SIST

SLOVENSKI STANDARD
oSIST prEN ISO 10426-5:2023

01-december-2023

Naftna in plinska industrija, vključno z nizkoogljično energijo - Cementi in materiali za cementiranje vrtin - 5. del: Določevanje krčenja in širjenja cementnih mešanic za vrtine (ISO/DIS 10426-5:2023)

Oil and gas industries including lower carbon energy - Cements and materials for well cementing - Part 5: Determination of shrinkage and expansion of well cement formulations (ISO/DIS 10426-5:2023)

Öl- und Gasindustrie einschließlich kohlenstoffarmer Energieträger - Zemente und Materialien für die Zementation von Tiefbohrungen - Teil 5: Bestimmung der Schrumpfung und Quellung von Bohrloch-Zementmischungen bei atmosphärischem Druck (ISO/DIS 10426-5:2023)

Industries du pétrole et du gaz, y compris les énergies à faible teneur en carbone - Ciments et matériaux pour la cimentation des puits - Partie 5: Détermination du retrait et de l'expansion des formulations de ciments pour puits (ISO/DIS 10426-5:2023)

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ICS:

75.180.10	Oprema za raziskovanje, vrtanje in odkopavanje	Exploratory, drilling and extraction equipment
91.100.10	Cement. Mavec. Apno. Malta	Cement. Gypsum. Lime. Mortar

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Oil and gas industries including lower carbon energy — Cements and materials for well cementing —

Part 5:
Determination of shrinkage and expansion of well cement formulations

ICS: 75.020; 91.100.10

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Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, Subcommittee SC 3, *Drilling and completion fluids, well cements and treatment fluids*.

This second edition cancels and replaces the first edition (ISO 10426-5:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

— Addition of an introduction, with background information on expansion and shrinkage.

— Inclusion of an informative annex describing a method to determine the stress generated by expansion under confined conditions at elevated temperature and pressure.

A list of all parts in the ISO 10426 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

When Portland cement reacts with water, there is an overall reduction in the absolute volume of components:

$$Volume_{cement} + Volume_{water} > Volume_{cement\ hydrates}$$

In this document the absolute volume decrease [$(Volume_{cement} + Volume_{water}) - Volume_{cement\ hydrates}$] is referred to as hydration shrinkage, although in other documents it may also be referred to as chemical shrinkage, total chemical contraction, or hydration volume reduction.

Depending on the exposure conditions, most influentially access to external water and presence of external stresses during setting, the hydration shrinkage may lead to bulk shrinkage of the set cement.

The change in the sample dimensions will be referred to as bulk shrinkage or expansion. Bulk shrinkage and expansion of the cement refer to the result of the measurement of a linear dimensional change or volume change. The volume to which all volume changes are related is the volume of the slurry immediately after mixing and emplacement in the experimental equipment. For small values of shrinkage or expansion, typically the case in well cement systems, the fractional volume dimensional change can be approximated as 3 times the fractional linear dimensional change.

Bulk shrinkage may cause:

— formation of a micro-annulus, resulting in a poor cement evaluation log;

— loss of zonal isolation leading to crossflow or sustained casing pressure;

— lack of a hydraulic seal when using cement inflatable packers;

— poor sealing of abandonment plugs.

Additives have been identified that can overcome the effects of hydration shrinkage and generate bulk expansion of set cement.

In this part of ISO 10426, units are given as SI, and where practical, U.S. Customary units are included in brackets for information.

Users of this part of ISO 10426 should be aware that further or differing requirements might be needed for individual applications. This part of ISO 10426 is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This can be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this International Standard and provide details.

This part of ISO is based on API Technical Report 10TR 2.

Oil and gas industries including lower carbon energy — Cements and materials for well cementing —

Part 5: Determination of shrinkage and expansion of well cement formulations

1 Scope

This document provides the methods for the testing of well cement formulations to determine the dimension changes during the curing process (cement hydration) at atmospheric pressure and the stress generated by expansion in a confined environment under elevated temperature and pressure.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Specification 10A, *Cements and Materials for Well Cementing*

API Recommended Practice 10B-2, *Recommended Practice for Testing Well Cements*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
bulk expansion
increase in the external volume or dimensions of a cement sample

3.2
bulk shrinkage
decrease in the external volume or dimensions of a cement sample

3.3
cement expansion additive
cea
additive used in a cement slurry formulation to provide bulk expansion, or reduce bulk shrinkage

3.4
hydration shrinkage
difference in the volume between the hydration products and the volume of the dry cement, additives and water

3.5
interface stress
stress generated at the interface between the set cement and casing or borehole wall due to bulk shrinkage or expansion of the cement

3.6
ultrasonic cement analyser
UCA
instrument used for the non-destructive sonic determination of compressive strength of cement

4 Determination of shrinkage or expansion under conditions of free access to water at atmospheric pressure — Annular ring test

4.1 General information

The annular expansion mould is a device suitable for measuring only the linear bulk shrinkage or expansion properties of a cement formulation. The magnitude of expansion depends on the amount and type of expanding agent, cement powder, slurry design and curing condition (pressure, temperature, time, fluid access). It should be noted that expansion is strongly affected by boundary conditions. The chemical process of mineral growth is strongly controlled by the state of stress and mineral growth will tend to occur relatively more in low stress locations, for example in pore spaces. Therefore, the degree of cement shrinkage and expansion is dependent on several conditions, not all of which can be uniquely defined. The test does not fully represent the annulus of a well.

4.2 Apparatus

4.2.1 Mould

4.2.1.1 General

Use corrosion-resistant material (e.g. stainless steel). The outer diameter (OD) of the inner ring shall be 50,8 mm ± 0,3 mm (2,0 in ± 0,01 in) and the inner diameter (ID) of the outer expansion ring shall be 88,9 mm ± 0,3 mm (3,5 in ± 0,01 in). See Figures 1, 2 and 3.

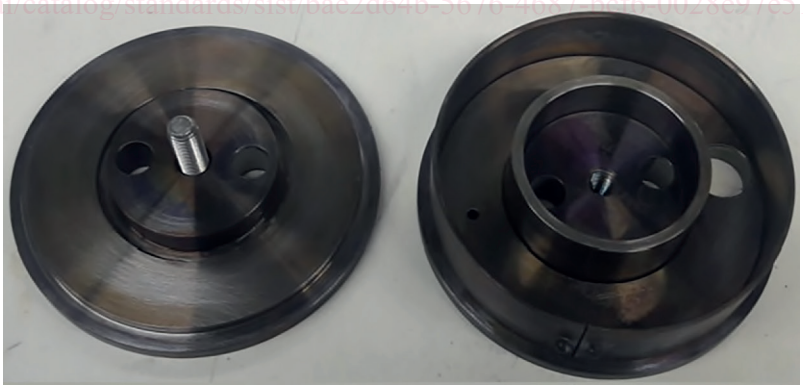

Figure 1 — Typical mould assembly - Left: bottom plate - Right: Inner and outer rings placed on the top plate (step D of 4.3.1)