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Standard Guide for Selection of Weirs and Flumes for Open-Channel Flow Measurement of Water¹

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1. Scope

1.1 This guide covers recommendations for selection of weirs and flumes for the measurement of the volumetric flow rate of water and wastewater in open channels under a variety of field conditions.

1.2 This guide emphasizes the weirs and flumes for which ASTM standards are available, namely, thin-plate weirs, broad-crested weirs, Parshall flumes, and Palmer-Bowlus (and other long-throated) flumes. However, reference is also made to other measurement devices and methods that may be useful in specific situations.

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:

- D 1129 Terminology Relating to Water²
- D 1941 Test Method for Open Channel Flow Measurement of Water with the Parshall Flume²
- D 3858 Test Method for Open-Channel Flow Measurement of Water by Velocity-Area Method²
- D 5242 Test Method for Open-Channel Flow Measurement of Water with Thin-Plate Weirs²
- D 5389 Test Method for Open-Channel Flow Measurement of Water by Acoustic Velocity Meter Systems²
- D 5390 Test Method for Open-Channel Flow Measurement of Water with Palmer-Bowlus Flume²
- D 5614 Test Method for Open-Channel Flow Measurement of Water with Broad-Crested Weirs²

2.2 ISO Standard:

- ISO 555-1973: Liquid Flow Measurement in Open Channels—Dilution Methods for Measurement of Steady Flow—Constant-Rate Injection Method³

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology D 1129.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *blackwater*—an increase in the depth of flow upstream of a channel obstruction, in this case a weir or flume.

3.2.2 *contracted weirs*—contractions of thin-plate weirs refer to the widths of weir plate between the notch and the sidewalls of the approach channel. In fully contracted weirs, the ratio of the notch area to the cross-sectional area of the approach channel is small enough for the shape of the channel to have little effect. In suppressed (full-width) rectangular weirs, the contractions are suppressed, and the weir crest extends the full width of the channel.

3.2.3 *crest*—in rectangular thin-plate weirs, the horizontal bottom of the overflow section; in broad-crested weirs and flumes, the plane, level floor of the flow section.

3.2.4 *critical flow*—open-channel flow in which the energy, expressed in terms of depth plus velocity head, is a minimum for a given flow rate and channel.

3.2.4.1 *Discussion*—The Froude number is unity at critical flow.

3.2.5 *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.

3.2.6 *head*—in this context, the depth of flow referenced to the crest of the weir or flume and measured at a specified location; this depth plus the velocity head are often termed the total head or total energy head.

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

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

3.2.9 *nappe*—the curved sheet or jet of water overfalling a weir.

3.2.10 *notch*—the overflow section of a triangular weir or of a rectangular weir with side contractions.

3.2.11 *primary instrument*—the device (in this case, a weir or flume) that creates a hydrodynamic condition that can be

¹ This guide is under the jurisdiction of ASTM Committee D-19 on Water and is the direct responsibility of Subcommittee D19.07 on Sediments, Geomorphology, and Open-Channel Flow.

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² *Annual Book of ASTM Standards*, Vol 11.01.

³ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.