Designation: F2303 – 03 (Reapproved 2021)

Standard Practice for Selection of Gravity Sewers Suitable for Installation of Optical Fiber Cable and Conduits[1]

This standard is issued under the fixed designation F2303; 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 specifically addresses the criteria for determining the suitability of gravity sewers for secondary uses such as the installation of optical fiber systems.

1.1.1 This practice applies to the process of selecting gravity sewers that are appropriate for accepting an optical fiber system as opposed to standards for the installation, operation and maintenance of such system within sewers.

1.2 This practice applies to both man accessible and man inaccessible sewer systems.

1.3 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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.*

1.5 *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:*[2]

D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents

D1600 Terminology for Abbreviated Terms Relating to Plastics

F412 Terminology Relating to Plastic Piping Systems

2.2 *Other Documents:*

NASSCO Standard "Gravity Sanitary Sewer Design and Construction," Manual of Practice No. FD-5, ASCE Recommended Specifications for Sewer Collection System Rehabilitation

Sewer Rehabilitation Manual (SRM) produced by the Water Research Center (WRc, Swindon, England)

3. Terminology

3.1 Definitions are in accordance with Terminology F412 and abbreviations are in accordance with Terminology D1600, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *combined sewers*—sewers that carry both wastewater and storm or surface water.

3.2.2 *engineer*—the licensed professional designated by the owner/operator of the sewer system to represent the owner's/operator's interests during the selection process.

3.2.3 *installer*—the person(s) or body installing the optical fiber system within the sewer.

3.2.4 *manholes*—vertical shafts to connect intersecting sewers to allow transitions in size, alignment and grade and to allow entry to the sewers for cleaning, inspection, and maintenance.

3.2.5 *optical fiber cable*—cable formed of many strands of optical fiber for transmission of data, video, audio, voice, and other information.

3.2.6 *optical fiber conduit*—fully-supported tubes suitably affixed to or suitably incorporated into the wall structure of the sewer.

3.2.7 *optical fiber system*—the complete set of installed optical fiber components including cable, conduit and attachment components.

3.2.8 *owner/operator*—the person(s) or body charged with maintenance and operation of the sewer system.

3.2.9 *sanitary sewers*—sewers that carry wastewater from users to the treatment plant.

3.2.10 *service lateral*—portion of the sewer system that connects a user to the sewer.

[1] This practice is under the jurisdiction of ASTM Committee F36 on Technology and Underground Utilities and is the direct responsibility of Subcommittee F36.10 on Optical Fiber Systems within Existing Infrastructure.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2.11 *sewer*—buried piping designed to carry wastewater or storm run-off.

3.2.12 *storm sewers*—sewers that carry storm or surface water away from roadways or structures to waterways.

4. Summary of Practice

4.1 Optical fiber cable and conduit systems in existing sewers shall be designed and installed so that they have a minimal effect on the sewer's hydraulic performance and no effect on their structural integrity. Their design and installation shall also allow for the safe and efficient operation and maintenance of the sewer, and provide for the safe and efficient operation of the optical fiber system. The ultimate success of the installation and operation of optical fiber and sewer systems depends upon the proper evaluation and selection of appropriate sewers. The steps in the process include the following items:

4.1.1 Cleaning,

4.1.2 Inspection and evaluation of the sewers which are candidates for optical fiber cable or conduit installation,

4.1.3 Selection of sewer route, and

4.1.4 Documentation of cable routing.

5. Significance and Use

5.1 This practice is intended to assist engineers and sewer owner/operators in determining the suitability of sewers for a secondary use as hosts for optical fiber cables and conduits. It must be kept in mind that the primary use of the sewers is to carry wastewater or storm water, or both. Any secondary use of the system shall not significantly impair the primary use. It is up to the engineer to decide upon any exceptions that may be involved in the selection process.

5.2 Before the selection procedure begins, the installer must have explicit authorization from the owner/operator allowing an evaluation to be conducted for the installation of optical fiber cables or conduits within their sewer system.

5.3 Engineers and owners should also be cognizant of how the installation of optical fiber cable or conduits will impact the future operational, maintenance, and rehabilitation needs of the sewers.

6. Sewer Selection Procedure

6.1 *Cleaning and Flow Bypass:*

6.1.1 *Requirement to Clean*—Prior to selection of a candidate sewer, the sewer must be thoroughly cleaned to allow for proper inspection and evaluation according to the selection criteria outlined below. The National Association of Sewer Services Companies (NASSCO) provides a helpful standard (NASSCO Standard). This cleaning process shall be performed with the equipment recommended by the optical fiber installer as being compatible (see 6.1.3). The cleaning process then serves as a test of the effectiveness of the cleaning equipment as well as allowing the inspection of the integrity of the sewer.

6.1.2 *Exceptions to Cleaning Requirement*—In cases where the pipe has recently been cleaned or has been recently installed, the cleaning requirement may be waived by mutual consent of the system owner and optical fiber system installer.

6.1.3 *Requirement for Compatibility*—The installer shall recommend compatible sewer-cleaning methods to the owner/operator. Such methods shall be compatible with both the existing pipeline (material and condition) and with the optical fiber system, and shall be effective in maintaining the operation of the sewer without compromising the performance of the sewer. The installer shall provide written assurance of the suitability for use of these methods throughout the term that the optical fiber system remains installed in the sewer.

6.1.4 *Requirement to Bypass*—Unless otherwise agreed by the owner/operator, the flow in the candidate sewer must be temporarily stopped or fully bypassed prior to inspection to allow for a complete examination and evaluation of the internal pipe circumference.

6.2 *Inspection:*

6.2.1 *Televising*—The inspection of the sewer system and appurtenances shall be accomplished by means of a closed circuit television system (CCTV) or other equivalent technology. Records of the inspection in analog or digital format will be maintained and forwarded to the system owner/operator in the selection report.

6.2.1.1 *Visual Quality*—The visual quality will be such as to allow determination of the presence of cracks, separated joints, grease, deposits, sags, high water marks, infiltration, corrosion, and root intrusion.

6.2.1.2 *Distance Recording*—The distance from the starting point of each inspection run must be designated by a specific reference (for example, middle of manhole) acceptable to the owner/operator.

6.2.1.3 *Acceptability of Digital Optical Scanning (New Technology)*—If acceptable to the owner, digital optical scanning may be substituted for CCTV. The requirement for degree of resolution and recording of data remains the same as for CCTV methods.

6.2.1.4 *Replicable System Assessment Method*—The method used to document the presence and severity of sewer faults shall be replicable. Unless otherwise specified by the owner/operator, a standard fault coding system such as the WRc Standard Fault Code (or equivalent) may be used to satisfy this criterion. The system selected should be capable of documenting, at a minimum, the presence and severity of the following types of faults: longitudinal cracks, radial cracks, breaks, gapped joints, damaged seals, infiltration/inflow, sags, levels of corrosion, out-of-round pipe, and uneven slopes.

6.2.1.5 *Requirement for Trained Professional*—The inspection operator shall be a trained individual with suitable professional qualifications (for example, NASSCO certification) to provide a qualified inspection opinion as to fault coding.

6.3 *Sewer Selection Criteria:*

6.3.1 The data from the inspection and evaluation should be used to identify the sewer sections and manholes suitable for installation of optical fiber cables and conduits. The candidate sewer must meet minimum criteria based upon hydraulic, structural, operations and maintenance, and flow chemistry analysis. Those sections not meeting the selection criteria shall be rejected, suitably repaired or rehabilitated, or otherwise

modified and re-inspected. Otherwise, an alternative route shall be selected in order for the project to receive recommendation.

6.3.2 *Requirement for Professional Opinion*—The individual(s) reviewing the inspection video and evaluating the sewer as a potential candidate for optical fiber cables and conduits must be a professional engineer or qualified individual acceptable to the owner/operator who has both the training and experience in sewer assessment required to provide a qualified opinion on the suitability of the sewer in accordance with the selection criteria.

6.3.3 *Selection Criteria*—The evaluation of candidate sewers requires careful consideration, research and review of the following criteria:

6.3.3.1 *Hydraulics*—The analysis must address the feasibility of installing optical fiber cables or conduits, or both, under current flow conditions and provide an assessment of the impact of optical fiber cable and conduit installations under both current and future design flow conditions, as determined by the owner/operator.

(1) Unless otherwise determined by the owner/operator, the design flow requirement must be satisfied at 50 % full for sanitary and storm sewers less than 15 in. diameter, and 75 % full for larger pipes.

(2) The pipe must be investigated for service history, unusual scouring, corrosion, grease buildup, dry-weather high flow, dry-weather low flow, wet-weather high flow, flow velocity, debris load, root intrusion, overflows, blockages, maintenance history, protruding laterals, hydraulic jumps, turbulence, sags, infiltration, curves, and any other factor that may affect the installation or maintenance of optical fiber cables and conduits.

(3) The analysis must also consider anticipated future flow requirements in terms of capacity and changes tributary to the pipe. This may occur when the pipe is used as a relief line to accept diverted flow from parallel sewers, or as industrial discharge is added to the system or as the sewer demand increases with population increases and development.

(4) Any non-structural defects (such as root intrusion, protruding laterals or infiltration) must be repaired to allow a pipe to remain a candidate for optical fiber system installation.

6.3.3.2 *Structural*—The pipeline and appurtenances must be structurally stable and capable of resisting all external loads.

(1) Pipes with dispersed short, hairline cracks or other minor defects are generally considered structurally sound provided the defects appear stable, there is no evidence of soil loss and there is no active infiltration. These pipes are candidates for optical fiber system installation.

(2) Characteristics that require further investigation and potential repairs include open cracks, offsets, deflection/flattening (refer to applicable product piping standard for limits), voids, missing pieces, infiltration and heavy corrosion. Pipes determined to be structurally challenged by the engineer must be suitably repaired or rehabilitated in order to remain candidates for optical fiber system installation.

6.3.3.3 *Operations and Maintenance (O&M) Analysis*—The candidate sewer must be capable of being satisfactorily operated and maintained after the installation of the optical fiber system. O&M elements and activities including sewer access, frequency of access, cleaning, flow monitoring, root control, odor control, corrosion control, vermin control, degreasing, operation of flow control and diversion structures, and provision for modification and upgrades must be compatible with the particular optical fiber system proposed. Consideration of chronic cleaning impediments such as grease, protruding laterals, root intrusion and a review of complaint records must be incorporated into the analysis. Results from the inspection, cleaning, testing and sewer record information should be used by the evaluator to ensure that O&M operations are not negatively impacted. This operational analysis should consider, as a minimum:

(1) Adequate clearance for entry of personnel, safety equipment, and maintenance equipment at manholes and access hatches.

(2) Adequacy of cleaning methods allowed by the particular optical fiber cable system proposed.

(3) Adequacy of root/grease/corrosion/vermin/odor control methods allowed by the particular optical fiber system proposed.

(4) Repair and maintenance methods (joint sealing, spot repairs) suitable to both the type of sewer and the optical fiber system.

(5) Ability to use equipment and devices to monitor, inspect, maintain and rehabilitate sewer after optical fiber system installation.

(6) Ability to modify the sewer to accept new service connections, new manholes or force mains after optical fiber system installation.

6.3.3.4 *Flow Quality*—Sewers contain a variety of corrosive chemicals (for example, microbiologically-generated sulfuric acid, industrial waste or maintenance treatments), a range in wastewater temperatures and humidity levels (for example, steam), and a variety of solid types and states. These parameters can have deleterious short and long term impacts on the optical fiber system components. Some sewer environments will be incompatible with the optical fiber system. Sampling of flow quality will provide a helpful analysis against which the material properties of the various optical fiber system components should be assessed for compatibility. Such an assessment may be conducted using both theoretical (literature review) and practical (coupon testing) methods such as Practices D543.

6.3.3.5 *Safety and Security*—Safety and security of the public, all sewer and optical fiber system workers and all users must be considered in the sewer selection and evaluation process. Consideration must be given to potential impacts on confined space entries and rescue for all personnel working on or in the sewer, as well as the impact of the optical fiber system on traffic flows during installation and operations, and on the safety of maintenance and monitoring equipment operating in the sewers. Items such as the frequency of access required, the amount and frequency of traffic disruptions and the deleterious effects of nuisance odors and sewer gases must be considered. The security and safety of the information network itself must also be considered given the nature of the sewer environment and the importance of information to network end users.