Designation: D5242 – 21

Standard Test Method for Open-Channel Flow Measurement of Water with Thin-Plate Weirs[1]

This standard is issued under the fixed designation D5242; 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 channels with thin-plate weirs. Information related to this test method can be found in Rantz (**1**)[2] and Ackers (**2**).

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:*[3]

D1129 Terminology Relating to Water

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

2.2 *ISO Standards:*[4]

ISO 1438 Flow Measurement in Open Channels Using Weirs and Venturi Flumes—Part 1: Thin-Plate Weirs

ISO 555 Liquid Flow Measurement in Open Channels, Delusion Methods for Measurement of Steady Flow-Constant Rate Injection Method

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 *crest, n*—the bottom of the overflow section or notch of a rectangular weir.

3.2.2 *head, n*—the height of a liquid above a specified point, for example, the weir crest.

3.2.3 *hydraulic jump, n*—an abrupt transition from supercritical flow to subcritical or tranquil flow.

3.2.4 *nappe, n*—the curved sheet or jet of water overfalling the weir.

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

3.2.6 *primary instrument, n*—the device (in this case the weir) that creates a hydrodynamic condition that can be sensed by the secondary instrument.

3.2.7 *scow float, n*—an in-stream float for depth sensing, usually mounted on a hinged cantilever.

3.2.8 *secondary instrument, n*—in this case, a device that measures the depth of flow (referenced to the crest) at an appropriate location upstream of the weir plate. The secondary instrument may also convert the measured depth to an indicated flow rate.

3.2.9 *stilling well, n*—a small free-surface reservoir connected through a constricted channel to the approach channel upstream of the weir so that a depth (head) measurement can be made under quiescent conditions.

[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 Dec. 15, 2021. Published January 2022. Originally approved in 1992. Last previous edition approved in 2013 as D5242 – 92 (2013). DOI: 10.1520/D5242-21.

[2] The boldface numbers in parentheses refer to a list of references at the end of the text.

[3] 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.

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

3.2.10 *subcritical flow, n*—open channel flow in which the average velocity is less than the square root of the product of the average depth and the acceleration due to gravity; sometimes called tranquil flow.

3.2.11 *submergence, n*—a condition where the water level on the downstream side of the weir is at the same or at a higher elevation than the weir crest; depending on the percent of submergence the flow over the weir and hence the head-discharge relation may be altered.

3.2.12 *supercritical flow, n*—open channel flow in which the average velocity exceeds the square root of the product of the average depth and the acceleration due to gravity.

3.2.13 *tailwater, n*—the water level immediately downstream of the weir.

4. Summary of Test Method

4.1 Thin-plate weirs are overflow structures of specified geometries for which the volumetric flow rate is a unique function of a single measured depth (head) above the weir crest or vertex, the other factors in the head-discharge relation having been experimentally or analytically determined as functions of the shape of the overflow section and approach channel geometry.

5. Significance and Use

5.1 Thin-plate weirs are reliable and simple devices that have the potential for highly accurate flow measurements. With proper selection of the shape of the overflow section a wide range of discharges can be covered; the recommendations in this test method are based on experiments with flow rates from about 0.008 ft ^{3}/s (0.00023 m ^{3}/s) to about 50 ft ^{3}/s (1.4 m ^{3}/s).

5.2 Thin-plate weirs are particularly suitable for use in water and wastewater without significant amounts of solids and in locations where a head loss is affordable.

6. Interferences

6.1 Because velocities are reduced in the backwater upstream of the weir, solids normally transported by the flow will tend to deposit and ultimately affect the approach conditions.

6.2 Weirs are applicable only to open channel flow and become inoperative under pressurized-conduit conditions.

7. Apparatus

7.1 A weir measuring system consists of the weir plate and its immediate channel (the primary) and a depth (head) measuring device (the secondary). The secondary device can range from a simple scale for manual readings to an instrument that continuously senses the depth, converts it to a flow rate, and displays or transmits a readout or record of the instantaneous flow rate or totalized flow, or both.

7.2 *Thin-Plate Weir:*

7.2.1 *Shapes*—The thin-plate weir provides a precisely shaped overflow section symmetrically located in a (usually) rectangular approach section, as in Fig. 1 and Fig. 2. Although information is available in the literature (**3**) on a variety of overflow-section or notch shapes (for example, rectangular, triangular, trapezoidal, circular) only the rectangular and triangular shapes are considered to have a data base sufficient for promulgation as a standard method.

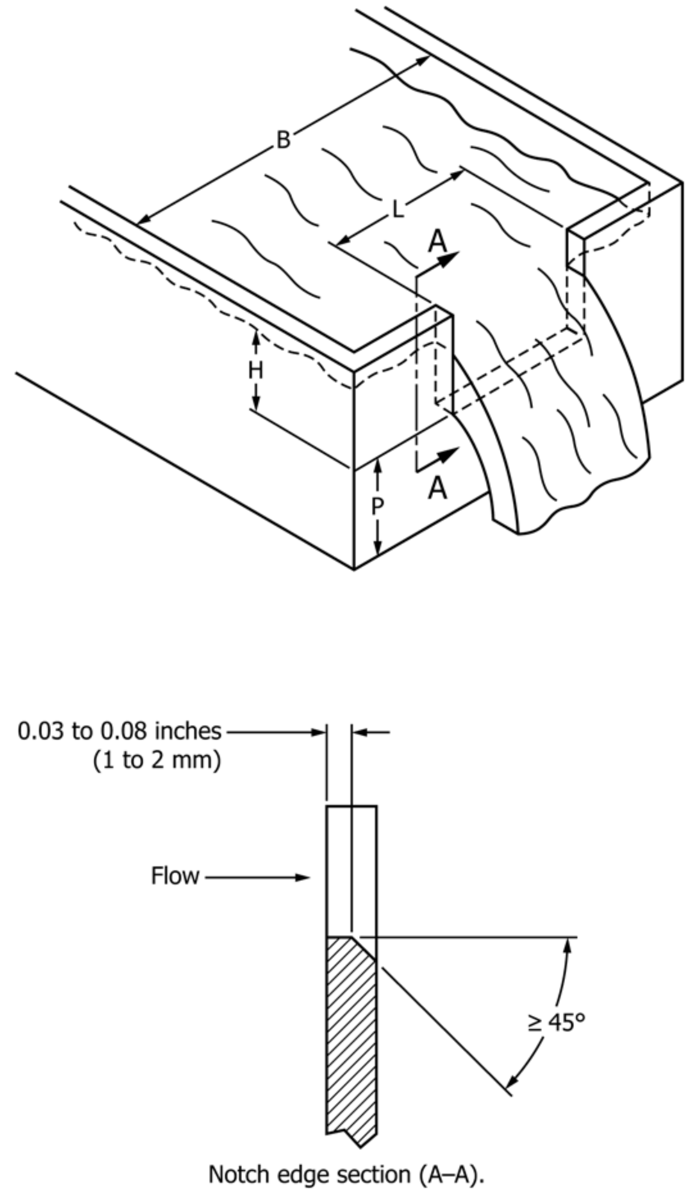

FIG. 1 Rectangular Weir

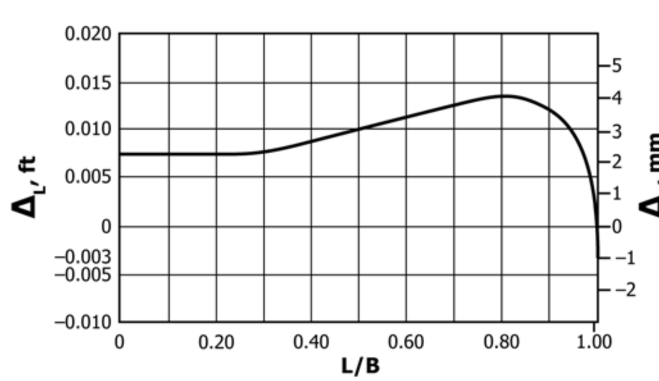

FIG. 2 Crest-Length Adjustment, Δ_L