



Standard Test Method for Determining Transmissivity and Storativity of Low Permeability Rocks by In Situ Measurements Using Pressure Pulse Technique¹

This standard is issued under the fixed designation D 4631; 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 a field procedure for determining the transmissivity and storativity of geological formations having permeabilities lower than $10^{-3} \mu\text{m}^2$ (1 millidarcy) using the pressure pulse technique.

1.2 The transmissivity and storativity values determined by this test method provide a good approximation of the capacity of the zone of interest to transmit water, if the test intervals are representative of the entire zone and the surrounding rock is fully water saturated.

1.3 The values stated in SI units are to be regarded as the standard.

1.4 *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.*

2. Terminology

2.1 Definitions of Terms Specific to This Standard:

2.1.1 *transmissivity, T*—the transmissivity of a formation of thickness, *b*, is defined as follows:

$$T = K \cdot b \quad (1)$$

where:

K = equivalent formation hydraulic conductivity (efhc).

The efhc is the hydraulic conductivity of a material if it were homogeneous and porous over the entire interval. The hydraulic conductivity, *K*, is related to the equivalent formation, *k*, as follows:

$$K = k\rho g/\mu \quad (2)$$

where:

ρ = fluid density,

μ = fluid viscosity, and

g = acceleration due to gravity.

2.1.2 *storativity, S*—the storativity (or storage coefficient) of a formation of thickness, *b*, is defined as follows:

$$S = S_s \cdot b \quad (3)$$

where:

S_s = equivalent bulk rock specific storage (ebrss).

The ebrss is defined as the specific storage of a material if it were homogeneous and porous over the entire interval. The specific storage is given as follows:

$$S_s = \rho g(C_b + nC_w) \quad (4)$$

where:

C_b = bulk rock compressibility,

C_w = fluid compressibility, and

n = formation porosity.

2.2 Symbols:

2.2.1 *C_b*—bulk rock compressibility [$M^{-1}LT^{-2}$].

2.2.2 *C_w*—compressibility of water [$M^{-1}LT^{-2}$].

2.2.3 *K*—hydraulic conductivity [LT^{-1}].

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

2.2.4 *L*—length of packed-off zone [*L*].

2.2.5 *P*—excess test hole pressure [$ML^{-1}T^{-2}$].

2.2.6 *P_o*—initial pressure pulse [$ML^{-1}T^{-2}$].

2.2.7 *S*—storativity (or storage coefficient) (dimensionless).

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

2.2.9 *T*—transmissivity [L^2T^{-1}].

2.2.10 *V_w*—volume of water pulsed [L^3].

2.2.11 *b*—formation thickness [*L*].

2.2.12 *e*—fracture aperture [*L*].

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

2.2.14 *k*—permeability [L^2].

2.2.15 *n*—porosity (dimensionless).

2.2.16 *r_w*—radius of test hole [*L*].

2.2.17 *t*—time elapsed from pulse initiation [*T*].

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 Ground Water and Vadose Zone Investigations.

Current edition approved Oct. 10, 1995. Published March 1996. Originally published as D 4631 – 86. Discontinued April 1995 and reinstated as D 4631 – 95.