



Standard Test Method for Open-Channel Flow Measurement of Water with Palmer- Bowlus Flumes¹

This standard is issued under the fixed designation D5390; 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 test method covers measurement of the volumetric flowrate of water and wastewater in sewers and other open channels with Palmer-Bowlus flumes.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

1.3 *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.*

2. Referenced Documents

2.1 ASTM Standards:²

[D1129 Terminology Relating to Water](#)

[D1941 Test Method for Open Channel Flow Measurement of Water with the Parshall Flume](#)

[D2777 Practice for Determination of Precision and Bias of Applicable Test Methods of Committee D19 on Water](#)

[D3858 Test Method for Open-Channel Flow Measurement of Water by Velocity-Area Method](#)

[D5242 Test Method for Open-Channel Flow Measurement of Water with Thin-Plate Weirs](#)

2.2 ISO Standards:³

[ISO 4359 Liquid Flow Measurement in Open Channels—Rectangular, Trapezoidal and U-Shaped Flumes](#)

[ISO 555 Liquid Flow Measurements in Open Channels—Dilution Methods for Measurement of Steady Flow—Constant Rate Injection Method³](#)

¹ This test method is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.07 on Sediments, Geomorphology, and Open-Channel Flow.

Current edition approved Jan. 1, 2013. Published January 2013. Originally approved in 1993. Last previous edition approved in 2007 as D5390 – 93 (2007). DOI: 10.1520/D5390-93R13.

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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

2.3 ASME Standard:⁴

[Fluid Meters— Their Theory and Application](#)

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method refer to Terminology [D1129](#).

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *boundary layer displacement thickness*— the boundary layer is a layer of fluid flow adjacent to a solid surface (in this case, the flume throat) in which, owing to viscous friction, the velocity increases from zero at the stationary surface to an essentially frictionless-flow value at the edge of the layer. The displacement thickness is a distance normal to the solid surface that the surface and flow streamlines can be considered to have been displaced by virtue of the boundary-layer formation.

3.2.2 *critical flow*—open channel flow in which the energy expressed in terms of depth plus velocity head, is a minimum for a given flowrate and channel. The Froude number is unity at critical flow.

3.2.3 *Froude number*—a dimensionless number expressing the ratio of inertial to gravity forces in free-surface flow. It is equal to the average velocity divided by the square root of the product of the average depth and the acceleration due to gravity.

3.2.4 *head*—the depth of flow referenced to the floor of the throat measured at an appropriate location upstream of the flume; this depth plus the velocity head is often termed the total head or total energy head.

3.2.5 *hydraulic jump*—an abrupt transition from supercritical flow to subcritical or tranquil flow, accompanied by considerable turbulence or gravity waves, or both.

3.2.6 *long-throated flume*—a flume in which the prismatic throat is long enough relative to the head for essentially critical flow to develop on the crest.

3.2.7 *primary instrument*—the device (in this case the flume) that creates a hydrodynamic condition that can be sensed by the secondary instrument.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.