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Current State of Practice: Municipal/DOT Storm-Sewer Inspection, Evaluation for Acceptance

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Home Inspection Tips for Buyers



The WHY of Pipe Inspection and Evaluation

A low-cost way of verifying that you are getting what you paid for Sewer line inspections are cheap, but sewer repairs can be extremely expensive.



What does PII accomplish ?

- Proof of proper installation
- Proof of appropriate soil compaction
- Confirms there are no issues in the pipe causing future operational issues
- Looks for damage during or after the installation of the pipe

Flexible and Rigid



Backfill > Pipe





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What Inspection Specifically Looking for in Installed Pipe?

- Rigid RCP
 - Joint Issues
 - Separations
 - Damage/Cracks/Chips
 - Infiltration
 - Cracks
 - Size length & Width
 - Location
 - Pattern (Longitudinal, Circumferential, Star Multi directional, etc....)
 - Other Items
 - Stains & Efflorescence
- Flexible CMP, Thermoplastics????

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What Inspection Specifically Looking for in Installed Pipe?

- CMP & Thermoplastic
 - Deflection
 - X-Y Deflection
 - Ovality Out of plane deformation
 - Wall Deformation
 - Buckling
 - Dents/Local Deformation
 - Cracking in pipe wall
 - Joint Damage
 - Separations
 - Damage
 - Infiltration
- CMP
 - Damage to any coatings

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Evaluation tools for post installation inspection



Designation: C1840/C1840M - 17 Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe¹ This standard is located and/or the bland decaymators C1000/C2000M, the secondard is benearing the decayments indicates the point of original adoption on, in the case of secondar, the point of just training A matching is particularly indicates the point of last respective. A sequencing trajector is indicates are adopted all charges matching the last training or straigeneet. L Scop 1.1 This practice covers the requirements for inspection and acceptance of installed miniorced concrete pipe by either person-entry, or remote inspection as shown in Figs. 1 and 2, espectively Barriers to Trafe (TBT) Committee 1.2 The scope of this specification is intended for installation related observations and assumes that pre-installation 2. Referenced Documents impection has been completed. 2.1 ASTM Youndarth: 1.3 The reinforced concrete culvert, storm drain and storm sewer pipe shall be manufactured in accordance with Specifi-cation C76, C506, C507, C655, or C1417 and accepted in Drain, and Sewar Pipe accontance with AASHTO 8073. This specification shall only Storm Drain, and Sewer Pipe be used for gravity, non-pressure storm drainage applications. 1.4 Person Emty shall be used unless extenuating circum-Culvert, Storm Dram, and Sever Pine. stances preclude this type inspection. Remote inspection is acceptable for use for pipe diameters of 30 in. (750 mm) and Calvert, Storn Drain, and Sewer Pipe smaller utiless otherwise specified by owner or engineer. Products 1.5 Access of installed pipe for manual impection shall follow OSHA 29 CFR PART 1926 SUBPART AA regulations for confined space mitry. However, this standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard Water-Formed Deposits to establish appropriate salety and health practices and deter-mine the applicability of regulatory limitations prior to use. 2.2 AASHTO Standards; 1.6 This martice does not cover deformation or deflection

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assessment. Concrete pipe is classified as a rigid structure because they do not bend or deflect appreciably order load before cracking. Due to these facts shape evaluation are of little or no value when evaluating concrete pipe. 1.7 The values stated in either Imperial/US or (SI units) are to be regarded separately as standard. The SI units are shown

in brackets. The values stated in each system may not be exact equivalents: therefore, each system shall be used independently of the other

¹This tore method is under the justification of ASEM Committee C(1) on Concret Pape and is the direct responsibility of Subcommittee C(1)(0) on Special 3. Terminology Carnes office approved April 15, 2207 Published April 2017, DOR 1011720 CIERCO CLEARNE.T

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1.8 This immuniant standard was developed in accordater with internationally recognized principles on standard Ization established in the Decision on Principles for the Development of International Standards, Guides and Recomnondations toxied by the World Trade Organization Technical

C76 Specification for Reinforced Concrete Cultert, Storm C506 Specification for Reinforced Concrete Arch Culturer, C507 Specification for Reinforced Concrete Elliptical C655 Specification for Reinforced Concrete D-Load

> C823 Terminology Relating to Concrete Pipe and Related C1417 Specification for Manufacture of Reinforced Concrete Sower, Storm Drain, and Culvert Pipe for Direct

19832 Practice for Filamentous Iron Bacuria in Water and

AASHTO LRFD Indge Design Specification AASHTO LRFD Bridge Construction Specification, Section AASHTO PPh3 Standard Practice for Pipe Joint Selection

for Highway Culturn and Storm Draim AASHTO R073 Standard Practice for Evaluation of Procest Concrete Drainage Product

2.3 Occupational Safety and Health Standards: OSHA 29 CFR Part 1926 Subpart AA for the Construction

2.4 ISO/IEC Standards ISO/DC 12025 General Requirements for the Competence of Testing and Calibration Laboratories

3.1 For definitions of other terms relating to concrete pipe

not defined in this specification, see Terminology CS22

AASHO

Guide Specifications for **Highway Construction**

2020 10th Edition



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Other evaluation tools...



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Other evaluation tools...

Standard Practice for

Evaluation of Precast Concrete Drainage Products

AASHTO Designation: R 73-16¹ Release: Group 2 (June 2016)



American Association of State Highway and Transportation Officials 444 North Capitol Street N.W., Suite 249 Washington, D.C. 20001

Standard Specifications

for Road, Bridge, and Municipal Construction





Setting the Industry Standards for the Rehabilitation of Underground Utilities

National Association of Sewer Service Companies

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ASTM C1840 "Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain & Storm Sewer Pipe"

- Pipe Inspection Equipment and Procedures
 - Excellent "How to Inspect" Tools and Techniques
 - Equipment and Operator Accuracy Verification
 - Inspection Report Requirements
- ► Installed Pipeline Evaluation and Acceptance Criteria
 - * Evaluation guidelines for cracks, joints and infiltration
 - * Establishes criteria for:
 - Acceptable condition
 - Repairable condition
 - Rejection of defective products
 - Products that require further evaluation

•OBJECTIVE & MEASURABLE CRITERIA

Designation: C1840/C1840M - 17	
Standard Practice for Inspection and Acceptance of Culvert, Storm Drain, and Stor	Installed Reinforced Concrete m Sewer Pipe ¹
This standard is sensed analy the Word Recomment CHRIC (NAL point of asigned adoption on its life some of sevenae, the year of suppressing A supercentry spokes (a) indicates an admittal allunger	d) the matthet transmittanty fulficency the designation inductors the basis terminan. A member in parenthenes inductor the your of last since the last involves or mappened.
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APPENDIX

(Nonmandatory Information)



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X2. Summary of Joint Evaluation Criteria

Joint Type	Condition	Section	Acceptance Criteria
silt and soil tight	separation < manuf requirements	8.3.1.1(1)	
	<u>cracks ≤ 0.10 on joint sealing surface</u>	<u>8.3.1.1(2)</u>	
	<u>< 0.75 offset</u>	<u>8.3.1.1(3)</u>	inte
	allow entry of soil particles per section 3.2	8.3.1.1(4)	
	chips or spalls w/o exposed circumferential reinf	<u>8.3.1.1(5)</u>	~ 0 •
	show stain, level 1 or level 2 infiltration if 1-5 criteria are met	<u>8.3.1.1(6)</u>	not requiring remediation
	exposed gasket or sealing material if 1-5 criteria are met	<u>8.3. (7)</u>	<u>not requiring remediation</u>
<u>leak resistant</u>	separation less than manuf reqmt	<u> 8 3.1.2(1)</u>	
	$\frac{\text{cracks} \le 0.05 \text{ on joint sealing surface}}{2}$	8.3.1.2(2)	
	< 0.75 offset	<u>8.3.1.2(3)</u>	
	chips or spalls w/o exposed gasket, sealing mat or since minimential reinf.	<u>8.3.1.2(4)</u>	
	show stain or level 1 infiltration	<u>8.3.1.2(5)</u>	
silt and soil tight	separation > manuf requirements	<u>8.3.2.1(1)</u>	
	cracks > 0.10 on joint sealing surface	<u>8.3.2.1(2)</u>	
	> 0.19 offset	<u>8.3.2.1(3)</u>	
	infiltration of sol particles > defined in section 3.2	<u>8.3.2.1(4)</u>	
	level 3 infiltration and not meeting criteria 8.3.1.1	<u>8.3.2.1(5)</u>	requiring further engineer
under	separation > manuf requirements	<u>8.3.2.2(1)</u>	evaluation
	<u>cracks > 0.05 on joint sealing surface</u>	<u>8.3.2.2(3)</u>	
	> 0.75 offset	<u>8.3.2.2(1)</u>	
	exposed gasket or sealing material	<u>8.3.2.2(4)</u>	
	level 2 infiltration and total line leakage rate > leak resistant joint	8 3 2 2(5)	
	requirements	0.0.2.2(0)	
silt and soil tight	chips or spalls in the sealing surface that expose structural reinf	<u>8.3.3.1(1)</u>	
	any joint separation that exposes the backfill material	<u>8.3.3.1(2)</u>	
leak resistant	chips or spalls in the sealing surface that expose structural reinf	<u>8.3.3.2(1)</u>	requiring remediation
	allow entry of any backfill	<u>8.3.3.2(2)</u>	
	level 3 infiltration	<u>8.3.3.2(3)</u>	

AASHTO LRFD Bridge Construction Specification

"Internal inspections shall be conducted on all buried rigid pipe installations to **evaluate issues that may affect longterm performance**, such as cracks, joint quality, and alignment." All pipes shall undergo inspection during and after installation to ensure proper performance. ... Final internal inspections shall be conducted on all buried thermoplastic pipe installations to evaluate issues that may affect long-term performance.

Source: <u>AASHTO LRFD Bridge Construction Specifications,</u> <u>Section 27: Concrete Culverts</u>

Source: <u>AASHTO LRFD Bridge Construction Specifications,</u> <u>Section 30: Thermoplastic Pipe</u>

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Cracks in Concrete Pipe Crack Limits – AASHTO

Longitudinal – AASHTO 27.6.4 Circumferential – AASHTO 27.6.5

- Cracks </= 0.01" are not concern
- Cracks > 0.01" evaluate to determine if detrimental (number of cracks, pattern and width)
- Cracks </= 0.10" Acceptable in non-corrosive environments (ph>5.5)



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Cracks in Concrete Pipe - AASHTO

Spalls – AASHTO 27.6.6

Spalling is a fracture of the concrete parallel or inclined to the surface of the concrete. Minor or Isolated spalls are not a problem.

Slabbing – AASHTO 27.6.7

Structural failure from tension forces causing large slabs of concrete "peel" away from the sides of the pipe. (remediated or replaced)



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Cracks in Concrete Pipe

Key Components of Crack Evaluation

Size +Pattern +Location Severity





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Pattern Cracks in Concrete Pipe

Star Cracks

Indicates Impact Damage

Depends on size of area, size of cracks

Star cracks greater than .05" in width in acidic areas are candidates for remediation



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Random Cracks in Concrete Pipe

Hairline Cracks

Due to shrinkage/curing cracking

Surface cracks w/ no depth

Significance NOT Structural or durability Issue



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Self Healing Cracks

What is This?

AUTOGENOUS HEALING

Concrete Extrudes Calcium Hydroxide

Converts to Calcium Carbonate or Limestone



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Defects in Thermoplastic Pipe

Deflection Limits – AASHTO 30.7.2

< 5% - no remediation required

5% to 7.4% - shall be evaluated

≥ 7.5% - remediate or replace

"Installed pipe deflections that exceed five percent of the initial inside diameter may indicate that the installation was substandard."



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Defects in Thermoplastic Pipe Deflection Limits – AASHTO 30.7.2



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Defects in Corrugated Metal Pipe

- Uneven laps
- Deflection greater than 7.5%
- Elliptical shaping (circular pipe only)
- Misalignment (vertical and horizontal)
- Ragged or diagonal sheared edges
- Loose, unevenly lined or spaced rivets, imperfectly shaped rivet heads



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Defects in Corrugated Metal Pipe

- Unfinished ends
- Lack of stiffness indicating wrong gauge
- Scaled or broken protective coating
- Dents or bends in the metal
- Improperly seated bells/spigots
- Joint separations exceeding manufacturer's recommendation



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How is PII Accomplished?

1. All Storm Sewer Pipes: Visual



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How is PII Accomplished?

1. All Storm Sewer Pipes: Visual and CCTV Inspection





BARREL DISTORTION TEST TARGET



High Barrel Distortion

ON A VIDEO MONITOR WHEN CAMERA HAS BARREL DISTORTION



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Camera with low barrel distortion



Camera with severe barrel distortion

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How is PII Accomplished?

- 1. All Storm Sewer Pipes: Visual and CCTV Inspection
- 2. Flexible and Semi-rigid: Mandrel Test – Laser Profiler No Sooner Than 30 Days Prior to Final Acceptance





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How is PII Accomplished?

- 1. All Storm Sewer Pipes: Visual and CCTV Inspection
- 2. Flexible and Semi-rigid: Mandrel Test – Laser Profiler No Sooner Than 30 Days Prior to Final Acceptance

3. All Pipe Materials:

Joint Widths

Cracks







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LOC: PALWAN BEACH WALK MH: B1 TO MH: 15 PRE-CON SEWER ID: DIR: D-STREAM DIA: 225mm OPR: GURU

Did You Get What You Paid For?

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