



Designation: D5388 – 21

Standard Test Method for Indirect Measurements of Discharge by Step-Backwater Method¹

This standard is issued under the fixed designation D5388; 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 of water in open channels or streams using representative cross-sectional characteristics, the water-surface elevation of the upstream-most cross section, and coefficients of channel roughness as input to gradually-varied flow computations.²

1.2 This test method produces an indirect measurement of the discharge for one flow event, usually a specific flood. The computed discharge may be used to define a point on the stage-discharge relation.

1.3 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.

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

1.5 *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

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:*

NOTE—Several of the following terms are illustrated in Fig.

1.

3.2.1 *alpha (α), n*—a dimensionless velocity-head coefficient that represents the ratio of the true velocity head to the velocity head computed on the basis of the mean velocity. It is assumed equal to unity if the cross section is not subdivided. For subdivided sections, α is computed as follows:

$$\alpha = \frac{\sum \frac{k_i^3}{a_i^2}}{\frac{K_T^3}{A_T^2}} \quad (1)$$

where:

k and *a* = the conveyance and area of the subsection indicated by the subscript *i*, and

K and *A* = the conveyance and area of the total cross section indicated by the subscript *T*.

3.2.2 *conveyance (K), n*—a measure of the carrying capacity of a channel without regard to slope and has dimensions of cubic feet per second. Conveyance is computed as follows:

$$K = \frac{1.49}{n} AR^{2/3} \quad (2)$$

3.2.3 *cross-section area (A), n*—the area at the water below the water-surface elevation that it computed. The area is computed as the summation of the products of mean depth multiplied by the width between stations of the cross section.

3.2.4 *cross sections (numbered consecutively in downstream order), n*—representative portions of a reach and channel and are positioned as nearly as possible at right angles to the direction of flow. They must be defined by coordinates of horizontal distance and ground elevation. Sufficient ground

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 Barnes, H. H., Jr., “Roughness Characteristics of Natural Streams,” U.S. Geological Survey Water Supply Paper 1849, 1967.

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.