



Designation: D5716 – 95(Reapproved 2006)

Standard Test Method for Measuring the Rate of Well Discharge by Circular Orifice Weir¹

This standard is issued under the fixed designation D5716; 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 construction and operation of a circular orifice weir for measuring the discharge from a well. This test method is a part of a series of standards prepared on the in situ determination of hydraulic properties of aquifer systems by single- or multiple-well tests. Selection of a well discharge measurement test method is described in Guide [D5737](#).

1.2 This test method is common to a number of aquifer test methods and to evaluation of well and pump performance.

1.3 *Limitations*—This test method is limited to the description of a method common to hydraulic engineering for the purpose of groundwater discharge measurement in temporary or test conditions.

1.4 Much of the information presented in this test method is based on work performed by the Civil Engineering Department of Purdue University during the late 1940s. The essentials of that work have been presented in a pamphlet prepared by Layne-Bowler, Inc.² and updated by Layne Western Company, Inc.³

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

1.6 *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 applicability of regulatory limitations prior to use.*

¹ This test method 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.

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² *Measurement of Water Flow Through Pipe Orifice With Free Discharge*, Bulletin 501, Layne-Bowler, Inc., Mission, KS, 1958.

³ *Measurement of Water Flow Through Pipe Orifice With Free Discharge*, Layne-Western Company, Inc., Mission, KS, 1988.

2. Referenced Documents

2.1 *ASTM Standards*:⁴

[D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)

[D5737 Guide for Methods for Measuring Well Discharge](#)

3. Terminology

3.1 *Definitions*:

3.1.1 *circular orifice weir*—a circular restriction in a pipe that causes back pressure that can be measured in a piezometer tube. Also called *orifice tube* and *orifice meter*.

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.

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

3.2 For definitions of other terms used in this guide, see Terminology [D653](#).

3.3 *Symbols and Dimensions*:

3.3.1 *A*—orifice plate open area [L^2].

3.3.2 *C*—coefficient of discharge for the orifice [nd].

3.3.3 *g*—acceleration due to gravity [LT^{-2}].

3.3.4 *h*—head in manometer [L].

3.3.5 *Q*—control well discharge [L^3T^{-1}].

3.3.6 *o*—orifice diameter [L].

3.3.7 *d*—pipe inside diameter [L].

4. Summary of Test Method

4.1 This test method involves pumping a control well at a constant or variable rate for a given period of time. Discharge is through an orifice weir that allows determination of the discharge rate.

⁴ 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.

4.2 This test method provides design information for construction of an orifice weir. It also describes setup, operation, inspection, calculation of discharge, and reporting.

5. Significance and Use

5.1 Many mathematical equations for determining aquifer properties based on controlled field tests utilizing a single or multiple-pumping wells include a dependent variable, termed discharge, and generally designated as Q . Equations have been developed for constant and variable discharge. Those for variable discharge may specify regularly increasing, or regularly decreasing, or randomly varying discharge rate.

to a straight horizontal length of discharge pipe. The pipe is at least 6 ft (1.8 m) in length. Twenty-four inches (609 mm) from the end plate and at least 4 ft (1.2 m) from the other end of the discharge pipe, a manometer is attached to the discharge pipe so that the head in the discharge pipe can be measured.

6.1.1 *Orifice Plate*—The orifice is a round hole with clean, square edges in the center of a circular steel plate. The plate must be a minimum of $\frac{1}{16}$ in. (1.59 mm) thick around the circumference of the hole. The remaining thickness of the orifice should be chamfered to 45° and with the chamfered edge down stream.

6.1.2 *Discharge Pipe*—The discharge pipe must be straight

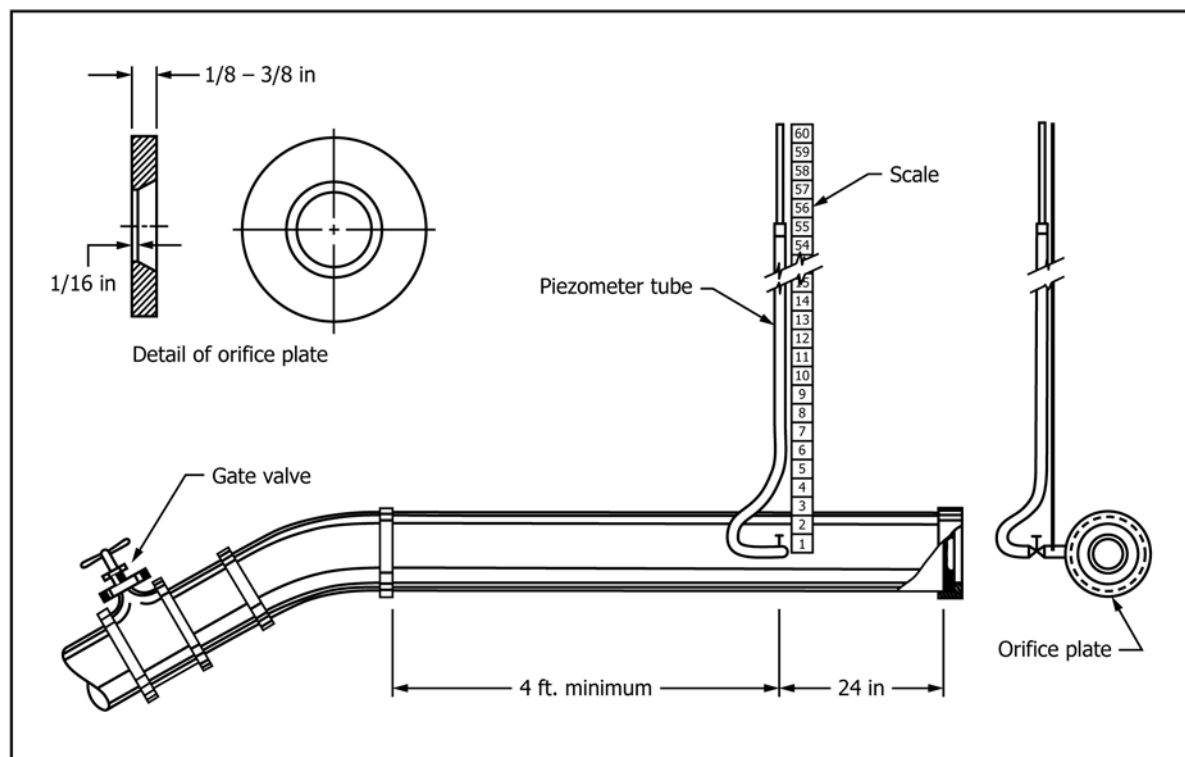


FIG. 1 Construction of a Circular Orifice Weir⁵

5.2 Aquifer testing has been conducted for the purposes of production and pressure relief well design and water resource assessment. Production wells are used for public and industrial water supplies, hydraulic controls, and groundwater capture. Pressure relief wells are for hydraulic controls. Test wells are for the purpose of water resource assessment.

5.3 Discharge must also be known for certain methods to evaluate well and pump performance.

6. Apparatus

6.1 *Construction of a Circular Orifice Weir*—A construction diagram of a circular orifice weir is presented in Fig. 1.⁵ The circular orifice is a hole located in the center of a plate attached

and level for a distance of at least 6 ft (1.8 m) before the water reaches the orifice plate. This approach channel should be longer if possible. The end of the pipe must be cut squarely so the plate will be vertical. The bore of the pipe should be smooth and free of any obstruction that might cause abnormal turbulence.

6.1.3 *Manometer*—The discharge pipe wall is tapped midway between the top and bottom with a $\frac{1}{8}$ -in. (3.17 mm) or $\frac{1}{4}$ -in. (6.35 mm) hole exactly 24 in. (609 mm) from the orifice plate. The manometer should be a distance of at least ten discharge pipe diameters from the gate valve used to control pipe flow. Any burrs inside the pipe resulting from the drilling or tapping of the hole should be filed off. A nipple is screwed into the tapped hole. The nipple must not protrude inside the discharge pipe. A clear plastic tube 4 or 5 ft (1.2 or 1.5 m) long is connected at one end to the nipple. A scale is fastened to a support so that the vertical distance from the center of the

⁵ Driscoll, F. G., *Ground Water and Wells*, Johnson Division, St. Paul, MN, 1986, pp. 537–541.