



Designation: D5390 – 21

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 flow rate 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 standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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

[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](#)

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.

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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.

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](#)

2.3 ASME Standard:⁴

[Fluid Meters Their Theory and Application](#)

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this standard, refer to Terminology [D1129](#).

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *boundary layer displacement thickness, n* —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, n* —the energy in open channel flow expressed in terms of depth plus velocity head and is a minimum for a given flow rate and channel. The Froude number is unity at critical flow.

3.2.3 *Froude number, n* —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, n* —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 Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

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