



Standard Practice for Laser Technologies for Measurement of Cross-Sectional Shape of Pipeline and Conduit by Non-Rotating Laser Projector and CCTV Camera System¹

This standard is issued under the fixed designation F3080; 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 procedure for the measurement to determine any deviation of the internal surface of installed pipe compared to the design. The measurements may be used to verify that the installation has met design requirements for acceptance or to collect data that will facilitate an assessment of the condition of pipe or conduit due to structural deviations or deterioration.

1.2 This practice applies to all types of pipe material, all types of construction, and pipe shapes.

1.3 This practice applies to depressurized and gravity flow storm sewers, drains, sanitary sewers, and combined sewers with diameters from 6 to 72 in. (150 and 1800 mm). The pipe shall be precleaned and free of debris that would prevent the CCTV camera and laser projector assembly, shown in Fig. 1, from moving through the pipe, or adversely affect the accuracy of the survey. Flow or debris, within the line, shall be less than 10 % of the nominal pipe diameter or 6 in. in depth whichever is the lesser.

1.4 The laser light projector shall be tested, labeled and certified to conform to US requirements for CDRH Class 2 or below (not considered to be hazardous) laser products or certified to conform to EU requirements for Class 2M or below laser products as per IEC 60825-1, or both.

1.5 The profiling process may require physical access to lines, entry manholes and operations along roadways that may include safety hazards.

1.6 This standard does not include all aspects of pipe inspection; for example the following are not covered by this standard: joint gaps, soil/water infiltration in joints, cracks, holes, surface damage, repairs, corrosion, and structural problems associated with these.

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 and health practices and determine the applicability of regulatory limitations prior to use.* There are no safety hazards specifically, however, associated with the use of the laser ring profiler specified (listed and labeled as specified in 1.3).

2. Referenced Documents

2.1 ASTM Standards:²

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F1216 Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

2.2 Other Standards:

IEC 60825-1 Safety of Laser Products – Part 1: Equipment Classification and Requirements, Jan 2011.³

CDRH Regulations CFR 21, Section I, Subchapter J, Parts 1002 to 1040.11⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

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

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 Available from International Electrotechnical Commission (IEC), 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, <http://www.iec.ch>.

⁴ Available from Center for Devices and Radiological Health (CDRH), Food and Drug Administration, 10903 New Hampshire Avenue, WO66-4621, Silver Spring, MD 20993, <http://www.fda.gov>.

¹ This test method 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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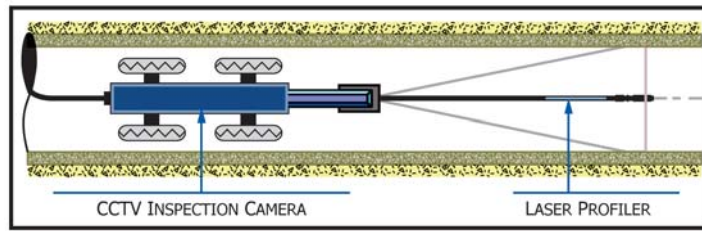


FIG. 1 CCTV—Laser Profiler Assembly

3.1.2 *barrel distortion*—distortion of an image produced by an optical system that causes straight lines at image margins to bulge outwards.

3.1.3 *barrel distortion correction confirmation target*—an X-Y axis grid patterned for the post processing verification of “fisheye distortion” lens correction within the processing software.

3.1.4 *CCTV, n*—a closed circuit pipeline and conduit inspection television system including an NTSC or PAL camera, camera transporter, integrated lighting, central control system, video monitor and recording device.

3.1.5 *CCTV camera transporter*—the device that provides mobility for the CCTV camera to move transverse to the pipe alignment once it enters the inside of the pipe through manholes and/or other line access openings.

3.1.6 *CCTV pipeline and conduit inspection system*—CCTV inspection system is composed of CCTV camera, transporter, controller and video recording unit.

3.1.7 *computer, n*—an electronic machine that performs rapid, complex calculations, correlates the processed data, generates imaging and corresponding alpha numeric information.

3.1.8 *curvature*—the reciprocal of the radius of the inner surface at a location along the perimeter of the noncircular shaped pipe, culvert or conduit.

3.1.9 *deflection*—shape change or reduction in diameter of a conduit produced without fracturing the material.

3.1.10 *deform*—to change the shape of an object so that it no longer has its original or normal shape.

3.1.11 *deviation*—a condition that is different from what is expected or specified.

3.1.12 *laser, n*—a solid state device that produces a monochromatic and coherent beam of visible light in an intense, narrow 360 degree beam.

3.1.13 *laser profile*—the spatial intensity profile of a laser beam at a particular plane that is perpendicular to the trajectory of the laser device along the axis of the pipe.

3.1.14 *laser profiling equipment*—equipment used in performing a laser profiling observation.

3.1.15 *laser profiling survey*—a survey composed of taking measurements of the cross sectional shape of the pipe at a rate greater than 24 images per second along its alignment, processing the recorded data using compatible software and producing a condition assessment report, including deviation, using laser profiling technology.

3.1.16 *laser projector assembly*—a 360 degree laser light projector assembly composed of two primary components: laser signal modulation unit.

3.1.17 *MTFB, n*—Mean Time Between Failures.

3.1.18 *NASSCO*—National Association of Sewer Service Companies.

3.1.19 *non-rotating laser projector, n*—a mobile, certified “eye safe” laser light source and internal optics capable of projecting a 360 degree narrow beam of laser light onto an internal pipe wall in pipes from 6 to 72 in. (150 to 1800 mm) in diameter regardless of material, design, or shape.

3.1.20 *NTSC*—National Television Systems Committee—Responsible for setting television and video standards in the United States. Defines a composite video signal as 60 half frames (fields) per second, 30 frames per second. Each frame contains 525 lines.

3.1.21 *ovality, n*—percentage of shape deflection in circular and noncircular pipes as calculated per Practice F1216 as defined in Annex A1.

3.1.22 *PAL*—Phase Alternating Line—A color encoding system for analog television not used in North America containing 25 half frames, 50 frames per second. Each frame contains 625 lines.

3.1.23 *processing or measurement software, n*—a software for processing the recorded CCTV images of a projected laser light line on the internal surfaces of a pipe while moving through the line at a speed not to exceed 30 ft/min (9 m/min) and generating specified reports.

3.1.24 *profiling software*—the software that analyzes the collected data from a laser profiling survey into cross sectional profiles along the pipe of conduit alignment.

3.1.25 *survey calibrator*—a calibrated measurement reference placed and recorded on the same plane and distance from the CCTV camera as the projected laser light ring during the profiling survey.

4. Significance and Use

4.1 Operational experience and independent testing have fully documented that the usable life, maintenance and failure and mean time between failures (MTBF) in buried storm and wastewater lines can be directly affected by the defects during manufacturing, incorrect pipe storage, and improper installation, including improper compaction often resulting in the deformation (Ovality or shape, or both) and physical damage in newly installed, repaired and replaced pipelines. Laser profiling assessment is an effective quality control