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Petroleum and natural gas industries — Equipment for well cementing —

Part 2:
Centralizer placement and stop-collar testing

Industries du pétrole et du gaz naturel — Équipement de cimentation de puits —

Partie 2: Mise en place des centreurs et essai des colliers d'arrêt

Reference number
ISO 10427-2:2004(E)

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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.

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ISO 10427-2 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 first edition of ISO 10427-2, together with ISO 10427-1 and ISO 10427-3, cancels and replaces ISO 10427:1993, which has been technically revised.

ISO 10427 consists of the following parts, under the general title *Petroleum and natural gas industries — Equipment for well cementing*:

- *Part 1: Casing bow-spring centralizers*
- *Part 2: Centralizer placement and stop-collar testing*
- *Part 3: Performance testing of cementing float equipment*

Introduction

This part of ISO 10427 is based on API Specification 10D, 5th edition, January 1995 [1].

In this part of ISO 10427, where practical, U.S. Customary units are included in brackets for information.

Petroleum and natural gas industries — Equipment for well cementing —

Part 2:
Centralizer placement and stop-collar testing

1 Scope

This part of ISO 10427 provides calculations for determining centralizer spacing, based on centralizer performance and desired standoff, in deviated and dogleg holes in wells for the petroleum and natural gas industries. It also provides a procedure for testing stop collars and reporting test results.

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 document (including any amendments) applies.

ISO 11960, *Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells*

3 Terms and definitions

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

3.1
annular clearance for perfectly centred casing
wellbore diameter minus casing outside diameter divided by two

3.2
centralizer permanent set
change in centralizer bow height after repeated flexing

NOTE A bow-spring centralizer is considered to have reached permanent set after being flexed 12 times.

3.3
flexed
condition of a bow-spring when a force three times the specified minimum restoring force (± 5 %) has been applied to it

[ISO 10427-1:2001, 3.1]

NOTE Specified minimum restoring force values are found in Table 1 of ISO 10427-1:2001.

3.4
holding device

device employed to fix the stop collar or centralizer to the casing

EXAMPLE Set screws, nails, mechanical dogs and epoxy resins.

[ISO 10427-1:2001, 3.2]

3.5
holding force

maximum force required to initiate slippage of a stop collar on the casing

[ISO 10427-1:2001, 3.3]

3.6
hole size

diameter of the wellbore

[ISO 10427-1:2001]

3.7
limit clamp

equivalent term for a stop collar

3.8
restoring force

force exerted by a centralizer against the casing to keep it away from the wellbore wall

NOTE Restoring-force values can vary based on the installation methods.

[ISO 10427-1:2001, 3.5]

3.9
rigid centralizer

centralizer manufactured with bows, blades or bars that do not flex

NOTE Adapted from ISO 10427-1:2001, 3.6.

3.10
running force

maximum force required to move a centralizer through a specified wellbore diameter

NOTE Running-force values can vary based on the installation methods.

[ISO 10427-1:2001]

3.11
sag point

point where the casing deflection is at a maximum

NOTE Casing that is supported at two points will tend to sag between the support points, this sag is called the casing sag or casing deflection.

3.12
slippage force range

range of forces required to continue to move a stop collar after the holding force has been overcome

3.13
solid centralizer
centralizer manufactured in such a manner as to be a solid device with nonflexible fins or bands

NOTE These centralizers have solid bodies and solid blades.

3.14
standoff
smallest distance between the outside diameter of the casing and the wellbore

[ISO 10427-1:2001, 3.8]

3.15
standoff ratio
R_s
ratio of standoff to annular clearance for perfectly centred casing

NOTE 1 It is expressed as a percentage.

NOTE 2 Adapted from ISO 10427-1:2001, 3.9.

3.16
starting force
maximum force required to insert a centralizer into a specified wellbore diameter

NOTE Starting-force values can vary based on the installation methods.

[ISO 10427-1:2001, 3.10]

3.17
stop collar
device attached to the casing to prevent movement of a casing centralizer

NOTE A stop collar can be either an independent piece of equipment or integral with the centralizer.

[ISO 10427-1:2001, 3.11]

4 Methods for estimating centralizer placement

4.1 General

The equations presented below are based on certain assumptions and are considered sufficiently accurate for general use. More specific calculations based on complete wellbore data may be available but are beyond the scope of this document.

There is no recommendation or requirement for a specific standoff ratio for casing centralization. The standoff ratio of 67 % is used in the specification for the purpose of setting a minimum standard for performance of casing bow-spring centralizers only. This number is used only in the specifications for bow-spring type centralizers and deals with the minimum force for each size of centralizer at that standoff. The 67 % standoff ratio is not intended to represent the minimum acceptable amount of standoff required to obtain successful centralization of the casing. The user is encouraged to apply the standoff ratio required for specific well conditions based on well requirements and sound engineering judgement.

Even a minor change in inclination and/or azimuth, with the string of casing hanging below it, materially affects the standoff and the requirements for centralizer placement.

The lateral load (force) on a centralizer is composed of two components. The first is the weight component of the section of pipe supported by the centralizer, and the second is the tension component exerted by the pipe hanging below the centralizer.

4.2 Standoff ratio calculation

Annular clearance (l_a) for perfectly centred casing can be calculated as follows (see Figure 1):

$$l_a = \frac{D_w - D_p}{2} \tag{1}$$

where

l_a is the annular clearance for perfectly centred casing, expressed in metres (inches);

D_w is the wellbore diameter, expressed in metres (inches);

D_p is the casing outside diameter, expressed in metres (inches).

The standoff at the centralizer in a given hole size is represented by the symbol S_c (see Figure 1). The standoff at a bow-spring centralizer is taken from the load deflection curve of the centralizer, tested in that hole size, based upon the lateral load applied (see ISO 10427-1:2001, A.1 [2]).

NOTE Differences in hole size alter the load-deflection curve of a centralizer.

Since the bows or blades of a solid or rigid centralizer do not deflect, the standoff at the centralizer is determined using the rigid or solid blade diameter as follows:

$$S_c = \frac{D_c - D_p}{2} \tag{2}$$

where

S_c is the standoff at the centralizer, expressed in metres (inches);

D_c is the outside diameter of the centralizer solid or rigid blades, expressed in metres (inches).

Standoff at the sag point may be determined by Equation (3), which considers the deflection of the casing string and compression of the centralizers due to lateral load (Figure 1).

$$S_s = S_c - \delta \tag{3}$$

where

S_s is the standoff at the sag point, expressed in metres (inches);

δ is the maximum deflection of the casing between centralizers, expressed in metres (inches).

The minimum standoff may occur at the location between centralizers where the deflection (δ) of the casing is at its maximum or at the centralizers. Therefore, standoff (S) of a section of casing is the minimum value of standoff at the centralizers (S_c) or standoff at the sag point (S_s).

The standoff ratio (R_s) may be calculated as follows:

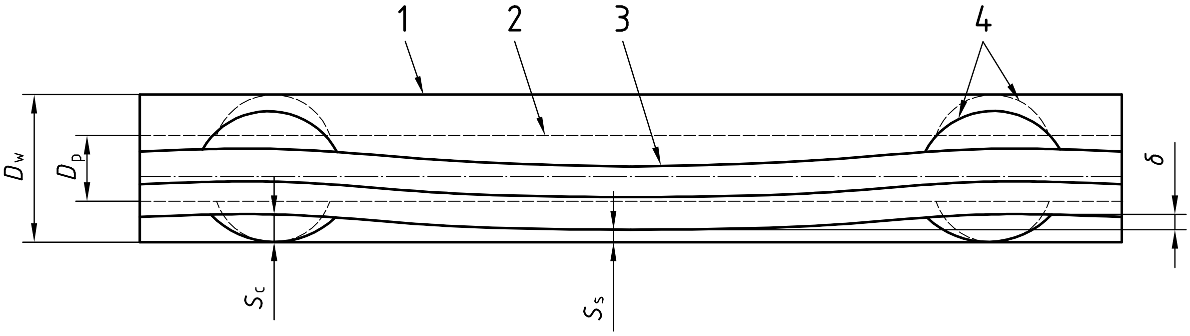
$$R_s = \frac{S}{l_a} \times 100 \tag{4}$$

where

R_s is the standoff ratio, expressed as a percentage;

S is the standoff, expressed in metres (inches);

l_a is the annular clearance for perfectly centred casing, expressed in metres (inches).



Key

1	wellbore
2	casing (perfectly centred)
3	casing (deflected)
4	centralizer

δ	maximum casing deflection
D_p	casing outside diameter
D_w	wellbore diameter
S_c	standoff at the centralizer
S_s	standoff at the sag point

Figure 1 — Calculation of casing standoff in a wellbore

4.3 Buoyed weight of casing

4.3.1 General

The buoyed weight of casing is the effective weight of the casing in the well. Consideration is given to the densities of the fluids inside and outside the casing, and the weight of the casing in air.

4.3.2 Generalized equation

The following is a generalization of the treatment of effective weight of casing to accommodate different internal and external fluids, based upon a model developed by Juvkam-Wold and Baxter [3].

$$W_b = W \cdot f_b \tag{5}$$

$$f_b = \frac{\left(1 - \dfrac{\rho_e}{\rho_s}\right) - \left(\dfrac{D_i}{D_p}\right)^2 \left(1 - \dfrac{\rho_i}{\rho_s}\right)}{\left(1 - \dfrac{D_i^2}{D_p^2}\right)} \tag{6}$$