Designation: F3220 – 17 (Reapproved 2023)

Standard Practice for Prioritizing Sewer Pipe Cleaning Operations by Using Transmissive Acoustic Inspection[1]

This standard is issued under the fixed designation F3220; 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 procedures for assessing the blockage within gravity-fed sewer pipes using transmissive acoustics for the purpose of prioritizing sewer pipe cleaning operations.[2] The assessment is based on an acoustic receiver measuring the acoustic plane wave transmitted through the pipe segment under test in order to evaluate the blockage condition of an entire segment and to provide an onsite assessment of the blockage within the pipe segment. (**1**, **2**, **3**, **4**, **5**)[3]

1.2 The scope of this practice covers the use of the transmissive acoustic inspection as a screening tool. The blockage assessment provided by the acoustic inspection should be used to identify and prioritize pipe segments requiring further maintenance action such as cleaning or visual inspection, or both. Thereby, also identifying the pipe segments which are sufficiently clean and do not require additional maintenance action.

1.3 This standard practice does not address structural issues with the pipe wall.

1.4 The inspection process requires access to the manhole (MH) from ground level. It does not require physical access to the sewer line by either the equipment or the operator.

1.5 This standard practice applies to all types of pipe material.

1.6 The inspection process requires access to sewers and operations along roadways or other locations that are safety hazards. This standard does not describe the hazards likely to be encountered or the safety procedures that must be carried out when operating in these hazardous environments.

1.7 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.8 *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.*

1.9 *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. Terminology

2.1 *Definitions:*

2.1.1 *authority, n*—party responsible for the generation and verification of performance to job specification(s) and contract requirements.

2.1.2 *blockage assessment, n*—the aggregate blockage within a pipe segment between two adjacent MHs.

2.1.3 *closed circuit television (CCTV), n*—a closed circuit pipeline inspection television system including a camera, camera transporter, integrated lighting, central control system, video monitor, and recording device.

2.1.4 *coordinated universal time (UTC), n*—the primary international time standard for regulating clocks and time.

2.1.5 *geographic information system (GIS), n*—system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data.

2.1.6 *global position system (GPS), n*—space-based navigation system that provides location and time information anywhere on or near the earth where there is an unobstructed line of sight to four or more GPS satellites.

2.1.7 *manhole (MH), n*—vertical shafts intersecting a sewer that allow entry to the sewer for cleaning, inspection, and maintenance.

2.1.8 *pipe segment, n*—the section of a sewer line between two adjacent MHs.

[1] This practice is under the jurisdiction of ASTM Committee F36 on Technology and Underground Utilities and is the direct responsibility of Subcommittee F36.20 on Inspection and Renewal of Water and Wastewater Infrastructure.

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[2] The transmissive acoustic inspection is covered by Patent US8220484B2. Interested parties are invited to submit information regarding the identification of an alternative(s) to this patented item to the ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

[3] The boldface numbers in parentheses refer to a list of references at the end of this standard.

2.1.9 *segment's acoustic fingerprint (SAF), n*—acoustic feature set which characterizes a pipe segment. The acoustic feature set is used in classifying the blockage assessment. (**2, 6**)

2.2 *Abbreviation:*

2.2.1 *ID*—identification

3. Summary of Practice

3.1 Transmissive acoustic inspection operational procedure is based on measuring the signal received from an active acoustic transmission through a pipe segment. Fig. 1 depicts the general configuration of a transmissive acoustic inspection. The acoustic transmitter generates sound waves just below the entrance to the MH which couple into the connecting sewer line segments. The sound wave propagates in the air gap above the wastewater flow from the speaker to the receiving microphone attached to the acoustic receiver located at the adjacent MH. The acoustic receiver measures the acoustic plane wave from the transmitted signal in order to evaluate the blockage condition of an entire segment and provides an onsite blockage assessment. Both the speaker and the microphone are placed just within the opening of the MH and should never come in contact with the wastewater flow. The operators have no requirement for confined space entry.

3.2 Transmissive acoustic inspection principle of operation is based on the observation that a pipe segment is a natural acoustic waveguide. Commonly encountered sanitary sewer defects, such as roots, grease, pipe sags, and pipe breakages naturally absorb or reflect acoustic energy. These defects change a segment's acoustic properties and produce a measurable impact on the received signal at the microphone, that is, the segment's acoustic fingerprint (SAF). Each segment has an individual SAF representative of its current state. Transmissive acoustic inspection measures and assesses the SAF to determine the Blockage Assessment, that is, an estimate of the aggregate blockage within the pipe segment between the acoustic transmitter and acoustic receiver.

4. Significance and Use

4.1 *Significance:*

4.1.1 Collection system maintenance requires allocating cleaning resources to the right place prior to system failure (sanitary sewer overflows, mainline blockages, and building backups). Transmissive acoustic inspection provides a tool to assist in allocating cleaning resources by prioritizing pipe segments based on their blockage assessment and thereby facilitating efficient cleaning resource allocation.

4.1.2 This standard practice provides minimum requirements and suggested practices regarding the transmissive acoustic inspection of gravity-fed sewer line blockage assessment to meet the needs of maintenance personnel, engineers, contractors, authorities, regulatory agencies, and financing institutions.

4.2 *Limitations and Appropriate Uses:*

4.2.1 The blockage assessment provided by the transmissive acoustic inspection may not resolve the type of blockage(s) within the pipe segment nor resolve the location(s) of the blockage(s) within the pipe segment.

4.2.2 Due to the physics associated with transmissive acoustic inspection, the blockage assessment may be confounded due to:

(1) Structural designs resulting in poor acoustic coupling,

(2) Pipe segments completely filled with water, for example, full pipe sag or inverted siphon, and

(3) Transient conditions within the pipe, for example, active lateral discharge or temporary flow surcharges.

These issues are addressed as part of the performance criteria specified in X1.5.

4.2.3 Due to physics associated with acoustics and tradeoffs in equipment design for conducting transmissive acoustic inspection, there are limitations based on the following pipe segment attributes:

(1) Pipe diameter,

(2) Pipe segment length,

(3) MH depth, and

(4) Flow levels.

Inspections conducted outside the manufacturer's recommended ranges for these pipe segment attributes may result in the transmissive acoustic blockage assessment deviating from the performance criteria specified in X1.5.

4.2.4 Inspections conducted between non-adjacent MHs, for example, skipping an intermediate MH, may result in the transmissive acoustic blockage assessment deviating from the performance criteria specified in X1.5.

5. Procedure

5.1 If the work is to be conducted by an outside contractor, apart from the provisions generally included in an inspection

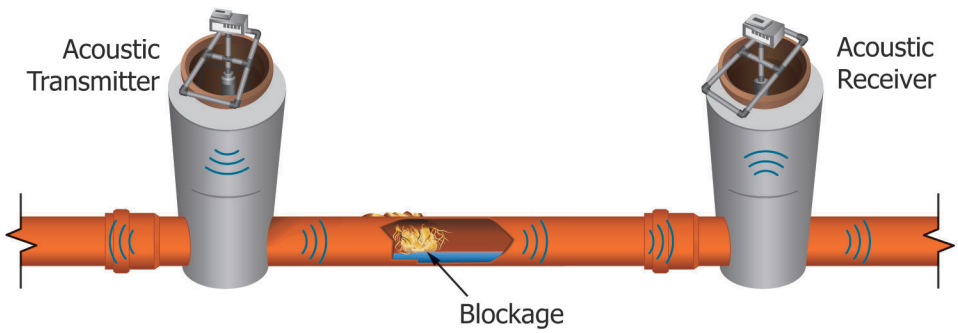

FIG. 1 Transmissive Acoustic Inspection System Operation