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An American National Standard

Standard Test Method for Open-Channel Flow Measurement of Water Indirectly at Culverts[1]

This standard is issued under the fixed designation D 5243; 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 the computation of discharge (the volume rate of flow) of water in open channels or streams using culverts as metering devices. In general, this test method does not apply to culverts with drop inlets, and applies only to a limited degree to culverts with tapered inlets. Information related to this test method can be found in ISO 748 and ISO 1070.

1.2 This test method produces the discharge for a flood event if high-water marks are used. However, a complete stage-discharge relation may be obtained, either manually or by using a computer program, for a gage located at the approach section to a culvert.

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

1.4 *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 Water[2]

D 2777 Practice for Determination of Precision and Bias of Applicable Methods of Committee D-19 on Water[2]

D 3858 Practice for Open-Channel Flow Measurement of Water by Velocity-Area Method[2]

2.2 *ISO Standards:*

ISO 748 Liquid Flow Measurements in Open Channels-Velocity-Area Methods[3]

ISO 1070 Liquid Flow Measurements in Open Channels-Slope-Area Methods[3]

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard*—Several of the following terms are illustrated in Fig. 1:

3.2.1 *alpha (α)*—a velocity-head coefficient that adjusts the velocity head computed on basis of the mean velocity to the true velocity head. It is assumed equal to 1.0 if the cross section is not subdivided.

3.2.2 *conveyance (K)*—a measure of the carrying capacity of a channel and having dimensions of cubic feet per second.

3.2.2.1 *Discussion*—Conveyance is computed as follows:

$$K = \frac{1.486}{n} R^{2/3} A$$

where:

n = the Manning roughness coefficient,

A = the cross section area, in ft ^{2}(m ^{2}), and

R = the hydraulic radius, in ft (m).

3.2.3 *cross sections* (numbered consecutively in downstream order):

3.2.3.1 The approach section, Section 1, is located one culvert width upstream from the culvert entrance.

3.2.3.2 Cross Sections 2 and 3 are located at the culvert entrance and the culvert outlet, respectively.

3.2.3.3 Subscripts are used with symbols that represent cross sectional properties to indicate the section to which the property applies. For example, A_1 is the area of Section 1. Items that apply to a reach between two sections are identified by subscripts indicating both sections. For example, $h_{f_{1-2}}$ is the friction loss between Sections 1 and 2.

3.2.4 *cross sectional area (A)*—the area occupied by the water.

3.2.5 *energy loss (h_f)*—the loss due to boundary friction between two locations.

3.2.5.1 *Discussion*—Energy loss is computed as follows:

$$h_f = L \left(\frac{Q^2}{K_1 K_2} \right)$$

[1] This test method 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. 42 nd Street, 13 th Floor, New York, NY 10036.

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