



The City of
OKLAHOMA CITY
Department of Public Works

February 13, 2024

RE: Clarification - Standard Specifications for Construction of Public Improvements - Section 452

Architects, Engineers, Contractors, and City Staff:

The use of Polypropylene pipe for storm sewer applications may be approved for use under paved areas when specifically designed for the application and included in the construction plans prepared, signed, and sealed by the design engineer. The design engineer is responsible for the structural design of storm sewer installations.

The structural design for installation of Polypropylene pipe must be included in the design engineer's approved plans and must be reviewed and approved by the City Engineer. Approval must be granted prior to advertisement for Public Construction contracts and before issuance of a work order for private development plans.

Polypropylene pipe is not an approved equal for reinforced concrete pipe and shall not be substituted or used in place of reinforced concrete pipe.

The use of Polypropylene pipe on Public Construction projects after a contract has been awarded or a work order has been issued for Private Development projects must be done via a Change Order to the project. Change Orders must be prepared, signed, and sealed by the design engineer and approved by the City Engineer.

The Standard Specifications can be found at www.okc.gov/departments/public-works/city-standard-specifications.

Should you have any questions related to the Standard Specifications, please contact Chad Harrison at 405-297-2058 or chad.harrison@okc.gov.

Sincerely,

A handwritten signature in blue ink, appearing to read "Deborah K. Miller".

Deborah K. Miller, P.E., Interim Director
Public Works/Interim City Engineer

Attachments

Section 452 – Standard Specifications for Construction of Public Improvements

SECTION 452 – POLYPROPYLENE PIPE (PP)

NOTE: This Section is for Storm Sewer only.

452.01 DESCRIPTION

This section covers the requirements for polypropylene pipe intended for non-pressure storm sewers and storm culverts.

452.01.01– REFERENCES

A) ASTM International

1. ASTM C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
2. ASTM D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers & Other Gravity-Flow Applications
3. ASTM D2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
4. ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
5. ASTM F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
6. ASTM F2881, Standard Specification for 12 to 60 in. Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications

B) AASHTO

1. AASHTO LRFD Bridge Construction Specifications, Section 30
2. AASHTO LRFD Bridge Design Specifications, Section 12
3. R 82-17 Standard Practice for Pipe Joint Selection for Highway Culvert and Storm Drains

C) OSHA (Occupational Safety and Health Standards)

1. 29 CFR Part 1926, OSHA Standards for the Construction Industry

452.02 MATERIALS

452.02.01– PLAN REQUIREMENTS

The design engineer must convey all assumptions used in design calculations such as trench widths, embedment materials and compaction effort, with clear detailed drawings and proper specifications. The design engineer shall not use less than one-foot cover for all pipe products.

Plan and profile drawings must indicate:

- Total length of the pipe run (ft)
- Pipe diameter (inch)
- Pipe material type
- Maximum fill height
- Pipe grade, in percent
- Other special pipe fittings, if applicable
- Flowline
- Other markings as specified by the owner

452.02.02– SUBMITTALS

Drawings, specifications, schedules, and other data showing complete details of the fabrication and construction of pipe and fittings, together with complete data covering all materials proposed for use, shall be submitted. The drawings and data shall include, but shall not be limited, to the following for each size of pipe.

- Details of joints
- Details of gasket
- Details of fittings and specials
- Test reports

All material furnished under certification shall be tagged, stenciled, stamped, or otherwise marked with a lot number, heat number, order number, or other appropriate identification which can be readily recognized and checked against the certification.

452.02.03– QUALITY ASSURANCE

Pipe size and type shall be consistent throughout a pipe run. All pipe and fittings shall be supplied from a manufacture that is prequalified according to this specification.

All pipe products shall be marked with a certification body's logo confirming that the production of the pipe is in accordance with National Transportation Product Evaluation Program (NTPEP).

452.02.04– PIPE MATERIALS

All thermoplastic pipe shall meet the following requirements.

A) Manufacturing Standard Designation

1. Dual-wall PP pipe (12– 60in) shall be used for storm sewer applications only.
2. Dual-wall PP pipe and fittings shall be manufactured in accordance with ASTM F2881.
3. All PP pipe shall have water resistant joints using elastomeric gaskets in accordance with ASTM F477.
4. PP pipe shall be installed within two years from the production date indicated on the pipe.
5. PP pipe shall have a maximum of 5% deflection

B) Markings

The following information must be clearly marked on each section of pipe:

- Nominal pipe size (inch).
- Manufacturer's name or trademark.
- Plant identification, if applicable.
- Manufacturing standard designation (ASTM)
- Date of Manufacture.
- Cell classification of materials.
- Quality certification program logo.

452.02.05– PIPE DESIGN

A) Flow Capacity

Pipe capacities shall be calculated using Manning's formula with a roughness coefficient (n) of 0.013 for all smooth-walled pipe materials (concrete and polypropylene). Final design shall be in accordance with the latest revisions of the city drainage ordinance and drainage criteria manual.

B) Structural Design

1. The design engineer responsible for the preparation of engineering drawings is also responsible for the structural design of sewer installations. In all cases, engineers shall keep a record of structural design calculations for pipe associated with each project. Design calculations for specific projects shall be provided to the Owner upon request.
2. All minimum and maximum fill height tables are only intended to provide answers to general cover height questions and shall not be used for project design.
3. Depth of cover for PP pipe shall be a minimum of 2 feet unless specifically called out by the design engineer.
4. Use of PP pipe may be approved under paved areas, when specifically designed for this application and approved by the design engineer.
5. Depth of cover for PP pipe is measured from the ultimate finished ground elevation to the outside top of the pipe.
6. Strength limit states calculations shall be completed per AASHTO LRFD Bridge Design Specifications, Section 12.
 - i. Thrust
 - ii. Buckling
 - iii. Combined Strain
7. Buoyancy of PP pipe should be considered, and flotation of pipes should be prevented with appropriate construction where high groundwater conditions are anticipated.
8. A design check for deflection shall be completed per AASHTO LRFD Bridge Design Specifications, Section 12.

452.02.06– JOINTS

Pipe shall be joined with a gasketed integral bell & spigot joint meeting the requirements of ASTM F2881 and ASTM F2764.

- A) Soil/Silt Tight Joint – Shall conform to ASTM F477
- B) Leak Resistant Joint – Shall conform to ASTM D3212

452.03 EQUIPMENT — VACANT

452.04 CONSTRUCTION METHODS

452.04.01– GENERAL

All flexible pipes are to be installed per ASTM D2321.

- A) The contractor must achieve all the design assumptions in the field. Conditions that arise during construction that fails to meet any design assumptions, such as

trench widths, must be reviewed to confirm whether the design is still valid.

- B) Pipe shall be laid within the alignment and grade tolerances specified in the Contract Documents. Begin at downstream end of pipe run with bell end of the pipe facing upstream.

452.04.02– PRE-INSTALLATION INSPECTION

All product deliveries shall be inspected for damages and defects prior to unloading. Any pipe, fitting, or gaskets that are unsound or damaged shall be rejected. The contractor shall confirm that the quantity, diameter, sheet thickness, and connecting band options match the project documents.

452.04.03– INSTALLATION

Physical properties, compaction characteristics, and gradations of pipe zone materials must meet local material specifications and be sourced from approved vendors. At the City's request, the contractor shall be required to perform field density tests to ensure that the pipe installation conforms to the requirements of the contract.

- A) The pipe embedment zone consists of the foundation, bedding, and haunch, and initial backfill as detailed in ASTM D2321 and applicable City Standard Details for flexible pipe installation.
- B) Materials for use as foundation, embedment, and backfill for PP pipe are classified in Table 1 and Table 2 in ASTM D2321. They include natural, manufactured, and processed aggregates and the soil types according to ASTM D2487 and applicable City Standard Details for flexible pipe installation.
 - 1. Class I, Class II, and Class III materials are suitable to use as foundation material and in the embedment zone subject to the limitations noted in Table 3 of ASTM D2321.
 - 2. Class IV-A materials should only be used in the embedment zone in special design cases, as they would not normally be construed as a desirable embedment material for thermoplastic pipe.
 - 3. Class IV-B and Class V Soils are not permitted in the embedment zone and should be excluded from the final backfill except where specifically allowed by project specifications.
- C) Pipe shall be laid within the alignment and grade tolerances specified in the Contract Documents. Begin at downstream end of pipe run with bell end of the pipe facing upstream.

452.04.04– MOVABLE SUPPORT SYSTEMS

Movable support systems (trench boxes or cages) shall be used in accordance with applicable Occupational Health and Safety requirements. Movable support systems with PP pipe must be used in accordance with ASTM D2321. When using movable support systems with PP pipe, the pipe location, jointing, and its embedment shall not be disturbed. This can be accomplished by limiting the use of standard movable trench boxes that are more than 2.5 pipe diameters on either side of the pipe to below the top of the pipe, or to a shelf above the top of the pipe. When advancing trench boxes or shields, longitudinal pipe movement or disjuncting shall not be allowed.

452.04.05– MINIMUM COVER FOR CONSTRUCTION LOADS

If the passage of construction equipment over an installed pipeline is necessary during project construction, compacted overfill in the form of a ramp shall be constructed to a minimum elevation of 3 ft over the top of the pipe or to a height such that the equipment loads on the pipe do not exceed the pipe design strength.

452.05 TESTING

452.05.01– CLEANING AND FLUSHING

All storm sewer pipe shall be cleaned and flushed immediately prior to inspection and acceptance.

452.05.02– POST INSTALLATION INSPECTION

All Polypropylene Pipe will be visually inspected and tested for deflection.

The Initial Inspection shall take place no sooner than 30 days following final backfill. A Final Inspection at the end of the warranty period shall be performed to verify performance. All inspection will be completed by City of Oklahoma City Staff.

Inspection of Polypropylene Pipe shall include the following:

- A) Visual inspection of surface features, manholes, and larger sewers.
- B) Image-based video inspection of the smaller sewers (up to and including 36" diameter). Pipe larger than 36" shall be inspected and observations recorded during a walk-through by City of Oklahoma City Staff and an image-based video inspection where authorized by the City Engineer
- C) A deflection test by mandrel, where authorized by the City Engineer. The deflection limit of the initial inspection is 5%.

452.05.03– DEFLECTION TESTING

Mandrel deflection testing shall be performed on all pipe sewers or culverts constructed using PP pipe. The allowable deflected pipe diameter is calculated as a percentage of the base inside diameter of the pipe. The initial inspection will be limited to 5%, and final inspection will be limited to 7.5%.

The following procedure outlines the mandrel test:

- A) A suitably designed device as defined below shall be pulled through the pipe sewer to demonstrate that the pipe deflection does not exceed the allowable deflected pipe diameter.
- B) For the Initial Inspection, the device shall be pulled manually through the pipe not sooner than 30 Days after the completion of backfilling and installation of service connections.
- C) The suitably designed device shall be a mandrel, cylindrical in shape, and constructed with an odd number of evenly spaced arms or prongs, minimum 9 in number. The minimum diameter of the circle scribed around the outside of the mandrel arms shall be equal to the allowable deflected pipe diameter \pm 0.04 in.

- D) The mandrel shall be checked with a go-no-go proving ring. The proving ring shall have a diameter equal to the allowable deflected pipe diameter ± 0.04 in. An acceptable mandrel shall not pass through the proving ring. The proving ring shall be fabricated from steel a minimum of $\frac{1}{4}$ in thick.
- E) Any section of pipe that does not allow the mandrel to pass shall be considered to have failed the deflection test.
- F) All sections of pipe that fail the deflection test shall be repaired or replaced, then retested.

452.05.04– DEFLECTION EVALUATION

The evaluation of deflection will take place during the initial and final inspections.

The contractor will be responsible for the performance of the installed pipeline. Deflection greater than the limits listed in the following table will be the responsibility of the contractor to repair or replace.

Table 452:1	
Initial Inspection - Deflection Evaluation Table	
Deflection	Evaluation
0 to 5%	Accepted
Greater than 5%	Remediate or replace at contractor's expense

Table 452:2	
Final Inspection - Deflection Evaluation Table	
Deflection	Evaluation
0 to 7.5%	Accepted
Greater than 7.5%	Remediate or replace at contractor's expense

452.06 METHOD OF MEASUREMENT

Will be measured by the linear foot in place. Payment shall be by the linear foot in place, but not to exceed quantity shown on the plans or called for in the special provisions.

452.07 BASIS OF PAYMENT

The City or Awarding Public Agency will pay for each pay item at the contract unit price per the specified pay unit as follows:

Pay Item:	Pay Unit:
(A) POLYPROPYLENE PIPE (SIZE)	Linear Foot

Such payment shall be compensation in full for furnishing all materials, labor, equipment, tools, and incidentals, and for performing the work in accordance with these specifications.

In the absence of pay items for trench excavation, bedding or embedment materials in a contract,