INTERNATIONAL

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Standard Guide for Operation of a Gaging Station[1]

This standard is issued under the fixed designation D5674; 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 The guide covers procedures used commonly for the systematic collection of streamflow information. Continuous streamflow information is necessary for understanding the amount and variability of water for many uses, including water supply, waste dilution, irrigation, hydropower, and reservoir design.

1.2 The procedures described in this guide are used widely by those responsible for the collection of streamflow data, for example, the U.S. Geological Survey, Bureau of Reclamation, U.S. Army Corps of Engineers, U.S. Department of Agriculture, Water Survey Canada, and many state and provincial agencies. The procedures are generally from internal documents of the preceding agencies, which have become the defacto standards used in North America.

1.3 It is the responsibility of the user of the guide to determine the acceptability of a specific device or procedure to meet operational requirements. Compatibility between sensors, recorders, retrieval equipment, and operational systems is necessary, and data requirements and environmental operating conditions must be considered in equipment selection.

1.4 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.

1.5 *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.*

1.6 *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:*[2]

D1129 Terminology Relating to Water
D1941 Test Method for Open Channel Flow Measurement of Water with the Parshall Flume
D3858 Test Method for Open-Channel Flow Measurement of Water by Velocity-Area Method
D5129 Test Method for Open Channel Flow Measurement of Water Indirectly by Using Width Contractions
D5130 Test Method for Open-Channel Flow Measurement of Water Indirectly by Slope-Area Method
D5242 Test Method for Open-Channel Flow Measurement of Water with Thin-Plate Weirs
D5243 Test Method for Open-Channel Flow Measurement of Water Indirectly at Culverts
D5388 Test Method for Indirect Measurements of Discharge by Step-Backwater Method
D5389 Test Method for Open-Channel Flow Measurement by Acoustic Velocity Meter Systems
D5390 Test Method for Open-Channel Flow Measurement of Water with Palmer-Bowlus Flumes
D5413 Test Methods for Measurement of Water Levels in Open-Water Bodies
D5541 Practice for Developing a Stage-Discharge Relation for Open Channel Flow

2.2 *ISO Standards:*[3]

ISO 1100 Liquid Flow Measurement in Open Channels—Part I: Establishment and Operation of a Gauging Station
ISO 6416 Measurement of Discharge by Ultrasonic (Acoustic) Method

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this guide, refer to Terminology D1129.

3.2 *Definitions of Terms Specific to This Standard:*

[1] This guide 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] 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.

[3] *Measurement of Liquid Flow in Open Channels*, ISO Standards Handbook 16, 1983. Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

3.2.1 *control, n*—the physical properties of a channel, which determine the relationship between the stage and discharge of a location in the channel.

3.2.2 *datum, n*—a level plane that represents zero elevation.

3.2.3 *discharge, n*—the volume of water flowing through a cross-section in a unit of time, including sediment or other solids that may be dissolved in or mixed with the water; usually cubic feet per second (f^3/s) or metres per second (m/s).

3.2.4 *elevation, n*—the vertical distance from a datum to a point; also termed stage or gage height.

3.2.5 *gage, n*—a generic term that includes water level measuring devices.

3.2.6 *gage datum, n*—a datum whose surface is at the zero elevation of all of the gages at a gaging station. This datum is often at a known elevation referenced to the national geodetic vertical datum (NGVD) of 1929.

3.2.7 *gage height, n*—the height of a water surface above an established or arbitrary datum at a particular gaging station; also termed stage.

3.2.8 *gaging station, n*—a particular site on a stream, canal, lake, or reservoir at which systematic observations of hydrologic data are obtained.

3.2.9 *national geodetic vertical datum (NGVD) of 1929, n*—prior to 1973 known as mean sea level datum, a spheroidal datum in the conterminous United States and Canada that approximates mean sea level but does not necessarily agree with sea level at a specific location.

3.2.10 *stilling well, n*—a well connected to the stream with intake pipes in such a manner that it permits the measurement of stage in relatively still water.

4. Summary of Guide

4.1 A gaging station is usually installed where a continuous record of stage or discharge is required. A unique relationship exists between water surface elevation and discharge (flow rate) in most freely flowing streams. Water-level recording instruments continuously record the water surface elevation, usually termed stage or gage height. Discharge measurements are taken of the stream discharge to develop a stage-discharge curve. The discharge data are computed from recorded stage data by a stage-discharge rating curve.

5. Significance and Use

5.1 This guide is useful when a systematic record of water surface elevation or discharge is required at a specific location. Some gaging stations may be operated for only a few months; however, many have been operated for a century.

5.2 Gaging station records are used for many purposes:

5.2.1 Resource appraisal of long-term records to determine the maximum, minimum, and variability of flows of a particular stream. These data can be used for the planning and design of a variety of surface water-related projects such as water supply, flood control, hydroelectric developments, irrigation, recreation, and waste assimilation.

5.2.2 Management, where flow data are required for the operation of a surface-water structure or other management decision.

6. Site Location

6.1 The general location of the station will be dependent on the purpose for which the station is established. Location constraints for a resource appraisal-type station may be quite broad, for example, between major tributaries. Constraints for a management-type station may require a location just below a dam, contaminant discharge point, or other point at which discharge information is required specifically.

6.2 *Site Requirements*—Certain hydraulic characteristics of the stream channel are desirable for collecting high-accuracy data of minimal cost. Hydraulically difficult sites can still be gaged; however, accuracy and cost are affected adversely. Desirable conditions include the following:

6.2.1 The general course of the river should be straight for approximately 300 ft (100 m) above and below the gage.

6.2.2 The flow is confined to one channel at all stages.

6.2.3 The stream bed is stable, not subject to frequent scour and fill, and is free of aquatic growth.

6.2.4 The banks are sufficiently high to contain flow at all stages.

6.2.5 A natural feature such as ledge rock outcrop or stable gravel riffle, known as a "control," is present in the stream. It is necessary and practical in some cases to install a low-head dam or artificial control to provide this feature. Additional information on man-made structures is given in Test Methods D1941, D5242, and D5390.

6.2.6 A pool is present behind the control where water-level instruments or stilling well intakes can be installed at a location below the lowest stream stage. The velocity of water passing sensors in a deep pool also eliminates or minimizes draw-down effects on stage sensors during high flow conditions.

6.2.7 The site is not affected by the hydraulic effects of a bridge, tributary stream entering the gaged channel, downstream impoundment, or tidal conditions.

6.2.8 A suitable site for making discharge measurements at all stages is available near the gage site.

6.2.9 There is accessibility for construction and operation of the gage.

6.3 *Site Selection*—An ideal site is rarely available, and judgement must be exercised when choosing between possible sites to determine that meeting the best combination of features.

6.3.1 *Office Reconnaissance*—The search for a gaging station begins with defining the limits along the stream at which the gage must be located on topographic maps of the area. The topographic information will indicate approximate bank heights or overflow areas, general channel width, constrictions, slope, roads, land use, locations of buildings, and other useful information so that promising locations can be checked out in the field.

6.3.2 *Field Reconnaissance*—If the range of possible gage locations is large, flying over the stream at a low altitude in a small aircraft is an efficient way of checking for promising sites. The view from the air on a clear day is much more helpful