



Designation: D 5541 – 94 (Reapproved 1998)

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428
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Standard Practice for Developing a Stage-Discharge Relation for Open Channel Flow¹

This standard is issued under the fixed designation D 5541; 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 practice covers the development of a curve relating stage (elevation) to discharge. Standard test methods have been documented for measuring discharge and for measuring stage (see Practice D 3858, and Test Methods D 5129, D 5130, D 5243, D 5388, and D 5413). This practice takes the discharge and stage determined by each respective test method and shows a relation between them using a curved line. This curved line is called a stage-discharge relation or rating curve.

1.2 The procedures described in this practice are used commonly by those responsible for investigations of stream-flow, for example, the U.S. Geological Survey, Army Corps of Engineers, Bureau of Reclamation, and U.S. Agriculture Research Service. For the most part, these procedures are adapted from reports of the U.S. Geological Survey.^{2,3}

1.3 The procedures described in this practice apply only to simple freely flowing open-channel flow. Ratings for complex hydraulic conditions of extremely low slope channels using multiple-stage inputs, channels affected by man-induced regulation, or tidal conditions are not described. These types of ratings are described in detail in the documents listed in Footnotes 2 and 3.

1.4 This practice uses the results of current-meter discharge measurements or indirect discharge measurements and the corresponding measured stage to define as much of the stage-discharge relation curve as possible. A theoretical curve is developed for the full range of stage and discharge to shape the curve.

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

1.6 *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 applica-*

bility of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards:

- D 1129 Terminology Relating to Water⁴
- D 3858 Practice for Open-Channel Flow Measurement of Water by Velocity-Area Method⁴
- D 5129 Test Method for Open Channel Flow Measurement of Water Indirectly by Using Width Contractions⁴
- D 5130 Test Method for Open-Channel Flow Measurement of Water Indirectly by Slope-Area Method⁴
- D 5243 Test Method for Open-Channel Flow Measurement of Water Indirectly at Culverts⁴
- D 5388 Test Method for Measurement of Discharge by Step-Backwater Method⁴
- D 5413 Test Methods for Measurement of Water Levels in Open Water Bodies⁴

2.2 ISO Standard:

- ISO 1100/2 Liquid Flow Measurement in Open Channels—Part 2, Determination of Stage-Discharge Relation⁵

3. Terminology

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

3.2 Symbols: Symbols:

GH = gage height or stage, ft (m).

Q = discharge, ft³/s (m³/s).

4. Summary of Practice

4.1 The stage-discharge relation is developed by plotting stage versus discharge from discharge measurements or other determinations of flow, either manually or through the use of computer programs and fitting a curve to these points. The stage should be determined at a single gage datum for the entire range in stage. Stages determined in stilling wells, at outside gages, and at bridge abutments can be significantly different and should not be interchanged. Discharge measurements may not be available for the entire range in stage of the stage-discharge relation. A theoretical rating curve should be developed for the entire range in stage using Test Method D 5388.

¹ This practice 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.

Current edition approved April 15, 1994. Published July 1994.

² Kennedy, E. J., "Discharge Ratings at Gaging Stations: U.S. Geological Survey," *Techniques of Water-Resource Investigations*, Book 3, Chapt. A10, 1984, p. 59.

³ Rantz, S. E., et al., *Measurement and Computation of Streamflow: Vol 2, Computation of Discharge*, U.S. Geological Survey, Water-Supply Paper No. 2175, 1982, p. 631.

⁴ *Annual Book of ASTM Standards*, Vol 11.01.

⁵ Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.