Test new water mains in accordance with AWWA C600, Section 4. Take all necessary precautions to prevent test pressure from entering adjoining distribution system. Test distribution mains at 150 psi for at least one hour. Hydrostatic test shall be completed with no measurable drop in pressure. Upon a drop in pressure, determine the amount of leakage by measuring the additional quantity of water that is pumped into the main to maintain pressure within 5 psi of the specified test pressure. Where the measured leakage exceeds the established allowable amounts then the Contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance. Repair all visible leaks, regardless of the amount of leakage.

1. Set Valve Boxes to grade, true and plumb, with valve operating nut centered in box.

3.4 BACKFILLING AND COMPACTING

A. Place and compact backfill in accordance with the Standard Specifications for Excavation, Refilling, Grading, Landscaping and Repaving, except as herein modified.

B. Do not place backfill around any structure requiring time to gain strength (e.g., masonry or concrete), until so directed by the Owner or Owner's Representative.

C. Placement of Sand Backfill, Ordinary Backfill and Select Backfill Material-2RC for water mains, water services and abandoned water manholes:

1. Place Sand Backfill as described in the Standard Details for Water Mains (as amended).
2. Place Ordinary Backfill Material (with all stones and other objectionable material removed) around and to a depth of 6 inches over all water services.
3. Place Ordinary Backfill Material up to 12 inches below subgrade elevation over all water mains and services.
4. Place Select Backfill Material-2RC for remaining 12 inches up to subgrade elevation over all water mains and services.
5. Place Select Backfill Material-2RC into all abandoned water manholes from bottom of manhole up to subgrade elevation.
6. Compact sand backfill under pipes and fittings by mechanical tamping. Compact sand backfill around and over pipes and fittings by hand tamping in 8 inch layers. Compact all other backfill in 8 inch layers by mechanical tamping. Puddling is prohibited.

3.5 REPAVING

A. Restore all disturbed paving, curb, and grass areas as required elsewhere in the Contract Documents.

3.6 PIPE STORAGE

A. Pipes shall be inspected and verified to be clean immediately upon delivery and then plugged so soil, trash, and other contaminates cannot easily enter them while they await installation. Pipes brought to the site with debris shall be cleaned and swabbed before plugging. Inspect pipes for missing caps regularly and replace immediately. During installation inspect pipes upon removing the plugs in order to ensure no debris is present.

PART 4 CONTRACTOR'S QUALITY CONTROL REQUIREMENTS

3.7 GENERAL

A. Comply with applicable provisions of Division 01 Section "Quality Requirements".

B. Quality Certification Standards: Precast Concrete Products, Gray / Ductile Iron Castings, Ready-Mixed Concrete, Fire Hydrants, Ductile Iron Pipe & Fittings, and Resilient-Seated Gates Valves (3" to 12" Dia.) shall conform to QC-1, QC-2, QC-3, QC-5, QC-8, and QC-12 respectively.

C. DI Pipe and Fittings: Inspection by Purchaser at manufacturer's plant is hereby waived. In addition to the standard acceptance tests, the manufacturer shall perform a special test for ductility (either the ball impression test or the ring test).

D. In addition, the Contractor supplied quality control shall consist of:

1. Maximum Density-Optimum Moisture. The Contractor shall obtain a maximum density-optimum moisture curve in accordance with requirements specified herein for each material used a backfill.
2. Compaction Tests. The Contractor shall obtain in-place field densities, at the sampling rate of one test per 10 cubic yards or less for the full width of each layer of backfill placed.
3. Reports. A report of all preliminary test results and maximum density-optimum moisture curves shall be made and given to the Owner's Representative prior to use of the material as backfill. A report of all in-place densities shall be made and given to the Owner's Representative within 48 hours of making the tests.

- END OF SECTION -

SECTION 331419 - VALVES AND HYDRANTS FOR WATER UTILITY SERVICE

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. Valves.
2. Valve Boxes.
3. Fire Hydrants.
4. Sanitary Yard (Post) Hydrants.

B. Related Requirements:

1. Section 033000 - Cast-in-Place Concrete
2. Section 310516 - Aggregates for Earthwork
3. Section 330509.33 - Thrust Restraint for Utility Piping
4. Section 330597.00 Identification and Signage for Utilities
5. Section 331413 - Water Distribution Piping

1.3 REFERENCE STANDARDS

A. American Society of Sanitary Engineers (ASSE)

1. ASSE 1052 - Performance Requirements for Hose Connection Backflow Preventers.
2. ASSE 1057 - Performance Requirements for Freeze Resistant Sanitary Yard Hydrants with Backflow Protection.

B. ASTM

1. B61 Standard Specification for Steam or Valve Bronze Castings
2. B62 Standard Specification for Composition Bronze or Ounce Metal Castings.
3. D2683 Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
4. D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

C. American Water Works Association:

1. AWWA C153-11 Ductile-Iron Compact Fittings
2. AWWA C216 Heat-Shrinkable Cross-Linked Polyolefin Coatings for Steel Water Pipe and Fittings
3. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
4. AWWA C502 - Dry-Barrel Fire Hydrants.
5. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
6. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
7. AWWA C521 – Plastic Ball Valves
8. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.
9. AWWA C901 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. for Waterworks
10. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 1/2 In. Through 3 In. for Waterworks

D. National Fire Protection Association:

1. NFPA 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants.

E. City of Camden Fire Department

F. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

A. Section 013100 – Project Management and Coordination: Requirements for coordination.

B. Coordinate Work of this Section with installation of water mains.

1.5 PREINSTALLATION MEETINGS

A. Section 013100 – Project Management and Coordination: Requirements for preinstallation meeting.

1.6 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information regarding component materials, fittings, assembly and parts diagram, and accessories.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.7 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution: Requirements for submittals.

B. Project Record Documents: Record actual locations of valves and hydrants.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Tools: Furnish three (3) tee wrenches of adequate length required for buried valves to Owner.

1.9 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

B. Cast manufacturer's name, pressure rating, and year of fabrication into valve body.

C. Maintain one copy of each standard affecting Work of this Section on Site.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Seal valve and hydrant ends to prevent entry of foreign matter.
2. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 VALVES

A. Performance and Design Criteria:

1. Pressure Rating:

a. 12-inch Diameter and Smaller: 200 psig.
b. 14-inch Diameter and Larger: 150 psig.

2. End Connections:

a. Mechanical Joint with internal stiffener for connection to HDPE Pipe.
b. Male Barbed Spigot with pressed HDPE Stub for electrofusion or butt fusion with steel compression sleeve complying with AWWA C906.
c. PE 4710 molded end spigot integral with body for electrofusion or butt fusion (2 inch and smaller).

3. Hardware and Internal HDPE Stiffeners

a. 304 Stainless Steel

4. Coatings:

a. Valves:

1) Comply with AWWA C550.

a) Application: Interior and exterior.

b. Steel Compression Sleeves

1) Comply with AWWA C216.

B. Double-Disc Gate Valves:

1. Manufacturers:

a. McWane, Inc.; Clow Valve Co. Div.
b. McWane, Inc.; Kennedy Valve Div.
c. McWane, Inc.; M & H Valve Company Div.
d. Mueller Co.; Water Products Div.

2. Description:

a. Comply with AWWA C500.
b. Materials:

1) Body: Iron.
2) Trim: Bronze.

c. Seat Type: Double disc; parallel.
d. Stem:

1) Type: Non-rising.
2) Seals: O-ring.

e. Operation:

1) Square operating nut.
2) Opening Direction: Counterclockwise.

C. Resilient-Wedge Gate Valves:

1. Manufacturers:

a. McWane, Inc.; Clow Valve Co. Div.
b. McWane, Inc.; Kennedy Valve Div.
c. McWane, Inc.; M & H Valve Company Div.
d. Mueller Co.; Water Products Div.
e. Leemco, Inc.
f. American AVK Company
g. American Valve & Hydrant Co.

2. Description:

a. Comply with AWWA C509 or C515.
b. Body: Ductile iron.

c. Seats: Resilient.
d. Stem:

1) Type: Non-rising.
2) Material: Bronze.

e. Operation:

1) Square operating nut.
2) Opening Direction: Counterclockwise.

D. HDPE Ball Valves:

1. Manufacturers

a. Integrity Fusion Products.
b. American AVK Company
c. Kerotest Manufacturing Corp.

2. Description:

a. Design: Comply with AWWA 521
b. Materials:
1) Comply with AWWA C901 or C906
2) Body: High Density Polyethylene (PE 4710), flat base.
3) Ends: High Density Polyethylene (PE 4710), butt fusion or electrofusion.
4) Ball: Polypropylene.
5) Retainer: Polypropylene
6) Stem: Stainless Steel
7) Operating Nut: Polypropylene.
8) Ball Seat: EPDM
9) Weather Seal: EPDM
10) Stem Seals: EPDM
c. Operating Nut: 2” square nut
d. Seals: Dual O-ring.
e. Operation: Positive position indication, over-torque protection.
f. Opening Direction: Counterclockwise
g. Connections: Butt Fusion or Electrofusion
h. Bore: Full Port
i. SDR: 9.0

3. Certifications:
a. NSF 61

2.2 FIRE HYDRANTS

A. Manufacturers:

1. Clow Valve Company
2. Kennedy Valve Company
3. Mueller Company
4. Furnish materials complying with:

    a. City of Camden Fire Department requirements.

B. Dry-Barrel, Breakaway Type:

1. Comply with AWWA C502.
2. Body: Cast iron.
3. Valve: Compression type.
4. Burial Depth: As indicated on Drawings.
5. Inlet Connection Size: 6 inches.
6. Valve Opening: 5-1/4 inches in diameter.
7. End Connections:

    a. Mechanical Joint with internal stiffener for connection to HDPE Pipe.
    b. Male Barbed Spigot with pressed HDPE Stub for electrofusion or butt fusion with steel compression sleeve complying with AWWA C906.

8. Bolts and Nuts: 304 Stainless Steel
9. Interior Coating: Comply with AWWA C550.
10. Opening Direction: Counterclockwise.
11. Operating Nut: Pentagon or Triangular to comply with City of Camden Fire Department requirements.

C. Hose Connections:

1. One pumper, two hose nozzles.
2. Obtain thread type and size from City of Camden Fire Department.
3. Attach nozzle caps by separate chains.

D. Finishes:

1. Primer and two coats of enamel as specified in Section 099000 - Painting and Coating.
2. Body Color: Orange.
3. Bonnet Color: Color coded to identify the diameter of the water main feeding the fire hydrant in accordance with City of Camden Fire Code Requirements.

2.3 YARD (POST) HYDRANTS

A. Manufacturers

1. MIFAB, Inc.
2. Murdock Manufacturing.
3. Woodford Manufacturing.

B. Description:

1. Sanitary Post Hydrant – Self purging, non-freezing, compression type sanitary yard hydrant. Hydrant design shall include vacuum breaker or other means designed to prevent the flow of water, or other liquids, into the potable water supply from any source other than those intended. There shall be no potential cross-connections between the potable water supply and any hose or drain outlet. The hydrant freeze protection feature shall not require the disconnection or removal of the delivery hose from the outlet connection.

    a. Inlet:
        1) Size: 1 inch, 1 ½ inch or 2 inch
    b. Nozzle:
        1) Size: 3/4 inch or 1 inch.
        2) Material: Brass.
        3) Fitting: Male thread.
        4) Type: Removable.
        5) Equipped with Vacuum Breaker
    c. Casing:
        1) Description:
            a) Cast Iron.
            b) Galvanized Steel
            c) Stainless Steel
            d) Bronze
    d. Drain:
        1) Self flushing with integral self purging reservoir located below frost line discharging above ground. Hydrants discharging to gravel bed or other point below grade are not acceptable.
    e. Operating Rod:
        1) Description: Stainless Steel.
        2) Operation: Lever or Wheel Handle.
    f. Valve: Bronze or Brass conforming to ASTM B61and B62.
    g. Working Pressure: Min. 30 psig
        1) Delivery Volume: Min. 2.5 GPM @ 30 psig
    h. Bury Depth:
            a) Min. 48” below finished grade.
            b) In accordance with local building codes or other Authority having jurisdiction.

i. Certifications:
   1) ASSE 1057 - Type 1
   2) ASSE 1052
   3) NSF 372 & NSF 61
j. Identification:
   1) Section 220553 - Identification for Plumbing Piping and Equipment defines requirements.
      a) Body Color – Safety Green complying with APWA Uniform Color Code
      b) Lettering – “POTABLE WATER”

2.4 VALVE BOXES

A. Manufacturers:

1. Bingham and Taylor
2. East Jordan Iron Works
3. Star Pipe Products

B. Description:

1. 12-inch Diameter Valves and Smaller:

   a. Material: Cast Iron - Two or three section as required, including Cover, Top, Bottom and Intermediate section(s).
   b. Type: Screw type adjustable circular valve box, with flush fitting lid and oval or circular bell type base designed for use with applicable valve size.
   c. Cover type: Non Locking
   d. Diameter: As noted on plans.

2. Lid Inscription: WATER.

2.5 ACCESSORIES

A. Thrust Restraints: As specified in Section 330509.33 - Thrust Restraint for Utility Piping.

B. Valve Box Aligner: High-strength plastic device designed to automatically center valve box base and to prevent it from shifting off center during backfilling

C. Fire Hydrant Drainage Gravel: As specified in Section 310516 - Aggregates for Earthwork.

D. Signage: Comply with Section 330597.00 Identification and Signage for Utilities

2.6 WARRANTIES

A. Fire Hydrants: 10 Years.

B. Valves: 10 Years

2.7 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution: Requirements for installation examination.

B. Determine exact location and size of valves from Drawings.

C. Identify required lines, levels, contours, and datum locations.

D. Verify that elevations of existing facilities prior to excavation and installation of valves and hydrants are as indicated on Drawings.

3.2 PREPARATION

A. Section 017000 - Execution: Requirements for installation preparation.

B. Locate, identify, and protect from damage utilities to remain.

C. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.

1. Notify Engineer not less than seven days in advance of proposed utility interruption.
2. Do not proceed without written permission from Engineer.

3.3 INSTALLATION

A. Perform trench excavation, backfilling, and compaction as specified in:

1. Section 312316.13 - Trenching

B. Install valves and hydrants in conjunction with pipe laying.

C. Install tracer wire and install Tracer Wire Connection Boxes as shown on the plans.

D. Provide buried valves with valve boxes installed flush with finished grade. Paint water valve box cover blue in accordance with the APWA Uniform Color Codes

E. Provide support blocking and drainage gravel while installing fire hydrants; do not block drain hole.

F. Orientation:

1. Set valves and hydrants plumb.
2. Set fire hydrants with pumper nozzle facing roadway.
3. Set fire hydrants with centerline of pumper nozzle 18 inches above finished grade and with safety flange not more than 6 inches nor less than 2 inches above grade.

G. After main-line pressure testing, flush fire hydrants and check for proper drainage.

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

- END OF SECTION -

SECTION 334200 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stormwater drainage piping.
2. Manholes.
3. Catch basins (Inlets).
4. Cleanouts.
5. Underdrains.
6. Bedding and cover materials.

B. Related Requirements:

1. Division 03, Section 033000 “Cast-in-Place Concrete”: Concrete type for inlet or manhole base pad construction.
2. Division 31, Section 310516.00 “Aggregates for Earthwork”: Aggregate for backfill in trenches.
3. Division 31, Section 312316.13 “Trenching”: Execution requirements for trenching as required by this Section.
4. Division 33, Section 330597.00 “Identification and Signage for Utilities”: Underground pipe markers.

1.2 DEFINITIONS

A. ABS: Acrylonitrile butadiene styrene.

B. NBR: Acrylonitrile Butadiene Rubber. (Buna-N)

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M252 - Standard Specification for Corrugated Polyethylene Drainage Pipe.
2. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
3. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.
4. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg Rammer and a 457-mm Drop.

B. ASTM International:

1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
2. ASTM A123/.
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
5. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
6. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
7. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
8. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).
9. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3).
10. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
11. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
12. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
13. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.
14. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
15. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
16. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
17. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
18. ASTM F405 - Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings.
19. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
20. ASTM F667/F667M - Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings.

C. New Jersey, Department of Transportation (NJDOT):

1. Standard Specifications for Road and Bridge Construction, 2019.

1.4 COORDINATION

A. Division 01, Section 013100 “Project Management and Coordination”: Requirements for coordination.

B. Coordinate Work of this Section with termination of storm sewer connections outside building, trenching, and connections to existing stormwater collection system.

1.5 SUBMITTALS

A. Division 01, Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Product Data: Submit manufacturer information describing pipe, pipe accessories, manholes, manhole accessories, pipe seals, cleanouts and utility castings.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit special procedures required to install specified products.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Division 01, Section 017700 “Closeout Procedures”: Requirements for submittals.

B. Project Record Documents: Record actual locations of pipe runs, connections, catch basins, cleanouts, and rim and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Perform Work according to NJDOT Specifications.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience and approved by:
   1. New Jersey, Department of Transportation:

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

   1. Protect materials from damage, moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

   1. Verify field measurements prior to installation.
   2. Indicate field measurements on Record Drawings.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Ductile-Iron Piping:

   1. Pipe:

      a. Comply with ANSI/AWWA Standards C151/A21.51, Class 56.
      b. Type: Service.
      c. Inside Nominal Diameter: as noted on the plans.
      d. Ends: Bell and spigot with push on or mechanical joints - gasketed.

   2. Fittings:

      a. Ductile Iron Fittings shall conform to ANSI/AWWA Standards C110/A21.10 or ANSI/AWWA Standards C153/A21.53.

   3. Joints and Joint Components:

a. Ductile Iron in accordance with the requirements of ANSI/AWWA Standards C111/A21.11
b. Gaskets: Nitrile (Buna-N) Rubber gasket.

2.2 CATCH BASINS (INLETS)

A. Shaft and Top Section:

1. Material: Reinforced precast or cast-in-place concrete.
2. Joints: Lipped male/female.
3. Nominal Dimensions:
   a. Circular – 48 inches minimum interior.
   b. Rectangular or Square – 30 inches minimum interior.
4. Top Section: Concentric, Eccentric or Flat Top as noted on the plans.

B. Grates and Frames:

1. Manufacturers:
   a. Barry Pattern & Foundry, Birmingham, AL
   b. Campbell Foundry, Harrison, NJ
   c. East Jordan Iron Works, East Jordan, MI
   d. Emporia Foundry, Emporia, VA
   e. Neenah Foundry, Neenah, WI

2. Materials:
   a. Grey Iron, ASTM A48 Class35.
   b. Ductile Iron, ASTM A536

3. Cover or Grate:
   a. Design: As indicated on plans.
   b. Load Rating: Heavy Duty (HS-20), unless noted otherwise on plans.

4. Nominal Cover and Frame Size:
   a. As noted on plans.

C. Base Pad:

1. Material: Cast-in-place concrete, as specified in Division 03, Section 033000 “Cast-in-Place Concrete”.

2.3 MATERIALS

A. Bedding and Cover:

1. Refer to Specification Division 31, Section 312316.13 “Trenching”.

2.4 FINISHES

A. Steel Galvanizing:

1. Comply with ASTM A123/A123M.
2. Hot-dip galvanized after fabrication.

B. Galvanizing for Nuts, Bolts, and Washers: Comply with ASTM A153/A153M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01, Section 017700 “Closeout Procedures”: Requirements for installation examination.

B. Verify that excavation base is ready to receive Work of this Section.

C. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Correct over-excavation with AASHTO No. 57 stone bedding.

B. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

3.3 INSTALLATION

A. Excavation and Bedding:

1. Excavate trench to depth below pipe invert, hand trim excavation for accurate placement of piping to indicated elevations and place bedding material at trench bottom as specified in Division 31, Section 312316.13 “Trenching”.

B. Pipe, Fittings, and Accessories:

1. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

2. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
3. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
4. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
5. Install gravity-flow, nonpressure, drainage piping according to the following:
    a. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
    b. Install piping at depths indicated on the plans.
    c. Install hub-and-spigot, ductile-iron piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.
7. Backfilling and Compaction:
    a. Do not displace or damage pipe while compacting.

C. Catch Basins (Inlets) and Cleanouts:

1. Form bottom of excavation clean and smooth, and to indicated elevation.
2. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe end sections.
3. Level top surface of base pad.
4. Sleeve concrete shaft sections to receive storm sewer pipe sections.
5. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.
6. Mount lid and frame level in grout, secured to top section to indicated elevation.

3.4 TOLERANCES

A. Division 01, Section 014000 “Quality Requirements”: Requirements for tolerances.

B. Maximum Variation from Indicated Pipe Slope: 1/8 inch in 10 feet.

3.5 FIELD QUALITY CONTROL

A. Division 01, Section 014000 “Quality Requirements”: Requirements for testing, adjusting, and balancing.

B. Inspection:

1. Request inspection by Engineer prior to and immediately after placing aggregate cover over pipe.

C. Testing:

1. Compaction Test:

a. Comply with ASTM D1557.
b. Testing Frequency: in accordance with Division 31, Section 312316.13 “Trenching”.

2. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

3.6 PROTECTION

A. ~~Division 01, Section 015000 “Temporary Facilities and Controls”: Requirements for protecting finished Work.~~

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

PART 4 – MEASUREMENT AND PAYMENT

A. Pay item shall be measured and paid for on a per foot basis for each diameter of pipe to be installed. Tying new piping into an existing manhole is considered incidental to this work.

- END OF SECTION -

SECTION 341110 – CONTINUOUS WELDED RAIL (CWR)

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the material requirements and performance criteria for the supply and fabrication of Continuous Welded Rail (CWR) to be furnished in accordance with Contract Documents.

1.2 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering
2. Portfolio of Trackwork Plans
3. Specifications for Special Trackwork

B. Association of American Railroads (AAR)

1. AAR: Manual of Standards and Rec. Practices
2. AAR Section J: Quality Assurance M-1003

C. American Society for Testing and Materials (ASTM):

1. ASTM E10: Test Method for Brinell Hardness of Metallic Materials
2. ASTM E94: Recommended Practice for Radiographic Testing
3. ASTM E164: Standard Practice for Ultrasonic Contact Examination of Weldments

D. American Welding Society (AWS):

1. AWS B2.1: Standards for Welding Procedures and Performance Qualifications
2. AWS D1.1: Structural Welding Code

1.3 DEFINITIONS

A. Detail Fractures – A progressive fracture originating near the rail surface from a shell or head check

B. Rail Wear – The change in shape of the cross-sectional area of the rail head due to the passage of rail traffic and grinding

C. Shelling – A rail condition consisting of one or more horizontal separation that may originate in the rail head and may crack out at the gage side of the rail.

Shelling normally originates towards the gage side of the rail head and extends longitudinally

D. Spalling – A rail surface condition that is the direct result of micro-cracking, often with material separating from the surface of the rail head.

1.4 SUBMITTALS

A. INFORMATIONAL SUBMITTALS

1. Submit supporting information within 30 days of award documenting the past successful performance in furnishing and fabricating CWR.to Class 1 Freight, passenger or commuter railroads within the last ten (10) years including references and contact numbers at the railroads where the CWR has been placed in service.
2. Submit specifications of the proposed equipment, materials, methods and procedures to be used for the electric flash butt welding process for joining of rail.

B. ACTION SUBMITTALS

1. Submit for review and approval quality control and quality assurance plans and related certifications such as ISO 9001 or equivalent, demonstrating that the Contractor has the processes, personnel, and systems to produce high quality CWR.
2. Submit all material testing results and submittals stipulated in the AREMA Manual and as required by this specification.
3. Submit qualifications of welding supervisor documenting flash butt welding experience of no less than three years.

1.5 QUALITY ASSURANCE

A. Contractor's Quality Control Program (QCP) shall be in accordance with the AAR M- 1003 or Engineer approved equivalent quality control program. Comply with AREMA Portfolio of Trackwork Plans.

B. Equipment used for the manufacturing materials shall be in good operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment shall be certified and traceable to national standards such as the National Institute of Standards and Technology.

C. Testing and inspection of CWR manufacture shall be performed by Contractor in conformance with AREMA Manual.

D. Material not meeting the requirements of this Specification shall not be used.

1.6 DELIVERY, STORAGE AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. The Contractor shall load, transport, and deliver rail in a manner which will prevent damage to the rail. Contractor shall submit to Engineer the procedures and equipment information for loading, unloading, handling, and storing rail.

C. The material is to be delivered to the project site at a place designated by the Engineer. The delivery must be coordinated with Engineer prior to shipping and loading. Orders can be combined and shipped on or before the delivery scheduled with approval by Engineer.

PART 2 - PRODUCTS

2.1 CWR

A. Rail furnished shall be new 136RE section conforming to AREMA Volume 1, Chapter 4, Section 2.1, Specifications for Steel Rails. and as follows:

1. Rail to be installed on tangent track and in curves equal to or less than 13 degrees (radius equal to or greater than 441.68') shall be Carbon Steel, Standard Strength and shall meet or exceed 310 HB (Brinell Hardness).
2. Rail to be installed in curves greater than 13 degrees (radius less than 441.68') shall be Carbon Steel, High Strength and shall meet or exceed 370 HB (Brinell Hardness).

B. If the Contractor furnished CWR are in sections of strings, CWR shall be manufactured on-site by welding rail sections of either 39 or 80 foot lengths into 1,400 feet strings. A maximum of 10 percent of the rails may be short lengths. For the 39-foot rail lengths acceptable shorts are 36, and 33 feet. For 80-foot rail lengths, acceptable shorts are 78, 74 and 70 feet.

2.2 SOURCE QUALITY CONTROL

A. Rail and welds shall be ultrasonically tested as per AREMA Section 2.1 8.

B. Surface and internal hardness shall be determined as per AREMA Section 2.1.3.

C. Perform ultrasonic testing on all welds in accordance with ASTM E164.

D. For fabrication of CWR, flash butt production welds shall be tested during the fabrication process by a qualified inspection agency as previously approved by the Engineer, using the dry powder method of magnetic particle inspection (or

ultrasonic method) in accordance with ASTM E709 and the AREMA Manual of Railway Engineering, Chapter 4.

PART 3 - EXECUTION

3.1 GENERAL

A. Flash butt welding and testing of rail shall conform to the current AREMA Manual, Chapter 4, Part 2, Section, "Specification for Fabrication of Continuous Welded Rail" unless otherwise specified herein.

B. Fabrication shall be in accordance with this specification.

C. Rejected welds shall be cut out and rewelded with a minimum of 19'-6” plugs at Contractor's expense.

D. Bolt holes at ends of CWR strings are only acceptable for use during loading and unloading of strings and must be cut out by approved methods following placement of the CWR in track prior to completing field welding. No payment for footage of CWR supplied shall be made to include any such footage removed as noted.

3.2 EQUIPMENT

A. The welding machine shall be capable of automatically recording pertinent data including pre-heating impulses, flashing time, upset current, time and platen travel during flashing and shall be capable of testing the welds during production using the ultrasonic testing method or the dry powder method of magnetic particle inspection. The Contractor shall maintain welding equipment in good working order at all times.

3.3 RAIL BENDING AND STRAIGHTENING

A. Straightened rail sections shall achieve the alignment tolerance as specified in AREMA Manual, Chapter 4.

B. Any rail sections that cannot be straightened shall be cut back a sufficient distance to achieve the specified tolerances.

C. If straightened rail does not meet specification tolerance in two passes through the straightener, it will be cut out of the string.

3.4 RAIL CUTTING AND END PREPARATION

A. Rails used for electric-flash butt welds shall have their ends saw-cut or abrasive disc-cut clean and square by means of accepted equipment.

B. Torch cutting of rail is prohibited.

C. The head and base of the rail for a length of approximately six inches from welding end shall have mill scale removed down to bright metal.

D. All burrs shall be removed from the area where the welding current carrying electrodes contact on the head and base of the rail.

E. Holes will not be permitted in the rail, except as approved by Engineer.

3.5 ELECTRIC FLASH BUTT WELDING

A. CWR strings shall be fabricated so that all of the branding appears on one side of the string.

B. Alignment of rail in the welding machine shall:

1. Be done on the head of the rail.
2. Vertical alignment shall provide for a flat running surface. Any difference in height of the rails shall be in the base.
3. Horizontal alignment shall be done in such a manner that any difference in the widths of heads of rails shall be divided equally on both sides of the head.
4. All electric flash butt welds shall be forged to point of refusal to further plastic deformation and have a minimum upset of 0.5 inches with 0.625 inches as standard.
5. The upset cylinder shall not bottom out during the upset portion of the weld cycle.
6. Post weld straightening may be permitted if performed before the surface temperature of the weld falls below 500 degrees Fahrenheit. Quenching the weld metal shall not be permitted on standard rail. Quenching of premium rail weld is permitted and shall be per the standard industry practice as accepted by class I railroad.

3.6 FINISHING AND ALIGNMENT

A. Jagged, notched or badly mismatched end faces shall be preflashed to an even or mated condition before setting up rails for preheating and final flashing to assure that the entire surfaces of rail ends are uniformly flashing immediately preceding upsetting.

B. All heavy grinding used in the finishing process shall be performed on the hot metal immediately following welding, to prevent metallurgical damage.

C. Finishing shall eliminate cracks visible to the unaided eye. Notches created by offset conditions shall be eliminated by grinding to blend variations.

D. All notches created by offset conditions or twisted rails shall be eliminated by grinding to blend the variations.

E. All fins on the weld due to grinding drag shall be removed prior to final inspection.

3.7 TOLERANCES IN ELECTRIC FLASH BUTT WELDS

A. Trimming and grinding of rail welds shall result in the weld being within the tolerances set forth in the AREMA Manual, Chapter 4, Part 2, Section "Specifications for Fabrication of Continuous Welded Rail."

3.8 RECORDS FOR ELECTRIC FLASH BUTT WELDING

A. A record shall be submitted to Engineer documenting the production of each string of CWR. Included shall be the following:

1. The CWR string designation number and station location in the field.
2. The heat numbers of each piece of rail in the string.
3. The heat numbers on each side of any weld which has been cut out and rewelded.
4. Record information produced by the welding equipment including the pre-heating impulses, flashing time, upset current, time and platen travel during flashing, a sketch or graph indicating the current flow during the production of each weld.

3.9 VISUAL INSPECTION

A. Production welds shall be visually inspected for surface cracks.

B. Welds with surface cracks visible to the eye will not be accepted.

3.10 REPLACEMENT OF DEFECTIVE WELDS

A. Flash butt production welds giving fault indication in magnetic particle inspection during production shall be cut, rewelded and retested and shall not be left for field welding.

PART 4 - MEASUREMENT AND PAYMENT

A. Work of this Section is considered incidental to work associated with project

- END OF SECTION -

SECTION 341123 - SPECIAL TRACKWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes specifications for furnishing all labor, materials, and equipment for the designing, manufacturing, testing, fabricating, shipping, and unloading of double tongue switches, crossing frogs, restraining rail, direct fixation rail plates & other miscellaneous hardware. All special trackwork will be designed to be compatible with direct fixation fasteners and embedment in concrete or other pavement materials/.

B. Related Sections: The work of the following Sections is related to the work of this Section. Other Sections, not referenced below, may also be related to the proper performance of this work.

1. Section 341110.00 - Continuously Welded Rail (CWR)
2. Section 341129.00 – Construct Continuously Welded Rail Track
3. Section 341133.00- Timber Crossties.
4. Section 341133.22 – Steel Crossties.
5. Section 341190.00 – Track Appurtenances and Accessories
6. Section 347205.00 – Construct Turnouts
7. Section 347210.00 – Field Weld Rails
8. Section 347215.00 – Rail Connections
9. Section 347220.00 – Other Track Material (OTM)

1.2 REFERENCES

A. This Section incorporates by reference the latest revision of the following documents.

1. American Railway Engineering and Maintenance-of-Way Association (AREMA)
   a. AREMA Manual for Railway Engineering, Chapter 4, "Rail" (AREMA Manual)
   b. AREMA Portfolio of Trackwork Plans (AREMA Plan)
      1) Plan No. 100, Specifications for Special Trackwork" (AREMA Specifications)

B. This Section incorporates by reference the latest revision of the following documents. It is a part of this Section as specified and modified. In case of a conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.

1. American Society for Testing and Materials (ASTM):
   a. ASTM A325 Specification for High Strength Bolts for Structural Steel Joints
   b. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
   c. ASTM D2240 Standard Test Method for Rubber Property – Durometer Hardness
   d. ASTM E10 Standard Test for Brinell Hardness of Metallic Materials
   e. ASTM E94 Standard Test for Radiographic Testing
2. American Welding Society (AWS)
   a. AWS D1.1 Structural Welding Code - Steel
3. American Association of State Highway and Transportation Officials (AASHTO)
   a. Standard Specification for Highway Bridges
4. American Institute of Steel Construction (AISC)
   a. Steel Construction Manual
5. American Society of Mechanical Engineers (ASME)
   a. B18 Lock Washers Specification

1.3 SUBMITTALS

A. Procedures: Section 013300, Submittal Procedures.

1. Name(s) of supplier(s) and manufacturers for the special trackwork components
2. Shop drawings and supporting drawings for the various types of special trackwork.
3. Installation and maintenance instructions by the manufacturer for the various trackwork components.
4. Inspection results in accordance with the requirements of other Sections of these specifications and applicable A.R.E.M.A. Specifications including but not limited to the following:
   a. Tests for Frog Depth Hardening.
   b. Section 340110.00, Continuously Welded Rail (CWR)
   c. Section 341129.00 - Construct Continuously Welded Rail Track.
   d. Section 3472220.00 - Other Track Material

1.4 QUALITY ASSURANCE

A. Develop and maintain a quality control program regulating methods, procedures, and processes to ensure compliance with standards of quality required by the Contract Documents, as specified in Section 014000, Quality Requirements, including inspection and testing, samples and use of certificates of compliance.

B. Survey the special trackwork to determine the acceptability of the installation and provide the Engineer with a copy of the report. Correct deviations from the Contract Drawings that exceed specified tolerances at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Fabricate special trackwork components as indicated on Contract Drawings, approved Shop Drawings, and in accordance with AREMA Standards and these specifications.

B. For special trackwork use direct fixation construction as documented on the Contract Drawings.

C. Construct special trackwork with zero cant throughout the installation.

2.2 RAIL

A. Running rail for switch, frog and restraining rails for special trackwork and precurved rails:

1. 136RE in accordance with AREMA Manual
2. High strength head hardened in accordance with AREMA Chapter 4, including Supplemental Requirements,
3. Brinell hardness: 341 to 401.
4. Accompanied by manufacturer's records of rail inspection as described in AREMA Chapter 4 Part 2 Section 2.1.14.

B. Guard rails for turnouts.

1. 136RE Section machined and drilled to guard length indicated on Contract Drawings.
2. Type: Bolted
3. Brinell hardness: 341 Brinell minimum.

2.3 CROSSING FROGS

A. SM crossing frogs: Designed by the special trackwork manufacturer.

B. SM frog castings: Depth hardened in accordance with Article 3.3 A, herein.

C. Frog plates: Designed by the special trackwork manufacturer. Final design of the fasteners for the frogs and the crossing design will be coordinated between the special trackwork supplier and the fastener supplier.

D. Rail crossing frogs for STS Crane Runway shall be of the Solid Manganese Steel type, designed and fabricated in conformance with the Contract Drawings and approved Shop Drawings, AREMA Specifications Article M2. and AREMA Portfolio of Trackwork Plans.

1. Fishing area of crossing frogs shall be designed for connection to 136RE for the railroad siding track legs and 135CR of the dockside STS Crane runway legs and in configuration and horizontal track centerline geometry as indicated on the drawings.

2.4 SWITCH APPURTENANCES

A. Joint Bars: Section 347215.00 - Rail Connections defines requirements for joint bars.

B. Track bolts, hex head bolts, square head bolts, nutlocks, and washers:

1. Complying with AREMA Specifications.
2. Hex or square head bolts for use in restraining rail attachment: ASTM A325.

C. Metal components:

1. Corrosion-resistant and consistent with strength and hardness requirements.
2. Sufficiently ductile to withstand installation and maintenance activities.
3. For iron castings use ductile iron conforming to ASTM A-536.

D. Resilient spring clips: Pandrol e-Clip, non-insulated, or equal, right hand mounted and considered part of the switch plate or direct fixation plates.

E. Rail Plates

1. Standard Rail Plates: For fastening single rail:
   a. One punched hole for one-anchor bolt assembly at each end of the plate in accordance with the drawings.
   b. Hole diameter: elongated as shown on the drawings or as recommended by the Contractor's Supplier of anchor bolt assembly.
   c. Thickness 1/2inch, minimum.
   d. Weld-on shoulders for spring clips rail fastening: Pandrol #7299 Forged Weld-on Shoulder or equal.
   e. Compatible for placement of non-shrink epoxy levelling grout beneath the plate as indicated on drawings and as location requires.

F. Other Special Trackwork Plates: For fastening two rails, frogs, guard rail, and restraining rail for direct fixation special trackwork construction:
   a. For anchoring two rails: Two punched holes for two-anchor bolt assemblies at each end of the plate. If spacing between two rails

allows for two rail clips installation, punch two additional mounting holes at the center of the plates.

b. Hole diameter: elongated as shown on the drawings or as recommended by the Contractor's Supplier of anchor bolt assembly.
c. Thickness 1/2inch, minimum.
d. Weld-on shoulders for spring clips rail fastening: Pandrol #7299 Forged Weld-on Shoulder or equal.
e. Place non-shrink epoxy grout under the plate as indicated on drawings and as installation location requires.

G. Direct fixation special trackwork anchor bolts and other threaded elements:

1. Threaded elements: high strength steel conforming to ASTM A325, compatible with anchor inserts.
   a. Thread length may vary from that specified for structural bolts.
   b. Threaded elements in the fastener: Include a positive means of preventing the loosening of the element due to in-service vibrations.
   c. Furnish threaded element installation data for the use by others. Include, at the least, data on the bolt torque range in foot-pounds. For the torque range provide the minimum tension as specified by the AISC - Steel Construction Manual.
2. Anchor bolts:
   a. 7/8-inch diameter, 9 UNC, Class 2A thread and capable of providing a minimum of 1 inch of insert thread engagement with 1/2 inch of vertical shims under the rail fastener.
   b. Coated with a water-resistant coating as thread protection against rusting prior to shipment.
3. Washers: 7/8-inch diameter, zinc-plated in accordance with ASTM B 633, Type III, SC2.
   a. Lock: ASME B18.21.1, Type 302, extra duty.
   b. Circular: ASME B18.22.1, Type B, regular.
4. Direct Fixation Special Trackwork Anchor Inserts:
   a. Description: Female threaded anchor inserts with 7/8-inch anchor bolts used to secure the rail fastener to the concrete trackbed and include a feature to prevent rotation of the insert after the concrete or epoxy grout has reached its design strength.
   b. Material: ASTM A325
   c. 7/8-inch diameter, 9 UNC, Class 2B thread fit.
   d. Accessories: Threaded Plug, metal or plastic material to preclude the entrapment of moisture, concrete, or other foreign materials during transport, handling, and installation. Plug shall be easily removable by use of a socket or other common drive device, and capable of reinsertion with no reduction in integrity of seal.
   e. Coating: Epoxy resin, 100 percent dry powder epoxy insulating coating applied with following characteristics:

1) Provide coating of between 10 mils and 20 mils when tested by a magnetic mil gauge at not less than two areas of the insert. Epoxy coating with runs, sags, or chips will not be acceptable.
2) Hardness: No less than 85 nor more than 90 Shore D, in accordance with ASTM D2240.
3) Application: In accordance with the manufacturer's recommendations and meeting the following test requirements:
    a) Perform Holiday Test to detect pin holes and breaks in coating as follows:
        (1) Place coated insert in a weak electrolytic solution.
        (2) Apply a 100 volt dc electrical current between the electrolyte and the insert.
        (3) Acceptance: No measurable current when the insert is immersed in the electrolytic solution.
        (4) The above tests shall be performed by the epoxy coating applicator at a frequency specified in the sequential statistical quality control plan developed by the epoxy coating applicator and approved by the Engineer.
        (5) The plan shall ensure that the average defective rate shall not exceed two percent and that the maximum defective rate shall not exceed five percent. These defective rates shall be demonstrated at a 90 percent degree of confidence.
4) Acceptable products:
    a) Scotch Kote Fusion Bonded Epoxy No. 206N, manufactured by the Minnesota Mining and Manufacturing Company
    b) Corvel Epoxy ECB-1363A, manufactured by the Polymer Corporation,
    c) Approved equivalent.

2.5 FROG GUARD RAILS:

A. Manufactured in accordance with the Contract Drawings.

1. 136RE Section, machined and drilled to guard rail lengths as shown on the Contract Drawings.
2. Furnished with the accessories as indicated on the Contract Drawings.
3. Separator Blocks: malleable or ductile iron.

B. Flangeway:

1. In accordance with AREMA Standard Plan #502.
2. End block and separator blocks: Cast or fabricated.
3. Frog guard rail bolts:
   a. High strength, conforming to the requirements of ASTM A325, A490 or Grade 8, and class 2A and 2B thread fit.
   b. Thread length may vary as required for the specified structural bolts.
   c. Use a steel spring washer or equivalent spring device as positive means of preventing the loosening of the element due to in-service vibrations.
4. Fasteners: Designed as indicated in the Contract Drawings.

2.6 RESTRAINING RAILS

A. Restraining rail: Fabricated of new standard 136 RE rail section in accordance with the requirements specified in Section 341110.00, Continuously Welded Rail, and modified as noted in this specification, and as shown on the Contract Drawings.

B. Precurve restraining rail to match each curve as shown on the Contract Drawings. Precurve restraining rail in accordance with the requirements specified in Section 341110.00, Continuously Welded Rail.

C. Furnish end rails of precurved restraining rails with tangent extensions 13 feet in length and planed at one end. as shown on the drawings.

D. Furnish restraining end sections complete with 12-inch-long filler block and reinforcing bars, 1/2 inch thick in accordance with AREMA Plan #325 for 136 RE rail and having two circular bolt holes, 1 inch diameter, 4 inch spacing. Include bolts, nuts, spring washer, headlocks and tailocks.

E. Separator blocks for use between inside running rails and restraining rail at locations as shown on the plans shall provide flangeway in accordance with that designated for track centerline curvature as noted on AREMA plan #791. Blocks shall be 4 inches in length, with one circular bolt hole 1-7/16 inch diameter, furnished complete with headlock and tailock washers. Ensure washers bear fully against the rail web and provide flat bearing surfaces for bolts. Include 1-3/8 inch diameter bolts, nuts and spring washers. Furnish seven separator blocks for each 39-foot length of restraining rail, including tangent extensions.

F. Furnish end blocks (two per curve) 12 inches long with 1-7/16 inch circular holes with restraining rail for each curve. Use end blocks in accordance with AREMA Plan 504-89 to provide required flangeway width and no taper. Furnish each end block with two 1-3/8 inch diameter bolts complete with washers.

G. Restraining rail bolts:

1. High strength type conforming to the requirements of ASTM Designations A325, A490 or Grade 8, and with Class 2A and 2B thread fit.
2. Thread length: may vary as required from that specified for structural bolts.
3. Equipped with a double coil steel spring washer, elastomeric rebound washer or equivalent spring device as a positive means of preventing the loosening of the element due to in-service vibrations.
4. Furnish restraining rail joint, end block, and separator block assemblies with filler blocks and appropriate reinforcing bars or washers wired together to prevent loss of parts.

2.7 SWITCH LUBRICANT

A. Dry graphite or insulating film-type.

1. Acceptable products:
   a. Dixon 500
   b. Whitmore Easy Switch
   c. Superior Graphite Co.
   d. Approved equal.

PART 3 - EXECUTION

3.1 RAIL PRECURVING

A. Where the Contract Documents require, perform precurving of rail in accordance with conventional railroad industry frog and switch shop procedures and in accordance with the track centerline radii shown on the Contract Drawings and approved Shop Drawings.

B. Identify precurved rail with painted identity numbering of each rail in accordance with the approved Shop Drawings prepared and submitted by the contractor to the Engineer. Paint identity numbers so that they are visible from both the top and side of the rails.

C. Precurve rail such that after curving the base of rail lies level or flat when positioned on the switch or tie plate. Do not use the fastening to draw the base down.

D. Uniformly curve rail such that the deviation of the interior mid-ordinate offset from the theoretical offset is within the tolerances for straight rail using the appropriate chord distance required by the straight rail specification.

3.2 RAIL CUTTING, DRILLING, AND BEVELING

A. Cut rails square and clean by means of rail saws or abrasive cutting wheels in accordance with AREMA Manual Chapter 4, Part 2 Specifications.

B. Where required, drill rail ends as follows:

1. Running rail: Drill for 36-inch, 6-hole joint bars as shown on approved Shop Drawings and in accordance with the AREMA Manual chapter 4, Part 1.
2. Restraining rail: Drill for 24-inch, 4-hole joint bars as shown on approved Shop Drawings and in accordance with the AREMA Manual chapter 4, Part 1
3. Grind drilled bolt holes to remove sharp edges.

3.3 FROG DEPTH HARDENING

A. Explosive depth hardened or otherwise treat castings accordance with the AREMA Specifications, Article M2.7, except attain a minimum Brinell hardness of 350. After the castings are hardened, employ an approved testing agency to inspect each casting as follows:

1. Visually inspect or penetration test for cracks, flaws, or porosity.
2. Test hardness in accordance with ASTM E10.

B. On Shop Drawings specify the procedures to be used in the depth hardening process, the portions of each frog that are to be depth hardened, and the Brinell hardness pattern that the Contractor normally achieves with such procedures.

C. Submit reports of the tests and inspections to the Engineer for review. Repair defective castings damaged as a result of this inspection as specified in Article 3.04, herein. Reharden castings rejected for lack of hardness at no additional cost. Defects detected in the immediate wheel running surfaces of the castings will be rejected and not be repaired. Replace non-repairable castings at no additional cost.

D. Repair defects in the castings in accordance with the AREMA Specifications Article M2.6, as modified herein. Repair defects only by shielding manual arc welding or semi-automatic arc welding, in accordance with AWS D1.1. Use only manganese filler to repair defective areas.

E. After weld repairs, employ an independent testing agency procured by the Contractor to re- inspect the repaired areas of the castings in accordance with ASTM E94 and determine the acceptance of the castings.

F. The tolerance for Brinell hardness is minus 10 Brinell points. The maximum hardness is unlimited, but subject to metallurgical steel structure detriment to the product.

3.4 SHOP ASSEMBLY AND INSPECTION

A. Prior to shipment, completely assemble each turnout or diamond crossing with plates or direct fixation fasteners installed and all fastenings shop tightened. Mount each turnout or diamond crossing in a uniform plane throughout the length of the turnout or crossing to allow inspection and measurement. Assemble components designed for field welding to final alignment using appropriate plates and clamps. After satisfactory inspection and testing with the switch completed, disassemble the switch operating mechanism from the switch to the degree necessary for shipment. Package loose materials in the manufacturer's original containers.

B. Place special trackwork plates and standard plates or fasteners at locations shown on the Contract Drawings and approved Shop Drawings. Mark base of rail with paint to indicate design location of plates or fasteners.

C. Provide the Engineer with templates to check flangeways, rail end drilling, and switch rail planing. Design templates such that using the templates will be easy and quick, requiring only one person for the operation.

D. Note approved variations from the dimensions, lengths, or angles shown on the previously approved Shop Drawings on the final Shop Drawings submitted for subsequent installation.

E. Paint identification on the web of rails, clear of joint bar area, at both ends according to the rail layout details shown. Paint rail joint members on the head of each rail at every joint. Do not confuse installation identification numbers with internal shop work order numbering system. Only paint installation numbers on track items.

F. For inspection of the turnout switches on direct fixation or embedded track, include the operation (hand thrown at the switch rod) to confirm function and proper position of switch points in relation to the stock rail. Switch tongues should fit tight against body casting within the full length as required.

G. Check switches in both thrown positions for conformance with the approved switch geometry. Verify tolerances meet the applicable requirements as stated in the AREMA "Portfolio of Trackwork Plans, Plan No. 1011".

H. Notify the Engineer a minimum of 4 calendar weeks before the required date for shop inspection of the completed, assembled turnout with identification markings.

3.5 HANDLING, SHIPPING AND UNLOADING

A. Submit the proposed method of grouping, packaging, handling, and loading for items in this Contract to the Engineer for review during the submittal of Shop Drawings.

B. Carefully handle rail and special trackwork components to minimize the chance of damage. Do not drop or strike rails sharply. Handle and ship rail and special trackwork in accordance with AREMA Specifications, Chapter 4.

C. For components pre-assembled for inspection prior to shipment of including diamond crossing, ship in complete partial subassemblies.

D. Contractor is responsible for shipping special trackwork subassemblies in sizes that can be delivered without special permits to their proposed locations.

E. Ship small loose parts in secure shipping boxes and kegs. Do not ship in cardboard boxes or pallets that are not fully banded. Loose items for shipping will not be acceptable.

F. Clearly mark or tag assembled parts, pallets, bundles, boxes, and kegs in the appropriate turnout identification color with the following: Identify items contained, Contractor's name, shipping date, number of pieces, destination, gross weight, turnout letter designation, and special trackwork unit for which parts are intended.

- END OF SECTION -

SECTION 341126.16 – SUBBALLAST

PART 1 - GENERAL

1.1 SUMMARY

A. The work of this Section includes supplying and placing a layer of crusher run granite or limestone below the limits of the ballast section in the area of track construction. This section includes the careful placement, compaction and testing of the subballast to the limits and elevations shown on the Contract Drawings.

B. Related Requirements:

1. Section 312000 - Earth Moving: Preparation of site for base course.
2. Section 310513 - Soils for Earthwork
3. Section 310516 - Aggregates for Earthwork
4. Section 312316.13 - Trenching
5. Section 312500 - Erosion And Sedimentation Control
6. Section 341126.00 – Ballasted Track Construction
7. Section 347201.00 - Track Layout. Includes setting line and grade for track alignment.
8. Section 347230.00 - Ballast

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

1. T191 Standard Method of Test for Density of Soil in-Place by the Sand Cone Method
2. T205 Standard Method of Test for Density of Soil in-Place by the Rubber Balloon Method
3. T238 Standard Method of Test for Density of Soil and Soil Aggregate in-Place by Nuclear Methods (Shallow Depth)
4. T239 Standard Method of Test of Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths)

B. American Society for Testing Material (ASTM)

1. D2922Test Method for Density of Soil and Soil Aggregate in-Place by Nuclear Methods (Shallow Depth)
2. D3017Test Method for Moisture Content of Soil and Soil Aggregate in-Place by Nuclear Methods (Shallow Depth)

C. AREMA Manual for Railway Engineering.

1. Section 2.11 – Sub-Ballast Recommended Practices

1.3 SUBMITTALS

A. Test reports and samples of all materials to be used and compaction testing reports as described in Section 312000 Earth Moving.

B. The Contractor shall be required to submit for approval a minimum of two suppliers. All suppliers will be required to submit product samples for testing.

C. List of Vendors, primary and secondary.

1.4 QUALITY ASSURANCE:

A. AREMA Manual of Railway Engineering, Chapter 1, Part 2, Sections 2.11-Subballast Recommended Practices.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Aggregate for subballast at the time it is deposited on the prepared subgrade or subbase shall conform to the following requirements:
   1. A.R.E.M.A. specifications for subballast:
      a. ASTM designation: D 1241, Type 1, Gradation 'A'.

PART 3 - EQUIPMENT

3.1 Compaction shall be accomplished with one or more of the following:

A. Pneumatic-Tire Roller. Self-propelled type consisting of two axles equipped with pneumatic tires mounted so as to completely cover the area to be compacted in a single pass. The wheels on at least one axle shall oscillate vertically, either singly or in pairs. The roller shall have a width of not less than 5 feet. Wobble-wheel rollers shall not be permitted. The wheels shall be equipped with smooth, wide tread compactor tires of equal size and diameter, capable of producing a uniform, ground-contact pressure on a level, unyielding surface through a range of 60 to 95 PSI on all wheels. Operating tire contact pressure shall be maintained by the use of ballast, and tire inflation pressure combinations shall not exceed the recommendations of the Tire and Rim Association Incorporated for the tire applicable tire size and ply rating. All tires shall be uniformly inflated so that their respective tire pressures do not vary

more than 5 lbs. Charts and tabulations shall be furnished showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loading for the tires used.

B. Dynamic Compactor: Vibratory roller or vibratory pad type compactor capable of operating at the frequency of vibration required for the size and type of compactor used and the type of material being compacted. Vibratory pad type compactors shall be used only when access with a vibratory roller is not practical. Vibratory rollers shall be equipped with a readily visible instruction plate containing the manufacturers' recommended operating frequency, amplitude and roller speed. A calibrated reed tachometer shall be provided with each roller to permit a mechanical check of the roller vibration system.

PART 4 - EXECUTION

4.1 GENERAL

A. The general requirements, placement of subballast and surfaces tolerances shall comply with AREMA Manual Section 2.11.

B. Contractor shall establish and maintain survey stakes that are clearly marked indicating proposed top of rail elevation and offset to centerline of track throughout the process of placing and compacting subballast.

C. The subgrade or subbase to receive the subballast course, immediately prior to spreading, shall conform to the compaction and elevation tolerances specified and indicated for the material involved and shall be free of standing water, snow or ice, and loose or extraneous material.

4.2 COMPACTION

A. The uniformly spread subballast shall be compacted by means of approved equipment, as herein specified, to be not less than 95-percent of the maximum dry weight density.

B. Compaction shall progress gradually from the sides to the center, with each succeeding pass uniformly overlapping the previous pass, and shall continue until the entire area is satisfactorily shaped and compacted to the required lines and grades.

C. One density determination shall be made for each 1,000-square yards or less, as conditions warrant, on each layer of completed subballast.

D. Subballast shall not be placed on soft, muddy, or frozen areas, nor until irregularities in the prepared areas, including soft areas in the subgrade have

been satisfactorily corrected. To verify the stability of the subgrade surface before placement of subballast, the Construction Manager may direct Contractor to proof roll the prepared subgrade by use of approved loaded rubber tired vehicles with a minimum loaded weight of 30-tons at no additional cost to Railroad. Subgrade, which shows pronounced elasticity or deformation as determined by the Construction Manager, when so proof loaded, shall be recompacted, or excavated and replaced with suitable material.

E. The placement and compaction of subballast shall be in accordance with AREMA Manual Section 2.11, except that the material shall be placed in two uniform horizontal layers for the full width of the cross-section. Self-spreading vehicles of a type approved by the Construction Manager may be used. When self-spreading vehicles initially spread stone a power grader of a type approved by the Construction Manager may be used to assist the spreading operation. If results of spreading with the power grader are found unsatisfactory, permission for use of a grader may be withdrawn. This section of subballast shall be shaped to a true section conforming to the subballast section shown on the Contract Drawings and thoroughly compacted until the surface is true and unyielding.

F. Tolerance: The final grade shall be plus or minus 0.01-foot. Thickness of finished subballast course may not vary more than 1 inch from the indicated thickness at any point. Reshape, rework, water and recompact subballast to achieve compliance with specified requirements.

PART 5 - MEASUREMENT AND PAYMENT

5.1 The work under this section will not be measured or paid for separately. All costs for Section 341126.16 Subballast, shall be included in the lump sum bid item price for trackwork.

5.2 The bid item shall be full compensation for furnishing all labor, material, tools, equipment and other incidentals necessary to complete the specified task.

- END OF SECTION -

SECTION 341129 – CONSTRUCT CONTINUOUSLY WELDED RAIL TRACK

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. Construction of continuously welded rail (CWR) ballasted track located on compacted subgrade utilizing steel or timber crossties, including the furnishing of new rail, OTM, crushed stone ballast, placement and tamping of crushed stone ballast, installation and thermal adjustment of rails, and furnishing, placement and finishing of reinforced concrete and bituminous pavement as shown on the drawings.
2. Construction of continuously welded rail (CWR) fully embedded track located on compacted subgrade utilizing steel crossties or other approved means and methods of setting the alignment, grade and gauge of rails, grading, and compaction of subgrade, furnishing of new rail, OTM, welding and thermal adjustment of rails and the furnishing, forming, placement and finishing of reinforced concrete embedment and pavement as required by the drawings.
3. Construction of continuously welded rail (CWR) direct fixation track located on the existing reinforced concrete pile supported deck portion of the deepwater berths of the Marine Terminal, including drilling and setting of embedded rail plate anchors, installation and grouting of rail base plates and direct fixation hardware, placement of track rails, thermal adjustment of rails the furnishing, installation and finishing of reinforced concrete embedment and pavement as required by the drawings.

B. Related Requirements:

1. Section 024119 - Selective Demolition: for removal of embedded track located on the pile supports reinforced concrete deck of the Marine Terminal berths.
2. Section 033000 - Concrete: Concrete for fully embedded sections of track, pavement, rail base plate grout.
3. Section 032000 – Concrete Reinforcing: Steel and fiber reinforcing materials.
4. Section 321216 – Bituminous Pavement: Pavement adjacent to newly constructed embedded track.

5. Section 341110.00 – Continuously Welded Rail: Running rails and Restraining rail.
6. Section 341193 – Track Appurtenances and Accessories: Flush mount switch stands for installation in pavement, Sliding Derails, Track Bumper, and Restraining Rail attachment hardware
7. Section 347205 – Construct Turnouts: Double Tongue Switch type turnouts.
8. Section 347201 – Track Layout: Setting alignment and grade of tracks.
9. Section 347210 – Field Weld Rails: Thermite or Flash Butt Welding of track rails.
10. Section 347215 – Rail Connections: Temporary or permanent bolted rail connections.
11. Section 347220 – Other Track Materials.

C. DEFINITIONS

1. DRFF – Direct Rail Fixation Fastener
2. OTM – Other Track Material

1.3 MEASUREMENT AND PAYMENT

A. Measurement shall be the number of feet of track constructed and in place, as measured along the center line of the track.

B. Payment shall be at the unit price bid.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Design Data: Submit manufacturer's latest published literature. Include illustrations, installation instructions, maintenance instructions, parts lists and shop drawings.

C. Manufacturer’s Certificates: Submit Statement of Compliance, supporting data, from material suppliers attesting that all components meet or exceed applicable A.R.E.M.A. Standards and specification requirements.

D. Submit Certificates of Compliance for all OTM. Include material qualification test reports for materials, components, and assemblies.

1.5 REFERENCES

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering
2. Portfolio of Trackwork Plans

3. Specifications for Special Trackwork

B. American Welding Society (AWS):

1. AWS B2.1: Standards for Welding Procedures and Performance Qualifications
2. AWS D1.1: Structural Welding Code

C. American National Standards Institute, Inc. (ANSI)

1. ANSI B1.1: Unified Inch Screw Threads
2. ANSI B1.3M: Screw Threads Gaging System for Dimensional Acceptability
3. ANSI B18.22.1: Plain Washers

D. American Society for Testing of Materials (ASTM)

1. A36: Standard Specifications for Carbon Structural Steel
2. A123: Standard Specification for Zinc (Hot-Dip-Galvanized) Coating on Iron and Steel Products
3. A325: Standard Specifications for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
4. C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
5. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Rails shall be New 136RE rail section welded into strings in accordance with the requirements of Section 341110 - Continuously Welder Rail, of these specifications.

B. Steel crossties shall be provided in accordance with the specifications set forth under Section 341133.22 Railroad Steel Crossties, of these specifications and include a positive restraint rail fastening system provided by the manufacturer of the steel crossties specifically designed to be used with the steel crossties supplied.

C. Rail joint bars and hardware shall conform to Section 347215-Rail Connections,

D. Ballast and tamping shall conform to Section 347230.00-Railroad Ballasting, of these specifications and other parts of this specification section.

E. Rail Field Welds: As specified in Section 347210 - Field Weld Rails.

F. Rail Fixation and Fastening Assemblies: Fabricate, furnish and supply rail alignment and track gauge setting fixtures in accordance with that shown on the project plans, or furnish and supply commercially manufactured product(s) designed specifically for setting the alignment and gauge of track rails employed in construction of track embedded in concrete. All materials furnished shall be designed and manufactured to work collectively as a system and shall conform with the requirements of the Project Specifications and drawings.

G. Non-Shrink Epoxy Grout: For use under rail base plates of portions of track located on the pile supported reinforced deck of the marine terminal berths shall be Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time. Provide grout with a compressive strength of 3,500 psi at 1 day, 5,000 psi at 3 days and 6,800 psi at 28 days.

H. Epoxy Adhesive: Provide a two-component 100% solids non-sag epoxy adhesive suitable for anchoring threaded anchor rods into hardened concrete. Epoxy adhesive shall meet the requirements of ASTM C881, Type IV, Grade 3, and C. Two-component system shall come in prepackaged cartridge systems with a static mixing attachment. Cartridges shall be designed specifically to be used with drop-in dispensing guns. The minimum compressive strength, prior to load application to the anchor rods, shall be 5000 psi.

I. Hardware: Furnish and install high strength bolts, nuts, nutlocks, embedded anchors, and other miscellaneous hardware necessary for use in construction direct fixation embedded trackwork in accordance with the details shown on the Contract Drawings.

J. Rail Fastening Components: Furnish and install positive restraint rail fasteners, rail shoulders, restraining rail spacer blocks, track bolts, washers, nuts, locknuts and other miscellaneous hardware as indicated on the contract drawings.

K. Concrete: As specified in Section 033000 - Concrete.

L. Concrete Reinforcing: As specified in Section 032000 Concrete Reinforcing.

2.2 PREPARATION

A. The contractor shall notify the Engineer a sufficient time before starting the work so that adequate arrangements can be made to progress the work of each phase in accordance with the approved schedule.

B. The contractor shall commence construction of each section of track only after completing the following work of each Phase as applicable:

1. The selective demolition and removal of existing pavements, track or embedded rails is complete and condition of the area where new track is to be installed is prepared to receive new construction.
2. All underground utilities including new stormwater drainage infrastructure, water supply system modifications and casing pipes have been properly installed and tested in accordance with the specifications and found to be functioning properly.
3. The contractor has performed track layout in accordance with Section 347201, Track Layout, of these specifications.
4. The area to receive new track has been inspected by the Engineer and approved for installation of new track.

2.3 EXECUTION

A. The contractor shall supply and utilize rollers for the handling and distribution of the welded rail. The type of rollers used and their application must be approved by the Engineer prior to their use.

B. The contractor shall place the welded rail onto the DRFF assemblies or on the steel crossties by use of a machine with a threader or rail tongs designed exclusively for that purpose. Under no circumstances shall rail be handled using a Prentiss log loader or “split-bucket” type excavator or loader. The rail shall be placed without expansion gaps.

C. Strings of welded rail shall only be pulled into position and not pushed. Bumping welded rail into position shall not be permitted.

D. The bottom of the rail and the top of the DRFF plate shall be clean and free of dirt and other foreign substances when the rail is laid.

E. The contractor shall perform field welding of running rails in accordance with Section 347210.00 – Field Weld Rails, of these specifications. Bolted rail connections shall conform to Section 347215 - Rail Connections, of these specifications.

F. The welded rail shall be properly adjusted, all DRFF assemblies shall be drawn tight, the alignment and surface of the track has been checked for compliance with the proposed geometry and has been inspected and approved by the Engineer prior to placing the final section of concrete and bituminous paving materials

- END OF SECTION -

SECTION 341133.16 - TIMBER CROSSTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. The work of this Section consists of the supply of treated timber crossties and Switch Timbers for use in the designated track. The Engineer reserves final judgment as to whether cross ties presented for inspection meet the requirements of this Technical Provision and are free from any defects that may impair their strength or durability including, but not limited to decay, large splits, slanting grain or large or numerous holes or knots.

B. Related Requirements

1. Section 341129.00 – Construct Continuously Welded
2. Section 347201.00 - Track Layout.
3. Section 347230.00 - Ballast

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. American Wood Preservers' Association (AWPA):
   a. C1 All Timber Products – Preservative Treatment by Pressure Processes.
   b. M1 Purchase of Treated Wood Products.
   c. M2 Standard for Inspection of Treated Timber Products.
   d. M3 Quality Control Procedures for Wood Preserving Plants.
   e. P2 Standard for Creosote Solutions.

2. American Railway Engineering Association (AREMA), Manual for Railway Engineering, Chapter 3

B. Quality Assurance Program:

1. Supplier's quality assurance program shall be subject to verification at any time. Verification shall include, but not be limited to, audit of quality assurance program; surveillance of operations to determine that practices, methods, and procedures of the program are being properly implemented; inspection to measure the quality of items offered for acceptance; and inspection of items before release for shipment to ensure compliance with the requirements of the Contract Documents.

2. Failure by supplier to promptly correct deficiencies discovered by either the Construction Manager or Engineer may be cause for rejection of crossties until corrective action has been taken or until conformance of the work to prescribed criteria has been demonstrated and approved by Engineer.

C. Provide certified test results or certificates of compliance.

D. Inspect crossties at the source locations designated on the purchase orders.

E. To ensure quality inspectors will make a close examination of the top, bottom, sides and end of each tie. Each tie will be judged independently, without regard for the decisions on other ties.

1.3 SUBMITTALS

A. Reports as required by AWPA M1 and M2 shall be maintained.

B. Manufacturer's certification.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All crossties shall be new and manufactured of Oak, except that not more than 20 percent of the crossties may be of one other hardwood of the following species: Beech, Hickory, Birch, Sweet Gum, Locust, Hard Maples, Sycamore, Cherry, Mulberry, Walnut, Elm, Sassafras, Ashes and Hackberries. African hardwoods, such as Azobe, shall not be used.

B. All ties shall be new. Any tie that has been installed in track, other than for this project shall not be regarded as new.

2.2 MANUFACTURE

A. Thickness and Width:

1. All crossties shall be graded in accordance with the APWA standards.

2. Crossties shall be accepted with the following thickness and width measurements. A variation of minus 1/4-inch and plus 1/2-inch is acceptable.

Grade/Size	Thickness & Width of Wider Face	Width of Narrower

	(Bottom)	Face (Top)
1	6”x7”, 6”x8”, 7”x9” 7”x8”	6”
2	6”x8”, 6”x8”	7”
3	6”x8”	8”
3A	7”x8”, 7”x9”	7”
4	7”x8”, 7”x9”	8”
5	7”x9”	9”

3. Only Grade 4 or 5 crossties are acceptable.

B. Length: All crossties shall be no less than 8’-6” (eight foot and six inches in length) plus 1” and minus 1/2” tolerance.

C. Straightness:

1. A new crosstie will be considered straight when a straight line from a point on one end to a corresponding point on the other end is no more than 1 inch from the surface at all points in every eight (8) feet.

2. A crossties not well sawn when its surfaces are cut into with score marks more than 1/2-inch deep or when its surfaces are not even.

3. The top and bottom of a new crosstie will be considered parallel if any difference in the sides or ends does not exceed 1/8-inch.

4. Crosstie ends must be flat and will be considered square with a sloped end of up to 1/2-inch.

D. Incising: All new crossties will be incised on four sides. Incisor teeth shall penetrate 3/8-inch plus or minus 1/8-inch and shall conform to the standard industry pattern.

2.3 WOOD QUALITY

A. Except as hereinafter provided, all crossties shall be free from any defects that may impair their durability or strength as crossties such as decay, splits large shakes, slanting grain, large or numerous holes or knots, or excessive checking from seasoning. Amtrak or its representatives reserve the right to inspect all crossties at any time up to and including substantial completion and reject any crossties that they may consider defective or of inferior quality.

B. Decay: "Blue Stain" is not decay and is permissible in any wood.

C. Holes:

1. A large hole is one more than 1/2-inch in diameter and 3-inch deep within, or more than 1/4 the width of the surface on which it appears, and 3-inches deep outside the rail bearing area.

2. Numerous holes are any number equaling a large hole in damaging effects. Such holes may be caused during manufacture of at other times.

D. Knots:

1. A large knot is one whose average diameter exceeds 1/4 of the width of the surface on which it appears when it appears in the rail bearing area.

2. Numerous knots are any number equaling a large knot in damaging effects.

E. Shake: Shake must not be greater than 1/3 the width of the crosstie nor closer than 1-inch to any surface.

F. Slanting Grain: Except in woods with interlocking grain, slant in excess of 1 in 15 is not permitted.

G. Splits:

1. In seasoned crossties, splits may be no wider than 3/16-inch and no longer than 4-inches.

2. When anti-splitting devices are applied to seasoned crossties, the following shall apply. Splits no larger than 3/8-inch wide and nor longer than 8-inches long may be repaired as long as the split is parallel with the narrow face and contained within the center 50-percent of the crossties to provide sufficient anchoring surface. Crossties with splits the width of face shall not be repaired and must be rejected in all instances. Post treatment splits parallel to the wide face shall not be nail plated and must be rejected in all instances.

H. Season Checks: Crossties with checks more than 3/8-inch in width on any face or longer in aggregate than 1/3 of the crosstie length must be rejected. Nail plates may be used to repair checks, but must be used in conformance with these specifications.

I. Bark Seams:

1. Bark seams are not permitted in the crosstie plate area.

2. Bark seams on the end of the crosstie shall be contained on the face.

3. Bark seams in the gage area (middle 40-inches) shall not extend more than 2-inches into the crosstie as measured from any surface and /or more than 10 inches long.

4. Bark seams that are considered strength impairing shall be rejected.

2.4 ANTI-SPLITTING DEVICES

A. Dowels:

1. Dowels are anti-splitting devices that are driven or pushed into pre-bored holes.
2. Dowels shall be in accordance with AREMA Specification 3.1.6.2.1 Dowels. 7-3/4-inch dowels are standard for crossties and switch timbers.

3. Dowels 5-3/4-inches long shall be used to close splits parallel to wide faces.

4. Use of lubricants to facilitate the driving of dowels is prohibited.

5. Dowels must be applied to unseasoned material upon arrival at the treatment plant to prevent splitting and checking.

B. Multiple (Gang) Nail Plates:

1. Multiple (Gang) Nail, as described in the AREMA Specification 3.1.7.2. or latest revision, shall be used. Plates shall be galvanized after cutting and forming of nails. Plates to be used for crossties shall also comply as follows:
   a. They are to be constructed of 18-gauge galvanized steel.
   b. Teeth must be at least 9/16-inch long.
   c. Plate dimensions for 7-inch crossties – 5-inches by 7-inches in area.
   d. Plate dimension for 6-inch crossties – 5-inches by 6-1/4-inches.
   e. Nail plates used on larger dimension lumber must cover at least 75-percent of the end of the timber.

2. All crossties must have multiple nail plates. Crossties may be multi-nail plated either before treatment as a preventative measure or after treatment as a recovery process for splits and season checks only. After application the nail plate must be flush with the crosstie end and there must be no observed separation along the plane of the splitting.

3. The equipment and for application of anti-splitting devices must be submitted and approved by the Construction Manager before its use.

C. “S” Irons and “C” irons shall not be used.

2.5 SEASONING

A. All new crossties shall be conditioned in accordance with AWPA C6 with the following exceptions:

1. When air seasoning is used, the moisture content shall be based on the entire volume of a given piece.

2. When Boulton drying is used, under normal conditions, unseasoned materials must have recorded water removal of not less than 5-pcf of wood. All Boulton systems must be equipped with effective anti-surge devices. Final moisture contents shall be as specified by the AWPA for air seasoning.

3. Vapor drying shall produce moisture contents as specified by AWPA for air seasoning.

2.6 PRESERVATIVES

A. Wood products shall be preserved with a 60/40-percent creosote-coal tar solution in accordance with AWPA P2. An 80/20-percent creosote-coal tar mixture may be substituted on the written approval of the Engineer.

2.7 TREATMENT

A. Following seasoning, all crossties shall be treated by the Rueping process in accordance with AWPA C1, C6, M1, M2, and M3. Retentions shall be as specified.

PART 3 - EXECUTION

3.1 PREPARATION FOR TREATMENT

A. Handling of timber shall, in general, follow the procedures and practices as described in the AREMA Manual, Chapter 3, Part 5.

B. Incising shall be performed at the start of the seasoning period, not later than 30 days after the ties are cut to shape. All faces, except ends, shall be incised. Incising shall be to a depth of 3/4 inch and in a pattern the same or similar to that shown in the AREMA Manual, Chapter 3, Part 6.2 and 9.1.

C. Anti-Splitting Devices: All crossties shall have gang nail plates applied to both ends at the start of the seasoning period.

1. Gang nail plates shall be centered, plus or minus 1/2 inch on timber ends.

2. Gang nail plates shall be inserted by machines capable of holding the crosstie in a clamped position under pressure while the gang plate is pressed into position.

3. Gang nail plates shall be flush with the ends of tie. Plates not flush may be driven down.

4. If in excess of 5 percent of the nails fail to penetrate fully, the plate shall be removed and a new plate installed.

D. Holes shall be bored only for those spikes, anchor bolts or lag spikes that will actually be installed. Hole tolerance and diameters shall be as described in the AREMA Manual, Chapter 3, Part 1.4 or latest revision. Holes in ties for tracks in electrified territory shall not be bored through. Hole depth shall be between 4 inches and 6 inches.

E. Trimming to length and all other woodworking operations that can be reasonable performed prior to installation of track and associated hardware shall be performed prior to preservative treatment. New anti-splitting devices shall be applied to trimmed ends to ensure that all ends of timbers have anti-splitting devices in place.

F. Seasoning: Ties shall be seasoned in accordance with the AREMA Manual Chapter 3, Part 6.3 or latest revision. Seasoning may be by air drying, Boulton drying, or vapor drying. Steam conditioning shall not be used. Moisture content limits shall be achieved before machining or preservative treatment commences.

3.2 MACHINING OF TIES

A. Adzing, boring, trimming or dapping and other woodworking operations shall be performed subsequent to seasoning and insofar as practical, prior to preservative treatment.

B. Adzing, leveling, of the tie plates areas, shall be to the minimum depth needed to provide for the rail seats to all be in the same plane. If the adzing depth is required to exceed 1/2 inch than the tie shall be rejected. The leveled area shall extend to not less than 1 inch beyond all areas covered by the tie plates. Rail seat flatness shall be such that a straight edge laid across the rail seat shall be within 1/16 inch of the adzed seat at any point.

3.3 PRESERVATIVE TREATMENT

A. Preparation: Crossties shall have all bark, dirt; saw grease and mud and other material that may hinder the penetration of the preservative removed from the surface of the crossties.

B. Sterilize the heartwood:

1. Ties and timbers with a least dimension of 7 1/2 inches or less shall be preheated to ensure that all ties spend not less than 6 consecutive hours at a temperature of 190° F or higher. Of this time, not less than 3 hours shall immediately precede impregnation with preservative.

2. Ties and timber, with a least dimension of more than 7 1/2 inches, including 9 inch by 9 inch timber if dapped, shall be preheated to ensure that all ties spend not less than 8 consecutive hours at a temperature of 190° F or higher. Of this time, not less than 5 hours shall immediately precede impregnation with preservative.

C. Preservative Retention:

1. In oak: 8 pounds per cubic foot.

2. In other hardwoods: 10 pounds per cubic foot.

3.4 INSPECTION

A. Pre-Treatment:

1. Unseasoned crossties must not be used on this project.

2. All crossties shall be inspected and approved prior to installation by Engineer or Construction Manager. Crosstie shall be presented in a suitable manner and in sufficient quantity to allow an adequate number per day to be inspected and accepted according to current customary standards.

3. Crossties accepted shall be legibly branded as follows: Current Year, with letters for plant identification, not less than 3/4-inch high.

B. Post-Treatment: Crossties shall be inspected after treatment is completed. The inspection shall include all items previously examined during the pretreatment inspection. The inspector shall pay particular attention looking for its or shakes that may have occurred during the treating process.

PART 4 - MEASUREMENT AND PAYMENT

4.1 The work under this section will not be measured or paid for separately. All costs for Section 341133, Crossties, shall be included in the bid price for item [_____],

- END OF SECTION -

SECTION 341133.22 - STEEL CROSSTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements for design, manufacture, testing and delivery of Steel Crossties and Steel Switch Ties and their associated rail fastening components of the type(s) specified.

B. The component parts of the crossties to be furnished shall be the products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use at least 5 years prior to bid opening. The parts need not all be made by the same manufacturer, but the crosstie assemblies shall be supplied by a single firm.

C. Related Sections

1. Section 310516.00 – Aggregates for Earthwork.
2. Section 341116.22 – Construct Welded Track - Steel Crossties.
3. Section 341126.00 – Ballasted Track Construction.
4. Section 341193.00 – Track Appurtenances and Accessories.
5. Section 347201.00 - Track Layout. Includes setting line and grade for track alignment.
6. Section 347205.00 – Construct Turnouts.
7. Section 347210.00 – Field Weld Rails.
8. Section 347220.00 - Other Track Material.
9. Section 347230.00 - Railroad Ballasting: Supply and placement and distribution of ballast.

1.2 REFERENCES

A. American Society for Testing of Materials (ASTM)

1. ASTM A6: Standard Specification for General Requirements for Rolled Structural Steel Bars, plates, Shapes and Sheet Piling
2. ASTM A242: Standard Specification for High-Strength Low Alloy Structural Steel
3. ASTM A370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products
4. ASTM A568: Standard Specification for Steel Sheet, Carbon, Structural, and High–Strength, Low Alloy, Hot- Rolled and Cold-Rolled, General Requirements.
5. ASTM G 101: Guide for Estimating the Atmospheric Corrosion Resistance of Low Alloy Steels

B. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering

C. ISO 9001 Quality Management Systems

1.3 CLASSIFICATION AND APPLICATION

Crosstie	Gross Ton Mi.	Max. Speed	Application
Type 1	< 3 MGTM/YR	P-15, F-10	Industrial, Yard, Storage, Unloading Tracks
Type 2	3-10 MGTM/YR	P-30, F-25	Branch Lines, Running, Embedded Siding, Bulk Materials Handling Tracks
Type 3	10-25 MGTM/YR	P-60, F-40	Main Tracks, Yard Lead Tracks, Grade Crossings
Type 4	> 25 MGTM/YR	P-30, F-25	Heavy Haul Tracks, Tunnels, Ballast Deck Bridges, High Speed Tracks
Type E	N/A	N/A	For tracks embedded in concrete pavement

1.4 PERFORMANCE REQUIREMENTS

A. Steel Crossties shall be designed to meet the following criteria:

1. Railcar Gross Weight - 286,000 pounds/4 axles
2. Operating Speed – As noted by crosstie type.
3. Rail Section – 136RE
4. Rail Seat Cant:
   a. 1:40 for Type 1, 2, 3, & 4.
   b. Zero (no cant) for Type E.
5. Service Life (including fastenings) - 50+ years
6. Track Gauge applicable to installation of new rail:
   a. 56½” $\pm$1/16” for tangents and curves where degree of curve is less than 13 degrees.
   b. 57” for curves 13 degrees and greater.
7. Maximum Rail Seat Force - 22,000#
8. Maximum Rail Seat Moment - 7350 ft.lb.
9. Minimum Rail Clamping Force - 4400# at each rail seat.
10. Minimum Longitudinal Restraint - 2200# at each rail seat

PART 2 - PRODUCTS

2.1 CROSSTIE DIMENSIONS

A. Overall Dimensions

1. Minimum Length:
   a. Types 1, 2, 3 & 4 in conventional track - 8.25'
      1) Length to be increased as applicable for use beneath precast concrete grade crossing panels.
   b. Type E - 8.00'
2. Minimum Width at base – Types 1 & 2 – 10.00", Types 3 & 4 – 11.80"
3. Minimum Width at rail seat – 6.00"
4. Minimum Depth – Types 1 & 2 -3.85", Types 3 – 4.5", Type 4 – 4.7", Type E – 3.85"
5. Minimum Thickness at shoulder – Types 1 & E - 0.31", Types 2 & 3 – 0.39", Type 4 - 0.47"

2.2 SWITCH TIE DIMENSIONS

A. Overall Dimensions

1. Length – As prescribed by manufacturer for switch tie set applicable to each specific turnout geometry.
2. Minimum Width at base – 11.80"
3. Minimum Width at rail seat – 6.00"
4. Minimum Thickness at shoulder – 0.39"

2.3 RAIL FASTENINGS

A. Rail fastenings shall be of the elastic type consisting of two shoulders and two Pandrol® "E" Clips or equivalent, per rail seat. Fastenings shall be able to be installed without requiring the use of any special tools.

B. Rail clips suitable for application adjacent to joint bars where bolted or "Huck bolt®" type rail joints are utilized shall be provided.

C. Fastenings must meet the design requirements of Section 1.4 and be of a proven design with the specified rail clamping force.

D. Unless otherwise specified, rail seat electrical insulation is not required.

2.4 MANUFACTURING CRITERIA

A. General

1. The crosstie shall be manufactured either from either pre-formed section (hot rolled sections or cold formed strip profiles) or hot rolled strip steel conforming to the requirements of ASTM A242. The properties shall comply with these specifications and the standards referenced.
2. The crossties shall be free of defects, which are likely to initiate fatigue failure in service, e.g. pipe, non-metallic inclusions and visible surface damage.

B. Chemical Composition

1. The atmospheric corrosion-resistance index, calculated on the basis of heat analysis of the steel, as described in ASTM G 101 shall be 6.0 or higher.
2. The chemical composition of the steel shall be within the following limits:
   a. Carbon 0.15% (max.)
   b. Manganese 1.00% (max.)
   c. Phosphorus 0.15% (max.)
   d. Sulphur 0.05% (max.)
   e. Copper 0.20% (min.)

C. Mechanical Properties

1. Adequate testing shall be conducted by the Contractor to control the manufacturing process and to maintain the minimum tensile requirements specified in ASTM A242 Table 2.

D. Rail Seat

1. Where required by the specifications the rail seats shall be canted (inclined) towards the center to achieve required rail cant. The cant shall be 1:40 unless zero (0) cant is specified.

E. End Section

1. The end section of the steel crosstie shall be bent down from the rail seat area so that the end sections of the crosstie are not above the center of the crosstie. Not applicable for Type E crossties specified for use in embedded track.

F. End Spade

1. The top surface of the crosstie shall be bent down at both ends to provide a surface which will bear against the ballast shoulders for lateral stability. The angle of the end sections shall be approximately 65º from horizontal with the bottom edge level with the lower crosstie edge and no gap at the corners (from metal distortion). Not applicable for Type E crossties specified for use in embedded track.

G. Punching

1. The crossties shall have four (4) pre punched holes of suitable diameter to receive the “hook-in” type rail shoulders without requiring the use of any special tools where applicable to the rail fastening system utilized.
2. The switch ties shall be complete with rail fastening components attached as part of the shop fabrication process during which the entire turnout shall be assembled and inspected in accordance with other parts of these specifications and the approved shop drawings, prior to disassembly and shipping.
3. The crosstie shall have 4 pre punched ballast inspection holes each, a minimum diameter of 7/8”. The ballast inspection holes shall be punched so that there are two in the gauge and one each, on the field side of the rails and shall be spaced approximately 6” away from the rail fastenings. All holes shall be punched along the centerline of the long horizontal axis of the crosstie and symmetrical about the short horizontal axis of the top face of the crosstie. Ballast inspection holes are not required for Type E crossties specified for use in embedded track.

H. Finished Dimensional Tolerances

1. Track Gauge: ±1/16” utilizing new rail.
2. Overall Length of Crosstie: ± 3/8” (measured at the outside edge of the end spade)
3. Internal Width of Crosstie at section toe: ± 3/16”
4. Overall depth of Crosstie: ±1/16”
5. Rail Seat Width: ± 1/32”
6. Rail Seat Flatness: +0” to -1/32”
7. Minimum Width of Spaded End : Nominal Crosstie Width +1½”
8. Straightness (over nominally straight portion) 1/32” per foot
9. Cant: 1:39 to 1:41 unless specified as Zero.
10. Overall Width of Crosstie: ± 3/16”
11. Thickness of Crosstie Web: +0.10” to -0.00”
12. Distance between outer edges of pair of rail seat (hook in shoulder) holes: ± 1/32”
    (measured at a height of rail seat (hook-in shoulder) holes ¼” above rail seat)
13. Maximum Width Within 16” of rail centerline: Nominal Crosstie Width ±¼”

I. Identification

1. Crossties shall be marked for identification. Marking shall be in the form of raised or embossed marking on the top surface at the center both axis of the crosstie. The marking shall be in capital letters in a block style font, a minimum of ¾” in height and of a nature such that they will remain clearly legible for the life of the crosstie as specified in Section 1.3. Markings shall

be such that they will induce no inherent fatigue weakness zones. The crossties shall be marked, at a minimum, with the following information:

a. Manufacturers name
b. Product identification code
c. Rail section
d. Date of manufacture

J. Corrosion Allowance

1. The Contractor shall demonstrate to the satisfaction of the Engineer that adequate allowance has been made for the effects of corrosion during the life of the steel crosstie.
2. If required by the contract specifications, steel crossties shall be hot dipped galvanized in accordance with the specifications pertaining to such treatment, as included in other parts of the overall project Specifications.

K. Shipment and Handling

1. Crossties must be nestable for shipment and be free of burrs and sharp edges for efficient stacking and safe handling.
2. Steel Crossties must be packaged for shipment and handling at the manufacturing facility in uniform bundles utilizing steel banding or similar methods durable enough to endure rigors of shipping and handling and withstand breakage. Bundles of crossties should contain a minimum of 10 but no more than would encumber handling when utilizing conventional material handling equipment such as forklift trucks.
3. Unless otherwise noted above, fastening system components should be packaged in bags or other durable means of packaging with each bag or package containing the number of components required to make a complete assembly of each crosstie in one bundle.
4. Bags or packages of fasteners must be clearly marked with the manufacturers name, item number, date of manufacture and applicable steel crosstie type for which they are designed. Markings must be made by durable, weather resistant means that will remain legible during normal shipping, handling, exposure to weather and effects of UV light.
5. Bags may also be marked, as directed by the purchaser, with the purchaser’s name, purchase order number and project name to aid in inventory control and shipment tracking.

2.5 INSPECTION FREQUENCY

A. Inspection procedures should be in accordance with ISO 9001 Quality Management Systems - Requirements, except as indicated below:

1. The first steel crossties produced following any shutdown or delay in production (for more than 30 minutes) shall be examined.

2. If the steel crosstie is rejected, the batch from which the steel crosstie was selected shall be subjected to detailed examination. Initially 10 steel crossties shall be selected at random from the batch and submitted for inspection. If all 10 steel crossties are found satisfactory the batch shall be accepted, otherwise the batch will be rejected.
3. Batches found unacceptable shall be resubmitted for inspection only after all items or units or product are re-examined and all defective items or units of product are removed.

PART 3 - EXECUTION

A. Covered in following Sections:

1. Section 341116.22 – Construct Welded Track – Steel Crossties
2. Section 341129.00 – Construct Fully Embedded Track.
3. Section 347205.00 – Construct Turnouts

- END OF SECTION -

SECTION 341134 - FULL DEPTH PRECAST CONCRETE GRADE CROSSING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes:

1. Material requirements and performance criteria for the Precast Concrete Grade Crossing Panels to be furnished in accordance with Contract Documents or required by the Engineer.

B. Related Sections:

1. Section 341116.22 – Construct Welded Track – Steel Crossties
2. Section 341126.00 – Ballasted Track Construction
3. Section 331133.00 – Timber Crossties
4. Section 341133.22 – Steel Crossties
5. Section 347201.00 - Track Layout

1.2 REFERENCES

A. American Galvanizers Association (AGA):

1. Inspection of Products Hot-dip Galvanized After Fabrication.
2. The Design of Products to be Hot-dip Galvanized After Fabrication.
3. Recommended Details of Galvanized Structures.
4. Quality Assurance Manual.

B. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering
2. Specifications for Special Trackwork

C. American Society for Testing of Materials (ASTM)

1. A36: Standard Specifications for Carbon Structural Steel
1. A123: Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products
2. A496 “Specification for Steel Wire, Deformed, for Concrete Reinforcement”.
3. A497 “Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement”.
4. C33, “Specification for Concrete Aggregates”.
5. C94 “Specification for Ready-Mix Concrete”
6. C150, “Specification for Portland Cement”.
7. C227: Standard Test Method for Potential Alkali Reactivity of Cement Aggregates Combinations (Mortar-Bar Method)
8. C260 “Air-Entraining Admixtures for Concrete
9. C494 “Chemical Admixtures for Concrete”.

10. C615 “Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement”.
11. C666: Standard test Method for Resistance of Concrete to Rapid Freezing and Thawing
12. C1260: Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
13. D257: Standard Test Methods for DC Resistance of Conductance of Insulating Materials
14. D395: Standard Test Methods for Rubber Property/Compression Test
15. D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension
16. D573: Standard Test Methods for Rubber Deterioration in an Air Oven
17. D624: Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
18. D2137: Standard test Methods for Rubber Property- Brittleness Points of Flexible Polymers and Coated Fabrics
19. D2240: Standard Test Methods for Rubber Property-Durometer Hardness
20. D2628: Standard Specifications for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

D. American Concrete Institute
   1. ACI-318 “Building Code Requirements for Reinforced Concrete.
   2. ACI 304 “Guide for Measuring, Mixing, Transporting and Placing Concrete

A. American Welding Society (AWS):
   1. AWS B2.1: Standards for Welding Procedures and Performance Qualifications
   2. AWS D1.1: Structural Welding Code

B. Association of American Railroads (AAR)
   1. M-1003: Manual, Specifications for Quality Assurance

C. Federal Specifications
   1. DOD-P-21035 Paint, High Zinc Dust Content, Galvanizing Repair
   2. MIL-P-26915 Primer Coating, Zinc Dust Pigmented

D. International Organization for Standardization (ISO)
   1. 9000: An International Consensus on Good Quality Management Practices

E. Prestressed Concrete Institute (PCI)
   1. MNL115: Fundamental of Prestressed Concrete Design
   2. MNL124: Design and Typical Details of Connection for precast and Prestressed Concrete

3. MNL138: PCI Connections Manual for Precast and Prestressed Concrete Construction

1.3 COORDINATION

A. Section 013100 - Project Management and Coordination:

B. Coordinate Work of this Section with installation of trackwork.

1.4 PREINSTALLATION MEETINGS

A. Section 013000 - Project Management and Coordination: Preinstallation conference

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures.

B. Product Data: Submit data documenting for manufacturers past performance within the last ten (10) years furnishing precast concrete grade crossing panels material to Class 1 Freight, passenger, or commuter railroads.

C. Shop Drawings: Indicate dimensions, general arrangement, installation instructions, hardware, accessories, and all other relevant details.

D. Manufacturer Instructions: Submit detailed documentation including:
1. Installation requirements, including storage and handling procedures.
2. Maintenance Schedules and Requirements.
3. Component Parts Lists.

1.6 QUALITY ASSURANCE

A. Materials or partially or fully assembled products not meeting the specifications shall be rejected.

B. Equipment used for the manufacturing materials shall be in good operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment shall be certified and traceable to national standards such as the National Institute of Standards and Technology.

C. Submit Certificates of Compliance for all precast concrete grade crossing panels. Include material qualification test reports for materials, components, and assemblies.

1.7 DELIVERY, STORAGE AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

1.8 WARRANTY

A. The manufacturer shall warranty the precast concrete grade crossing panels for a minimum ten (10) years against defects in materials and workmanship.

1.9 DEFINITIONS

A. Field Side – Portion of track or component designated as being located on the opposite side of the rails from the centerline of track.

B. Gage Side – Portion of track or component designated as being located on the side of the rails closest to the centerline of track.

C. OTM – A general term referring to all miscellaneous materials other than rail and ties.

PART 2 - PRODUCTS

2.1 GENERAL

A. Precast concrete grade crossing panels shall be new, manufactured to fit the rail section of the track to which the crossing panels are to be installed and conform to these Specifications.

B. Precast concrete grade crossing panels shall be designed to support AASHTO HS-20 vehicle loading when installed on tracks with crossties spaced in accordance with the panel manufacturer’s instructions.

2.2 CONCRETE PANELS

A. Precast concrete grade crossing panels shall be heavy duty full depth reinforced concrete panels between 10 and 12 feet in width, as measured perpendicularly to the centerline of track, which eliminate the need for crossties and include a positive restraint rail fastening system utilizing cast-in rail shoulders located along preformed troughs designed to receive the running rails. The rail fixation system shall be located so that the rails will be installed at proper track gauge of 4 feet –

8 ½ inches for tangent track. The fasteners shall be of such design that they may be installed or removed without the use of special tools.

B. Precast concrete grade crossing panels shall include separate EPDM or similar material rubber fillers incorporated in the design of the panels. The rubber fillers shall be installed such that they abut the rails on each side to fill the void between the rail head and the edge of the rail trough after the rails have been installed. The gauge side rubber filler shall be designed to prevent infiltration of stormwater yet provide the required 3 inch flangeway while compressed between the rail web and the gauge side of the rail trough in the correctly installed position. The field side panel rubber filler shall be designed to prevent infiltration of stormwater when compressed between the rail head and web and the field side of the rail trough in the correctly installed position. The panels shall be so designed that the preformed rubber flangeway fillers will be held captive by the installed rails and a continuous recess or ridge cast in the face of the rail trough wall and yet permit removal of the rubber fillers for maintenance without damaging the concrete panel, rubber flangeway filler, rails or the rail fastening system.

C. Precast concrete grade crossing panels shall be designed such that when the rails are fully installed, a level plane is created across the full width of the panels perpendicular to the centerline of the roadway without use of shims.

D. Precast concrete grade crossing panels shall incorporate four (4) lifting inserts per panel for use in handling and installation of the panels. The lifting inserts shall be mechanically galvanized or similarly protected against corrosion. Lifting devices shall be useable with Burke or Dayton 5-ton clutch systems. Lifting device shall be designed with a minimum safety factor of four and be OSHA certified.

E. Panels shall be provided incorporating End Ramps at each end of each grade crossing, capable of deflecting dragging railway equipment. The End Ramps shall be the full width of the grade crossing end panels and provide for proper flangeway as specified in this section, End ramps composed of formed bituminous concrete wedges placed at the ends of the grade crossing are not acceptable as end ramps.

2.3 CONCRETE MATERIALS

A. Concrete utilized in fabrication of the Grade Crossing Panels shall meet the following criteria;

1. Concrete compressive strength: Minimum 6000 psi.
2. A concrete sealant shall be used to prevent cracks and ion migration. Sealant shall be applied to fresh concrete as an aid in curing, hardening, water proofing, acid proofing and oil proofing each panel.

2.4 STEEL REINFORCEMENT

A. Reinforcing Bars: Reinforcing bars utilized in construction of Concrete Grade Crossing panels shall be as follows:

B. Galvanized Reinforcing Bars:
   1. Steel Bars: ASTM A615/A615M, Grade 60 deformed bars.
   2. Zinc Coating: ASTM A767/A767M, Class I zinc coated after fabrication and bending.

C. Epoxy-Coated Reinforcing Bars:
   1. Steel Bars: ASTM A615/A615M, Grade 60, deformed bars.
   2. Epoxy Coating: ASTM A934/A934M with less than 2 percent damaged coating in each 12-inch (305-mm) bar length.

2.5 RUBBER FLANGEWAY FILLER

1. Rubber flangeway filler shall meet the following requirements:
   a. Tensile strength – 850 psi
   b. Ultimate elongation – 400% minimum
   c. Tear strength at 25˚ Celsius – 150 psi minimum
   d. Shore A Durometer Hardness – 75
   e. Compression set 100˚ Celsius for 70 hours
   f. Accelerated aging test – 70 hours
   g. Ozone resistance test – 5- PPHM for 96 hours
   h. Electric resistance – 10 mega ohms minimum

2.6 RAIL FASTENING SYSTEM

A. The Rail Fastening System shall be of the positive restraint type, incorporating rail shoulders installed during the pre-casting process and shall apply sufficient longitudinal and vertical force upon the rails when fully installed, so as to prevent movement of the rails from thermal forces due to temperature variations or from dynamic loads created by movement of rail vehicles over the track section in which the crossing panels are located. The fastening system shall be of a design that will permit installation of the rails and fasteners without use of special tools or result in damage to the concrete panels during either installation or removal of the rails if required for future maintenance work.

2.7 FINISHES

A. All recess and minor concrete spalls are to be filled and finished to the panel dimensions using the proper bonding agent and repair material. Surface of the repaired area is to match the color and texture of the surrounding area.

B. The driving surface is to incorporate a herringbone pattern or other non-slip surface finish during the pre-casting and as approved by New Jersey State DOT. The use of non-slip surfaces or materials applied after the pre-casting process is not acceptable.

2.8 MARKING

A. Each precast concrete grade crossing panel shall be marked with concrete imprint for size of rail, weight of panel, Manufacturer's ID, month/day/year of manufacture and crossing type. End of each panel will be stenciled painted with size of rail, weight of panel and crossing type.

2.9 SOURCE QUALITY CONTROL

A. During precast concrete grade crossing panel fabrication, perform the tests and inspections specified in these Specifications.

PART 3 - EXECUTION

3.1 GENERAL

A. Track rails through the crossing area shall be fully welded and shall have no bolted rail connections (joints), field welds or bolt holes within the limits of the roadway surface nor within 15 feet of either edge of the roadway surface. Where a bolted joint falls within the limits of the crossing, the joint bars shall be removed, and the rail ends shall be flash butt welded in accordance with Section 347210.00 – Field Weld Rails

B. Before installing Grade Crossing Panels, a subdrain pipe system shall first be installed where called for on the plans and the subgrade material placed and fully compacted to grade within specified tolerances.

C. Contractor shall advise the Construction Manager when the portion of the track alignment to receive the Grade Crossing Panels has been completed. The Construction Manager shall then inspect the portion of the subgrade for compliance to tolerances and specifications and Contractor shall take any corrective action required at no additional costs or expense to Owner, prior to the installation of the Grade Crossing Panels.

D. Grade Crossing Panels shall be handled solely utilizing the incorporated lifting inserts and compatible clutch system, spreader bar and cables or chains. Handling with forklift, Prentis type log loader grapple, split bucket or fork attachments of backhoe or excavator or by dragging or shoving along ground is prohibited.

E. Where Grade Crossing Panels are to be installed adjacent to concrete paving, the panels shall be installed before the concrete paving is placed. The Grade Crossing Panels shall not be utilized as part of the concrete paving formwork in order to facilitate removal of the Grade Crossing Panels in the event of future required track maintenance activities. Formwork located along the edge of pavement abutting the Grade Crossing Panels track shall be of a design suitable to be left in place. Alternately a bond breaker or a reinforced precast concrete header curb designed and fabricated to become part of the finished roadway surface and installed prior to placing the concrete pavement may be utilized as approved by the Engineer.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Work of this Section is considered incidental to work associated with project item in Section 347150, Highway-Rail Grade Crossings.

4.2 PAYMENT

A. No separate measurement and payment will be made to the Contractor for Work of this Section.

END OF SECTION

SECTION 341193.00 – TRACK APPURTENANCES AND ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes:

1. Track Bumpers.
2. Switch Stands.
3. Split Switch Point Derails
4. Sliding Derails.
5. Signage and Marking
6. Other associated miscellaneous fasteners and hardware.

B. Related Sections:

1. Section 099000.00 – Painting and Coating
2. Section 341123.00 – Special Trackwork
3. Section 341129.00 – Construct Continuously Welded Rail Track
4. Section 331133.00 – Timber Crossties
5. Section 331133.22 – Steel Crossties
6. Section 347201.00 - Track Layout
7. Section 347205.00 - Construct Turnouts
8. Section 347220.00 – Other Track Material

1.2 MEASUREMENT AND PAYMENT

A. Measurement or payment will be made as follows:

1. Track Bumpers – Payment will be on an each basis, installed complete and in accordance with these specifications and the manufacturer's instructions.
2. Switch stands **-** Payment will be incidental to bid item for Derails installed complete with operating rod, reflectorized target, latches (keepers) and supply and installation of the treated switch ties, on which the operating switch stand is installed, and all necessary hardware, and in accordance with these specifications and the manufacturer's instructions.
3. Derails - Payment will be on an each basis, installed complete with the derail appliance, rails, braces, tie plates rail fasteners, switch stand, operating rod, reflectorized target, latches (keepers), marker post or sign, supply and installation of the treated switch ties, on which the Split Switch Point or sliding derail is installed, and in accordance with these specifications in order to furnish an installed, fully operating derail.
4. Signage, Marking, Other Miscellaneous Fasteners and Hardware**.** - No separate payment will be made for these items. Payment will be made under the applicable track or other item that requires this work.

1.3 REFERENCE STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering
2. Specifications for Special Trackwork
3. Portfolio of Trackwork Plans

B. American National Standards Institute, Inc. (ANSI)

1. ANSI B1.1: Unified Inch Screw Threads
2. ANSI B1.3M: Screw Threads Gaging System for Dimensional Acceptability
3. ANSI B18.22.1: Plain Washers

C. American Society for Testing of Materials (ASTM)

1. ASTM A36: Standard Specifications for Carbon Structural Steel
2. ASTM A123: Standard Specification for Zinc (Hot-Dip-Galvanized) Coating on Iron and Steel Products
3. ASTM A325: Standard Specifications for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

D. American Welding Society (AWS):

1. AWS B2.1: Standards for Welding Procedures and Performance Qualifications
2. AWS D1.1: Structural Welding Code

E. Consolidated Rail Corp. (Conrail)

1. Industrial Sidetrack Construction Specifications

F. New Jersey Department of Transportation, (NJDOT)

1. Standard Specifications for Road and Bridge Construction

1.4 COORDINATION

A. Section 013100 - Project Management and Coordination:

B. Coordinate Work of this Section with installation of trackwork.

1.5 PREINSTALLATION MEETINGS

A. Section 013000 - Project Management and Coordination: Preinstallation conference

1.6 SUBMITTALS

A. Section 013300 - Submittal Procedures.

1. Product Data: Submit manufacturer information for all materials

B. Shop Drawings:

1. Indicate dimensions, general arrangement, installation instructions, finishes and all other relevant details.

C. Submit data documenting past performance and projects within the last ten (10) years furnishing to freight, passenger or commuter railroads:

1. Track Bumpers
2. Sliding Derails
3. Split Switch Point Derails
4. Switch Stands

D. Manufacturer Instructions: Submit detailed documentation including:

1. Installation requirements, including storage and handling procedures.
2. Maintenance Schedules and Requirements.
3. Repair Parts Lists.

1.7 QUALITY ASSURANCE

A. Materials or partially or fully assembled products not meeting the specifications shall be rejected.

B. Equipment used for the manufacturing materials shall be in good operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment shall be certified and traceable to national standards such as the National Institute of Standards and Technology.

1.8 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

1.9 WARRANTY

A. The Manufacturers shall warranty the items as follows:

1. Track Bumpers.- One Year
2. Switch Stands – One Year
3. Sliding Derails – One Year

PART 2 - PRODUCTS

2.1 MATERIALS

A. All material furnished and installed in accordance with this specification shall be NEW unless otherwise noted.

B. Track Bumpers:

1. Western Cullen Hayes Type WG with Middle Rails.
2. Approved equal.

C. Switch Stands for Sliding Derails shall be:

1. Racor 36E Tri-Handle “Non-trailable”.
2. National Track Model #1004ARS.
3. Bethlehem Model #51A with Bow type handle.
4. Equipped with fully adjustable operating rod.
5. Equipped with latches capable of:
    a. Securing the handle in either position.
    b. Accommodating a lock:
        1) Approved by the serving railroad
        2) Capable of preventing the switch stand from being operated when the operating lever is latched in either position.

D. Sliding Derails:

1. Model: Hayes type HB Series.
2. Hand: As noted on plans.
3. Shall be a size to fit the rail section on which installed.
4. Include an operating stand of one the types indicated above.
5. Shall be as installed on parent track incorporating crosstie materials as follows:
    a. Timber Crossties - Treated size 5, 14’-0” long treated switch timbers.
    b. Steel Crossties - Type 3, 15’0” steel crossties.
6. Include a red reflectorized target on the operating stand spindle.
7.

E. Signage and Marking:
   a. Derail Color: Blaze Orange (Safety Orange)
   2. Derail Signs shall be:
      a. Fabricated as shown the plans:
      b. Convey information as indicated on the plans.

PART 3 - EXECUTION

3.1 EXECUTION

A. Track bumpers shall be installed in accordance with the manufacturer's instructions, be equipped with "Middle Rails" and shall be painted High Visibility Orange.

B. Sliding Derails shall be painted High Visibility Orange.

C. Signs for or Marker Posts for Derails or to mark Clearance Points of tracks, shall be in accordance with that shown on the plans and installed in conformance with the Railroads requirements.

D. Switch Stands for Sliding type or Split Switch Point Derails as noted on the plans and shall be installed in accordance the manufacturer's or supplier's instructions and or plans and equipped with reflectorized red target as part of the switch stand. The target shall be affixed so that when the derail is in the "normal" or derailing position, the target is perpendicular the centerline of the track and parallel to the centerline of the track when the derail in in the "reverse" position.

E. Switch Stands for Sliding type or Split Switch Point Derails shall be equipped with latches and a lock approved by the railroad and affixed so that the derail may be locked in the "normal" or derailing position.

F. Switch Stands for Sliding type derails shall be installed on the far rail relative to the location of the derail appliance.

G. Sliding derails shall be supplied and installed so as to derail towards the outside of curved track when installed on curves and in the direction noted on the plans when installed on tangent track.

H. All derails shall be supplied and installed so as to prevent railcars located on industry owned or controlled tracks from unintended movement onto tracks owned or controlled by the operating railroad or across unprotected public or private grade crossings.

- END OF SECTION -

SECTION 341193.13 - CASING PIPES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Casing pipes for pressurized pipes under tracks.

B. Casing pipe spacers (insulators).

C. Casing pipe end seals.

D. Casing pipe vents.

1.2 SUBMITTALS

A. Section 013000 - Submittals: Procedures for submittals.

B. Product Data: Provide data on casing pipe materials, spacers, end seals and vents.

1.3 SUBMITTALS FOR INFORMATION

A. Submit submittals to the Engineer for approval prior to proceed with installation.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Product Data: Provide data on casing pipe materials, spacers and end seals. Provide manufacturers catalog information.

1.4 PROJECT RECORD DOCUMENTS.

A. Submit to the Engineer following:
   1. Record actual locations of casing pipes.
   2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1.

PART 2 - PRODUCTS

2.1 CASING PIPE

A. Steel Pipe:

1. The steel casing pipe shall conform to ASTM Specification A-139.
2. Steel casing pipe, with a minimum cover of 5 ½ ft. (1.7m), shall have a minimum wall thickness as shown in the following table:

Pipe Diameter	Uncoated & Unprotected	Coated or Cathodically Protected
Nominal Pipe Size (in.)	Nominal Wall Thickness (in)	Nominal Wall Thickness (in)
10 and under	0.188	0.188
12 & 14	0.250	0.188
16	0.281	0.219
18	0.312	0.250

3. Ductile Iron Pipe:

1. The pipe shall have mechanical or restrained type joints.
2. Ductile iron pipe shall conform to the requirements of ANSI A21.51/AWWA C-151. Class 56 pipe shall be used.
3. Ductile Iron casing pipe, with a minimum cover of 5 ½ ft. (1.7m), shall have a minimum wall thickness as shown in the following table:

Pipe Diameter	Thickness Class	
	Wall thickness	Class
Inches	Inches	
6	0.25	50
8	0.27	50
10	0.32	51
12	0.34	51
14	0.39	52
16	0.40	52
18	0.44	53

2.2 CASING PIPE ISOLATORS

A. Factory made casing isolators/spacers of the following description shall be installed on any carrier pipe passing through a pipe casing. They are designed to protect the carrier pipe corrosion coating and electrically isolate the carrier pipe from the casing.

B. Upon completion of the installation of the steel pipe encasement, the contractor shall furnish and install casing spacers. Casing spacers shall be spaced a maximum of eight (8) feet apart along the length of the carrier pipe with one casing spacer within one (1) foot of each side of a pipe joint and the rest evenly spaced.

C. Wood skids are not an acceptable method of supporting the carrier pipe.

D. Casing spacers shall be all non-metallic (polypropylene) molded in segments, or PVC lined cold formed steel with glass reinforced polymer runners tools and shall be designed so as to prevent their displacement when inserting the carrier pipe into the casing. The PVC liner shall have a hardness of 85-90 Durometer “A”.

E. Casing spacers shall be designed for field assembly without any special tools. Spacer segments shall be secured around carrier pipe by threaded fasteners or other manufacturer specific means without requiring any special tools. All fastener hardware shall be 304 stainless steel.

F. The casing spacer polymer shall contain ultraviolet inhibitors and shall have a minimum compressive strength of 3,000 psi when tested in accordance with the requirements of ASTM D-695.

G. Dielectric strength shall be equal to or greater than 500 Volts/mil as tested according to requirements of ASTM D-149, Method B (Step method).

H. Impact strength shall be greater than or equal to 1.5 ft-lbs /inch as tested in accordance with the requirements of ASTM D-256.

I. Each casing spacer shall have full length legs extending beyond the bell or mechanical joint of the carrier pipe.

2.3 CASING PIPE END SEALS

A. Factory made casing pipe end seals of the one of the following descriptions shall be installed at the ends of any casing pipe passing beneath a track(s). They are designed to prevent the entry of water or soil into the annular space between the carrier pipe and the casing pipe.

B. Pull on end seals shall be custom made per application or sized for ANSI steel pipe specifications with a minimum 1/8” thick synthetic rubber. Banding clamps are to be 304 stainless steel with worm screws. Pull on end seals shall have locating ribs on the outside for banding clamps and ribs in the inside to prevent leakage. Seals shall be designed to fit the diameter of the casing pipe and the carrier pipe to which they are applied.

C. Wrap around end seals shall be made with a minimum 1/8” thick synthetic rubber and a self-curing seam. Seam shall have plastic backing release strip, to

protect self-curing rubber. Banding clamps are to be 304 stainless steel with worm screws.

2.4 VENTS

A. Sealed casings for flammable substances shall be properly vented. Vent pipes shall be of sufficient diameter, but in no case less than two inches (51mm) in diameter, and shall be attached near each end of the casing and project through the ground surface at right-of-way lines or not less than 45 feet (13.7m), measured at right angles from centerline of nearest track.

B. Vent pipes shall be steel tubing and shall extend not less than 4 feet (1.2m) above the ground surface. Top of vent pipe shall have a down-turned elbow, properly screened, or a relief valve. Vents in locations subject to high water shall be extended above the maximum elevation of high water and shall be supported and protected in a manner approved by the Engineer

C. Vent pipes shall be at least 4 feet (1.2m), vertically, from aerial electric wires or greater if required by national Electrical Safety Code (ANSI C2)..

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate work in accordance with section #013112 Project Coordination.

B. ~~Provide temporary facilities where required in accordance with section #~~015000 ~~Temporary Facilities and Controls.~~

3.2 INSTALLATION - CASING PIPES

A.

1. Casing pipe shall be so constructed as to prevent leakage of any substance from the casing throughout its length, except at ends of casing for non flammable fluids where ends are indicated to be left open. Casing shall be installed so as to prevent the formation of a waterway under the railroad, and with an even bearing throughout its length, and shall slope to one end (except for longitudinal occupancy).
2. After insertion of the carrier pipe into the casing, the ends of the casing shall be closed by installing 1/8" thick synthetic rubber end seals where specified.
3. The casing pipe and joints shall be steel and of leakproof construction when the pipeline is carrying liquid flammable products or highly volatile substances under pressure.

4. The inside diameter of the casing pipe shall be such as to allow the carrier pipe to be removed subsequently without disturbing the casing or the roadbed. For steel pipe casings, the inside diameter of the casing pipe shall be at least 3 inches greater than the largest outside diameter of the carrier pipe joints or couplings, for carrier pipe less than 6 inches in diameter, at least 4 inches greater for carrier pipe 6 inches and over in diameter.
5. Joints between the sections of steel pipe shall be fully welded around the complete circumference of the pipe.
6. Steel pipe may be installed by open cut, boring, directional drilling or jacking.
7. Ductile iron pipe may be used only when placed by the open cut method. Jacking or boring through the railroad embankment is not permitted due to the bell and spigot joints.

3.3 FIELD QUALITY CONTROL

A. Section 014000 Quality Requirments: Field inspection and testing.

B. Perform backfilling in accordance with section 312323.15 Trench Backfill Compaction testing will be performed in accordance with the provisions of Section 322323.15.

- END OF SECTION -

SECTION 347201 – TRACK LAYOUT

PART 1 - GENERAL

1.1 SUMMARY

A. The contractor shall field survey and stake the proposed horizontal and vertical track alignments. The alignments shall be the same as those shown on the plans.

B. The railroad plans will indicate survey coordinates for control points along the centerline of track on tangents, spirals, curves, and turnouts.

1.2 MEASUREMENT AND PAYMENT

A. No measurement or payment will be made for this item. Payment will be made under the applicable track or turnout item that requires this work.

PART 2 - PRODUCTS

A. This Section not applicable

PART 3 - EXECUTION

3.1 EXECUTION

A. Trackwork control points shall be offset and protected by the contractor. Lost or destroyed survey reference points, bench marks, and control points shall be restored by the contractor.

B. Staking shall be done a minimum of two times: Once after the subballast has been placed to ensure that the subballast has been placed in compliance with the plans; and again after final ballasting to ensure that the track has been placed in compliance with the plans.

C. Field staked points shall be a hard wood hub with a tack, or a center punched iron pin. Stakes shall be driven into the ground or ballast a minimum of 12 inches and shall not be easily disturbed.

D. Tangent track and curves flatter than 5 degrees shall be staked along the centerline of track at intervals of 50 feet or less.

1. Track with curves of 5 degrees or sharper shall be staked along the centerline of track at intervals of 25 feet or less.
2. Tracks with super elevation shall have their profile or vertical alignment follow the low rail. The low rail shall be the inside rail of the curve.

3. Spirals up to and including 124 feet in length shall be staked at both end points of the spiral, and at every other chord point of an A.R.EM.A. ten chord spiral. Spirals longer than 124 feet shall be staked at both end points of the spiral, and at every chord point of an A.R.E.M.A. ten chord spiral.
4. Super elevation shall be changed at a constant rate throughout the length of the spiral.

E. All turnouts must be staked on the centerline of track at the point of switch (P.S.), turnout point of intersection (T.O.P.I.), and half-inch point of frog (P.F.).

F. Equilateral turnouts and turnouts on curves shall be staked as described for all turnouts, and also as described for track on curves.

G. The top of rail elevation shall be set to within 0.01 feet of the designed profile elevation shown on the plans.

H. Horizontal control points shall be set to within 0.01 feet of the coordinates shown on the plans.

- END OF SECTION -

SECTION 347205.00 – CONSTRUCT TURNOUTS

PART 1 - GENERAL

1.1 SUMMARY

A. The contractor shall furnish and construct new, 136RE turnouts as indicated and designated at the locations shown on the plans.

B. Related Sections

1. Section 341126.16 – Subballast.
2. Section 341123.00 – Special Trackwork
3. Section 341133.22 – Steel Crossties
4. Section 341193.00 – Track Appurtenances and Accessories
5. Section 347201.00 - Track Layout.
6. Section 347205.00 - Construct Turnouts
7. Section 347210.00 – Field Weld Railroad Rails.
8. Section 347215.00 – Rail Connections
9. Section 347220.00 - Other Track Material
10. Section 347230.00 - Ballast

1.2 MEASUREMENT AND PAYMENT

A. Measurement shall be the number of turnouts of each rail weight and each frog number constructed and in place.

B. Payment shall be at the unit price(s) bid.

1.3 REFERENCE STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering, Chapter 5, Part 4 – “Track Construction”.
2. Specifications for Special Trackwork
3. Portfolio of Trackwork Plans

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Materials:

1. Submit individual certifications that all materials furnished by the Contractor conform to the specified requirements.

C. Shop Drawings:

1. Submit Shop Drawing and product data for trackwork items not specifically defined by engineering standards.
2. Shop Drawings and Bill of Materials for each size and direction of Turnout will be required.
3. Where Steel Switch Tie Sets are specified for installation, submit Steel Switch Tie manufacturers scale layout drawing(s) for each size and hand of turnout to be supplied.

D. Product Data: Submit data on accessories, fittings, hardware and OTM.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The contractor shall assume complete responsibility for unloading, inventorying, storing, and providing security for the turnout materials.

Turnout material shall be furnished by the contractor and shall conform to the AREMA Manual for Railway Engineering, Chapter 5, Part 4 – "Track Construction", Specifications for Special Trackwork and Portfolio of Trackwork Plans.

B. Each turnout shall include the complete double tongue switch, switch operating stand with pavement box, spring connecting rod, frog, frog guard rails, hardware, fillers, joint bars, track bolts for the switch and frog, and all other required items, including closure rails, rail fixation plates, and rail fasteners.

C. Turnout material shall be new.

D. Steel Switch Ties shall conform to the requirements of Section 341133.22 – Steel Crossties and details as shown on the project plans.

E. Frog Guard Rails and the Rail Fastening System shall conform to the requirements of Section 341123.00 – Special Trackwork of these specifications.

F. Rail connections shall conform to the requirements of Section 347215.00, Rail Connections, of these specifications.

G. Switch Frogs may be of the following types:

1. Rail Bound Manganese (RBM)
2. Solid Manganese.

H. Switch Stands and Connecting Rod for Double Tongue Switches shall be:
   1. #336EC Flush Mount Parallel Throw type enclosed in cast or ductile iron Pavement Box supplied with hinged access lid. Including spring-hydraulic type connecting rod enclosed in Pavement Box with hinged access lid.

   2. Approved Suppliers:
      a. Voestalpine Railway Systems Nortrak
      b. Irwin Transportation Products.

I. All material furnished by the contractor and condemned by the engineer shall be replaced by the contractor. Condemned material is considered scrap, remains the contractor's property, and shall be removed from the Owner's property by the contractor.

PART 3 - EXECUTION

3.1 EXECUTION

A. Turnouts shall be constructed in accordance with the project plans and approved shop drawings.

B. Track shall be gauged as specified in the project documents and specifications.

C. Rail connections shall be as specified in Section 347215.00, Rail Connections, of these specifications.

D. Switch operating stand and connecting rod pavement boxes shall be provided with means of positive stormwater drainage connected to the site stormwater system.

E. The contractor shall be responsible for and pay all costs for repairing finished work damaged through negligence.

- END OF SECTION -

SECTION 347210.00 – FIELD WELD RAILS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. The work specified in this Section consists of providing labor, materials, equipment and superintendence necessary and sufficient to field weld together abutting ends of railroad rails to create strings of CWR.

B. Related Sections:

1. Section 341126.00 – Ballasted Track Construction
2. Section 341126.22 – Construct Welded Track – Steel Crossties
3. Section 347201 - Track Layout. Includes setting line and grade for track alignment.
4. Section 347205 – Construct Turnouts
5. Section 347215 – Rail Connections

1.2 DEFINITIONS

A. CWR: Continuously Welded Rail.

B. Thermite: A mixture of finely-divided metallic aluminum and ferric oxide that when ignited produces extremely high temperatures as the result of the union of the aluminum with the oxygen of the oxide. The reaction, also called the Goldschmidt process, is used for thermite welding, often used to join rail tracks.

1.3 REFERENCE STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA):

1. Manual for Railway Engineering.
   a. Chapter 4, Part 3
      1) Section 3.10 Specification For The Quality Assurance of Electric-Flash Butt Welding of Rail.
      2) Section 3.11 Specification for Fabrication of Continuous Welded Rail
      3) Section 3.13 Specification For The Quality Assurance of Thermite Welding Of Rail.
2. Specifications for Special Trackwork
3. Portfolio of Trackwork Plans

B. American Society for Testing of Materials (ASTM)

1. E 164, Practice for Ultrasonic Contact Examination of Weldments

C. American Welding Society (AWS):

1. AWS B2.1: Standards for Welding Procedures and Performance Qualifications
2. AWS D1.1: Structural Welding Code

1.4 COORDINATION

A. Section 013100 - Project Management and Coordination specifies requirements for coordination.

1.5 PREINSTALLATION MEETINGS

A. Section 013100 - Project Management & Coordination specifies requirements for preinstallation conferences.

B. Convene minimum one week prior to commencing Work of this Section.

1.6 SUBMITTALS

A. Section 013300 - Submittal Procedures specifies requirements for submittals.

B. Contractor shall prepare for submission to and approval by the Engineer, a detailed specification covering procedures for making welds. A complete description of each of the following items and any other essential characteristics shall be included in the procedure submittal:

1. The manufacturer's trade name for the welding process.
2. The method used for cutting and cleaning of the rail ends. Flame cutting of rails will not be allowed.
3. The minimum and maximum spacing between abutting rail ends.
4. The method to be used for pre-heating, including time and temperature.
5. The tapping procedure, including the minimum time required to cool the weld under the mold insulation.
6. The method used, including a description of the special tools and equipment for removing the upset metal for finishing the contour of the weld.
7. A schedule of field welds to be made, their location in the finished track, including track number, survey station, and field cuts required to finish the weld. Each weld is to be individually and uniquely number in a system as approved by the Engineer. This welding schedule shall be updated daily as the work progresses so that there will be a single consolidated record of all field welds.

8. Quality Control procedures to be followed. This shall include the name, address and telephone number(s) of the independent testing laboratory to be used by the contractor for testing of the welds. It shall also include field quality control results.
9. Contractor agreement with any subcontractor or vendor employed by the Contractor in performing the work of this Section.
10. At the completion of all welding operations the Contractor shall submit to the Engineer a complete record of all the welds.

C. Qualifications Statements:

1. Submit qualifications certificates issued by the particular welding material and/or equipment supplier for each employee engaged in the performance of the welding process.
2. Submit manufacturer's approval of welding contractor.

1.7 CLOSEOUT SUBMITTALS

A. Section 017700 - Execution and Closeout Requirements specifies requirements for submittals.

B. Project Record Documents: Record weld information as required by this specification using form included at the end of this specification or other approved form.

1.8 QUALITY ASSURANCE

A. Welding shall be done in accordance with the following AREMA Specifications

1. Specification for Quality Assurance of Electric Flash Butt Welding of Rail
2. Thermite Welding – Rail Joints
3. Inspection and Classification of Secondhand rail for Welding
4. Specification for Fabrication of Continuous Welded Rail
5. Recommended Field Repairs to Pressure Butt Weld Failures, except as modified herein.

B. Welding Supervision: All welding shall be performed under the direct supervision of an experienced and manufacturer – qualified supervisor or foreperson.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products and equipment specified in this Section with minimum five years' documented experience.

B. Welding Contractor: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by the manufacturer of the Electric Flash Butt Welding equipment or Thermite Weld Kits.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements specifies requirements for transporting, handling, storing, and protecting products.

B. Deliver materials in manufacturer's packaging including application instructions.

C. Store Weld Molds and related materials according to manufacturer's instructions.

D. Protect all Thermite Weld Kits from moisture.

1.11 AMBIENT CONDITIONS

A. ~~Section 015000 - Temporary Facilities and Controls specifies ambient condition control facilities for product storage and installation.~~

B. Minimum Conditions: Do not perform welding when weather conditions do not comply with specific welding equipment and material manufacturer’s requirements.

1.12 EXISTING CONDITIONS

A. Verify that adequate laydown and material storage areas are available for execution of the work.

B. Performance of the welding will not interfere with existing Owners operations or other construction activities.

1.13 WARRANTY

A. Section 017700 - Execution and Closeout Requirements specifies requirements for warranties.

B. Furnish guarantee of all field welds made in accordance with the requirements of the AREMA Specifications noted in Section 1.8 of this Specification.

PART 2 PRODUCTS

A. FLASH BUTT WELDING EQUIPMENT:

1. Electric flash butt welds shall be made in the field using one of the following portable plants:
   a. Chemetron Portable Welding Plant by Chemetron Rail Products
   b. Holland Portable Flash Butt Welding Plants by Holland Company
   c. Railtech Schlatter AMS Superflex Mobile Welder by Railtech
   d. Or approved equal.

B. THERMITE WELDING EQUIPMENT AND MATERIALS

1. Thermite type rail welds shall be formed using one of the following brands of rail welding kits:
   a. Boutet, as distributed by Railtech Boutet, 25 Interstate Drive, Napolean, OH 43545.
   b. Orgo-Thermit®, 3500 Colonial Drive, Manchester, NJ 08759
   c. Or approved equal.
2. Substitutions: Specified in Section 016000 - Product Requirements, comparable products.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements specifies testing, inspection, and analysis requirements.

B. Certificate of Compliance: When Welding Contractor is approved by the manufacturer of the Electric Flash Butt Welding equipment or Thermite Weld Kits, submit proof of certificate of compliance indicating past work performed conforms to Contract Documents.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution specifies requirements for installation examination.

B. Verify rails conform to the requirements of the AREMA Manual, Section 3.11 Specification for Fabrication Of Continuous Welded Rail

3.2 PREPARATION

A. Rails used for electric-flash butt welds shall have their ends saw-cut or abrasive disc-cut clean and square by means of accepted equipment.

B. Torch cutting of rail is prohibited.

C. The head and base of the rail for a length of approximately six inches from welding end shall have mill scale removed down to bright metal.

D. All burrs shall be removed from the area where the welding current carrying electrodes contact on the head and base of the rail.

E. Holes will not be permitted in the rail, except as approved by the Engineer.

F. Rail ends for thermite welding shall be prepared in accordance with the recommendations of the welding kit manufacturer.

G. For thermite welding, the rail ends shall be preheated prior to welding to a sufficient temperature and for sufficient time to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld.

H. The completed weld shall be finished by mechanically controlled grinding to conform to the same requirements specified for shop welding.

I. Thermite welds shall not be made at the following locations:

1. Within 5 inches of the edge of any bolt hole in the rail.
2. Within 2 inches of a Cadweld® or copper bond wire (If this type of bond exists, remove any presence of copper by grinding. The rail ends must be inspected and cleaned after grinding is complete).
3. Closer than 2 feet from an existing plant weld.
4. Closer than 6 feet to an existing thermite weld.
5. On both ends of a rail plug simultaneously unless the rail is 15 feet or longer on tangent track and 24 feet long or longer on curved track.

J. Follow Manufacturer recommendations for compromise welds.

K. Follow recommendations of rail manufacturer for welding high strength (alloy or heat-treated) rails.

L. Thermite welds shall be located in cribs between ties. The edge of the weld must be no closer than 3 inches from the edge of the nearest tie.

M. Electric Flash Butt welds with the base of the rail smoothly ground may be located anywhere.

3.3 PERFORMANCE OF WORK

A. Perform work according to the AREMA Manual for Railway Engineering, Chapter 4, Part 3, Section 3.11, Specification for Fabrication Of Continuous Welded Rail.

B. The contractor shall supply rollers for the fabrication of the welded rail strings. The type of rollers used, and their application must be approved by the engineer prior to their use.

C. Fabrication of Continuous Welded Rail:

1. Fabricate continuous welded rail using the Electric-Flash Butt Welding process in accordance with AR.E.M.A. Manual for Railway.
2. Weld all rail lengths with the brand facing the same side for the entire length of each welded string.
3. Use abrasive saw for cropping rail. Torch cutting will not be permitted.
4. Inspection and Tests:
   a. The Contractor shall provide, at his expense, an approved, Independent Testing Agency to provide the following tests after welding:
      1) Perform testing of all rails in accordance with A.R.E.M.A. Manual for Railway Engineering:
         a) Section 3.10 Specification For The Quality Assurance of Electric-Flash Butt Welding of Rail.
         b) Section 3.11 Specification for Fabrication of Continuous Welded Rail.
5. Record of Welds:
   a. Provide records of all welds giving pertinent details of the welds such as current values, travel time, and any other data pertinent to the welds utilizing the form attached to this specification or other approved form.
   b. Group records for each rail string and location. Furnish plans indicating installed location of each string. Mark each rail string at the center of the string, with the string number. Submit records to the Project Manager.

3.4 TOLERANCES

A. As specified in the AREMA Manual:

1. Section 3.11 Specification for Fabrication Of Continuous Welded Rail.
2. Section 3.13 Specification for the Quality Assurance of Thermite Welding of Rail.

3.5 FIELD QUALITY CONTROL

A. Weld Inspection: All welds shall be visually inspected at the time of welding and ultrasonically tested once the rail has been laid in final position in the track. Ultrasonic inspection shall be in accordance with ASTM E 164. Ultrasonic test equipment shall be capable of detecting 3/64 inch discontinuity,

6 ½ inches below the top of the rail. The sensitivity and resolution of the proposed testing equipment shall be demonstrated using appropriate area amplitude and distance amplitude reference blocks made of material similar to the steel rails being tested. All equipment shall be equipped with a distance amplitude correction feature. The equipment shall be calibrated daily using an 11W correction block, also made of steel. All equipment and calibration methods will be submitted to the Engineer for approval. All inspection personnel shall be technicians qualified in accordance with AWS D1.1. All welds giving fault indication in ultrasonic inspection shall be cut out and re-welded according to these Technical Provisions.

B. REPLACEMENT OF DEFECTIVE WELDS

Welds in installed track that the Engineer determines to be unacceptable shall be cut out of the rail and replaced by a section of new rail and two new welds. The minimum length of a new rail shall be 13-feet and shall be installed with rail gaps as specified in Article 3.01 above. Saw cuts shall be made at least six inches from the centerline of the faulty weld. Replacement welds and replacement rails shall be at the sole expense of Contractor. Replacement welds shall be renumbered as indicated. Replacement welds made in track shall be ultrasonically tested as specified herein.

C. ATTACHMENTS

1. Record of Field Weld Form

- END OF SECTION -

Record of Field Weld			
Contractor:			
Weld Number: _____			
Date :_____ __	Time: _____ _	AM/PM Track_____ ___	Station: _____
Air Temperature: _____°F		Weather: _____ _____	
Rail Temperature: _____°F		Track Alignment & Construction: _____ _____	
Rail Gap:_____ _____ (Nearest 1/16")		Rail Cut Required? (Circle) YES NO	
Back Rail: Year/Month Rolled: _____/_____ _	Heat No.: _____	Rail Type: CC HT OH (Circle)	_____ _____ Shop Curved Rail
CC = Control Cooled; HT = Heat Treated; OH = Open Hearth			
Ahead Rail: Year/Month Rolled: _____/_____ ____	Heat No.:_____ __	Rail Type: CC HT O H (Circle)	_____ _____ Other
Remarks: _____ _____ _____ _____ _____ _____			
Kit Manufacturer Representative Present: _____ _____		Welding Supervisor _____ _____	

Engineering Representative Present: _____	
Recorder: _____ _____ (Signed)	Recorder: _____ ____ (Signed)

SECTION 347215.00 - RAIL CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Furnishing and installing rail connections

B. Related Sections
   1. Section 341126.00 – Ballasted Track Construction
   2. Section 341116.22 – Construct Steel Track – Steel Crossties
   3. Section 347205.00 – Construct Turnouts
   4. Section 347210.00 – Field Weld Railroad Rails
   5. Section 347220.00 – Other Track Material

1.2 DESCRIPTION

A. Bolted Rail Joints
   1. Bolted Rail Joints consist of either head free or head contact standard bars and head contact compromise joint bars held in position by track bolts.

B. Temporary Rail Connections
   1. Temporary rail connections consist of rail joints it that are intended to be welded into CWR where becomes necessary to apply joint bars temporarily. These connections will not have the end holes of the rails drilled to permit subsequent prompt field welding. The temporary joints will have proper joint bars with four bolts, nuts and lock washers applied to the joint until such time that the joint can be welded and the track is placed into service. It may be necessary to apply additional rail anchors to prevent pull apart prior to field weld being made. These additional anchors should be removed after field welds have been made.

A. Compromise Joint Bars
   1. Compromise joints shall be designed to adequately connect different sections of rail and provide a smooth rail surface over the top and gauge face of the rail head at the joint.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Joint Bars
   1. Joint bars shall conform to the A.R.E.M.A. Manual Volume 1, Chapter 4, Part 3 “Joining of Rail” sections 3.1, 3.2, 3.3 and 3.4.

2. Joint bars may be new or second hand (fit).

B. Compromise Joint Bars
   1. Compromise joints shall be specifically designed for the rail sections they are meant to connect and provide a smooth rail surface over the top and gauge face of the rail head at the joint.
   2. Compromise joint bars shall be new and shall be factory manufactured.
   3. Correct compromise bars shall be used as determined by the weight and section of the rail, wear on the rail, whether the joint is designated right hand, left hand, or no hand, and whether the joint bar is gage side or field side.

C. Joint bars shall be free from all cracks or breaks after installation.

D. Track Bolts, Spring Washers and Nuts
   1. Track Bolts and Nuts shall conform with the A.R.E.M.A. Manual Volume 1, Chapter 4, Part 3 section 3.5 “Specification For Heat Treated Carbon Steel Track Bolts and Carbon Steel Nuts.
   2. Spring Washers shall comply with the A.R.E.M.A. Manual Volume 1, Chapter 4, Part 3 section 3.6 Specification For Spring Washers**”**.

PART 3 - EXECUTION

3.1 LOCATION

A. Where joints in conventional track are required, they shall be located, as nearly as possible, to the third point of the opposite rail, except through turnouts, and shall not vary more than 72 inches in either direction from the third point of the opposite rail.

B. Compromises may not be made except at connections to existing track and at connections to fit material removed from this project and re-used on this project.

3.2 TOLERENCES

A. The tops of the heads and the gauge faces of adjoining rails shall match within one eighth (1/8) inch of each other.

B. Abutting rail ends shall be fastened together by fully bolted standard or compromise joints, insulated joints or glued joints, except where butt welded.

C. Holes for bolting of cut rails shall be drilled by an approved type of rail drill. The use of a torch for cutting bolt holes is **prohibited**.

D. All rail cut in the field shall be cut squarely with a rail saw. Cutting rail with a torch is **prohibited.**

E. The ends of field cut rail for permanent bolted joints shall be de-burred, beveled chamfered or peened, and end hardened.

F. Bolted rail joints consist of either head free or head contact standard bars and compromise joint bars held in position by track bolts having sufficient tension to firmly support abutting rail ends, but not too tight to prevent longitudinal movement in joints to accommodate expansion and contraction due to variation in rail temperature.

G. Head free bars must have the inner surface of the head of the bar held tightly against the rail head fillet with the heel of the bar standing out the proper distance from the base fillet, where all of the "draw-in" for wear is concentrated.

H. Head contact bars must have the top surface of the bar held tightly against the fishing surface under the rail head outside of the rail head fillet area. Bars must be secured in a vertical position without "cocking".

3.3 INSTALLATION

A. The contractor shall install joint bars in accordance with the following procedures:

1. Before applying bolted rail joints, the contractor shall coat the joint bars and rail ends within the joint bar areas including webs, fishing surfaces, bolt holes and inside surfaces, with an approved oil or grease.
2. Joint bars shall be applied with their full number of bolts, nuts and nut locks according to standard plans and specifications.
3. New bolts, nuts and spring washers should be used when new or reformed joint bars are applied or renewed out-of-face.
4. When initially applying joint bars, the bolt tension should be brought in the range of 20,000 to 25,000 pounds, and for subsequent retightening from 15,000 pounds to 20,000 pounds. This may be approximated by an average man with a 36 inch track wrench.

B. Head Free Joints.

1. The following procedure should be followed in applying nut locks and nuts.
    a. Set bars in position, insert all bolts and apply nut locks and nuts by hand.
    b. Run up the No.3 and No.4 nuts with a power track wrench in high gear, without fully tightening to avoid locking the bars in an improper position.
    c. Strike the bead on the heads of both the inside and outside bars at both ends with a hammer to force the inside faces of bars tightly against rail head fillets. Do not strike the toe of the bar as this tends to force the head of the bar outwards.
    d. Tighten remainder of bolts from center of joint bars outward in high gear.

e. Tighten all bolts in low gear, working from center of joint bars outward. During this final tightening, drive the toe of the bars inward by tapping with a spike maul or sledge.

By following the above procedure, proper contact will be obtained between the inner face of the head of bar and the rail head fillet. Also, the heel of the bar will stand out the proper distance from the rail base fillet.

C. Head Contact Joints.

1. The following procedure should be followed in applying head contact joint bars:
   a. Set bars in position on rail, insert all the bolts and apply nut locks and nuts by hand.
   b. See that the bars are in a vertical (uncocked) position as one of the center bolts is tightened by:
      1) Inserting a bar in the bolt hole (necessary when applying 131 lb. or 152 lb. joint bars only)
      2) Tapping toes of joint bars as bolt is tightened.
   c. Tighten all bolts in low gear, working from center of joint bars towards ends, tapping toes of joint bars with a spike maul or sledge so that their vertical position is maintained.

D. Joint bars shall be applied with their full number of bolts, nuts and washers.

E. All defective joint bars shall be removed and replaced before work will be accepted.

- END OF SECTION -

SECTION 347230 – BALLAST

PART 1 - GENERAL

1.1 DESCRIPTION

A. The contractor shall furnish and place ballast under all proposed tracks and other specified locations shown on the plans.

B. Ballast shall consist of crushed stone which is angular fragments resulting from crushing by mechanical means the following types of rocks quarried from undisturbed, consolidated deposits: granite and similar phanero-crystalline igneous rocks, extrusive igneous rocks, or massive metamorphic quartzite or similar rocks. No crushed gravel shall be allowed. Material for ballast shall be sourced from a quarry that is currently an approved supplier to Norfolk Southern, CSXT or Amtrak.

C. The contractor shall supply, unload, haul, place, and compact the ballast.

1.2 RELATED SECTIONS

1. Section 341110.00 - Continuously Welded Rail (CWR)
2. Section 341126.16 – Subballast
3. Section 341129.00 – Construct Continuously Welded Rail Track
4. Section 341133.00- Timber Crossties.
5. Section 341133.22 – Steel Crossties.
6. Section 341190.00 – Track Appurtenances and Accessories
7. Section 347201.00 - Track Layout.
8. Section 347205.00 - Construct Turnouts

1.3 REFERENCE STANDARDS

A. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.

B. American Society for Testing and Materials (ASTM):

1. C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
2. C 117 Test Method for Material Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
3. C 127 Test Method for Specific Gravity and Absorption of Coarse Aggregate.
4. C 136 Method for Sieve Analysis of Fine and Coarse Aggregates
5. C 142 Test Method for Clay Lumps and Friable Particles in Aggregates.

6. C 535 Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
7. D4791 Standard Test Method for Flat Particles, Elongated Particles, or
8. Flat and Elongated Particles in Coarse Aggregate.
9. D3744 Standard Test Method for Aggregate Durability Index.
10. E11 Standard Specification for Wire Cloth and Sieves for Testing Purposes.

1.4 DELIVERY, STORAGE AND HANDLING

A. Prepared ballast shall be handled in such a manner that it is kept clean and free from segregation, and when delivered, the ballast shall be clean and free from rubbish or any substance, which might foul the ballast.

B. Blending, stockpiling, and other production and handling operations must be managed by the Contractor minimize segregation of finished product.

C. Stockpiling operations shall minimize breakage or excessive fall in stockpiling operations.

D. The movement of wheeled or tracked machines over stockpiled or installed Materials shall be limited.

1.5 MEASUREMENT AND PAYMENT

A. Measurement and payment will not be on a separate basis, but will be included in the cost per foot of constructing track and included in the cost on a per each basis of constructing turnouts.

PART 2 - PRODUCTS

2.1 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for Submittals.

B. Submit Certificate of Compliance and supporting data, from material suppliers attesting that components meet or exceed applicable A.R.E.M.A. Standards and these project specification requirements. Include material qualification test reports for materials. Contractor shall furnish a certification of compliance stating that the material meets or exceeds the requirements of the specification.

C. Graded aggregates subject to on site stockpiling prior to placement shall be reblended as directed by the Engineer to ensure compliance with the original gradation specified.

2.2 MATERIALS

A. Mainline ballast shall conform to A.R.E.M.A. specifications for stone ballast size #4. Ballast used in the construction of yard tracks and sidetracks shall conform to A.R.E.M.A. specifications for stone ballast size #5. (A.R.E.M.A. size #5 Gradation is also known as “Walkway” stone.) Yard leads, and ladder switches shall have size #4 material with walkway stone applied on top as necessary for walking conditions.

B. Gradation, as determined using ASTM C 136, using square opening sieves conforming to ASTM E11. One test shall be performed each 1000 tons or fraction thereof of material loaded for delivery.

1. Clay lumps and friable material percentage as determined by ASTM C 142 shall not exceed 0.5%.
2. Material finer than #200 sieve -percentage as determined by ASTM test C 117 shall not exceed 0.5%
3. Absorption -as determined by ASTM C 127 shall not exceed 1.0%.
4. Sodium sulfate soundness -average weighted loss after five (5) cycles shall not exceed 2.5%, as determined by ASTM C 88.
5. Resistance to degradation -as determined by ASTM C 535, grading type 2, (Los Angles Abrasion Test 535-2) shall not result in a wear percentage greater than 27.5% for granite.
6. Flat and/or elongated particles -as determined by U.S. Army Corps of Engineers' Test CRD-C-119, using a 3:1 ratio shall not exceed 5.0%.

C. Slag material, crushed concrete, dolomite or limestone will not be accepted as ballast.

PART 3 - EXECUTION

3.1 PRE-BALLASTING

A. Vehicles used for spreading of ballast must be approved by the project engineer in writing. If stone is initially spread by a self-spreading vehicle, the use of a power grader to assist the spreading operation is permissible only where approved in writing by the project engineer.

B. Ballast shall not be spread over snow or ice.

C. All rutting and pocketing of the roadbed shall be corrected by restoring the roadbed to a smooth surface.

D. The ballast shall be placed in loose lifts which are no thicker than 5 inches, and then compacted.

E. Minimum requirements for ballast compaction are as follows:

1. Compaction equipment shall be a minimum 10 ton vibratory roller capable of generating 1100 to 1500 cycles per minute.
2. Compaction equipment shall be operated as directed by the project engineer, but in no case shall the speed exceed four (4) feet per second, and the normal operating speed shall be two-and-one-half (2-1/2) feet per second.
3. A minimum of six (6) complete passes with the compaction equipment shall be made over each lift, and each lift shall be compacted until no deformation under load is observed.

3.2 FINAL BALLASTING

A. The contractor shall furnish and place ballast on the track and uniformly distribute it in sufficient quantities to properly raise the track to the proposed top of rail profile shown on the plans. The raise shall be approximately 2 inches. The ballast shall be placed and the track raised and tamped after the tracks are installed, spiked, and anchored.

B. To the extent possible, ballast shall be unloaded in position for use with a minimum of redistribution and dressing. Special ballast cars shall be used when available.

C. Ballast must be distributed or immediately dressed so that ample clearance is provided for rolling equipment, and so that switches and guard rails are unobstructed

D. Track cross level shall be maintained, and both rails shall be raised simultaneously when track is being raised.

E. Track shall not be lifted above the established profile when lining. Ballast at the ends of the ties shall be replaced immediately after lining the track.

F. The grades and alignments of each complete track shall conform to the design shown on the plans. The grade rail on all curves shall be the inside rail of the curve.

G. Tamping shall be done with approved multiple tamping machines.

H. The contractor shall neatly dress the ballast and add or remove quantities of ballast as required to provide a uniform appearance that conforms to the typical after the track has been tamped. Surplus ballast shall be stockpiled at the direction of the engineer.

I. If the contractor contaminates the ballast with foreign material, then the contractor shall replace and re-compact the contaminated ballast. The contractor shall re-compact all previously compacted ballast which is disturbed.

- END OF SECTION -