

BACKGROUND

The American Association of State Highway and Transportation Officials (AASHTO) released a "Culvert & Storm Drain System Inspection Guide" in 2020. This document is intended to replace the previous "1986 FHWA Culvert Inspection Manual." The guide was developed for assessing the condition of in-service culvert & storm drain systems (culverts) that would ensure the systems safety and performance as well as the economical use of owner resources. The development of this guide was overseen by the US Department of Transportation (DOT), Federal Highway Administration (FHWA), engineers, academia, industry leaders, and pipe manufacturers. This will provide inspectors clear guidelines to assess and rate the condition of culverts and all system components.

HIGHLIGHTS



Unbiased 3rd Party Guidance

The guide was developed as an NCHRP project and approved by AASHTO.



Equal Treatment

Encourages states to adapt a more robust inspection program. The guide includes an equal rating system for all pipe types.



Comprehensive Material Coverage

The 2020 "Culvert & Storm Drain Inspection Guide" includes ratings for common culvert pipe materials such as plastic, reinforced concrete, and corrugated metal.

OPPORTUNITIES



Roadway Impact

This section of the Guide helps to identify and evaluate structural distress within the roadway above culverts. It discusses the importance of culvert backfill, culvert materials, and system integrity which all can contribute to asphalt cracks and sags.



Culvert Rating Impacting Post-Installation Inspection

While the Guide is intended to be a tool for in-service inspection (not post-installation inspection), it can be a tool for equitable post-installation treatment. **In jurisdictions where competitive materials have more lenient post-installation performance than the guide would recommend for "fair" in-service performance, why would owners allow acceptance of competitive materials that would rate as "poor" on its first day of service?**

Crack Widths & Deflections

The Culvert Inspection Guide is a national reference for owners and specifiers as they assess the condition of RCP, CSP, and plastic pipes. A "good" rating requires RCP cracks to be ≤ 0.01 " and plastic pipe deflection to be $\leq 5\%$. A "fair" rating for RCP would include crack widths of 0.01" to 0.05" and plastic pipe deflections of 5 to 7.5%. RCP cracks > 0.05 " and plastic pipe deflection greater than 7.5% would score a "poor" rating.



Reinforced Concrete Pipe

Crack Width (in.)	AASHTO Construction Specs (intended for new structures)	Culvert & Storm Drain Barrel Rating	
		Rating	Action
≤ 0.01	Note in report	1 - Good	No Action
0.01 to 0.05	Measure in detail, measure cracks	2 - Fair	No immediate action
0.05 to 0.1	Measure in detail, measure cracks	3 - Poor	Evaluation needed for corrective action
> 0.1	Consider repair	4 - Severe	Corrective action required
Offset Cracks	Repair or replace	4 - Severe	Corrective action required



Plastic Pipe

Vertical Deformation	AASHTO Construction Specs (intended for new structures)	Culvert & Storm Drain Barrel Rating	
		Rating	Action
$\leq 5\%$	Note in report	1 - Good	No Action
5% - 7.5%	Measure in detail, measure diameters	2 - Fair	Evaluate. No immediate action required
7.5% - 10%	Measure in detail, measure diameters	3 - Poor	Evaluate & implement appropriate corrective action
$> 10\%$	Consider repair	4 - Severe	Corrective action required



CULVERT & STORM DRAIN SYSTEM INSPECTION GUIDE

The tables below should be used when evaluating and rating each characteristic of the culvert & storm drain components. The highest numerical rating assigned to any of these characteristics is the rating of the system component as a whole.

RATING SCALE & ASSOCIATED ACTION	(1) Good	(2) Fair	(3) Poor	(4) Severe
Condition	Like new, with little or no deterioration, structurally sound and functionally adequate	Some deterioration, but structurally sound and functionally adequate	Significant deterioration and/or functional inadequacy, requiring maintenance or repair.	Very poor conditions that indicate possible imminent failure which could threaten public safety.
Action Indicated	No action is recommended. Note in inspection report only.	No immediate action is recommended, but more frequent inspection may be warranted. Maintenance personnel should be informed.	Team Leader (Inspector) evaluates need for corrective action and makes recommendation in inspection report.	Corrective action is required and urgent. Engineering evaluation is required to specify appropriate repair.

PLASTIC PIPE	(1) Good	(2) Fair	(3) Poor	(4) Severe
Shape	Barrel maintains round shape with no local wall flattening. Vertical deformation less than 5% of original inside diameter.	Minor wall flattening. Vertical deformation 5%-7.5% of original inside diameter.	Significant wall flattening or increased wall curvature. Vertical deformation 7.5%-10% of original inside diameter. Visual out-of-roundness.	Extreme wall flattening with reversal of curvature (global buckling), and/or kinks. Vertical deformation greater than 10% of original inside diameter. Significant visual out-of-roundness.
Surface Damage	No indication of wear, abrasion, impact damage or UV degradation.	Minor wear, abrasion, less than 10% of wall thickness. Minor staining or UV degradation. Blistering over less than 25% of pipe inner surface (FRP).	Wear, abrasion that exceeds 10% of wall thickness. UV degradation (pipe ends) causing discoloration. Blistering over greater than 25% of pipe inner surface (FRP).	Wear, abrasion that exceeds 25% of wall thickness. UV degradation (pipe ends) resulting in cracked or broken pipe wall.
Local Buckling, Splits, and Cracking	Smooth interior wall. No splits in welded seams nor cracking in wall.	Initiation of local buckling indicated by rippling in wall. Wall cracking or splits, less than a quarter of circumference. No infiltration. No longitudinal cracking.	Advanced and widespread local wall buckling indicated by extensive interior surface rippling. Wall cracking or splits up to half of circumference. Minor water infiltration but no soil infiltration. Longitudinal cracking less than 12 in. in length.	Kinks through the full wall thickness. Pipe wall buckles inward locally. Wall cracking or splits greater than half of the pipe circumference. Longitudinal cracking more than 12in. in length. Cracks with indication of soil infiltration.

CONCRETE PIPE	(1) Good	(2) Fair	(3) Poor	(4) Severe
Cracking	No measurable crack width greater than hairline (maximum 0.01 in.).	Longitudinal cracks 0.01 in. to 0.05 in. wide (thickness of dime) with spacing of 3.0 ft or more. Some circumferential cracks with no infiltration. Efflorescence but no rust staining emanating from cracks.	Longitudinal cracks between 0.05 in. and 0.1 in. wide, no exposed rebar with spacing 1.0 – 3.0 ft. Water infiltration through circumferential cracks. Efflorescence and/or rust staining emanating from cracks. No cracks with vertical offset. No increase in cracking from previous inspection.	Longitudinal cracks greater than 0.1 in. wide, exposed rebar, significant water infiltration and/or soil migration. Cracks with vertical offset. Large areas of rust staining emanating from cracks.
Slabbing, Spalling, Delamination, Patches	No spalling or slabbing, as indicated by wall visual appearance. No delamination. Any patched areas are sound.	Localized spalls less than 0.5 in. depth and less than 6 in. in diameter. No exposed rebar. No slabbing. Small delaminations indicated by hollow sounds at patches but patch remains stable.	Spalling and/or delaminations from 0.5 to 0.75 in. in depth and larger than 6 in. in diameter. No exposed rebar. Some rust staining from spalled area, structure stable. Patched areas that are delaminated or deteriorating.	Widespread spalling greater than 0.75 in. in depth or delamination with exposed rebar, structure unstable. Slabbing of concrete.
Deterioration	No scaling, abrasion, or other surface damage.	Light or moderate scaling (less than 0.25 in. exposed aggregate). Abrasion less than 0.25 in. deep over less than 20% of pipe surface. Localized superficial (less than 0.25 in.) impact damage. No rebar exposed. Multiple plugged weep holes.	Moderate to severe scaling (aggregate clearly exposed). Abrasion between 0.25 in. and 0.5 in. deep over more than 30% of pipe surface. Impact damage with exposed rebar.	Extensive surface damage and aggregate pop-out includes exposed and/or corroded rebar. Complete invert deterioration and loss of pipe wall section.

CORRUGATED METAL PIPE	(1) Good	(2) Fair	(3) Poor	(4) Severe
Surface Damage	No dents or other localized damage.	Small dents or impact damage to pipe wall or end section with no wall breaches.	Large dents or impact damage to pipe wall or end section with localized wall breaches no more than one corrugation over circumferential length of 6 in.	Dents or damage that warrant engineering evaluation. Through-wall holes greater than one corrugation over a length more than 6 in. allowing unimpeded soil infiltration.
Corrosion	Isolated areas of freckled rust.	Freckled rust, corrosion of pipe wall material. No loss of section, no through-wall penetration from corrosion.	Corrosion of pipe material and widespread section loss less than 10% of wall thickness. Localized deep pitting. Several holes less than 1 in. diameter. Penetration possible with hammer pick strike.	Widespread through-wall penetration. Invert missing in localized sections. Through-wall penetrations present. Holes greater than 1 in. diameter or many smaller holes grouped closely.
Abrasion	No damage due to abrasion.	Small or local abrasion of wall or coating with no breaches in the coating exposing structural wall or signs of corrosion.	Widespread abrasion of protective coating with breaches exposing the pipe wall material and allowing through wall penetration during inspection probing with a pick.	Abrasion has worn large holes through the metal pipe greater than one corrugation in length for more than 6 in. around the circumference.
Shape (Closed Shape)	Smooth curvature in barrel, deformation less than 5% of inside diameter.	Top half smooth. Minor bulges or flattening of bottom. Deformation 5%-10% of original inside diameter.	Significant distortions or flattening. Lower third may be kinked. Deformation 10%-15% of original inside diameter. Visible out-of-roundness.	Extreme distortion throughout pipe, local areas of reverse curvature and kinks. Deformation greater than 15% of original inside diameter. Significant out-of-roundness.
Shape (Open Shape)	Smooth curvature, rise and span measurements within tolerance.	Refer to shape inspection requirements for specific structure types.	Refer to shape inspection requirements for specific structure types.	Refer to shape inspection requirements for specific structure types.

* Information from AASHTO Culvert & Storm Drain Inspection Guide.