

ADDENDUM NUMBER THREE

DUPONT PUMP STATION AND BASIN IMPROVEMENTS – PHASE 2 W-12-026-202

CITY OF CHATTANOOGA, TENNESSEE

The Bid Date shall be extended to Thursday, June 15, 2017 at 2:00 PM.

The following changes shall be made to the Contract Documents, Specifications, and Drawings:

I. CONTRACT DOCUMENT

- Inclusion of Hayward Flow Control as an approved vendor for valves was requested. This inclusion is acceptable.
- Inclusion of BioAir as an approved vendor for the odor control systems was requested. This inclusion is acceptable.
- Inclusion of PureAir as an approved vendor for the odor control systems was requested. This inclusion is acceptable.
- References to "Tennessee American Water" in the specifications shall be replaced with "Hixson Utilities".
- Add attached specification Section 32 12 16 – Asphalt Paving.
- Add attached specification Section 33 05 60 – Precast Concrete Structures.
- In Section 01 11 00, revise paragraph 1.01.A.7 to "Installation of a diesel back-up pump at the existing DuPont Pump Station".
- In Section 01 45 27, paragraph 3.03.B.1, Delete "They shall also be disinfected in accordance with AWWA C653."
- In Section 07 42 13, paragraph 2.02.A.3 – delete "Ultra High" and replace with "Medium".
- In Section 33 05 05, Table 33 05 05-A shall be deleted and replaced with the attached table.
- In Section 33 05 19, the title of 2.01.C shall be changed from "Cement-mortar Lining" to "Interior Lining". Additionally, the following paragraph shall be added:
 3. Where specified in the piping schedule, pipe and fittings shall be lined with a ceramic-filled amine-cured epoxy, Protecto 401 by Induron. The lining thickness shall be a minimum of 40 mils. Application shall be performed by an applicator approved by the coating manufacturer, in accordance with the manufacturer's instruction.
- In Section 40 90 00, paragraph 1.01 E 2, add the following paragraph:

The only other accepted optional pump station control system is the MultiSmart with the DuoProbe as provided by Multitrode. The Multismart shall be provided with network connectivity to the existing SCADA system.
- Sheet A-4: Revise detail 1 to show ½" minimum caulk joint with comp filler, rod and elastomeric sealant between EIFS and concrete trim.

- Sheet C-3
 - Call-out for chain link fence shall read "8' Chain Link Fence" instead of 6'.
 - Call-out for asphalt should be changed from "See Note #1" to "See Note #8".
 - Add the following as Note #8: "Contractor is to remove all existing pavement and repave to the limits shown."
- Sheet CD-7, Detail B, add the following Note: "1. Materials of construction shall comply with TDOT requirements for W-Beam Guardrail, Detail S-GR31-1."
- Sheet M-5
 - Section 1, Replace "16" MOTOR OPERATED PV 104" with "16" MOTOR OPERATED PV 1010-4".
 - Section 2, Replace "16" MOTOR OPERATED PV 103" with "16" MOTOR OPERATED PV 1010".

Q&A/COMMENTS

1. Section 01 45 25 Tightness Testing of Liquid Retaining Structures, Article 1.05.B.2 says to dispose of test water "in an approved manner". Can you confirm that the Contractor will be allowed to discharge the structure leak testing water to the sanitary sewer?

Response: This will be acceptable.

2. Section 01 45 27 Equipment Testing and Startup, Article 3.03.C.2 specifies a 7-day demonstration period as a prerequisite of Substantial Completion. Section 01 75 16 Starting of Systems, Article 1.06.A specifies a 30-day operating test period which seems excessive for the type of equipment/facilities being installed. Please clarify the duration required for the operating/demonstration test period on this project.

Response: A 30-day operating test is a standard provision for City of Chattanooga Consent Decree Program projects and shall be assumed for this project.

3. The Bid Form includes an option price to accelerate Substantial Completion to 4/24/2018. The Advertisement for Bids indicates that bids may be held up to 120 days. General Conditions, Article 2.03 indicates that Notice To Proceed (NTP) may take up to 60 days after Award.

Part A: If the project bids on 6/8/2017, then the Contractor could potentially be left with only 4-1/2 months to achieve Substantial Completion by 4/24/2018. Can you specify a NTP date to assume for determining the acceleration cost for this option?

Part B: Who is responsible for the Owner/Engineer's costs for extended work hours relating to accelerating Substantial Completion to 4/24/2018?

Response: Notice to proceed is expected on or before September 1, 2017. Bidders may state whatever assumptions they would like related to the optional escalation price. Per Section 00 72 00 6.02(D), Contractor shall pay all extra costs associated with work outside normal working hours. This includes Engineer inspection costs.

4. Section 09 97 23 Concrete Coating, Paragraph 1.01.A specifies coating for interior surfaces exposed to wastewater and as indicated on the drawings. The Diversion Structure is called out in Paragraph 1.01.C. Can you confirm that the Diversion Structure is the only facility that requires coating per Section 09 97 23?

Response: Confirmed.

5. Section 31 23 16 Rock Removal, Paragraph 1.06.A.3 indicates that rock will be measured for payment, however the Bid Form does not include a unit price for rock excavation. Please clarify how rock removal will be paid for.

Response: The lump sum bid item is to be inclusive of all materials, equipment, and labor to construct the project as shown in the design documents. Any unforeseen conditions not identified in the design documents, such as rock excavation, will be handled through a Change Request process.

6. In spec section 01 12 16 it references bypassing upstream of manhole S118E057 in order to make the modifications to the existing pump station as well as other activities in the final phase of construction. Can the manhole locations/sizes upstream of manhole S118E057 be provided in order to formulate a bypass cost?

Response: Immediately upstream of manhole S118E057 along the 48" interceptor are the following:

MH ID	Approximate Distance from S118E057	Location
S118E058 (48" DIA)	360 feet	Between DuPont Pkwy and rear of homes along Elm St / Memphis Dr
S118D121 (48" DIA)	730 feet	
S118D125 (48" DIA)	1,300 feet	South side of N Access Rd

7. Can the bidders qualify the escalation cost for early substantial completion with a required NTP date, after which the additional cost will no longer be valid?

Response: See response to Question #3.

8. The early completion date of 4/24/18 references substantial completion. Can a list of items not required for substantial completion be provided in order to determine if 4/24/18 is an achievable date?

Response: See response to Question #3.

9. Spec section 01 61 16 references noise criteria for operating equipment. Please confirm if this criteria will also apply to temporary equipment, specifically bypass pumps, which will be in operation for several months in the final project phase.

Response: Confirmed.

10. Spec section 01 12 16 states "Where water is required in large quantity for preoperational testing or other use, purchase it from the Tennessee American Water Company. Pay all fees and water usage charges." Please provide the cost per gal if possible.

Response: See specification correction above. A schedule of fees and rates can be found on the Hixson Utilities website (www.hixsonutility.com).

11. The Bid Form includes an optional add price for achieving Substantial Completion by 4/24/2018. For this item, can you clarify if all work needs to be substantially completed or is some reduced scope of work acceptable to meet compliance by this date?

Response: See response to Question #3.

12. Drawing CD-7 includes Detail D for a domed riser with outlet. An additional detail for a dome grate with concrete collar is included to the left of Detail D. The dome grate with collar is not called out on Drawing C-3. Please clarify the quantity of dome grates with concrete collars that are required.

Response: There are two dome grates required, one at the Bio-Retention Pond and one to the northwest of the Storage Tank.

13. General Conditions, Article 14.02.D.4.b. indicates that the Contractor may be responsible for "other permit violations" levied against the Owner.

Part A) The terms "or other permit violations" exposes the Contractor to risks that we are not able to determine. We respectfully request "or other permit violations" be stricken from Article 14.02.D.4.b.

Part B) Is the Contractor responsible for any amounts/fines/damages above and beyond the Liquidated Damages specified in Section 00 52 00 if the project completion times are delayed?

Part C) If the Contractor is responsible for any additional amounts listed above relating to delayed project completion, please clarify the nature and magnitude (dollar value) of these fines/damages.

Response: No changes to Article 14.02.D.4.b will be allowed by the City. Please refer to the Agreement (Section 00 52 00) and Standard General Conditions (Section 00 72 00) for Liquidated Damages provisions and potential Contractor liability.

14. Sheet C-3 includes a call-out for "6' Chain Link Fence", and references Detail B on Sheet CD-4. Detail B indicates the Chain Link Fence is 8' tall (plus barbed wire). Please clarify the correct height for the Chain Link Fence.

Response: See Contract Document change identified above.

15. Referencing drawing C-3, specification section 32 31 00, the proposed chain link fence is to the 6'. When viewing the detail of the chain link fence provided on drawing CD-4, details A,B,C shows the fence to be 8'. Please advise as to the correct height of the proposed chain link fence.

Response: See Contract Document change identified above.

16. The ornamental fence along the road frontage is detailed on drawing CD-4 and has no mention of material type. A specification section is not available for this fence. Please provide the proper specification and/or proposed material requirements for the ornamental fence.

Response: Ornamental fence along the road frontage will be determined as part of the landscaping plan and handled via the landscaping allowance.

17. In reviewing the Limits of Disturbance for the site during different construction sequences area will become limited. If additional space is required for temporary soil and material stock pile and storage can the limits of disturbance be adjusted as seen fit by the engineer while remaining within the property lines?

Response: Yes, provided that applicable provisions of the future land disturbance permit and NPDES stormwater construction permit are met.

18. Sheet ED 3, Detail C. Is an expansion fitting required at both end if the conduit in the duct bank? Please verify the expansion fitting would be required to be PVC coated where located in a corrosive area.

Response: Expansion fittings are only required as noted in Specification 26 05 33 3.03.A and 3.04.Y. Where expansion fittings are used with PVC coated conduit, the expansion fittings shall also be PVC coated.

19. Sheet ED 3, Detail R. Is handhole required at each pole light type B?

Response: Lighting handholes are only required where necessary to prevent more than the equivalent of four quarter bends (360 degrees total) between pull points as required by the NEC.

20. Drawing CD-5 includes conceptual details for meter and valve vaults. Can you provide structural details for these vaults?

Response: See Contract Document change identified above for the addition of a specification section for this work.

21. First off, it also lists the enclosure as Type 12, which is an indoor enclosure. It also calls for an air conditioner, but lists the ambient temperature as 0-40C, which wouldn't need an air conditioner. This will significantly add to the cost and lead time.

Response: It is unclear specifically what this question refers to. The VFDs shall be rated NEMA 4X and supplied with an integral air conditioning unit as specified in 26 29 23, paragraph 2.02.H.

22. Is the 5 minute UPS backup really required for these drives or it listed as a spec/general?

Response: VFDs do not require UPS backup.

23.

Is there a "burn in" required for these drives? It is a significant adder to the cost. We can add it, but most likely as a separate line item so that it can be deleted if not needed.

Response: VFDs shall be tested in accordance with the specifications 26 29 23 and 26 08 10.

24. On Sheet CD-2, Detail D does not identify the thickness of concrete. Please provide this information. Additionally, Detail D indicates 12" crushed stone base in the asphalt section. Detail A indicates 8" mineral aggregate base in the asphalt section. Please clarify what is intended.

Response: Concrete pad is to be 8" thick. This detail is to mark the transition from what is shown in Detail A to what is shown in Detail C. The base materials and thickness shown in those details are correct.

25. No Technical Specifications are found in the Bid Documents for:

- Ornamental Fence and Gate
- Asphalt Paving
- Steel Guardrail and Related Items

Please provide applicable information for these items.

Response: Ornamental Fencing is to be selected by the Owner and payment will be addressed as part of the landscaping allowance. See Contract Document change identified above for addition of Asphalt Paving specification. Guardrail materials shall be provided in accordance with TDOT requirements for W-Beam Guardrail, detail S-GR31-1.

26. On Sheet C-3, a call-out indicates "Asphalt (A/CD-2) (See Note #1). Note #1 on Sheet C-3 pertains to an 8-foot high berm. Please clarify what is intended.

Response: See Contract Document changes identified above.

27. Drawing E-12 note 7 states that the electrical contractor to provide the heat tape and thermostat, in the specifications 23 07 00 -03 sect 2.03 states that this fall under Thermal Insulation and Pipe Insulation.

Response: Electrical contractor shall provide heat trace system in accordance with specification 40 41 13.

28. Who is to supply and install the 1000 gallon fuel tank? Who is responsible for the initial fillup of the fuel tank?

Response: The selected Contractor will be responsible for supplying, installing, and initially filling the fuel tank as specified in Section 23 13 23.

29. Section 00 45 77, Contractor's Identification, indicates the project bid date to be Thursday, June 15, 2017. Please provide a corrected form.

Response: As the bid date has been extended via this addendum, a corrected form is no longer necessary.

30. Section 01 12 16, Construction Sequence, and Section 01 45 25, Tightness Testing of Liquid Retaining Structures, indicate the Contractor is to pay Tennessee American Water Co. for the necessary water. Given the nature and magnitude of the water requirement, please consider have the Owner be responsible for this fee.

Response: Please include in the bidder's lump sum total. The Owner will be paying the fee regardless, whether directly or indirectly.

31. Drawing C-2 indicates demolition of the existing diversion box and sewer line. This area is currently paved and secured with a perimeter fence. Please clarify the restoration requirements for this area. Does the pavement and/or fence need to be restored after the work is complete?

Response: Fencing is to be restored. Paving does not need to be restored, but site inside limits of fence should be graded out level and acceptable to Owner.

32. Reference spec section 01 45 27-3.03.B.1 regarding the use of potable water for testing/flushing of all facilities and then the requirement to disinfect the facilities. First, please confirm that the GC must pay for all potable water for the project (directly from Tennessee American Water) – this is a big deal due to the size of the storage tank. Second, please confirm that potable water must be used to test/flush all facilities (tanks, structures, pipes, etc.) in lieu of other sources of non-potable water (creek/river or other surface water, sewage, etc.). Third, please confirm that facilities must be “disinfected” – since these are wastewater handling/holding facilities, it seems that this requirement could/should be waived. Please advise.

Response: Potable water must be used and paid for by the GC. Facilities are not required to be disinfected. See Contract Document change identified above.

33. Reference spec sections 01 45 27-3.03.C.2 and 01 75 16-1.06.A regarding the duration of the successful “operating test period” of facilities after initial startup. Section 01 45 27 specifies a duration of 7 days and 01 75 16 specifies a duration of 30 days – which is correct? Further, please confirm that completion of a successful “operating test period” is a requirement to attain “substantial completion”. Please consider Q7 below as part of your response(s). Please advise.

Response: See responses to Questions #'s 2 and 3.

34. Reference spec section 02 41 00-3.02.C regarding the use of explosives for this project. Is this spec section disallowing the use of explosives only for “demolition” purposes? Or, is this spec section disallowing the use of explosives for any purpose for this project? Please advise.

Response: Explosives are disallowed for any purpose of this project.

- 35.

Reference spec sections 26 29 23-1.01.B/C & 1.03.A.12 and 43 21 39-1.01.A/D, 1.04, & 1.05.A regarding whether or not the pump manufacturer/supplier is to “furnish” and/or “coordinate” the VFD’s. The words “furnish” and “coordinate” are both used regarding the pump manufacturer/supplier’s responsibility regarding the pump VFD’s. Is it the intent of the specs that the pump manufacturer/supplier “must” or is “mandated” to furnish/supply the VFD’s as part of the pump package or not? Or, can either the GC or electrical contractor furnish the pump VFD’s as long as they are properly “coordinated” with the pump motors? Please advise.

Response: The VFD shall be supplied by the pump manufacturer/supplier in accordance with Section 43 21 39 Paragraph 2.05.B and 26 29 23 Paragraph 1.01.C. The Contractor shall coordinate and be fully responsible for proper operation and compatibility in accordance with Section 43 21 39 Paragraph 1.04.A.

36. Reference spec sections 01 43 23-1.06.K/L regarding 30-day and 6-month follow up field service and/or training services. In conjunction with the requirement to professionally videotape these follow up sessions, this will be expensive. Please confirm that these follow up visits/sessions are required and that additional training provided at these visits/sessions must be professionally videotaped.

Response: Confirmed.

37. Reference Addendum #2-II.5 regarding drawings for the existing facilities. The response indicates that “available drawings” will be made available to the successful bidder. If the drawings exist for the existing Diversion Structure and DuPont Pump Station, it would be best for bidders to have these for review prior to bidding the project. Please provide as-built information/drawings for the existing Diversion Structure and DuPont Pump Station.

Response: Considering the limited work associated with the existing pump station as identified in the response to Question #44, the response provided in Addendum #2 stands.

38. Reference spec section 00 41 00-5.01 (Bid Form) – in particular, the “Extra Items” (Bid Item #6) regarding offering a lump sum price for the escalation cost to achieve substantial completion on or before 4/24/18. Without knowing an assumed Notice to Proceed date, this is asking a lot of bidders – knowing that bids can remain open for 120 days before contract award and then, say (or guess?), another 60 days for council approval, contract execution, pre-construction meeting/planning, etc., it could be close to 6 months before the project is even started – say December 1, 2017 – this would allow less than 5 months to construct the project during the worst construction times/periods of the year. We understand and have no issue with the Owner desiring as early a completion date as possible to meet the consent decree timeline – but a “no later than” NTP date must be provided to us to entertain pricing this bid item. Has the Owner considered offering a “bonus” (\$/day) for early completion of the project? This may (or possibly not) offer a better landscape for attaining early completion.

Response: See response to Question #3. The Owner is not considering a bonus for early completion at this time.

39.

Please confirm the EIFS (Section 07 24 13) is to have a full range of colors, and that it will not receive any field coats of paint.

Response: Confirmed.

40. In spec section 33 05 05 it seems to have the incorrect buried piping schedule. Please provide correct schedule.

Response: See Contract Document change identified above for revised piping schedule.

41. We have a few questions from one of the EIFS subcontractors planning to quote us.

A) Section 07 24 13-5A.3 calls out Ultra High Impact Resistant mesh. This mesh is very expensive and hard to work with, please confirm the location that this mesh is required, is it required over the entire surface or most applications of this type of mesh is only installed up to 8' or less?

B) Section 07 24 13-5A.3 calls out Ultra High Impact Resistant mesh. Also consider that installing this type of mesh at the "brick" pattern (Color #3) will require an additional layer of base coat and lighter mesh to follow the pattern. Please confirm this is your intent.

C) Section 1/A4 refers to Detail 1. Detail 1 shows the EIFS butting up tight to the bottom of the concrete band. EIFS manufacturers require a caulking joint at this location. Please confirm this is your intent.

Response: Ultra High Impact Resistant mesh is not required. See Contract Document changes identified above.

42. Drawing C-5 indicates that Manhole S118E097 is to be replaced but this work is not addressed in the sequencing prescribed in Section 01 12 16.

A) Please clarify whether replacement of MH-S118E097 is required.

B) If replacement of MH-S118E097 is required, where is the next downstream manhole located for bypass pump system discharge?

Response: Replacement of MH-S118E097 is required. The next manhole (S118E053) is approximately 400 feet downstream located at the intersection of Elm St. and Birmingham Dr.

43. Section 01 12 16 Sequence of Construction, Paragraph 1.03F says to bypass from a location upstream of MH-S118E057. Where is the location of the nearest upstream manhole from S118E057 that we can bypass from?

Response: See response to Question #6.

44.

Section 01 11 00 Summary of Work, Paragraph 1.01.A.7 indicates that a pump is to be installed in the existing pump station. Also, Drawing C-5 shows the 30" FM connecting to the existing pump station, and Drawing E-4 indicates new electrical routed to the existing building (Note 5). Can you provide details for all work at the existing pump station including piping connection(s)/modifications, pump installation, and electrical work? As-built drawings of this facility would also be helpful if the above scope of work is included.

Response: No pumps are to be replaced or modified in the existing pump station for this contract. See Contract Document change identified above. A new 30-inch ductile iron force main will be connected to the existing pump station as shown on the drawings. Division 26 is only providing a fiber conduit (fiber cable by division 40) from the new PLC to the existing PLC as shown on site plan, ductbank schedules, and instrumentation riser diagram.

45. Section 01 11 00 Summary of Work, Paragraph 1.01.A.7 indicates that a 4th pump is to be installed in the existing pump station, however no work relating to an additional pump is shown in the Drawings. If an additional pump is required, please provide specifications for the new pump.

Response: See Contract Document change identified above.

46. What is the anticipated award date? This information is critical for determining the cost of the acceleration to complete by the April date.

Response: See response to Question #3.

47. Iran Divestment Action Compliance Certification form is not in the spec book.

Response: This form was provided in Addendum #2.

The following questions were also received. Responses are still being developed and will be provided in a separate addendum.

1. General Conditions, Article 6.06.J requires a minimum of 50% of onsite labor to be performed by the Contractor's own employees. This may be difficult to achieve due to the significant amount of work that will be performed by specialty subcontractors--deep foundations, prestressed concrete tank, etc. Please advise if this requirement can be waived or reduced to a smaller percentage.
2. Please provide hourly wage rate and fringe benefit information for: painters, EIFS installers, sheet metal workers, HVAC workers, roofers, carpenters, and formsetters.
3. Please provide hourly wage rate and fringe benefit information for: plasterers, pipefitters.
4. Based on the grades shown on the plans, an estimated 600 truckloads of fill material will need to be imported to the site. Are the city streets in the area capable of handling this amount of truck traffic? Will the contractor need to factor into their bid repair of existing streets when damaged?

June 1, 2017

Justin C Holland, Administrator
City of Chattanooga

Buried Piping Installation

TABLE 33 05 05-A, BURIED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class	Joint	Test	Remarks
Sanitary Sewer (SS)	10 - 48	DI	CL, 401	AC, PEW	350-250	RPOJ	HYD (15)	-
Overflow (OF)	436	DI	CL, 401	AC, PEW	250	RPOJ	HYD (25)	-
Influent (INF)	24	DI	CL, 401	AC, PEW	250	RPOJ	HYD (25)	-
Effluent (EFF)	16	DI	CL, 401	AC, PEW	250	RPOJ	HYD (25)	-
Force Main (FM)	16 - 30	DI	CL, 401	AC, PEW	250	RPOJ	HYD (60)	-
Water	4	DI	CL	-	350	RPOJ	HYD (150), DBT	-

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Furnish all labor, materials, equipment and incidentals required for asphalt paving complete as shown on the Drawings and as specified herein.
- B. Section Includes:
 - 1. Hot-mix asphalt patching.
 - 2. Hot-mix asphalt paving.

1.02 RELATED WORK

- A. Subgrade preparation and fill material is included in Section 31 23 00.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01 33 23, detailed information on materials proposed and installation methods.
- B. 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.
- C. Qualification Data: For manufacturer and testing agency.
- D. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.
- E. Material Test Reports: For each paving material, by a qualified testing agency.
- F. Field quality-control reports.

1.04 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials
 - 1. AASHTO M 17-2007: Specification for Mineral Filler for Bituminous Paving Mixtures
 - 2. AASHTO M 29-2003: Specification for Fine Aggregate for Bituminous Paving Mixtures
 - 3. AASHTO M 140-2003: Specification for Emulsified Asphalt

4. AASHTO M 208-2001: Specification for Cationic Emulsified Asphalt
5. AASHTO M 288-2006: Geotextile Specification for Highway Applications
6. AASHTO M 320-2009: Specification for Performance Graded Asphalt Binder
7. AASHTO M 324-2008: Standard Practice for Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements
8. AASHTO T 168-2003: Specification for Sampling Bituminous Paving Mixtures
9. AASHTO T 245-1997 (Reapproved 2008): Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

B. Asphalt Institute

1. AI MS-2-1997 (Sixth Edition): Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types
2. AI MS-22-2001 (Second Edition): Construction of Hot Mix Asphalt Pavements

C. ASTM International

1. ASTM D 242/D 242M-09: Specification for Mineral Filler for Bituminous Paving Mixtures
2. ASTM D 692/D 692M-09: Specification for Coarse Aggregate for Bituminous Paving Mixtures
3. ASTM D 946/D 946M-09a: Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
4. ASTM D 977-05: Specification for Emulsified Asphalt
5. ASTM D 979-01 (Reapproved 2006): Practice for Sampling Bituminous Paving Mixtures
6. ASTM D 1073-07: Specification for Fine Aggregate for Bituminous Paving Mixtures
7. ASTM D 1188-07: Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
8. ASTM D 2027-97 (Reapproved 2004): Specification for Cutback Asphalt (Medium-Curing Type)ASTM D 2041-03a: Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
9. ASTM D 2397-05: Specification for Cationic Emulsified Asphalt
10. ASTM D 2726-09: Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
11. ASTM D 2950-2009: Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
12. ASTM D 3141/D 3141M-09: Specification for Asphalt for Undersealing Portland-Cement Concrete Pavements

13. ASTM D 3381/D 3381M-09a: Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
14. ASTM D 3549-03: Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens
15. ASTM D 3666-09a: Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
16. ASTM D 3910-07: Practices for Design, Testing, and Construction of Slurry Seal
17. ASTM D 6690-07: Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
18. ASTM D 6927-06: Test Method for Marshall Stability and Flow of Bituminous Mixtures

D. Tennessee Department of Transportation (TDOT)

1. Standard Specifications for Road and Bridge Construction.

E. Unless noted otherwise, where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by TDOT.
- 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 TDOT Standard Specifications for Road and Bridge Construction for asphalt paving work.

1.06 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 3. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
 4. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 PRODUCTS

2.01 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured.
- C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.02 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320, PG 64-22.
- B. Cutback Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30.
- C. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- D. Water: Potable.

2.03 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

2.04 MIXES

- A. Surface Course Limit: Recycled content no more than 10 percent by weight.
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by TDOT and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - 2. Base Course: Grade BM-2, per section 307 of TDOT specifications.
 - 3. Surface Course: Grade E, per section 411 of TDOT specifications.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.02 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
 - 1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
 - 2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

- D. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.03 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.04 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt surface course in single lift.
 - 2. Spread mix at a minimum temperature of 250 deg F (121 deg C).
 - 3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 - 4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
 2. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.05 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.06 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent or greater than 100 percent.

2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
 - E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
 - F. 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.
 - G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
 - H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.07 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 10-foot (3-m) straight-edge applied transversely or longitudinally to paved areas:
 1. Base Course: 1/4 inch.
 2. Surface Course: 1/8 inch.
 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install precast concrete manholes, structures, frames and covers, access hatches, manhole rungs, ladders and appurtenances all as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Excavation and backfill is included in Section 31 23 00.
- B. Cast-in-place concrete is included in Section 03 30 00.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01 33 23, shop drawings showing details of construction, reinforcing, joints, pipe connection to manhole, manhole rungs, manhole platforms (if applicable), manhole frames and covers, access hatches, and ladders.
- B. Submit for review, structural calculations and drawings for all precast structures.
- C. Concrete design mix data and concrete test cylinder reports from an approved concrete testing laboratory certifying that the concrete used in the precast structures conforms with the strength requirements specified herein.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A48 - Standard Specification for Gray Iron Castings
 - 2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 3. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
 - 4. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale).
 - 5. ASTM C150 - Standard Specification for Portland Cement.
 - 6. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 7. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

8. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 9. ASTM D4101 - Standard Specification for Propylene Plastic Injection and Extrusion Materials.
- B. American Concrete Institute (ACI)
1. ACI 318 - Building Code Requirement for Structural Concrete.
- C. American Association of State Highway and Transportation Officials (AASHTO)
- D. Occupational Safety and Health Administration (OSHA)
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer, or other representative of the Owner. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places and the materials shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein; even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.
- B. At the time of inspection, the materials will be carefully examined for compliance with the ASTM standard specified below and this Section and with the approved manufacturer's drawings. All manhole sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.
- C. Imperfections in manhole sections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at 7 days and 5,000 psi at 28 days, when tested in 3-in by 6-in cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

PART 2 PRODUCTS

2.01 PRECAST CONCRETE MANHOLE SECTIONS

- A. Precast concrete barrel sections and transition top sections, shall conform to ASTM C478 and meet the following requirements:

1. The wall thickness shall not be less than 5-in for 48-in diameter reinforced barrel sections, 6-in for 60-in diameter reinforced barrel sections and 7-in for 72-in diameter reinforced barrel sections.
2. Top sections shall be eccentric except that barrel sections shall be used where shallow pipe cover requires a top section less than 4-ft as shown on the Drawings.
3. Barrel sections shall have tongue and groove joints.
4. All sections shall be cured by an approved method and shall not be shipped nor subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair, whichever is longer.
5. Precast concrete barrel sections with precast top slabs and precast concrete transition sections shall be designed for a minimum of H-20 loading plus the weight of the soil above at 120 pcf.
6. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on the inside of each precast section.
7. Precast concrete bases shall be constructed and installed as shown on the Drawings. The thickness of the bottom slab of the precast bases shall not be less than the manhole barrel sections or top slab whichever is greater.
8. Knock out panels shall be provided in precast manhole sections at the locations shown on the Drawings. They shall be integrally cast with the section, 2-1/2-in thick and shall be sized as shown on the Drawings. There shall be no steel reinforcing in knock out panels.

2.02 PRECAST CONCRETE STRUCTURES

- A. The precast reinforced concrete structures shall be manufactured by Rotundo & Sons, Inc.; American Precast or equal. The inside dimensions, headroom requirements and minimum thickness of concrete shall be as indicated on the Drawings. The manufacturer shall notify the Engineer at least 5 working days prior to placing concrete during the manufacturing process. The Engineer may inspect the reinforcing steel placement and/or require the manufacturer to provide photographs of each section showing the location of all reinforcing steel prior to the placing of concrete. Should it be found that the placement of steel is not as detailed in the shop drawing submittals, the section in question shall be rejected and a replacement section shall be manufactured at the Contractor's expense. Failure to properly notify the Engineer prior to placing concrete shall require the precast sections to be rejected and replacement sections to be manufactured at the Contractor's expense.
- B. Structural design calculations and Drawings shall be prepared and stamped by a professional engineer registered in the State of Tennessee.
- C. All precast concrete shall have a minimum compressive strength of 5,000 psi at 28 days. Water shall be kept to a minimum to obtain concrete which is as dense and watertight as possible. The maximum water-to-cement ratio shall be 0.40 by weight and the minimum cement content shall be 600 lbs. of cement per cubic yard of concrete. The above ratios shall be revised for sacks of cement weighing different from 94 pounds per sack.

D. Design Criteria

1. All precast concrete members shall conform to ACI 318.
 2. When the design yield strength "fy" for tension reinforcement exceeds 40,000 psi, the "z" values referred to in ACI 318 shall not exceed 95 kips/in. The flexural stress in reinforcement under service loads "fs" shall be calculated and shall not be greater than 50 percent of the specified yield strength fy.
 3. The precast concrete structure's elements shall be designed to support their own weight, the weight of soil above at 120 pcf and shall be capable of withstanding a live load equal to an AASHTO HS-20 highway loading applied to the top slab.
 4. The base slab and walls shall be cast together to form a monolithic base section.
 5. All exterior walls shall be designed for an equivalent fluid pressure of 90 lbs. /sq. ft. The top of the pressure diagram shall be assumed to originate at finished ground level. Additional lateral pressure from approaching truck wheels shall be considered in accordance with AASHTO.
 6. The structural design shall take into account discontinuities in the structure produced by openings and joints in the structure.
 7. The structures shall be designed to prevent flotation without the benefit of skin friction when the ground water level is at finished ground surface. Flotation forces shall be resisted by the dead load of the structure and soil directly above the structure. Weight of equipment and piping within the structure and soil frictional forces shall not be considered as being effective in resisting flotation forces.
 8. If the design of the box structure requires a concrete pad to prevent flotation, the cost of designing, furnishing and installing a reinforced concrete pad shall be included in the price for the structure. Details of the design of the concrete pad (if required) shall be submitted to the Engineer for review.
 9. All walls and slabs shall be analyzed by accepted engineering principles. Openings shall be completely framed as required to carry the full design loads to support walls. All slabs and walls shall be fully reinforced on both faces and the minimum reinforcing shall be No. 5 at 12-in E.F.E.W. Additional reinforcing shall be provided around all openings.
 10. The horizontal wall joints shall not be located within 18-in of the horizontal centerline of wall penetrations.
- E. The structure shall be built by the manufacturer in no more than four major sections including the top slab if required.
- F. Where top slabs are used or required, lifting hooks shall be provided.
- G. As required, access openings and pipe penetrations shall be formed openings and located as shown on the Drawings.
- H. Wall sleeves as shown on the Drawings, shall be provided to the precast concrete manufacturer for inclusion in the manufacture of the structure.

2.03 BRICK MASONRY

- A. The bricks shall be good, sound, hard and uniformly burned, regular and uniform in shape and size, of compact texture and satisfactory to the Engineer. Underburned or salmon brick will not be acceptable and only whole brick shall be used unless otherwise permitted. In case bricks are rejected by the Engineer, they shall be immediately removed from the site of the work and satisfactory bricks substituted therefor.
 - 1. Bricks for the channels and shelves shall comply with ASTM C32 for Sewer Brick, Grade SS (from clay or shale) except that the mean of five tests for absorption shall not exceed 8 percent and no individual brick exceed 11 percent.
 - 2. Bricks for building up and leveling manhole frames shall conform to ASTM C62.
- B. Mortar used in the brickwork shall be composed of 1 part Type II Portland Cement conforming to ASTM C150 to 2 parts sand to which a small amount of hydrated lime not to exceed 10 lbs. to each bag of cement shall be added.
- C. The sand used shall be washed, cleaned, screened, sharp and well graded as to different sizes and with no grain larger than will pass a No. 4 sieve. It shall be free from vegetable matter, loam, organic or other materials of such nature or of such quantity as to render it unsatisfactory.
- D. The hydrated lime shall also conform to ASTM C207.

2.04 MANHOLE FRAME AND COVER

- A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30.
- B. Manhole covers shall have a diamond pattern, pickholes and the words SANITRAY SEWER, WATER, ELECTRIC, etc., as appropriate, cast in 3-in letters. Manhole frame and covers shall be LeBaron Foundry; Mechanics Iron Foundry; Neenah Foundry or equal.

2.05 JOINTING PRECAST MANHOLE SECTIONS AND STRUCTURES

- A. Tongue and groove joints of precast manhole and structure sections shall be sealed with either a round rubber O-ring gasket or a preformed flexible joint sealant. The O-ring shall conform to ASTM C443. The preformed flexible joint sealant shall be Kent Seal No. 2 by Hamilton-Kent; Ram-Nek by Henry Company, El Segundo, CA or equal.
- B. Joints shall be designed and manufactured so that the completed joint will withstand an internal water pressure of 15 psi without leakage or displacement of the gasket or sealant.

2.06 MANHOLE RUNGS

- A. Manhole rungs shall be either of the following types:
1. Manhole rungs shall be steel reinforced copolymer polypropylene plastic. Rungs shall be 14-in wide, M.A. Industries Type PS2-PF-SL or equal. Copolymer polypropylene shall conform to ASTM D4101, PP0344 B33534 Z02. Steel reinforcing shall be 1/2-in diameter, grade 60 conforming to ASTM A615 and shall be continuous throughout the rung. The portion of the legs to be embedded in the precast section shall have fins and be tapered to insure a secure bond.

2.07 PIPE CONNECTIONS

- A. Pipe connections may be accomplished in the following ways:
1. A tapered hole filled with non-shrink waterproof grout, Hallemite; Waterplug; Embeco or equal, after the pipe is inserted is acceptable, providing the grout is placed carefully to completely fill around the pipe. If this method is used, place concrete encasement to assure a total 12-in of concrete including manhole thickness around the pipe stub.
 2. The "Lock Joint Flexible Manhole Sleeve" shall be cast in the precast manhole base. The stainless steel strap shall be protected from corrosion with a bituminous coat.
 3. "A-Lok" shall be a rubber like gasket cast in the precast manhole base. The rubber gasket shall be cast into a formed opening in the manhole.
 4. "KOR-N-SEAL" joint shall be installed as recommended by the manufacturer. The stainless steel clamp shall be protected from corrosion with a bituminous coat.

2.08 DAMPPROOFING

- A. Brushed dampproofing shall be an asphalt emulsion reinforced with fibers conforming to ASTM D1227, Type II, Class 1. The dampproofing shall be Hydrocide 700B by Sonneborn Building Products, Division of BASF; Karnak 220 Asphalt Emulsion by Karnak Corporation, Clark, NJ or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Manhole and Structure Installation
1. Manhole and structure shall be constructed to the dimensions shown on the Drawings and as specified herein. All work shall be protected against flooding and flotation.
 2. The bases of manholes shall be placed on a bed of 12-in screened gravel as shown on the Drawings. The bases shall be set at a grade to assure that a

maximum of 8-in thickness of brickwork will bring the manhole frame and cover to final grade. Cast-in-place bases shall be constructed in accordance with the requirements of Division 3 and the details shown on the Drawings.

3. Precast concrete barrel sections and structures shall be set plumb and with sections in true alignment with a 1/4-in maximum tolerance to be allowed. The joints of precast barrel sections shall be sealed with either a rubber O-ring set in a recess or the preformed flexible joint sealant used in sufficient quantity to fill 75 percent of the joint cavity. The outside and inside joint shall be filled with non-shrink mortar and finished flush with the adjoining surfaces. Allow joints to set for 24-hours before backfilling. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides. If any leaks appear in the manholes, the inside joints shall be caulked with lead wool to the satisfaction of the Engineer. Install the precast sections in a manner that will result in a watertight joint.
4. Holes in the concrete barrel sections required for handling or other purposes shall be plugged with a non-shrinking grout or non-shrinking grout in combination with concrete plugs and finished flush on the inside.
5. Where holes must be cut in the precast sections to accommodate pipes, cutting shall be done prior to setting manhole sections in place to prevent any subsequent jarring which may loosen the mortar joints.

B. Manhole Pipe Connections

1. Manhole pipe connections shall be accomplished in the ways specified herein. Pipe stubs for future extensions shall also be connected and the stub end closed by a suitable watertight plug.

C. Manhole Rung Installation

1. Steel reinforced polypropylene plastic manhole rungs shall be driven into tapered holes in the precast riser and cone sections during the manufacture of the sections. Holes for rungs shall be performed during the casting of the sections and shall not be drilled out after casting. The preformed holes shall be a minimum of 3-1/2-in deep and shall taper from 1-1/8-in to 1-3/8-in diameter.

D. Brickwork

1. Mortar shall be mixed only in such quantity as may be required for immediate use and shall be used before the initial set has taken place. Mortar shall not be retained for more than 1-1/2 hours and shall be constantly worked over with hoe or shovel until used. Anti-freeze mixtures will not be allowed in the mortar. No masonry shall be laid when the outside temperature is below 40 degrees F unless provisions are made to protect the mortar, bricks and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. The Engineer's decision as to the adequacy of protection against freezing shall be final.
2. Channels and shelves shall be constructed of brick and concrete as shown on the Drawings. The brick lined channels shall correspond in shape with the lower half of the pipe. The top of the shelf shall be set at the elevation of the crown of the highest pipe and shall be sloped 1-in per foot to drain toward the flow through

channel. Brick surfaces exposed to sewage flow shall be constructed with the nominal 2-in by 8-in face exposed (i.e. bricks on edge).

3. Manhole covers and frames shall be set in a full mortar bed and bricks, a maximum of 8-in thick, shall be utilized to assure frame and cover are set to the existing grade. If full width paving is the permanent paving, the manhole frame and cover shall be reset to final grade prior to placement of permanent paving.

E. Dampproofing

1. Outer surfaces of precast and cast-in-place manholes [and structures] shall dampproofed at the rate of 30 to 35 sq. ft. per gallon as directed by the Engineer and in accordance with manufacturer's instructions.

3.02 LEAKAGE TESTS

- A. Leakage tests shall be made and observed by the Engineer on each manhole. The test shall be the exfiltration test made as described below:
- B. After the manhole has been assembled in place, all lifting holes and those exterior joints within 6-ft of the ground surface shall be filled and pointed with an approved non-shrinking mortar. The test shall be made prior to placing the shelf and invert and before filling and pointing the horizontal joints below the 6-ft depth line. If the groundwater table has been allowed to rise above the bottom of the manhole, it shall be lowered for the duration of the test. All pipes and other openings into the manhole shall be suitably plugged and the plugs braced to prevent blow out.
- C. The manhole shall then be filled with water to the top of the cone section. If the excavation has not been backfilled and observation indicates no visible leakage, that is, no water visibly moving down the surface of the manhole, the manhole may be considered to be satisfactorily water-tight. If the test, as described above is unsatisfactory as determined by the Engineer, or if the manhole excavation has been backfilled, the test shall be continued. A period of time may be permitted if the Contractor so wishes, to allow for absorption. At the end of this period, the manhole shall be refilled to the top of the cone, if necessary and the measuring time of at least 8 hours begun. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour rate and the leakage determined on the basis of depth. The leakage for each manhole shall not exceed 1 gallon per vertical foot for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed 3 gallons per vertical foot per day, repairs by approved methods may be made as directed by the Engineer to bring the leakage within the allowable rate of 1 gallon per foot per day. Leakage due to a defective section or joint or exceeding the 3 gallon per vertical foot per day shall be the cause for the rejection of the manhole. It shall be the Contractor's responsibility to uncover the manhole as necessary and to disassemble, reconstruct or replace it as directed by the Engineer. The manhole shall then be retested and, if satisfactory, interior joints shall be filled and pointed.
- D. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc., i.e. it will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete. Furthermore, take

any steps necessary to assure the Engineer that the water table is below the bottom of the manhole throughout the test.

- E. If the groundwater table is above the highest joint in the manhole, and if there is no leakage into the manhole as determined by the Engineer, such a test can be used to evaluate the water-tightness of the manhole. However, if the Engineer is not satisfied, lower the water table and carry out the test as described hereinbefore.
- F. Leakage Tests for Structures
 - 1. The Engineer will visually inspect structure(s) for possible leaks before backfilling of structures is allowed. All joints shall be sealed to the satisfaction of the Engineer.
 - 2. The Engineer may require an exfiltration test as described for manholes on any structure for which he/she deems the test appropriate.

3.03 CLEANING

- A. All new manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION