

SECTION 33 41 00

STORM DRAINAGE

SUMMARY OF CHANGE(S):

Rev	Date	Package	DESCRIPTION / JUSTIFICATION	AUTHOR
0	29 May 2025	SP-01 IFC	Initial issue	C. Hardesty

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes requirements necessary for installation of storm drain systems.
- B. Connection of building storm drain system to main storm drain line and building piping.
- C. Related Sections:
 - 1. Section 31 00 00 – Earthwork.
 - 2. Section 01 81 13 – Sustainable Design Requirements
- D. CAUTION: Use of this Section without including the above-listed items results in omission of basic requirements.
- E. In the event of conflict regarding Storm Drainage requirements between this Section and another section, the provisions of this Section govern.

1.2 REFERENCES

- A. In addition to compliance with industry standards and Owner requirements, ensure that the following government acts and regulations (as applicable for any particular equipment or material) are complied with in design, fabrication, testing and shipment of equipment and materials.
- B. Meet or exceed the requirements of the latest edition of the following codes, regulations and standards.
- C. American Society of Testing Materials (ASTM):
 - 1. ASTM A716 – Standard Specification for Ductile Iron Culvert Pipe
 - 2. ASTM A746 – Standard Specification for Ductile Iron Gravity Sewer Pipe
 - 3. ASTM B788 - Standard Practice for Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe.

4. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
 5. ASTM C387 – Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar.
 6. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 7. ASTM C507 - Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
 8. ASTM D1056 – Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
 9. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 10. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 11. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 12. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
 13. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 14. ASTM F894 – Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.
 15. ASTM F1668 - Standard Guide for Construction Procedures for Buried Plastic Pipe.
 16. ASTM F2881 – Standard Specification for 12 to 60 in Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications
- D. American Water Works Association (AWWA):
1. AWWA C104/ANSI A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 2. AWWA C110/ANSI A21.10 – Ductile-Iron and Gray-Iron Fittings.
 3. AWWA C111/ANSI A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 4. AWWA C115/ANSI A21.15 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 5. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
- E. AASHTO:
1. AASHTO M36 – Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
 2. AASHTO M190 – Standard Specification for Asphalt-Coated Corrugated Metal Culvert Pipe and Pipe Arches.
 3. AASHTO M218 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized), for Corrugated Steel Pipe.

1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. Comply with Section 01 81 13 – Sustainable Design Requirements.

1.4 SUBMITTALS

- A. Refer to Submittal Schedule at end of Part 3 for a list of submittal requirements for this Section.

PART 2 PRODUCTS

2.1 GENERAL

- A. For gravity storm drain pipe use polyvinylchloride (PVC), ductile iron pipe (DIP), rubber gasketed reinforced concrete pipe (RGRCP), corrugated metal pipe (CMP) (for culverts only), polypropylene, or high-density polyethylene (HDPE) as shown on Drawings.

2.2 PIPE AND PIPE JOINTS

- A. Polyvinylchloride (PVC):
 - 1. Pipe:
 - a. Pipe 15 inches diameter and under: ASTM D3034.
 - b. Standard Dimension Ratio (SDR): Not to exceed 35.
 - 2. Joints: Bell and spigot per ASTM D3212.
 - 3. Rubber Gaskets: ASTM F477.
 - 4. Adapter for connecting pipe to manholes: As recommended by pipe manufacturer.
- B. Ductile Iron Pipe (DIP):
 - 1. Pipe Size 3 inch to 12 inch: ASTM A746, Pressure Class 350.
 - 2. Pipe Size 14 inch to 64 inch: ASTM A716.
 - a. Pipe Joints:
 - 1) Below Ground: Push-on. Do not use multiple types of joints.
 - 2) Above Ground: Flanged joint (AWWA C115) or when exposed in pits or trenches.
 - 3) Gaskets: AWWA C111 (rubber), flanged joint rubber, full face, 1/8-inch thick.
 - b. Outside Coating: 1 mil minimum thick petroleum asphaltic coating.
 - c. Inside Coating: AWWA C104, cement lined with petroleum asphaltic seal coat.
 - d. Fittings:
 - 1) Pressure Rating: 350 psi for 3-inch through 48-inch sizes.
 - 2) Joints: Match pipe.
 - 3) Inside Coating: Cement lined with petroleum asphaltic seal coat.
- C. High-Density Polyethylene Pipe (HDPE):
 - 1. Pipe:

- a. Pipe 18 inches and larger in diameter: Profile wall conforming to ASTM F894.
 - b. Minimum wall thickness: Ring stiffness constant (RSC) of 63.
 - 2. Joints: Bell and spigot.
 - 3. Rubber Gaskets: Per ASTM F477.
 - 4. Adapter for connecting pipe to manholes: As recommended by pipe manufacturer.

- D. Rubber Gasketed Reinforced Concrete Pipe (RGRCP):
 - 1. Circular: ASTM C76, Class III with Wall B design unless shown otherwise. Elliptical reinforcement is not permitted.
 - 2. Horizontal Elliptical: ASTM C507. Class HE-III minimum.
 - 3. Joints: Rubber gasket type conforming to ASTM C443.
 - 4. Joint Lubricant: Furnished by pipe manufacturer.
 - 5. End Sections: Precast concrete with same joint type as pipe, same quality as pipe.

- E. Polypropylene:
 - 1. Pipe: ADS HP Storm, or approved equivalent, per ASTM F2881
 - 2. Joints: Bell and spigot per ASTM D3212.

- F. Corrugated Metal Pipe (CMP):
 - 1. Pipe:
 - a. AASHTO M36, Type 1:

Diameter	Gauge
12 through 24 inches	16
30 through 48 inches	16
 - b. Coating: Zinc, conforming to AASHTO M218, overcoated with 0.05 inch thick, measured at crest of corrugations, bituminous conforming to AASHTO M190.
 - 2. Coupling Bands:
 - a. Base Metal and Coating: Same as pipe.
 - b. Width: 12 inches.
 - c. Thickness: Two numerical thicknesses less than for equivalent diameter of pipe but not less than 0.064 inch.
 - d. Connecting Bolts: Hot-dip galvanized; 1/2-inch diameter for pipe 12 inches diameter and larger.
 - e. Gasket: Band of expanding rubber conforming to ASTM D1056, Type 2, Class B, Grade 4, watertight.

- G. Spill Containment Pipe:
 - 1. Pipe:
 - a. Pipe 24 inches and smaller: High-density polyethylene per ASTM D3350 by Chevron Phillips Chemical Company LP, DriscoPlex 4000/4100.
 - b. Standard Dimension Ratio (SDR) of 17 as a minimum wall thickness.
 - 2. Joints: Butt fusion.

2.3 FITTINGS

- A. PVC Pipe:
 - 1. Gasketed joint and shop molded or fabricated.
 - 2. Service Connection Joint - Tee or Wye: Gasketed type or approved adapter to join service pipe connection.
- B. Ductile Iron Pipe - Fittings: AWWA C110.
- C. Rubber Gasketed Reinforced Concrete Pipe:
 - 1. Joint: Gasketed type or approved adapter to join service pipe connection.
 - 2. 18 inches and smaller pipe: Shop fabricated.
 - 3. 21 inches and larger pipe: Field or shop fabricated.
 - 4. For tees fabricated by inserting a stub into a hole cut in pipe, grout with a non-shrinking grout. Prior to grouting, coat surface with epoxy bonding agent. Ensure tee stubs don't protrude inside of pipe.
- D. CMP: Field or shop fabricated. Include a saddle plate curved to same diameter as main line pipe for field-fabricated tees.
- E. Polypropylene: Shop fabricated with gasketed joints
- F. HDPE Pipe: Shop fabricated with gasketed joints. Same RSC as main line pipe.

2.4 PIPE ACCESSORIES

- A. Couplings Between Dissimilar or Plain-End Pipe: Flexible mechanical compression joint coupling with stainless steel contracting sleeve and neoprene rubber gasket for positive seal.
 - 1. Acceptable Manufacturers:
 - a. Joints, El Monte, California.
 - b. Fernco Joint Sealer Company, Davison, Michigan.

2.5 MORTAR

- A. Standard premix mortar conforming to ASTM C387, Type N, or proportioned one part Portland cement to two parts of clean, well-graded sand which will pass a 1/8-inch screen.
- B. Admixtures: May be used not exceeding following percentages by weight of cement:
 - 1. Hydrated Lime: 10 percent.
 - 2. Diatomaceous Earth or Other Inert Materials: 5 percent.
- C. Consistency: Adhere readily to pipe. Don't use mortar mixed for longer than 30 minutes.

PART 3 EXECUTION

3.1 PREPARATION OF TRENCH

- A. Trenching: As specified in Section 31 00 00 – Earthwork.
- B. Bedding Material: As specified in Section 31 00 00 – Earthwork.

3.2 PIPE PREPARATION AND HANDLING

- A. Inspect pipe and fittings prior to lowering into trench. Reject cracked, broken, or otherwise defective materials. Remove damaged pipe from jobsite.
- B. Use proper implements, tools, and facilities for safe and proper protection of work. Lower pipe into trench in such a manner as to avoid physical damage to pipe. Do not drop pipe.
- C. Unload PVC pipe and fittings by hand or use canvas slings to avoid damaging pipe. Reject pipe with scratches greater than 10 percent of thickness of pipe wall.
- D. Stack PVC pipe no higher than 5 feet. Support pipe barrel to prevent bending. Cover stockpiled pipe to protect from sun's rays. Provide for air circulation through stockpile.

3.3 TOLERANCES

- A. Pipe invert may deviate up to 1/2 inch for line and 1/8 inch for grade, provided that such variation does not result in a level or reverse sloping invert.

3.4 INSTALLATION OF PIPE AND FITTINGS

- A. General:
 - 1. Proceed upgrade when laying pipe with socket or collar ends at upgrade end.
 - 2. Clean end of pipe to be joined, inside of joint, and rubber ring (when required) immediately before joining pipe.
 - 3. Assemble joint in accordance with recommendations of pipe manufacturer.
 - 4. Ensure pipe bedding has a continuous and uniform bearing and pipe support at every point between joints.
 - 5. Prevent pipe joints from pulling apart when moving trench shield.
 - 6. Plug or close off pipes that are stubbed off for manhole construction or for connection by others with temporary plugs.
 - 7. Prevent uplift or floating of line prior to completion of backfilling operation.
 - 8. When cutting or machining pipe is necessary, use tools and methods recommended by pipe manufacturer.
- B. During construction and when laying operations are not in progress, prevent excavated or other foreign material from entering pipe. At end of workday, close and block open end of last laid section of pipe to prevent entry of foreign material.

- C. Rubber Gasketed Reinforced Concrete Pipe: Install concrete pipe with spigot end pointing in direction of flow.
- D. Corrugated Steel Pipe:
 1. Install per ASTM B788.
 2. Place pipe in trench with outside laps of circumferential joints upgrade and with longitudinal laps positioned other than in the invert. Firmly join sections together with coupling bands.
 3. Where plain concrete or concrete pipe is to be placed in contact with metal pipe, clean pipe with solvent to remove contaminants and paint with two coats of paint conforming to Federal Specification TT-P-645 (Primer, Paint, Zinc Molybdate, Alkyd Type).
 4. Use a tapping saddle for connections to an existing corrugated storm drain pipe as recommended by pipe manufacturer. Apply mastic between saddle plate and pipe.
- E. PVC, HDPE, and Polypropylene Pipe:
 1. Install in accordance with ASTM D2321 and ASTM F1668.
 2. Where PVC, HDPE, and Polypropylene pipe is connected to manholes or concrete structures, provide an adapter at each point of connection. Provide adapters suitable for jointing with PVC, HDPE, and Polypropylene pipe furnished and provide a watertight seal.
- F. Ductile Iron Pipe:
 1. Install in accordance with AWWA C600.
 2. Provide all special tools and devices, such as special jacks, chokers, and similar items required for installation.

3.5 TESTING

- A. Visual Inspection:
 1. When inspected with reflected light, show a clear, unobstructed view between manholes. Show a practically full circle of light is seen when viewed from adjoining end of line.
 2. Correct defects as a result of this test at Contractor's expense.
- B. Piping Deflection Testing:
 1. Test 100 percent of PVC, HDPE, Polypropylene, and CMP pipes.
 2. Test pipe by pull through device (mandrel or sewer ball) permitting no greater than maximum 5 percent deflection.
 3. Remove and replace pipe not passing deflection limitation test.
 4. Test 100 percent of pipe when deflections are noted.
 5. Replace pipe with deflection greater than 5 percent at end of warranty period.

3.6 FINAL CLEANING

- A. Prior to final acceptance and final manhole-to-manhole inspection of storm drain system by Owner, flush and clean system parts. Remove accumulated construction debris, rocks,

gravel, sand, silt, and other foreign material from storm drain system at or near closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.

- B. Upon Owner’s final manhole-to-manhole inspection of storm drain system, if foreign matter is still present, reflush and clean sections and portions of lines as required.
- C. Defective Piping Sections: Repair or replace as specified.

3.7 ACCEPTANCE

- A. Post Installation Inspection: Inspect 100 percent of pipe and structures:
 1. Deflection less than specified.
 2. No open pipe joints.
 3. No soil entering through pipe or catch basins joints.
 4. Pipe penetrations grouted and water tight.
 5. No settlement or misalignment.
 6. Piping system clean of debris and sediments.
- B. Post Installation Inspection Report:
 1. Results of deflection testing.
 2. Equipment used for testing.
 3. Name of inspector.
 4. Digital photographs of items inspected.
 5. As-built survey of piping and stormwater management basin(s) including outlet structure elevations from register land surveyor.

3.8 SUBMITTAL SCHEDULE

ITEM NO.	SUBMITTAL REQUIREMENT	WITH BID	AS INDICATED
33 41 00-01	Product Data: <ul style="list-style-type: none"> • Coupling for joining dissimilar or plain end pipes. 		Provide 2 weeks prior to installation.
33 41 00-02	Product Data: <ul style="list-style-type: none"> • Adapter for connecting piping to manholes or concrete structures. 		Provide 2 weeks prior to installation.
33 41 00-03	Certificate of Manufacturer’s Compliance: <ul style="list-style-type: none"> • Pipe and Fittings. 		Provide 2 weeks prior to installation.
33 41 00-04	Post Installation Inspection Report		Provide 1 week after installation.
33 41 00-05	Coordinate submittal requirements with Section 01 81 13 – Sustainable Design Requirements.		Per construction schedule.

END OF SECTION