INTERNATIONAL STANDARD

ISO 10427-3

First edition
2003-04-01

Petroleum and natural gas industries — Equipment for well cementing —

Part 3: Performance testing of cementing float equipment

Industries du pétrole et du gaz naturel — Matériel pour la cimentation des puits —

Partie 3: Mode opératoire des tests des équipements de cimentation des cuvelages

Reference number
ISO 10427-3:2003(E)

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Published in Switzerland

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Foreword

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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 10427-3 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 cancels and replaces the first edition of ISO 18165, which has undergone an ISO number change and a minor revision.

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 Recommended Practice 10F, second edition, November, 1995.

Users of this part of ISO 10427 should be aware that further or differing requirements may be needed for individual applications. This part of ISO 10427 is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this part of ISO 10427 and provide details.

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 3: Performance testing of cementing float equipment

1 Scope

This part of ISO 10427 describes testing practices to evaluate the performance of cementing float equipment for the petroleum and natural gas industries.

This part of ISO 10427 is applicable to float equipment that will be in contact with water-based fluids used for drilling and cementing wells. It is not applicable to float equipment performance in non-water-based fluids.

2 Functions of cementing float equipment

The term "cementing float equipment" refers to one or more check valves incorporated into a well casing string that prevent fluid flow up the casing while allowing fluid flow down the casing. The primary purpose of cementing float equipment is to prevent cement that has been placed in the casing/wellbore annulus from flowing up the casing (U-tubing). In some cases, such as liner cementing, float equipment may be the only practical means of preventing U-tubing. In other cases, the float equipment serves to allow the cement to set in the annulus without having to increase the pressure inside the casing to prevent U-tubing. Increased pressure in the casing while cement sets is generally undesirable because it can result in gaps (micro-annuli) in the cemented annulus.

Float equipment is also sometimes used for the purpose of lessening the load on the drilling rig. Since float equipment blocks fluid flow up the casing, the buoyant force acting on casing run with float equipment is greater than the buoyant force acting on casing run without float equipment. If either the height or the density of the fluid placed inside casing equipped with float equipment while the casing is being run is less than that of the fluid outside the casing, the suspended weight of the casing is reduced compared with what it would be without the float equipment.

The ability of float equipment to prevent fluid flow up the casing is also important in certain well control situations. If the hydrostatic pressure of the fluid inside the casing becomes less than the pressure of formation fluids in formations near the bottom of the casing, fluids from the well may try to flow up the casing. In such a situation, the float equipment becomes a primary well control device.

Float equipment is also sometimes used as a device to assist in pressure testing of casing. This is normally done by landing one or more cementing plugs on top of the float equipment assembly. The plugs seal the casing so that the pressure integrity of the casing may be tested.

Float equipment is also used by some operators as a device to lessen the free fall of cement inside the casing. The free fall of cement is the tendency of cement to initially fall due to the density differences between the cement and the fluid in the well. The float equipment lessens the free fall, to some extent, by providing a constriction in the flow path.

Casing fill-up float equipment is a special type of float equipment that allows the casing to fill from the bottom as the casing is run. This is desirable, in some cases, to help reduce pressure surges as the casing is lowered. Fill-up type float equipment also helps ensure that the collapse pressure of the casing is not exceeded. Once the casing is run, the check valve mechanism of fill-up type float equipment is activated. This is normally done by either pumping a surface-released ball through the equipment or by circulating above a certain rate.

3 Float equipment performance criteria

3.1 General

There are a number of performance criteria, listed below, that may be used to evaluate the suitability of a particular piece of float equipment for a given well.

3.2 Durability under downhole conditions

Float equipment should still function after a fluid containing abrasive solids has been circulated through the equipment for a period of time. The equipment should function in various orientations and while exposed to elevated temperatures and pressures.

3.3 Differential pressure capability from below

Float equipment should be capable of withstanding a differential pressure with the higher pressure being exerted from below the check valve, because the hydrostatic pressure of the fluid occupying the annulus immediately after the cement has been placed is usually greater than the hydrostatic pressure of the corresponding column of fluid inside the casing, or while the casing is being run.

3.4 Ability to withstand force exerted through cementing plugs from above

Float equipment should be able to withstand a force exerted through cementing plugs from above. Some operators occasionally pressure-test the casing by increasing the pressure shortly after a cementing plug (top plug) used to separate the cement from the displacement fluid has landed downhole. This can cause a force to be applied to the float equipment that could cause the equipment to fail.

3.5 Drillability of the equipment

Float equipment should be easy to drill through, since in many cases, float equipment must be drilled out after cementing.

3.6 Ability to pass lost circulation materials

Float equipment may be required to allow easy passage of lost circulation material (LCM). On occasion, the fluid that is circulated through cementing float equipment contains LCM designed to bridge on highly permeable, vugular or fractured formations to lessen the amount of fluid that is lost to the formations. Since float equipment generally provides a constricted flow area for fluid passage, there can be a tendency for the LCM to bridge on the float equipment valve and partially or totally block fluid circulation. Therefore, the ease with which the LCM can pass through the float equipment may be a performance criterion for some wells.

3.7 Flow coefficient of the valve

Since float equipment provides a constriction in the flow path, there will be a pressure loss associated with circulating fluid through the float valve. If the pressure loss through the float equipment is too high, circulation rates can be limited. In some cases, however, a large pressure loss is desirable to reduce free fall of the cement. The flow coefficient of the valve provides a means of estimating the pressure loss for a given fluid density and a given rate.

3.8 Reverse-flow resistance of casing fill-up valves

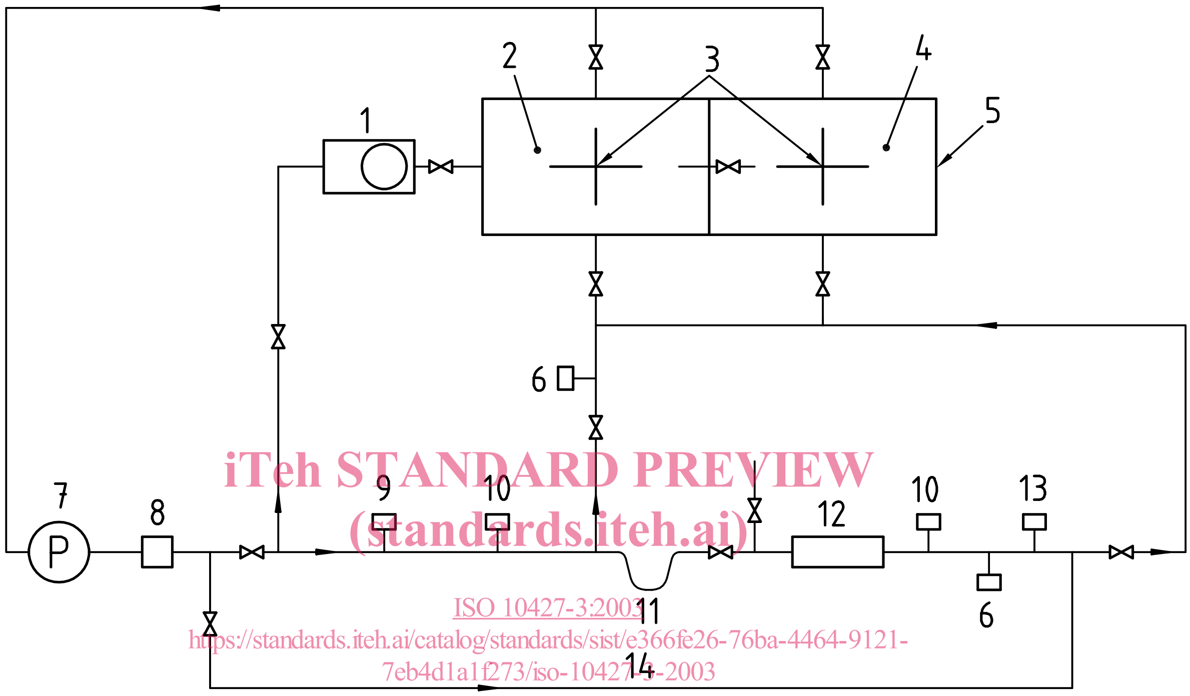
One of the functions of casing fill-up float equipment is to reduce pressure surges as the casing is run by allowing flow into the casing from the bottom. Therefore, the resistance of the valve to reverse flow is indicative of the relative performance of the valve in reducing surge pressure.

4 Apparatus and materials

4.1 Flow loop

4.1.1 General

Figure 1 shows a diagram of one possible configuration of a flow loop for durability testing. Other configurations are possible. The major components of the loop are the mud tank, the piping network, the pump and the instrumentation. These components are discussed in the following paragraphs.



Key

1	hopper	8	flow meter
2	compartment 1	9	LP safety valve
3	agitator	10	pressure transducer
4	compartment 2	11	hose
5	mud tank	12	float collar
6	temperature probe	13	HP safety valve
7	triplex pump	14	high-pressure line

Figure 1 — Suggested layout for cementing float equipment test flow loop

4.1.2 Mud tank

It is suggested that the mud tank consist of two compartments, with each compartment capable of holding about 15,9 m^3 (100 bbl) of fluid. Each compartment should be fitted with adequate agitation and mixing devices to ensure that the fluids remain well mixed. A valve should be arranged to allow communication between the compartments so that the volume of fluid in the active tank can be adjusted. This will facilitate temperature regulation during a test. A mud hopper should be arranged to facilitate the mixing of mud chemicals.