INTERNATIONAL

Designation: ~~C1840/C1840M – 22~~ C1840/C1840M – 24

Standard Practice for
Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe[1]

This standard is issued under the fixed designation C1840/C1840M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the requirements for inspection and acceptance of installed reinforced concrete pipe by either person-entry, or remote inspection as shown in Figs. 1 and 2, respectively.

1.2 The scope of this specification is intended for installation related observations and assumes that pre-installation inspection has been completed.

1.3 The reinforced concrete culvert, storm drain and storm sewer pipe shall be manufactured in accordance with Specification C76, C506, C507, C655, C1417, or C1846/C1846M and accepted in accordance with AASHTO R 73. This specification shall only be used for gravity, non-pressure storm drainage applications.

1.4 Person Entry shall be used unless extenuating circumstances preclude this type inspection. Remote inspection is acceptable for use for pipe diameters of 30 in. [750 mm] and smaller unless otherwise specified by owner or engineer.

1.5 Access of installed pipe for manual inspection shall follow OSHA 29 CFR PART 1926 SUBPART AA regulations for confined space entry. *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 to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 This practice does not cover deformation or deflection assessment. Concrete pipe is classified as a rigid structure because they do not bend or deflect appreciably under 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.

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*

[1] This test method is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.05 on Special Projects.

Current edition approved ~~Sept. 1, 2022~~Jan. 1, 2024. Published ~~September 2022~~January 2024. Originally approved in 2017. Last previous edition approved in ~~2017~~2022 as ~~C1840/C1840M – 17.~~C1840/C1840M – 22. DOI: ~~10.1520/C1840_C1840M-22~~10.1520/C1840_C1840M-24

FIG. 1 Person Entry Inspection

FIG. 2 Remote Inspection Camera

C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
C506 Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
C507 Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
C655 Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C822 Terminology Relating to Concrete Pipe and Related Products
C1417 Specification for Manufacture of Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe for Direct Design
C1846/C1846M Specification for Performance Based Manufacture of Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
D932 Practice for Filamentous Iron Bacteria in Water and Water-Formed Deposits

2.2 *AASHTO Standards:*
AASHTO LRFD Bridge Design Specification
AASHTO LRFD Bridge Construction Specification, Section 27
AASHTO R 82 Standard Practice for Pipe Joint Selection for Highway Culvert and Storm Drains
AASHTO R 73 Standard Practice for Evaluation of Precast Concrete Drainage Products

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

2.4 *ISO/IEC Standards:*
ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories

3. Terminology

3.1 For definitions of other terms relating to concrete pipe not defined in this specification, see Terminology C822.

3.2 *Definitions:*

3.2.1 *calcium carbonate crystals*—as shown in Fig. 3, crystals are formed when the carbon dioxide in the surrounding soil, air and water carbonates the free (un-hydrated) calcium oxide in the cement and the calcium hydroxide liberated by the hydration of the tricalcium silicate of the cement. This chemical process results in white crystals along the pipe wall at a crack location and if it fills the crack is commonly referred to as autogenous healing.

3.2.2 *clock positions*—the relative circumferential position, direction or location of an observation on the pipe interior is described using the analogy of a 12-hour clock as shown in Fig. 4. For example, 12 o'clock is the pipe crown; 3 o'clock the spring line right; 6 o'clock the invert; and 9 o'clock the spring line left. The viewing orientation (upstream or downstream) of the clock position observations must be identified to establish the spring line positions. When two clock positions are utilized to characterize the location or relative size of an anomaly within the pipe, the clock positions should be entered clockwise (for example, circumferential crack begins at 10 o'clock and ends at 2 o'clock).

3.2.3 *quadrant*—descriptor for one fourth of the circumference of the pipe, or a circumferential 90-degree arc. An example quadrant shown in Fig. 5.

3.2.4 *crack*—a measurable surface separation found in concrete indicating stress is being transferred from the concrete to the reinforcement.

3.2.4.1 *circumferential crack*—a crack aligned with the circumference of the pipe and perpendicular to the longitudinal axis of the pipe as shown in Fig. 6.

3.2.4.2 *hinge cracks*—when more than one longitudinal crack (at 12, 3, 6, or 9 o'clock) occurs at the same cross section location in the pipe as shown in Fig. 7.

3.2.4.3 *longitudinal crack*—a crack aligned with the axis of the pipe as shown in Fig. 8.

3.2.4.4 *multi-directional crack*—a combination of longitudinal and circumferential cracks that intersect at one point as shown in Fig. 9.

3.2.4.5 *diagonal tension crack*—longitudinal cracks ±30 to 60 degrees from the invert or obvert of the pipe (1-2 o'clock, 4-5 o'clock, 7-8 o'clock, or 10-11 o'clock) with a visible vertical offset across the crack.

3.2.4.6 *Discussion*—
Normal load induced longitudinal cracks can be present in the same locations but will not have a vertical offset across the crack.

FIG. 3 Calcium Carbonate Filled Crack

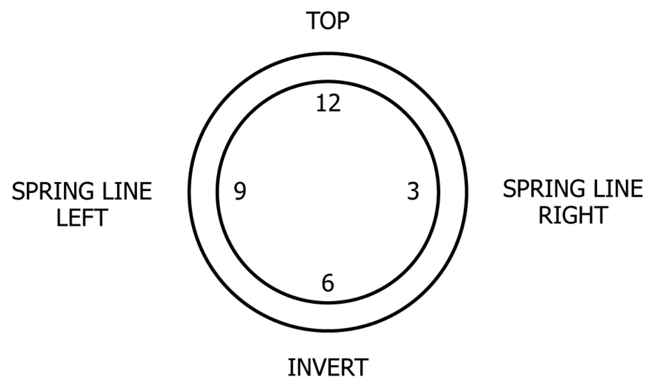

FIG. 4 Clock Positions

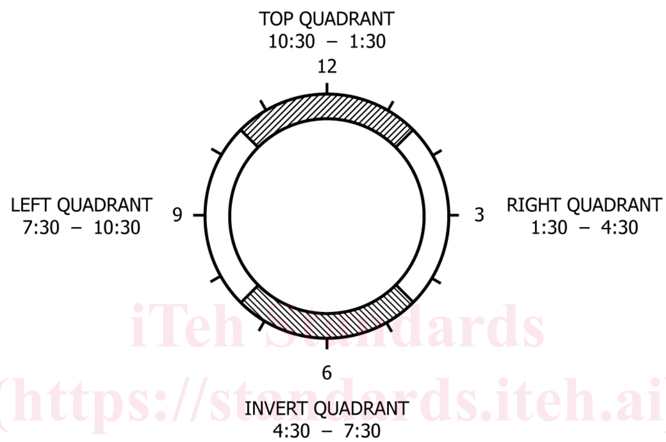

FIG. 5 Pipe Wall Quadrants

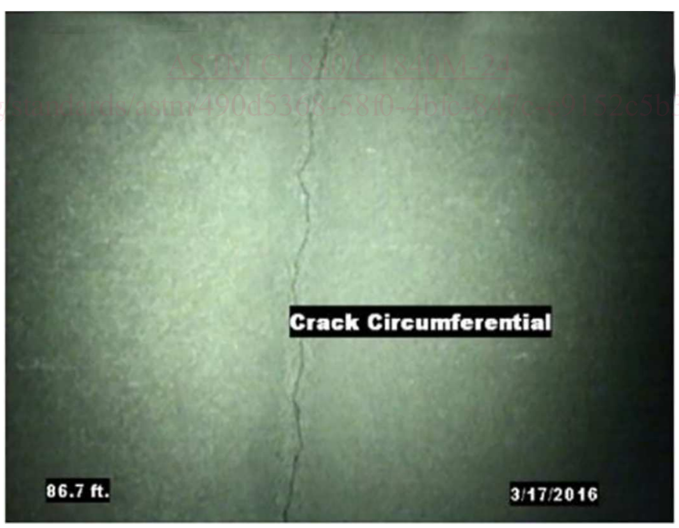

FIG. 6 Circumferential Crack

3.2.5 *engineer*—The qualifications for an engineer involved in the evaluation of installed RCP shall be established by the owner. Engineer designation as noted in this standard can be the design engineer of record for the subject project, an engineer working for or on behalf of the owner, or an engineer specializing in the evaluation of installed RCP.

3.2.6 *infiltration*—ground water entering the pipe.

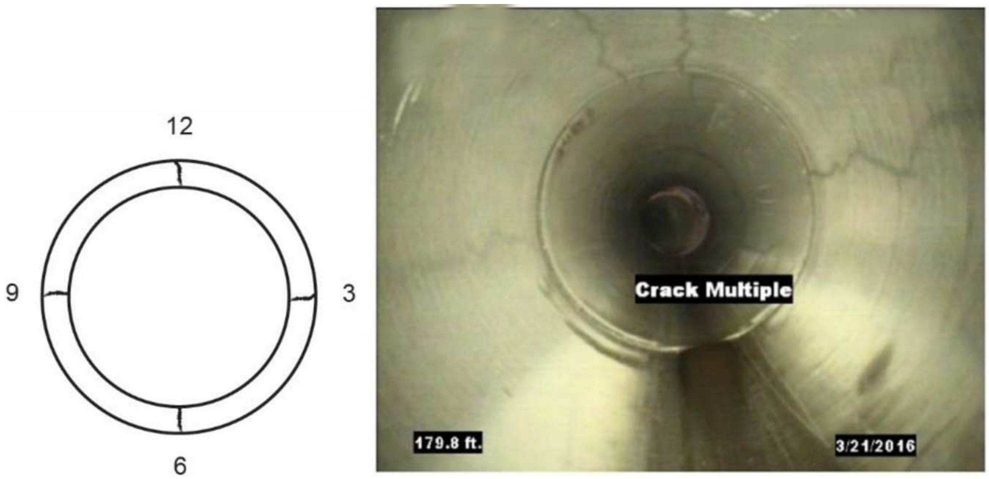

FIG. 7 Hinged Cracks (Multiple Longitudinal Cracks)

FIG. 8 Longitudinal Crack

FIG. 9 Multi-Directional Crack

3.2.6.1 *Level 1 Infiltration*—moisture visible on the surface of the pipe wall without any observable active water movement such as drips or water traveling along the surface as shown in Fig. 10.

3.2.6.2 *Level 2 Infiltration*—the slow entry of water identified by visible drips or a constant flow of water traveling along the surface. See Fig. 11.

FIG. 10 Level 1 Infiltration

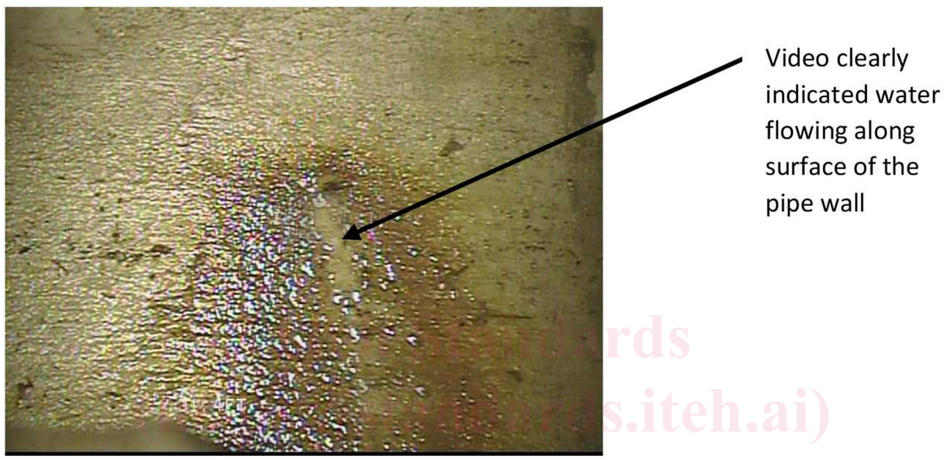

FIG. 11 Level 2 Infiltration

3.2.6.3 *Level 3 Infiltration*—a continuous stream of water running into the pipe or spraying through the pipe "under pressure." See Fig. 12.

3.2.7 *joint offset*—when the inside surface of the spigot (tongue) is not in alignment or centered with the interior pipe surface on the Bell (groove) end of the installed joint. See Fig. 13.

3.2.8 *joint separation*—the space from the end of the spigot (tongue) to the face (shoulder) of the bell (groove) of the installed joint. See Fig. 14.

3.2.9 *leak resistant joint*—according to AASHTO R 82 and for the purpose of this specification, a joint that limits water leakage at a maximum rate of 200 gallons/(inch of internal diameter) (mile of pipeline) (24h) [18.5 L/(mm of internal diameter) (km of pipeline) (24h)] for the pipeline sysytem.

FIG. 12 Level 3 Infiltration