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Australia



# Petroleum and natural gas industries — Completion fluids and materials

## Part 1: Measurement of viscous properties of completion fluids



AS ISO 13503.1:2024

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- Australian Energy Producers
- Australian Industry Group
- Australian Organisation for Quality
- Australian Pipelines and Gas Association
- Department for Energy and Mining (SA)
- Department of Industry, Tourism and Trade (NT)
- DNV
- Energy Safe Victoria
- Engineers Australia
- National Energy Resources Australia
- Office of Energy and Climate Change-NSW Treasury
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# Petroleum and natural gas industries — Completion fluids and materials

## Part 1: Measurement of viscous properties of completion fluids

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## Preface

This Standard was prepared by the Standards Australia Committee ME-092, Oil and gas industries including lower carbon energy.

The objective of this document is to provide consistent methodology for determining the viscosity of completion fluids used in the petroleum and natural gas industries. For certain cases, methods are also provided to determine the rheological properties of a fluid.

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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 13503-1 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*.

This second edition cancels and replaces the first edition (ISO 13503-1:2003), which has been technically revised. It also incorporates the Technical Corrigendum ISO 13503-1:2003/Cor.1:2005.

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*
- *Part 6: Procedure for measuring leakoff of completion fluids under dynamic conditions*

## Introduction

For the purposes of this part of ISO 13503, completion fluids are defined as viscosified treating fluids used during the completion or workover of a petroleum- or natural-gas-producing well. The objective of this part of ISO 13503 is to provide a standard procedure for measuring the viscous properties of single-phase, non-particulate-laden completion fluids. These fluids are viscosified brines, gravel-pack carrier fluids, and fracturing fluids. These fluids can be either crosslinked or non-crosslinked (aqueous, hydrocarbon- or acid-based).

An optional shear-history simulation procedure is provided for fluids that are potentially shear-sensitive. This procedure is designed to simulate the shearing effects experienced by a fluid in surface apparatus and during the time it is being conveyed down the wellbore. Shear-history simulation is most often used during the development of new fracturing fluids to characterize their sensitivity to shear.

These standard procedures were compiled on the basis of several years of comparative testing, debate, discussion, and continued research by the industry.

This standard procedure is largely based on API RP 13M, first edition, July 2004.

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

## NOTES

# Australian Standard®

## Petroleum and natural gas industries — Completion fluids and materials

### Part 1: Measurement of viscous properties of completion fluids

#### 1 Scope

This part of ISO 13503 provides consistent methodology for determining the viscosity of completion fluids used in the petroleum and natural gas industries. For certain cases, methods are also provided to determine the rheological properties of a fluid.

#### 2 Terms and definitions

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

##### 2.1

##### **bob**

inner cylinder of a concentric-cylinder viscometer

##### 2.2

##### **completion fluid**

viscosified treating fluid used during the completion or workover of a petroleum- or natural-gas-producing well

##### 2.3

##### **concentric-cylinder viscometer**

rotational viscometer that consists of a concentric-cylindrical bob and a cylindrical rotor

##### 2.4

##### **elasticity**

capability of a material to regain its original shape and condition upon removal of an acting stress

##### 2.5

##### **laminar flow**

flow property of fluids in which all layers of the fluid move parallel to each other and no material is transferred between layers

##### 2.6

##### **non-crosslinked fluid**

linear, polymer-viscosified solution or any fluid that does not exhibit significant elasticity leading to the Weissenberg effect (bob climbing)

##### 2.7

##### **rheology**

science of the deformation and flow of matter

##### 2.8

##### **rotor**

outer rotating cylinder of a concentric-cylinder viscometer

##### 2.9

##### **shear history**

sequence of shear rates and temperatures applied to fluids prior to and during measurements

##### 2.10

##### **shear-history simulator**

apparatus used to simulate shear history in a fluid

**2.11****shear rate**

rate at which one particle of fluid is sliding by another particle divided by the distance between those particles

**2.12****shear stress**

force required to sustain fluid flow

**2.13****viscoelastic fluid**

crosslinked polymer solution or other fluid that exhibits significant elasticity, leading to the Weissenberg effect (bob climbing)

**2.14****viscosity**

measure of the internal friction of a fluid when caused to flow by an external force

**3 Measurement and precision**

Temperatures shall be measured to an accuracy of  $\pm 1$  °C ( $\pm 2$  °F); pH shall be measured to an accuracy of  $\pm 0,1$  units. All other quantitative measurements shall be made to an accuracy of  $\pm 2$  %, unless specified otherwise.

**4 Fluid preparation**

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

The procedure used to prepare the fluid sample shall be documented, including the following information:

- a) description and/or composition of the base fluid; preparation of the fluid shall be described, starting with the fluid source, such as deionized water, tap water, completion brines, produced water, seawater or type of oil;
- b) identification of mixing apparatus, container volume, and total volume of fluid prepared;
- c) identification of each fluid component and amount added;
- d) the order and method of addition of each component;
- e) mixing speeds, with time at each speed;
- f) ageing or holding time prior to measurements, if required;
- g) temperature;
- h) pH (for aqueous fluids);
- i) all other aspects of the fluid preparation which are known to affect the outcome of the viscosity measurement, such as filtration of completion fluids.