Evaluation Table

PEP ID:	**XXXXX**
Manufacturer:	**Name of Manufacturer**
Product Name:	**Name of Product**

501 Pipe
501 Type SP Corrugated HDPE: Perforated Drainage Plastic Pipe
Additional Specifications: AASHTO M252 (4-10 inch), AASHTO M294 (12-60 inch)
ASTM D3350 Cell Classification 424420C (4-10 inch) and 435400C (12-60 inch)
Responsible Section: Roadway Group

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
AASHTO M252 Specification Requirements (4-10 in. diameter)				
Extruded Pipe and Blow Molded Fittings	AASHTO M252 ASTM D3350 ASTM D4218	Pipe and fittings shall be made of virgin PE resin compounds meeting the requirements of ASTM D3350 and cell classification 424420C, except that the carbon black content shall not exceed 4 percent when tested in accordance with D4218. Resins that have higher cell classifications in one or more properties are acceptable provided product requirements are met.		
Rotational Molded Fittings and Couplings	AASHTO M252 ASTM D3350 ASTM D4218	Fittings and couplings shall be made of virgin PE resins meeting the requirements of ASTM D3350 and cell classification 213320C, except that the carbon black content shall not exceed 4 percent when tested in accordance with D4218. Resins that have higher cell classifications in one or more properties are acceptable provided product requirements are met.		
Injection Molded Fittings and Couplings	AASHTO M252 ASTM D3350 ASTM D4218	Fittings and couplings shall be made of virgin PE resins meeting the requirements of ASTM D3350 and cell classification 424420C, except that the carbon black content shall not exceed 4 percent when tested in accordance with D4218. Resins that have higher cell classifications in one or more properties are acceptable provided product requirements are met.		
Reworked Material	AASHTO M252	In lieu of virgin PE, clean reworked material may be used, provided that it meets the cell class requirements described above.		

Last Modified: 7/11/2023

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
Workmanship	AASHTO M252	The pipe and fittings shall be free of foreign inclusions and visible defects as defined herein. The ends of the pipe shall be cut squarely and cleanly so as not to adversely affect joining or connecting.		
Visible Defects	AASHTO M252	Cracks, creases, delamination, and unpigmented or non-uniformly pigmented pipe are not permissible in the pipe or fittings as furnished. There shall be no evidence of cracking or delamination when tested in accordance with AASHTO M252 Section 9.2.		
Nominal Size	AASHTO M252	Nominal diameters shall be sized for Type SP pipe in not less than 2 in. (50mm) increments from 4 to 10 in. (100 to 250mm).		
Liner Thickness	AASHTO M252	For Type SP pipe, the liner shall have a minimum thickness of 0.02 in. (0.5mm) for pipe of 4 in. (100mm) and 6 in. (150mm) nominal size and a minimum thickness of 0.025 in. (0.6mm) for pipe of 8 in. (200mm) and 10 in. (250mm) nominal size, when measured in accordance with AASHTO M252 Section 9.5.4.		
Inside Diameter Tolerances	AASHTO M252	The tolerance on the specified inside diameter shall be +4.5, -1.5 percent when measured in accordance with AASHTO M252 Section 9.5.2.		
Fitting and Coupling Dimensions	AASHTO M252	The maximum allowable gap between fitting or coupling and pipe shall not exceed 0.1 in. (3mm) unless otherwise specified.		
Fitting and Coupling Dimensions	AASHTO M252	All fittings and couplings shall be within an overall length dimensional tolerance of ±0.5 in. (12mm) of the manufacturer's specified dimensions.		
Perforations	AASHTO M252	The perforations shall be cleanly cut so as not to restrict the inflow of water. When circular perforations are preferred, the drill shall not penetrate the side walls of the corrugations. Pipe connected by couplings or bands may be unperforated within 4 in. (100mm) of each end of each length of pipe.		

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
Class 1 Perforations	AASHTO M252	The perforations shall be approximately circular and shall have nominal diameters of not more than 0.2 in. (5mm) for 4- and 6-in. (100 and 150mm) diameter pipe and not greater than 0.4 in. (10mm) for 8- and 10-in. (200 and 250mm) diameter pipe. The holes shall be arranged in rows parallel to the axis of the pipe. The location of the perforations shall be in the valley of the outside corrugation and in each corrugation. The rows of perforations shall be arranged in two equal groups placed symmetrically on either side of the lower unperforated segment corresponding to the flow line of the pipe. The spacing of the rows shall be uniform. The distance of the centerlines of the uppermost rows above the bottom of the invert and the inside chord lengths of the unperforated segments illustrated in AASHTO M252 Figure 1 shall be as specified in AASHTO M 252 Table 1. All measurements shall be made in accordance with AASHTO M252 Section 9.5.3.		
Class 2 Perforations	AASHTO M252	Circular and slotted perforations shall conform to the maximum dimensions as shown in AASHTO M252 Table 2. Perforations shall be placed uniformly in the outside valleys of the corrugations. The water inlet area shall be a minimum of 1 $in.^2/ft$ (20 cm^2/m) of pipe. All measurements shall be made in accordance with AASHTO Section 9.5.3.		
Pipe Flattening	AASHTO M252	There shall be no visual evidence of buckling (a decrease or downward deviation in the load-deflection curve), cracking, splitting, or delamination when the pipe is tested in accordance with AASHTO M252 Section 9.2.		
Environmental Stress Cracking	AASHTO M252	There shall be no cracking of the pipe when tested in accordance with AASHTO M252 Section 9.3.		
Brittleness	AASHTO M252	There shall be no cracking of the pipe wall or liner when tested in accordance with AASHTO M252 Section 9.4.		

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
Fitting and Coupling Requirements	AASHTO M252	The fittings and couplings shall not reduce or impair the overall integrity or function of the pipe line.		
Fitting and Coupling Requirements	AASHTO M252	Fittings and couplings shall not reduce the inside diameter of the pipe being joined by more than 5 percent of the nominal inside diameter. Reducer fittings shall not reduce the cross-sectional area of the smaller size.		
Fitting and Coupling Requirements	AASHTO M252	The coupling shall not crack or crease when tested in accordance with AASHTO M252 Section 9.6.2.		
Fitting and Coupling Requirements	AASHTO M252	The design of the couplers shall be such that when connected with the pipe, the axis of the assembly will be level and true when tested in accordance with AASHTO M252 Section 9.6.3.		
Marking	AASHTO M252	All pipe shall be clearly marked at intervals of not more than 11.5 ft (3.5m), and fittings and couplings shall be clearly marked, as follows: 1. Manufacturer's name or trademark 2. Nominal size 3. The specification designation AASHTO M252 4. The plant designation code 5. The date of manufacture or an appropriate code. If a date code is used, a durable manufacturer sticker that identifies the actual date of manufacture shall be adhered to the inside of each length of pipe.		
AASHTO M294 Specification Requirements (12-60 in. diameter)				

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
Extruded Pipe and Blow Molded Fittings	AASHTO M294 ASTM D3350 ASTM D4218	Pipe and fittings shall be made of virgin PE resin compounds meeting the requirements of ASTM D3350 and cell classification 435400C, except that the carbon black content shall not exceed 4.0 percent when tested in accordance with D4218. Resins that have higher cell classifications in one or more properties, with the exception of density, are acceptable provided product requirements are met. For slow-crack-growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test according to the procedure described in AASHTO M294 Section 9.4. For slow-crack-growth resistance, the following two requirements shall be met.		
Extruded Pipe and Blow Molded Fittings	AASHTO M294 ASTM F2136	To ensure adequate resistance to SCG propagation, Notched Constant Ligament Stress (NCLS) testing shall be conducted on specimens die cut either directly from the finished pipe liner or from ground-up pieces of pipe (from liner or outer wall, or both) that have been compression-molded into a plaque. Testing shall be conducted in accordance with ASTM F2136 and procedures described in AASHTO M294 Section 9.4. Notes: 1. If testing is conducted on specimens taken directly from the finished pipe liner, the average failure time of five specimens shall not be less than 18h. 2. If testing is conducted on specimens taken from ground-up pieces of pipe that have been compression molded into a plaque, the average failure time of five test specimens shall not be less than 24h.		

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
Extruded Pipe and Blow Molded Fittings	AASHTO M294 ASTM F3181	For pipes manufactured with recycled PE materials (PCR or PIR, or both), Un-notched Constant Ligament Stress (UCLS) testing shall be conducted in accordance with ASTM F3181 and the procedures described in AASHTO M294 Section 9.4 to ensure the desired service life is met. The minimum UCLS failure time shall be prescribed based on the service conditions (temperature and factored design stress) and desired service life as detailed in A2 of the Annex. In the absence of design data, a service life of 100 years at a service temperature of 23°C and factored tensile design stress of 500 psi shall be conservatively specified. For this condition, the average UCLS failure time for five specimens shall not be less than 34h, with no single specimen failing in less than 18h.		
Extruded Pipe and Blow Molded Fittings	AASHTO M294 ASTM D3895 ASTM D638 ASTM D4883	Pipes manufactured from recycled PE materials (PCR or PIR, or both) shall have an Oxidation Induction Time (OIT) of 20 minutes when tested in accordance with ASTM D3895 and a break strain of 150 percent when tested in accordance with ASTM D638. Density of pipe compounds containing recycled PE materials (PCR or PIR, or both) should be conducted by the ultrasound technique in accordance with ASTM D4883.		
Rotational Molded Fittings and Couplings	AASHTO M294 ASTM D3350	Fittings and couplings shall be made of virgin PE resins meeting the requirements of ASTM D3350 and cell classification 213320C, except that the carbon black content shall not exceed 5 percent. Resins that have higher cell classifications in one or more properties are acceptable provided product requirements are met.		

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
Injection Molded Fittings and Couplings	AASHTO M294 ASTM D3350	Fittings and couplings shall be made of virgin PE resins meeting the requirements of ASTM D3350 and cell classification 314420C, except that the carbon black content shall not exceed 5 percent. Resins that have higher cell classifications in one or more properties are acceptable provided product requirements are met.		
Reworked Plastic	AASHTO M294	Clean reworked plastic may be used by the manufacturer, provided that it meets the cell class requirements as described in AASHTO M294 Section 6.1.		
Resin Blending	AASHTO M294	When blended resins are used, the components of the blend must be PE and the final blend must meet all the above requirements for Extruded Pipe and Blow Molded Fittings, Rotational Molded Fittings and Couplings, and Injection Molded Fittings and Couplings.		
Workmanship	AASHTO M294	The pipe and fittings shall be free of foreign inclusions and visible defects as defined herein. The ends of the pipe shall be cut squarely and cleanly so as not to adversely affect joining or connecting.		
Visible Defects	AASHTO M294	Cracks, creases, delamination, and unpigmented or non-uniformly pigmented pipe are not permissible in the pipe or fittings as furnished. There shall be no evidence of cracking or delamination when tested in accordance with AASHTO M294 Section 9.7.		
Nominal Size	AASHTO M294	Nominal diameters shall be 12, 15, 18, 21, 24, 27, 30, 36, 42, 48, 54, and 60 in. (300, 375, 450, 525, 600, 675, 750, 900, 1050, 1200, 1350, and 1500 mm)		
Inside Diameter Tolerances	AASHTO M294	The tolerance on the specified inside diameter shall be 4.5 percent oversize and 1.5 percent undersize, but not more than 1.5 in. (37mm) oversize when measured in accordance with AASHTO M294 Section 9.6.1.		

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
Length	AASHTO M294	Lengths shall not be less than 99 percent of the stated quantity when measure in accordance with AASHTO M294 Section 9.6.2.		
Perforations	AASHTO M294	The perforations shall be cleanly cut so as not to restrict the inflow of water. Pipe connected by couplings or bands may be unperforated within in. (100mm) of each end of each length of pipe. Pipe connected by bell and spigot joints may not be perforated in the area of the bells and spigots.		
Class 1 Perforations	AASHTO M294	The perforations shall be approximately circular and shall have nominal diameters of not less than 0.2 in. (5mm) nor greater than 0.4 in. (10mm) and shall be arranged in rows parallel to the axis of the pipe. For Type SP pipe, the perforations shall be located in the external valleys with perforations in each row for each corrugation. (The perforations shall not be cut into the corrugation sidewalls.) The perforations shall not be cut into the vertical sections of the cells. The rows of perforations shall be arranged in two equal groups placed symmetrically on either side of the lower unperforated segment corresponding to the flow line of the pipe. The spacing of the rows shall be uniform. The distance between the centerlines of the rows shall not be less than 1 in. (25mm). The minimum number of longitudinal rows of perforations, the maximum height of the centerlines of the uppermost rows of perforations above the bottom of the invert, and the inside chord lengths of the unperforated segments illustrated in AASHTO M294 Figure 1 shall be as specified in AASHTO M294 Table 1.		

Product Property	Specification/ Test Method	Requirement		Results	Pass/ Fail
Class 2 Perforations	AASHTO M294	Circular perforations shall be a minimum of 0.2 in. (5mm) and shall not exceed 0.4 in. (10mm) in diameter. The width of slots shall not exceed 0.1 in. (3mm). The length of slots shall not exceed 2.75 in. (70mm) for 12 in. (300mm) and 15 in. (375mm) pipe and 3 in. (74mm) for 18 in. (450mm) and larger pipe. Perforations shall be placed in the external valleys for Type SP pipe. Perforations shall be uniformly spaced along the length of circumference of the pipe. The water inlet area shall be a minimum of 1.5 $in.^2/ft$ ($30cm^2/m$) for pipe sized 12 to 18 in. (300 to 450mm) and 2 $in.^2/ft$ ($40cm^2/m$) for pipe sized larger than 18 in. (450mm). All measurements shall be made in accordance with AASHTO M294 Section 9.6.3.			
Pipe Stiffness	AASHTO M294	The pipe shall have a minimum pipe stiffness at 5 percent deflection as follows when tested in accordance with AASHTO M294 Section 9.1.		See below	
		Diameter	Pipe Stiffness		
		12 in. (300mm)	50 psi (345kPa)		
		15 in. (375mm)	42 psi (290kPa)		
		18 in. (450mm)	40 psi (275kPa)		
		21 in. (525mm)	38 psi (260kPa)		
		24 in. (600mm)	34 psi (235kPa)		
		27 in. (675mm)	30 psi (205kPa)		
		30 in. (750mm)	29 psi (200kPa)		
		36 in. (900mm)	22.5 psi (155kPa)		
		42 in. (1050mm)	21 psi (145kPa)		
		48 in. (1200mm)	20 psi (135kPa)		
		54 in. (1350mm)	18 psi (120kPa)		
		60 in. (1500mm)	15 psi (105kPa)		

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
Pipe Flattening	AASHTO M294	Pipe specimens shall show no visible evidence of cracking, splitting, or delamination when tested in accordance with AASHTO M294 Section 9.2. Additionally, pipe specimens shall not exhibit decrease or downward deviation in the load-deflection curve prior to the buckling deflection limit calculated in AASHTO M294 Section 9.2.1.		
Brittleness	AASHTO M294	Pipe specimens shall not crack or split when tested in accordance with AASHTO M294 Section 9.3. Five nonfailures out of six impacts will be acceptable.		
Sub Compression Test	AASHTO M294	Profile compression capacity in any specimen in the stub compression test shall not be less than 50 percent of the gross cross-sectional area times the minimum specified yield strength when tested in accordance with AASHTO M294 Section 9.8.		
Fitting Requirements	AASHTO M294	The fittings shall not reduce or impair the overall integrity or function of the pipe line.		
Fitting Requirements	AASHTO M294	All fittings shall be within an overall length dimensional tolerance ±0.5 in. (12mm) of the manufacturer's specified dimensions when measure in accordance with AASHTO M294 Section 9.6.2.		
Fitting Requirements	AASHTO M294	Fittings shall not reduce the inside diameter of the pipe being joined by more than 0.5 in. (12mm). Reducer fittings shall not reduce the cross-sectional area of the smaller size.		
Fitting Requirements	AASHTO M294	Couplings shall be corrugated to match the pipe corrugations and shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Couplings shall be bell and spigot or split collar. Split couplings shall engage at least two full corrugations on each pipe section.		

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
Fitting Requirements	AASHTO M294	The design of the fittings shall be such that when connected with the pipe, the axis of the assembly will be level and true when tested in accordance with AASHTO M294 Section 9.5.2.		
Fitting Requirements	AASHTO M294	Only fittings supplied or recommended by the pipe manufacturer shall be used. Fabricated fittings shall be manufactured from pipe meeting the requirements of this specification and all seams must be completely scaled with compatible PE material.		
Fitting Requirements	AASHTO M294	Fabricated fittings shall be supplied with joints compatible with the overall system.		
Joint Requirements	AASHTO M294	All joints shall meet the requirements of a soiltight joint unless otherwise specified by the owner/designer.		
Joint Requirements	AASHTO M294	Soiltight joints are specified as a function of opening size, channel length, and backfill particle size. If the size of the opening exceeds 0.12 in. (3mm), the length of the channel must be at least four times the size of the opening.		
Joint Requirements	AASHTO M294 ASTM F477	Silt-tight joints should be used where the backfill material has a high percentage of fines. Silt-tight bell and spigot joints will utilize an elastomeric rubber seal meeting ASTM F477. Silt-tight joints must be designated to pass a laboratory pressure test of at least 2 psi (14kPa).		
Joint Requirements	AASHTO M294 ASTM D3212 ASTM F477	Watertight joints must meet a 10.8 psi (74kPa) laboratory test per ASTM D3212 and utilize a bell and spigot design with a gasket meeting ASTM F477.		

Product Property	Specification/ Test Method	Requirement	Results	Pass/ Fail
Marking	AASHTO M294	All pipe shall be clearly marked at intervals of no more than 10 ft (3m) as follows: 1. Manufacturer's name or trademark 2. Nominal size 3. The plant designation code 4. This specific designation, M294 5. If the pipe was manufactured with only virgin materials, it shall be marked with the code "V"; if the pipe was manufactured with recycled PE materials (PCR or PIR, or both), it shall be marked with the code "R" and the phrase "Contains Recycled Resins" 6. The date of manufacture or an appropriate code. If a date code is used, a durable manufacturer sticker that identifies the actual date of manufacture shall be adhered to the inside of each length of pipe. 7. Fittings shall be marked with the designation number of specification M294, and with the manufacturer's identification symbol.		