

Technical Memorandum

To: Electronic Distribution Recipients

From: Michael Beer, P.E. Digital signature on file
Assistant Commissioner (Acting), Engineering Services

Subject: Use of Plastic Pipe for Storm Sewer and Culverts on Trunk Highways

Expiration

This Technical Memorandum supersedes 17-05-B-02: Use of Plastic Pipe for Storm Sewer and Culverts on Trunk Highways, and will remain in effect until April 18, 2027 unless superseded or placed into the MnDOT Drainage Manual prior to that date.

Implementation

The provisions contained in this Technical Memorandum are for immediate implementation on trunk highway projects.

Introduction

This Technical Memorandum is an update to Technical Memorandum No. 17-05-B-02. The Technical Memorandum is being revised to remove specifications for polypropylene pipe which has been incorporated in the current MnDOT Standard Specifications for Construction. Flexible pipe bedding and backfill requirements have been added to the Standard Plans. State transportation departments have the autonomy to determine culvert and storm sewer material types to be included in the construction of a project on a Federal-aid highway. This means MnDOT has the sole authority and discretion to make a decision regarding culvert and storm sewer material types. Where use of alternative pipe materials increases competition, MnDOT continues to recommend consideration of alternative pipe materials including plastic pipe where appropriate.

Purpose

The purpose of this Technical Memorandum is to provide design criteria on the use of plastic pipe for storm sewer and culverts including minimum cover, maximum fill height, design considerations and requirements. Detailed information is given for the use of corrugated polyethylene (CP) pipe, polypropylene (PP) pipe, and polyvinyl chloride (PVC) pipe.

Guidelines

When approved by the District Hydraulic Engineer, plastic pipe located within MnDOT right of way may be used in accordance with the following guidelines. For pipe placed off of MnDOT right of way, such as a storm sewer outfall along a city street, or pipe located on property to be turned back to a local entity such as a frontage road, contact the local unit of government to determine the type(s) of pipe to include in the plan.

Within the guidelines of this Technical Memorandum, plastic pipe with bell and spigot joints using an elastomeric rubber seal (gasket) to provide a water-tight joint may be used. AASHTO M 294 Type S dual wall corrugated polyethylene (CP), AASHTO M 330 Type S dual wall polypropylene (PP) and polyvinyl chloride (PVC), meeting the materials specifications in the Standard Specifications for Construction may be used on trunk highway projects as an alternative to reinforced concrete (RC) or corrugated steel (CS) pipe when identified in the plan. Qualified plastic pipe products and manufacturers are listed on the Approved/Qualified Products List under drainage products.

Storm Sewer

The maximum allowable diameter is 48".

Plastic pipe can be used as storm sewer under pavement with no ADT restrictions.

Corrugated polyethylene (CP), polypropylene (PP) and polyvinyl chloride (PVC) are allowable plastic pipe options for storm sewer installations. Watertight joints are required. In order to make it clear which pipes have options; the allowable options shall be noted in the drainage tabulation for each reach of pipe. On the Statement of Estimated Quantities, the listed pay item will be reinforced concrete pipe. A note shall be provided on each appropriate pay item noting that plastic pipe may be used as an option.

In the situation where some of the storm sewer pipe qualifies for the plastic pipe option and the remainder is reinforced concrete pipe, the pay item shall have a note on the estimate sheet showing how much pipe may be plastic.

Centerline Culvert

The maximum allowable diameter is 48".

Allowed at locations where ADT is less than 5000, or under unpaved roads.

Corrugated polyethylene (CP) and polypropylene (PP) are allowable plastic pipe options for centerline culvert installations. In order to make it clear which pipes shall have options; the allowable options shall be noted in the drainage tabulation for each reach of pipe. On the Statement of Estimated Quantities, the listed pay item will be reinforced concrete pipe. A note shall be provided on each appropriate pay item noting which plastic pipe types may be used as an option.

Side Culvert

The maximum allowable diameter is 48".

Allowed at locations where ADT is less than 5000, or under unpaved roads.

Corrugated polyethylene (CP) and polypropylene (PP) are allowable plastic pipe options for side culvert installations. In order to make it clear which pipes have options; the options should be noted in the drainage tabulation for each culvert. On the Statement of Estimated Quantities, the listed pay item will be a generic pipe culvert and generic apron with a note indicating the applicable pipe options.

As with all other drainage products, engineering judgment should be used in determining the suitability of specific materials on individual projects. To ensure adequate hydraulic capacity and suitability of plastic pipes for site and

project constraints, applicable pipe options must be approved by the District Hydraulics/Water Resource Engineer.

When conditions warrant, additional locations beyond those identified in these guidelines may be considered; contact the State Hydraulics Engineer to discuss the options.

Do not use plastic pipe unless maximum fill height and minimum cover requirements are met. Maximum fill height and minimum cover are measured from the outside top of the pipe to the top of the road or ground surface.

<i>Nominal Inside Diameter (inches)</i>	<i>Minimum Cover (feet) ¹</i>			
	<i>Paved Roads</i>	<i>Unpaved Roads ³</i>	<i>Private Entrances ³</i>	<i>Non-Roadway ^{2 3}</i>
12	3 ⁴	2 ⁴	1.5 ⁴	1.5
15	3	2	1.5	1.5
18	3	2	1.5	1.5
24	3	2	1.5	1.5
30	3	2	2.5	2
36	3	2	2.5	2
42	3	2	2.5	2
48	3	2	2.5	2

¹ Include a minimum of 12" compacted embedment material over the top of the pipe.

² Topsoil and erosion control products are not included in minimum cover depth.

³ Potential for rutting, frost heave and grading tolerances have been considered.

⁴ Minimum 3 feet of cover required for 12" Diameter CP pipe under all roadway types.

Plastic pipe should not be used in locations with standing water without requirements for dewatering and in some cases buoyancy prevention. Plastic pipe is buoyant and may float. Plastic pipe requires deflection testing and post-construction inspections that cannot be completed if the pipe is submerged without dewatering.

Pipes can be stabilized with anchors such as a concrete headwall or in-ground anchors; installations in these cases require a design detail in the plan and a special provision indicating additional cost of buoyancy mitigation is included in the contract unit price of the pipe pay item.

Where buoyancy potential exists and buoyancy prevention is not used, the required minimum cover will be the greater of the depths from the Minimum Cover Table and the Buoyancy Minimum Cover Requirement Table.

Buoyancy Minimum Cover Requirement (feet)		
Nominal Diameter (inches)	Cover for PVC (feet)	Cover for CP and PP (feet)
12	1	1
15	1	1
18	1	1.5
24	1	1.5
30	1.5	2
36	2	2.5
42	2	2.5
48	2.5	3

The plastic pipes included in this Technical Memorandum have watertight joints that prevent loss of soil and silt embedment material through the joint. Pipe materials have been analyzed using LRFD methodology, and if installed correctly are expected to meet the loads in the maximum fill height and minimum cover tables.

Nominal Inside Diameter (inches)	Maximum Fill Height for Round Plastic Pipe (feet)		
	Corrugated Polyethylene (CP)	Polypropylene (PP)	Polyvinyl Chloride (PVC)
12	12	18	27
15	12	18	27
18	12	18	27
24	12	16	27
30	12	16	27
36	12	14	22
42	10	14	22
48	10	14	22

Minimum plastic pipe bedding and installation requirements are provided in Standard Plan 5-297.440 Standard Culvert Bedding for Flexible Pipe and 5-297.442 Standard Storm Sewer Bedding for Rigid and Flexible Pipe. When culvert treatments are required and plastic pipe is allowed, follow the District Materials Engineer recommendation, and include a design detail for flexible pipe culvert bedding, backfill and treatments in the plan.

Plastic pipe should not be used where there is a likelihood of exposure to fire without fire mitigation. Fire mitigation alternatives include concrete slope paving, concrete headwall, and concrete aprons. Use of fire mitigation alternatives requires a design detail in the plan and a special provision indicating additional cost of fire mitigation is included in the contract unit price of the pipe pay item.

Polyvinyl Chloride (PVC) pipe is sensitive to ultraviolet (UV) radiation and exposure to sunlight may accelerate deterioration. It is recommended PVC be limited to applications and locations where pipe is not exposed to UV radiation.

Safety grates may interfere with required deflection testing and post-construction inspections. Plastic pipe is not recommended in locations within the clear zone where safety grates are required or where errant vehicles leaving the roadway may damage the pipe. Use metal aprons for end treatments unless an alternative is specified in the plan.

Plastic pipe is considered to be resistant to deterioration in corrosive soils and resistant to salts, alkalides, and chlorides. Chemical contamination such as petroleum or solvents may degrade gaskets but will typically not affect the plastic pipe material. Ensure that pipe and gasket materials are compatible with contaminants present in soil or surface waters in the area of placement.

Pipes conveying public waters must meet DNR requirements. Smooth plastic pipe should be evaluated to verify velocity requirements are met and that there are no negative impacts to fish passage or increase in erosion potential.

Deflection testing is required for plastic pipe installation acceptance and payment. Follow the Schedule for Materials Control to provide mandrel testing or other deflection testing results to the State Hydraulic Engineer.

Locations of plastic pipe installations should be reported by construction staff to the State Hydraulic Engineer so inventory data, date built, and deflection testing results can be entered into the Department's asset management system for pipes, HydInfra. Future updates to design recommendations and pipe material selection criteria will be dependent on the ability to monitor and track pipe performance over time.

All costs associated with using an alternative, such as differences in installation requirements including but not limited to deflection testing, dewatering, trench width, buoyancy prevention, fire mitigation, or embedment material specifications and quantities are included in the contract unit prices of the relevant pipe pay items.

Questions

Any questions regarding the technical provisions of this Technical Memorandum can be addressed to the following:

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Or

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Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards Unit, DesignStandards.DOT@state.mn.us. A link to all active and historical Technical Memoranda can be found at <http://techmemos.dot.state.mn.us/techmemo.aspx>.

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