



Designation: D5920/D5920M – 20

Standard Practice for (Analytical Procedure) Tests of Anisotropic Unconfined Aquifers by Neuman Method¹

This standard is issued under the fixed designation D5920/D5920M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This practice covers an analytical procedure for determining the transmissivity, storage coefficient, specific yield, and horizontal-to-vertical hydraulic conductivity ratio of an unconfined aquifer. It is used to analyze the drawdown of water levels in piezometers and partially or fully penetrating observation wells during pumping from a control well at a constant rate.

1.2 The analytical procedure given in this practice is used in conjunction with Guide [D4043](#) and Test Method [D4050](#).

1.3 The valid use of the Neuman method is limited to determination of transmissivities for aquifers in hydrogeologic settings with reasonable correspondence to the assumptions of the theory.

1.4 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard. Reporting of test result in units other than SI shall not be regarded as nonconformance with this standard.

1.5 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice [D6026](#).

1.5.1 The procedures used to specify how data are collected/recorded or calculated in the standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope

of this standard to consider significant digits used in analysis methods for engineering data.

1.6 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of the practice 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 the 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.*

1.7 *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.*

1.8 *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

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

[D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction](#)

[D4043 Guide for Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques](#)

[D4050 Test Method for \(Field Procedure\) for Withdrawal and Injection Well Testing for Determining Hydraulic Properties of Aquifer Systems](#)

¹ This practice 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 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.

*A Summary of Changes section appears at the end of this standard



D4105/D4105M Practice for (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Modified Theis Nonequilibrium Method

D4106 Practice for (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Theis Nonequilibrium Method

D6026 Practice for Using Significant Digits in Geotechnical Data

3. Terminology

3.1 *Definitions*—For definitions of common technical terms used within this standard, refer to Terminology **D653**.

3.2 *Symbols and Dimensions*:

3.2.1 b [L]*—initial saturated thickness of the aquifer.*

3.2.2 d [L]*—vertical distance between top of screen in pumping well and initial position of the water table.*

3.2.3 d_D [nd]*—dimensionless d , equal to d/b .*

3.2.4 $J_0(x)$ *—zero-order Bessel function of the first kind.*

3.2.5 K_r [LT^{-1}]*—hydraulic conductivity in the plane of the aquifer, radially from the control well.*

3.2.6 K_z [LT^{-1}]*—hydraulic conductivity normal to the plane of the aquifer.*

3.2.6.1 *Discussion*—The use of the symbol K for the hydraulic conductivity is the predominant usage in groundwater literature by hydrogeologists, whereas, the symbol k is commonly used for this term in soil and rock mechanics and soil science.

3.2.7 l [L]*—vertical distance between bottom of screen in control well and initial position of water table.*

3.2.8 l_D [nd]*—dimensionless l , equal to l/b .*

3.2.9 Q [L^3T^{-1}]*—discharge rate.*

3.2.10 r [L]*—radial distance from control well.*

3.2.11 s [L]*—drawdown.*

3.2.12 s_c [L]*—corrected drawdown.*

3.2.13 s_D [nd]*—dimensionless drawdown, equal to $4\pi Ts/Q$.*

3.2.14 s_{wt} [L]*—drawdown of the water table.*

3.2.15 S [nd]*—storage coefficient, equal to $S_s b$.*

3.2.16 S_s [L^{-1}]*—specific storage.*

3.2.17 S_y [nd]*—specific yield.*

3.2.18 t [T]*—time since pumping started.*

3.2.19 t_r [T]*—time since recovery started.*

3.2.20 t_s [nd]*—dimensionless time with respect to S_s , equal to Tt/Sr^2 .*

3.2.21 t_y [nd]*—dimensionless time with respect to S_y , equal to $Tt/S_y r^2$.*

3.2.22 t_β [T]*—time, t , corresponding to intersection of a horizontal line through the intermediate data with an inclined line through late data on semilogarithmic paper.*

3.2.23 $t_{y\beta}$ [nd]*—dimensionless time, t_y , corresponding to the intersection of a horizontal line through intermediate data with an inclined line through late data in Fig. 1.*

3.2.24 $(t/r^2)_e$ [T]*— t/r^2 corresponding to the intersection of a straight line through the early data with $s = 0$ on semilogarithmic paper [TL^{-2}].*

3.2.25 $(t/r^2)_l$ [T]*— t/r^2 corresponding to the intersection of a straight line through the late data with $s = 0$ on semilogarithmic paper.*

3.2.26 T [L^2T^{-1}]*—transmissivity, K_b .*

3.2.27 z [L]*—vertical distance above the bottom of the aquifer.*

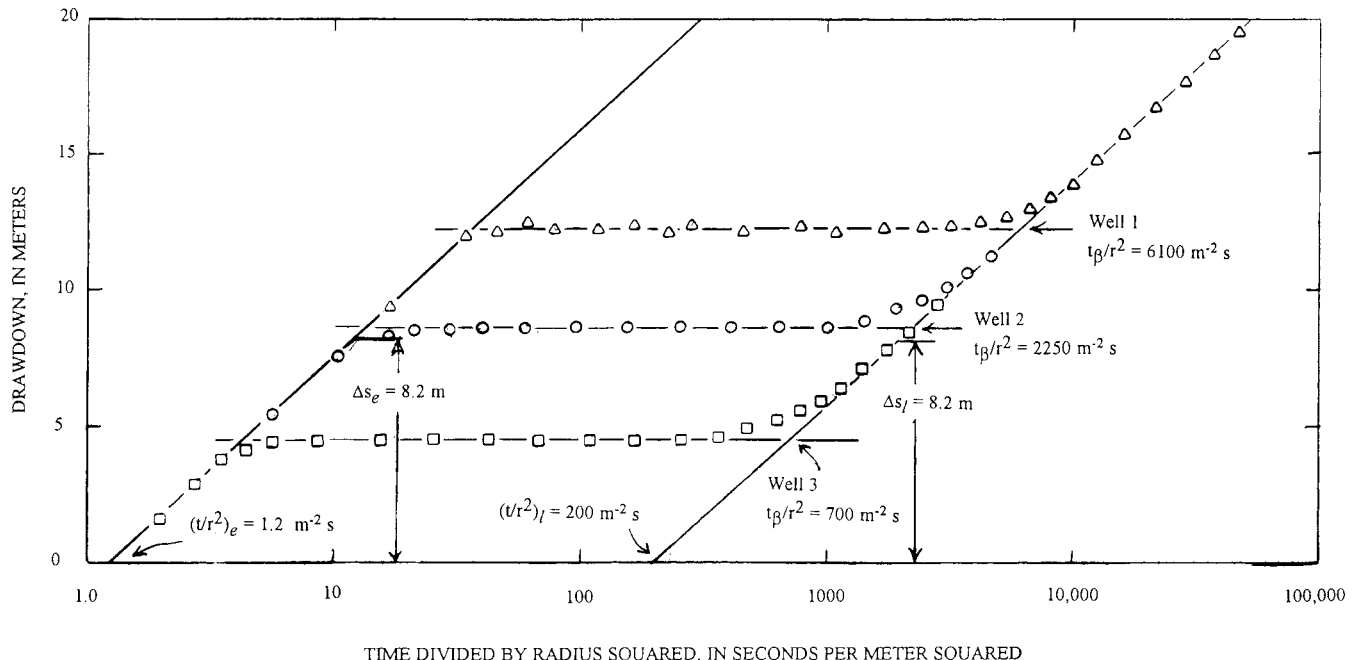


FIG. 1 Aquifer-Test Analysis, Example Two