Measuring Conductivity of Proppants

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Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001, standards@api.org.

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Introduction

This document is largely based on API Recommended Practice 61, “Recommended Practices for Evaluating Short Term Proppant Pack Conductivity.” Informative references are also included in the bibliography.

The tests and test apparatus herein have been developed to establish standard procedures and conditions for use in evaluating the conductivity of various hydraulic fracture proppant materials under laboratory conditions. This procedure enables users to compare the conductivity characteristics under the specifically described test conditions. The test results can aid users in comparing proppant materials for use in hydraulic fracturing operations.

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This document uses a format for numbers which follows the examples given in API *Document Format and Style Manual*, First Edition, June 2007 (Editorial Revision, November 2017). This numbering format is different than that used in API 19D, First Edition. In this document the decimal mark is a period and separates the whole part from the fractional part of a number. No spaces are used in the numbering format. The thousands separator is a comma and is only used for numbers greater than 10,000, i.e. 5000 items, 12,500 bags.

In this document, where practical, U.S. customary (USC) units are included in parentheses for information. The units do not necessarily represent a direct conversion of metric units (SI) to US Customary units, or USC units to SI units. Consideration has been given to the precision of the instrument making the measurement. Consideration has also been given to the nature of the measurement, is it critical or simply informational.

In this document, calibrating an instrument refers to assuring the accuracy of the measurement. Accuracy is the degree of conformity of a measurement of a quantity to its actual or true value. Accuracy is related to precision, or reproducibility, of a measurement. Precision is the degree to which further measurements or calculations will show the same or similar results. Precision is characterized in terms of the standard deviation of the measurement. The results of calculations or a measurement can be accurate, but not precise, precise but not accurate, neither or both. A result is valid if it is both accurate and precise.

Measuring Conductivity of Proppants

1 Scope

This standard provides recommended testing procedures for evaluating proppants used in hydraulic fracturing and gravel-packing operations.

NOTE The "proppants" mentioned henceforth in this document refer to natural sand, ceramic media, resin-coated proppants, gravel packing media, and other materials used for hydraulic fracturing and gravel-packing operations.

The objective of the document is to provide consistent methodology for testing procedures used to measure performance of hydraulic-fracturing or gravel-packing proppants, or both. The testing procedures in this document are not designed to provide values of proppant conductivity under downhole reservoir conditions. Long-term test data have shown that time, elevated temperatures, fracturing fluid residues, cyclic stress loading, embedment, formation fines and other factors further reduce fracture proppant pack conductivity. Also, this reference test is designed to measure only the frictional energy losses corresponding to laminar flow within a pack. It is recognized that fluid velocity within an actual fracture can be significantly higher than in these laboratory tests and can be dominated by inertial effects.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced standard (including any amendments) applies.

API Standard 19C, *Measurement of and Specifications for Proppants Used in Hydraulic Fracturing and Gravel-packing Operations*

ISO [1] 3506-1, *Mechanical properties of corrosion-resistant stainless-steel fasteners — Part 1: Bolts, screws, and studs*

3 Terms, Definitions, Symbols, and Abbreviations

3.1 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
conductivity
Width of the fracture multiplied by the permeability of the proppant pack

3.1.2
laminar flow
Darcy flow
Type of streamlined flow for single-phase fluids in which the fluid moves in parallel layers, or laminae, such that the layers flow smoothly over each other with instabilities being dampened by the viscosity.

3.1.3
permeability (*k*)
A measure of the ability of a porous medium to allow flow of fluid or gases.

[1] International Organization for Standardization, 8 chemin de Blandonnet, CP401, 1214 Vernier, Switzerland; www.iso.org.