NOTICE: This standard has either been superseded and replaced by a new version or withdrawn.
Contact ASTM International (www.astm.org) for the latest information

Designation: D5737 – 95(Reapproved 2006)

Standard Guide for Methods for Measuring Well Discharge[1]

This standard is issued under the fixed designation D5737; 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 guide covers an overview of methods to measure well discharge. This guide is an integral part of a series of standards prepared on the in-situ determination of hydraulic properties of aquifer systems by single- or multiple-well tests. Measurement of well discharge is a common requirement to the determination of aquifer and well hydraulic properties.

1.2 This guide does not establish a fixed procedure for any method described. Rather, it describes different methods for measuring discharge from a pumping or flowing well. A pumping well is one type of control well. A control well can also be an injection well or a well in which slug tests are conducted.

1.3 This guide does not address borehole flow meters that are designed for measuring vertical or horizontal flow within a borehole.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.* Furthermore, it is the user's responsibility to properly dispose of water discharged.

1.6 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D1941 Test Method for Open Channel Flow Measurement of Water with the Parshall Flume

D4043 Guide for Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques

D5242 Test Method for Open-Channel Flow Measurement of Water with Thin-Plate Weirs

D5390 Test Method for Open-Channel Flow Measurement of Water with Palmer-Bowlus Flumes

D5716 Test Method for Measuring the Rate of Well Discharge by Circular Orifice Weir

2.2 *ISO Standard:*

Recommendation R541 Measurement of Fluid Flow by Means of Orifice Plates and Nozzles[3]

2.3 *ANSI Standard:*

Standard 1042 Part 1 Methods for the Measurement of Fluid Flow in Pipes, 1, Orifice Plates, Nozzles and Venturi Tubes[3]

2.4 *ASME Standard:*

Standard MFC-3M-1989 Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *conceptual model*—an interpretation or description of the characteristics, interactions, and dynamics of a physical system.

3.1.2 *control well*—a well by which the head and flow in the aquifer is changed, by pumping, injection, or imposing a change of head.

iTeh Standards
(https://standards.iteh.ai)
Document Preview
ASTM D5737-95(2006)
https://standards.iteh.ai/catalog/standards/sist/20f5a600-0c72-4331-ac7f8d4f5966/astm-d5737-952006

[1] This guide is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Groundwater and Vadose Zone Investigations.

Current edition approved July 1, 2006. Published August 2006. Originally approved in 1995. Last previous edition approved in 2000 as D5737 – 95 (2000). DOI: 10.1520/D5737-95R06.

[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] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

[4] Available from American Society of Mechanical Engineers, 345 E. 47th Street, New York, NY 10017.

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. United States

3.1.3 *discharge*—or rate of flow, is the volume of water that passes a particular reference section in a unit of time.

3.1.4 *totalizing flow meter*—a flow meter that indicates the cumulative flow displayed as a volume. The flow rate is calculated based on the time between two readings.

3.2 For definitions of other terms used in this guide, see Terminology D653.

4. Significance and Use

4.1 This guide is limited to the description of test methods typical for measurement of groundwater discharge from a control well.

4.1.1 Controlled field tests are the primary means of determining aquifer properties. Most mathematical equations developed for analyzing field tests require measurement of control well discharge.

4.1.2 Discharge may be needed for evaluation of well design and efficiency.

4.1.3 For aquifer tests, a conceptual model should be prepared to evaluate the proper test method and physical test requirements, such as well placement and design (see Guide D4043). Review the site data for consistency with the conceptual model. Revise the conceptual model as appropriate and consider the implications on the planned activities.

4.1.4 For aquifer tests, the discharge rate should be sufficient to cause significant stress of the aquifer without violating test assumptions. Conditions that may violate test assumptions include conversion of the aquifer from confined to unconfined conditions, lowering the water level in the control well to below the top of the well screen, causing a well screen entrance velocity that promotes well development during the test, or decreasing the filter pack permeability characteristics.

4.1.5 Some test methods described here are not applicable to injection well tests.

4.2 This guide does not apply to test methods used in measurement of flow of other fluids used in industrial operations, such as waste water, sludge, oil, and chemicals.

5. Test Methods

5.1 *Selection of a Well Discharge Rate Measurement Method*—Select a well discharge measurement method based on the desired discharge rate or rates, the desired pumping method, the required accuracy and frequency of measurement, the type of pump discharge and the water conveyance method.

5.2 *Principal Well Discharge Rate Measurement Methods*—A summary of principal methods is given below for typical hydrogeologic testing. Additional information may be found in a publication of the National Institute of Standards and Technology (NIST) (**1**),[5] the American Society of Mechanical Engineers (ASME) (**2**), or in a comprehensive book on the subject of flow meter engineering (**3**). Discharge methods can be classified as open channel flow and closed conduit flow. Open channel flow is limited to calibrated control structures, such as weirs and flumes. Closed conduit flow includes methods such as turbine meters and magnetic meters. Also included are methods that measure the discharge of water from the closed conduit to the air, such as the orifice tube.

5.3 *Open Channel Flow Methods:*

5.3.1 *Weirs*—A weir is a vertical obstruction that restricts the total flow of water in channel. Weirs fall into three general classifications, sharp crested, broad crested, and suppressed. Sharp crested weirs use a flat plate that is configured in a triangular "V" or rectangular shape; they are described in 5.3.1.1. See Test Method D5242. Broad crested weirs are wide rectangular restrictions that are usually only used as spillways in dams. They are not described here. More information on broad crested weirs may be found in Ref (**4**). A third classification of weirs, called suppressed weirs, are more commonly known as flumes. Flumes are discussed in 5.3.2.

5.3.1.1 *Sharp Crested Weirs*—The weir is placed flush against the flowing stream, and the notch is made as sharp as possible using a flat piece of metal with sharp edges forming the weir notch. The relation between the head and the discharge of a weir varies according to the shape of the weir notch. A weir is inexpensive to construct, easy to install and highly accurate when installed and used properly.

5.3.2 *Flume*—A flume is a device that restricts flow in the channel which causes the water to accelerate, producing a corresponding change in the water level. The head can then be related to discharge. Several types of flumes have been developed; the most common flume for measuring well discharge is the Parshall flume, originally designed by R. L. Parshall of the U.S. Soil Conservation Service (**5**). See Test Methods D1941 and D5390.

5.3.2.1 Flumes have several advantages over weirs. The most important of these is the self-cleaning capacity of flumes compared with sharp-edged weirs. Head losses through a flume are also much less than for a weir, so when the available head is limited, flumes are more desirable. Flumes can function over a wide range of discharges and still require only a single upstream head measurement. However, flumes require more time to set up than weirs.

5.4 *Closed Conduit Methods:*

5.4.1 *Invasive Methods:*

5.4.1.1 *Turbine-Type (Propeller) Flow Meters*—A totalizing flow meter is a device used in measuring water in most domestic and commercial potable water uses. This flow meter consists of a flow tube in which a rotor blade is mounted together with either a means of generating an electrical signal proportional to the angular velocity of the rotor or a mechanical system of gears that rotates proportional to the flow volume. The meter is installed as a section of the water line between the pump and the point of discharge. Turbine-type flow meters have a limited operating range. The meter must be calibrated and the pipe must be full. Mechanical turbine meters typically only totalize flow.

5.4.2 *Noninvasive Methods:*

5.4.2.1 *Magnetic Flow Meters*—The magnetic flow meter operates on the same general principle as an electric generator (**2**). The pipe is placed such that the fluid path is normal to the magnetic field. The motion of the fluid through the magnetic field induces an electromotive force across the fluid. By

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

iTeh Standards (https://standards.iteh.ai) Document Preview ASTM D5737-95(2006) https://standards.iteh.ai/catalog/standards/sist/3b73aee0-0c7