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Standard Practice for Locating Leaks in Sewer Pipes By Measuring the Variation of Electric Current Flow Through the Pipe Wall[1]

This standard is issued under the fixed designation F2550; 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.

INTRODUCTION

Infiltration of groundwater into a sewer through defects in the pipe can considerably increase the operation and capital costs of a sewer system. Exfiltration of sewage out of a sewer pipe may cause degradation of aquifers and shoreline waters. Accurate location, measurement, and characterization of all potential pipe leak defects are essential inputs for cost-effective design, testing, and certification of pipe repairs, renewal, and new construction. While commonly used sewer leak assessment methods, such as air and water pressure testing, represent cost effective methods to provide overall Pass/Fail pipe assessments, their inability to provide accurate location and size of leaks, particularly at individual joints and service connection, limit their use in remediation and rehabilitation decision support.

1. Scope

1.1 This practice covers procedures for measuring the variation of electric current flow to detect and locate potential pipe leaks in pipes fabricated from electrically nonconductive materials such as brick, clay, concrete, and plastic pipes (that is, reinforced and non-reinforced). The method uses the variation of electric current flow through the pipe wall to locate defects that are potential water leakage paths either into or out of the pipe.

1.2 This practice applies to mainline and lateral gravity flow storm sewers, sanitary sewers, and combined sewers with diameters between 3 and 60 in. (75 and 1500 mm). The pipes must be free of obstructions that prevent the probe passing through the pipe.

1.3 The scanning process requires access to sewers, filling sewers, and operations along roadways 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. (7.1.3) There are no safety hazards specifically associated with the use of an electro-scan apparatus that complies with the specifications provided in this standard. (6.7 and 6.10.)

1.4 The measurement of the variation of electric current requires the insertion of various items into a sewer. There is always a risk that due to unknown structural conditions in the sewer such items may become lodged in the pipe or may cause the state of a sewer in poor structural condition to further deteriorate. This standard does not describe methods to assess the structural risk of a sewer.

1.5 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.

1.6 *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 to determine the applicability of regulatory limitations prior to use.*

1.7 *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 of Terms Specific to This Standard:*

2.1.1 *lateral, n*—sewer pipe connecting the common sewer collection system to the user.

2.1.2 *mainline, n*—pipe that is part of the common sewer collection system.

[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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2.1.3 *maintenance hole, n*—(MH) vertical shafts intersecting a sewer that allows entry to the sewer for cleaning, inspection and maintenance.

2.1.4 *owner, n*—entity holding legal rights to, and responsible for the operation and maintenance of the sewer pipe.

2.1.5 *probe, n*—scan electrode placed in a pipe.

2.1.6 *sliding pipe plug, n*—device that blocks the flow through a pipe and at the same time can be pulled through the pipe.

3. Significance and Use

3.1 The testing of sewers for leaks is a regular practice necessary for the maintenance and optimal performance of sewer collection systems so remedial action can be prioritized, designed, and carried out to reduce infiltration and exfiltration.

3.2 This practice serves as a means to detect and locate all types of pipe defects that are potential sources of water leaks either into or out of electrically non-conducting pipes. Leaking joints and defective service connections are detected that often may not show as a defect when viewed from inside the pipe. The scan data may be processed and analyzed to provide some information on the size and type of pipe defect. (8.4.1)

3.3 This practice applies to mainline and lateral gravity flow storm sewers, sanitary sewers, and combined sewers fabricated from electrically non-conducting material with diameters between 3 and 60 in. (75 and 1500 mm). The pipes must be free of obstructions that prevent the probe passing through the pipe.

4. Contract Responsibilities

4.1 Apart from the provisions generally included in a testing services contract, testing contracts for measuring the variation in electric flow through a pipe wall should define or affix responsibility for or make provisions for the following items:

4.1.1 Access to the site of work is to be provided to the extent that the owner is legally able to so provide or, if not so able, a written release from responsibility for the performance of work at sites where access cannot be made available;

4.1.2 Clearances of blockages or obstructions in the sewer system;

4.1.3 Location and exposure of all maintenance holes (MH);

4.1.4 MH numbering system for all areas of the project and MH invert elevations and depths;

4.1.5 Shutdown or manual operation of certain pump stations if such becomes necessary for performance of the work;

4.1.6 Permission to use water from fire hydrants at the work site, or other suitable designated sources within a reasonable distance from the work areas, which is necessary for contracted work performance;

4.1.7 Authorization to perform work that must be performed during nighttime hours, weekends, or holidays; and

4.1.8 Traffic control by uniformed officers or contract personnel when the safety of workers or the public requires such protection.

5. Principle of Operation

5.1 Most sewer pipe materials such as clay, plastic, concrete, reinforced concrete, and brick are poor conductors of electrical current. A defect in the pipe wall that leaks water will also leak electrical current, whether or not water infiltration or exfiltration is occurring at the time of the test.

5.2 The test is carried out by applying an electrical potential of 9 to 11 Volts rms with a frequency of 500 Hz to 30 kHz between an electrode in the electrically nonconductive pipe and an electrode on the surface, which is usually a metal stake pushed into the ground. A simplified electrical circuit for this procedure is shown in Fig. 1. The water in the pipe is at a level that ensures that the pipe is full at the electrode location. Provided electrical current is prevented from flowing along the inside of the pipe, the electrical resistance of the current path between the electrode in the pipe and the surface electrode is very low except through the electrically nonconductive pipe wall. The high electrical resistance of the pipe wall allows only a very small electrical current to flow between the two electrodes unless there is a defect in the pipe such as a crack, defective joint, or faulty service connection. The greater the electric current flow through the pipe opening, the larger the size of the leak.

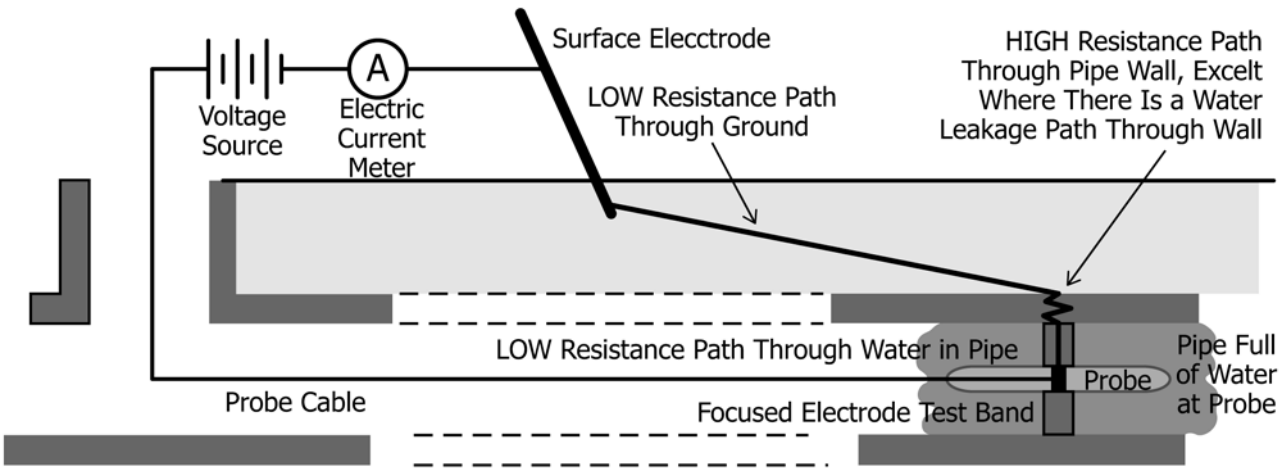

FIG. 1 Schematic of a Simplified Electrical Scanning Circuit in a Non-Conductive Pipe