INTERNATIONAL STANDARD

ISO 13503-4

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Petroleum and natural gas industries — Completion fluids and materials —

Part 4: Procedure for measuring stimulation and gravel-pack fluid leakoff under static conditions

Industries du pétrole et du gaz naturel — Fluides de complétion et matériaux —

Partie 4: Mode opératoire pour mesurer la stimulation et la fuite du fluide filtrant dans des conditions statiques

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13503-4 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 3, *Drilling and completion fluids, and well cements*.

ISO 13503 consists of the following parts, under the general title *Petroleum and natural gas industries — Completion fluids and materials*:

— *Part 1: Measurement of viscous properties of completion fluids*

— *Part 2: Measurement of properties of proppants used in hydraulic fracturing and gravel-packing operations*

— *Part 3: Testing of heavy brines*

— *Part 4: Procedure for measuring stimulation and gravel-pack fluid leakoff under static conditions*

— *Part 5: Procedures for measuring the long-term conductivity of proppants*

Introduction

The objective of this part of ISO 13503 is to provide a standard procedure for measuring fluid loss under static conditions. This standard procedure was compiled on the basis of several years of comparative testing, debate, discussion and continued research by the industry[1)].

In this part of ISO 13503, where practical, US Customary (USC) units are included in parentheses for information.

1) PENNY, G.S. and CONWAY, M.W. Fluid Leakoff, *Recent Advances in Hydraulic Fracturing*, J.L. Gidley, S.A. Holditch. D.E. Nierode and R.W. Veatch Jr. (eds), SPE Monograph 1989.

Petroleum and natural gas industries — Completion fluids and materials —

Part 4: Procedure for measuring stimulation and gravel-pack fluid leakoff under static conditions

1 Scope

This part of ISO 13503 provides for consistent methodology to measure fluid loss of stimulation and gravel-pack fluid under static conditions. However, the procedure in this part of ISO 13503 excludes fluids that react with porous media.

2 Terms and definitions

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

2.1
base fluid
solution media used to prepare completion fluid

2.2
filtrate
fluid that permeates into the porous medium

2.3
filter cake
build-up of materials on the face or within the matrix of porous medium due to fluid leakoff

2.4
fluid loss
fluid loss is a measure of fluid volume that leaks into a porous medium over time

2.5
gravel-pack fluids
fluids used to place filtration media to control formation sand production from oil and gas wells

2.6
leakoff
entry of fluid into a porous media

2.7
pH
negative of the logarithm (base 10) of the hydrogen ion concentration

2.8
spurt time
time between the initial entry of fluid into porous medium and the onset of square-root-of-time leakoff behaviour

2.9
shut-in time
time from loading the cell to the initiation of leakoff test

2.10
spurt loss
theoretical loss of fluid/filtrate at first exposure of that fluid into a porous medium

2.11
stimulation fluids
fluids used to enhance production from oil and gas wells by fracturing or acidizing

2.12
viscosity-controlled fluid-loss coefficient
measure of the leakoff rate controlled by the viscosity of filtrate

2.13
viscosity of fluid
measure of the internal friction of a fluid whenever it is caused to move by an external force

2.14
wall-building coefficient
measure of the leakoff rate due to filter cake formation

3 Measurement and precision

Temperature shall be measured to a precision of ± 1 °C (± 2 °F). All other quantitative measurements shall be made to a precision of ± 2 %, unless specified otherwise.

4 Fluid preparation

Certain aspects of sample preparation and handling can affect properties of a fluid. During all procedures, steps shall be taken to minimize air entrainment into the fluid.

The procedure used to prepare the fluid sample shall be documented as follows:

a) description and/or composition of the base fluid;

b) base fluid pre-treatment such as filtration;

c) preparation of the fluid, which shall be described, starting with the base fluid, such as deionized water, tap water source, seawater (location) or type of organic fluids;

d) identification of mixing apparatus, container volume and total volume of fluid prepared;

e) time of mixing [should include mixing time(s) at one or more mixer speed(s)];

f) identification of each component and amount added;

g) order and method of addition of each component;

h) aging or holding time at temperature, if required, prior to tests;

i) test temperature;

j) pH (for aqueous fluids, where applicable);

k) all other aspects of the fluid preparation that are known to affect the outcome of measurement.

5 Instrument calibration

The instruments associated with these procedures shall be calibrated according to each manufacturer's recommended method.

6 Measurement procedure

6.1 Introduction

6.1.1 General considerations

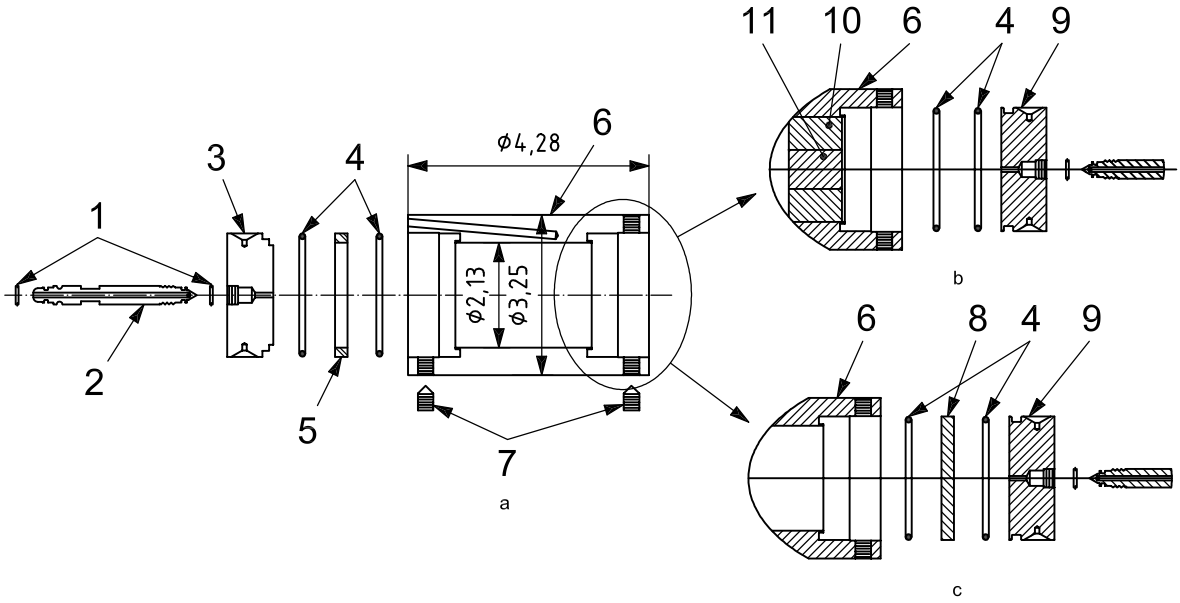
Fluid-loss tests are conducted to simulate leakoff into a formation. Fluid-loss tests measure the rate of leakoff into a porous medium to calculate fluid-loss coefficients to guide engineering design of well completion operations.

This part of ISO 13503 provides guidelines on known limitations to the testing procedure. Where data are reported as being obtained using this procedure, the procedure shall be followed exactly. The fluid shall not react with instrument surfaces to generate contaminants, change critical measurement dimensions or impair proper mechanical operation.

6.1.2 Apparatus

Figures 1 and 2 present drawings of two types of typical static fluid-loss apparatus [2] with 175 ml and 500 ml capacities, respectively.

2) Examples of suitable fluid-loss cells are Baroid HPHT Filter Press Part Number 38700 and Chandler Engineering Model 4214. This information is given for the convenience of users of this part of ISO 13503 and does not constitute an endorsement by ISO of these products.

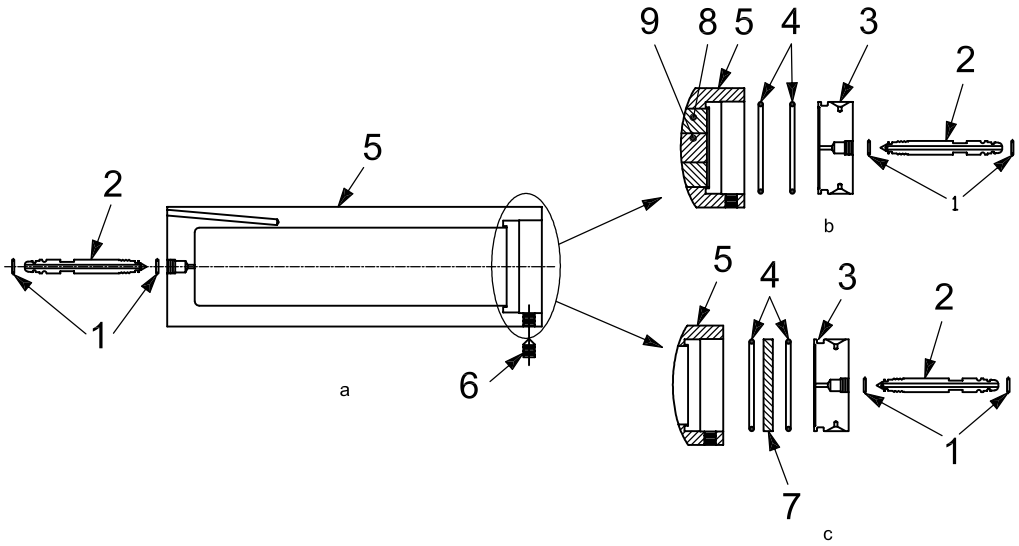


Key

1 O-ring seal
2 stem/valve
3 top cap
4 O-ring seal
5 backup ring
6 cell body
7 set screw
8 filter-paper assembly or synthetic core
9 bottom cap
10 seal mechanism
11 natural core

a Assembly fluid-loss cell, 175 ml, 12 400 kPa (1 800 psi), 303 SS.
b Natural core.
c Synthetic core or filter-paper assembly.

Figure 1 — Typical 175 ml fluid-loss cell



Key

1 O-ring seal
2 stem/valve
3 bottom cap
4 O-ring seal
5 cell body
6 set screw
7 filter-paper assembly or synthetic core
8 seal mechanism
9 natural core

a Assembly fluid-loss cell, 500 ml, 12 400 kPa (1 800 psi), 303 SS.
b Natural core.
c Synthetic core or filter-paper assembly.

Figure 2 — Typical 500 ml fluid-loss cell

The type of fluid-loss cell is not specified. However, the fluid-loss cell should permit use of filter paper, natural- or synthetic-core samples as the filter medium. It shall be further equipped with a back-pressure receiver to be used when the test temperature exceeds the boiling point of the filtrate. Both the fluid-loss cell and back-pressure receiver shall have operating limits of at least 10 342 kPa (1 500 psi) and 121° C (250 °F). The test core or filter medium shall be mounted within the cell in such a way that fluid cannot bypass the core or filter medium. A schematic diagram of fluid-loss apparatus is shown in Figure 3.