INTERNATIONAL STANDARD

ISO 16070

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Petroleum and natural gas industries — Downhole equipment — Lock mandrels and landing nipples

Industries du pétrole et du gaz naturel — Équipement de fond de trou — Mandrins a clé d'ancrage et sièges d'ancrage

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16070 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, Subcommittee SC 4, *Drilling and production equipment*.

The requirements of this International Standard supersede the requirements for lock mandrels and landing nipples specified in ISO 10432:1999.

Annexes A and B of this International Standard are for information only.

Introduction

This International Standard has been developed by users/purchasers and suppliers/manufacturers of lock mandrels and landing nipples intended for use in the petroleum and natural gas industry worldwide. This International Standard is intended to give requirements and information to both parties in the selection, manufacture, testing and use of lock mandrels and landing nipples. Furthermore, this International Standard addresses the minimum requirements with which the supplier/manufacturer is to comply so as to claim conformity with this International Standard.

This International Standard has been structured to allow for grades of increased requirements in quality control and design validation. These variations allow the user/purchaser to select the grade required for a specific application.

There are three quality control grades which provide the user/purchaser the choice of requirements to meet specific preference or application. Quality control grade Q3 is the minimum grade of quality offered by this International Standard. Quality control grade Q2 provides additional inspection and verification steps and quality control grade Q1 is the highest grade provided.

There are three design validation grades which provide the user/purchaser the choice of requirements to meet specific preference or application. Design validation grade V3 is the minimum grade and represents equipment where the validation method has been defined by the supplier/manufacturer. The complexity and severity of the validation testing increases as the grade number decreases.

Users of this International Standard should be aware that requirements above those outlined in this International Standard may be needed for individual applications. This International Standard is not intended to inhibit a supplier/manufacturer from offering, or the user/purchaser from accepting, alternative equipment or engineering solutions. This may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the supplier/manufacturer should identify any variations from this International Standard and provide details.

Petroleum and natural gas industries — Downhole equipment — Lock mandrels and landing nipples

1 Scope

This International Standard provides the requirements for lock mandrels and landing nipples within the production/injection conduit for the installation of flow control or other equipment used in the petroleum and natural gas industries. It includes the interface connections to the flow control or other equipment, but does not cover the connections to the well conduit.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3601-1, *Fluid power systems — O-rings — Part 1: Inside diameters, cross-sections, tolerances and size identification code*

ISO 3601-3, *Fluid power systems — O-rings — Part 3: Quality acceptance criteria*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

ISO 6892, *Metallic materials — Tensile testing at ambient temperature*

ISO 10422, *Petroleum and natural gas industries — Threading, gauging and thread inspection of casing, tubing and line pipe threads — Specification*

ISO 13628-3, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 3: Through flowline (TFL) systems*

ISO 13665, *Seamless and welded steel tubes for pressure purposes — Magnetic particle inspection of the tube body for the detection of surface imperfections*

ASME Boiler and Pressure Vessel Code, Section V:1998, *Non-destructive testing*

ASME Boiler and Pressure Vessel Code, Section VIII:1998, *Pressure vessels*

ASME Boiler and Pressure Vessel Code, Section IX:1998, *Welding and brazing qualifications*

ASTM A 388/A 388M, *Standard practice for ultrasonic examination of heavy steel forgings*

ASTM A 609/A 609M, *Standard practice for castings, carbon, low-alloy, and martensitic stainless steel, ultrasonic examination thereof*

ASTM D 395, *Standard test methods for rubber property — Compression set*

ASTM D 412, *Standard test methods for vulcanized rubber and thermoplastic rubbers and thermoplastic elastomers — Tension*

ASTM D 638, *Standard test method for tensile properties of plastics*

ASTM D 1414, *Standard test methods for rubber O-rings*

ASTM D 1415, *Standard test method for rubber property — International hardness*

ASTM D 2240, *Standard test methods for rubber property — Durometer hardness*

ASTM E 94, *Standard guide for radiographic testing*

ASTM E 140, *Standard hardness conversion tables for metals (relationship among Brinell hardness, Vickers hardness, Rockwell hardness, Rockwell superficial hardness, Knoop hardness, and scleroscope hardness)*

ASTM E 165, *Standard test method for liquid penetrant examination*

ASTM E 186, *Standard reference radiographs for heavy-walled [2 to 4 ½-in. (51 to 114-mm)] steel castings*

ASTM E 280, *Standard reference radiographs for heavy-walled [4 ½ to 12-in. (114 to 305-mm)] steel castings*

ASTM E 428, *Standard practice for fabrication and control of steel reference blocks used in ultrasonic inspection*

ASTM E 446, *Standard reference radiographs for steel castings up to 2 in. (51 mm) in thickness*

BS 2M 54:1991, *Specification for temperature control in the heat treatment of metals*

NACE MR 0175:1999, *Sulfide stress cracking resistant metallic materials for oilfield equipment*

SAE-AMS-H-6875:1998, *Heat treatment of steel raw materials*

3 Terms and definitions

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

NOTE For quality system terms used in the text of this International Standard but not defined below, see ISO 9000.

3.1
ambient temperature
prevailing temperature at test site

3.2
design acceptance criteria
defined limits placed on characteristics of materials, products, or services established by the manufacturer to ensure conformance to the product design

3.3
full life cycle
expected period of time in which the product shall function according to the manufacturer's specifications

3.4
landing nipple
any receptacle containing a profile designed for the installation of a lock mandrel

3.5
lock mandrel
retention device used for flow control or other equipment

3.6
manufacturing
process and action performed by an equipment supplier/manufacturer that are necessary to provide finished component(s), assembly(ies) and related documentation, that fulfil the requests of the user/purchaser and meet the standards of the supplier/manufacturer

NOTE Manufacturing begins when the supplier/manufacturer receives the order and is completed at the moment the component(s), assembly(ies) and related documentation are surrendered to a transportation provider.

3.7
model
lock mandrel or landing nipple with unique components and operational characteristics that distinguish it from other lock mandrels or landing nipples of the same type

3.8
operating environment
set of conditions to which the product is exposed during its full life cycle

3.9
profile
feature that is designed for the reception of the lock mandrel's locking mechanism

3.10
production/injection conduit
all tubular and equipment which provide the flow path between the reservoir and the christmas tree, including the riser for subsea applications

3.11
sealing device
device preventing passage (i.e. communication) of liquid and/or gas across the interface between the lock mandrel and the landing nipple

3.12
size
diameter of a landing nipple seal bore or the related lock mandrel diameter

3.13
test pressure
pressure at which the equipment is tested based upon all relevant design criteria

NOTE See 6.5.1 for test pressure requirements.

3.14
test temperature
temperature at which the equipment is tested based upon all relevant design criteria

3.15
type
lock mandrel and/or landing nipple distinguished by a particular method of being positioned and retrieved from a well

4 Abbreviated terms

— AQL Acceptance quality limit

— NDE Non-destructive examination

— TFL Through flowline

5 Functional specification

5.1 General

The user/purchaser shall prepare a functional specification for ordering products which conform with this International Standard and specify the following requirements and operating conditions, as applicable, and/or identify the supplier's/manufacturer's specific product. These requirements and operating conditions may be conveyed by means of a dimensional drawing, data sheet or other suitable documentation.

5.2 Functional characteristics of lock mandrels and landing nipples

The following functional characteristics shall be specified, as applicable, for lock mandrels and landing nipples:

a) conveyance method;

b) locking mechanism;

c) no-go;

d) selectivity;

e) sealing device;

f) dimensions;

g) passage of lines (electrical and/or hydraulic) in the annulus (for landing nipples only).

5.3 Well parameters

The following well parameters shall be specified, as applicable, for the lock mandrel and landing nipple:

a) size, mass[1)], material and grade of the casing and tubing;

b) well depth and angle from the vertical to the installed position;

1) The term "weight" is commonly incorrectly used to mean mass, but this practice is deprecated.

c) casing and tubing architecture, deviations, and restrictions through which the lock mandrel and/or landing nipple pass;

d) anticipated loading conditions which might be applied to the lock mandrel and landing nipple.

5.4 Operational parameters

The following operational parameters shall be specified, as applicable, for the lock mandrel and landing nipple:

a) acidizing, including the acid composition, pressure, temperature, velocity, exposure time and any other chemicals used during the stimulation;

b) fracturing, including proppant description, fracture fluid velocity, proppant-to-fluid ratio;

c) sand consolidation operations;

d) type of well intervention including service equipment such as electric line, slick line, braided line, coiled tubing, or snubbing equipment.

5.5 Environmental compatibility

The following shall be identified, as applicable, for the lock mandrel and landing nipple to ensure environmental compatibility:

a) production/injection fluid composition, mass, chemical and/or physical composition and the condition of the fluid and/or its components, being solid (sand production, scale, etc.), liquid and/or gaseous to which the lock mandrel and landing nipple is exposed during its full life cycle;

b) both the minimum and the maximum anticipated values of the production/injection pressures, pressure differentials, temperatures and flow rates;

c) in cases where the user/purchaser has access to corrosion property historical data and/or research which is applicable to the functional specification, the user/purchaser should state to the manufacturer which material(s) has the ability to perform as required within the corrosion environment.

5.6 Compatibility with the related well equipment

5.6.1 Lock mandrels

The following information shall be specified, as applicable, to ensure the compatibility of the lock mandrel with the related well equipment:

a) size and/or type of the lock mandrel required to position the flow control equipment in the landing nipple;

b) landing nipple size, model and type into which the lock mandrel is to be installed;

c) size, type, material, configuration and interface dimensions of the connection between the flow control equipment and the lock mandrel;

d) size, type and configuration of other products to be used with the lock mandrel.

5.6.2 Landing nipples

The following information shall be specified, as applicable, to ensure the compatibility of the landing nipples with the related well equipment:

a) top and bottom tubular connection(s), the material and dimensions of the landing nipple which is connected to the tubing;

b) internal receptacle profile(s), sealing bore dimension(s), outside diameter, inside diameter and their respective locations;

c) size, type and configuration of lock mandrels or other products to be used with the landing nipple.

5.7 Quality control

The quality control grade (i.e. Q1, Q2 or Q3 as given in 7.4) shall be specified by the user/purchaser.

5.8 Design validation

The design validation grade (i.e. V1, V2 or V3 as given in 6.5) shall be specified by the user/purchaser. When requested by the user/purchaser, an operating envelope for the lock mandrel and sealing device validation grade V1 shall be supplied. An example of an operating envelope is shown in annex A.

6 Technical specification

6.1 General

The supplier/manufacturer shall prepare the technical specification which responds to the requirements defined in the functional specification. The supplier/manufacturer shall also provide product data as defined in 7.2.1 to the user/purchaser.

6.2 Technical characteristics of lock mandrels and landing nipples

6.2.1 Characteristics of lock mandrels

The following criteria shall be met:

a) the lock mandrel shall locate and/or seal at the specified location and remain so until intentional intervention defines otherwise;

b) while installed, the lock mandrel shall perform in accordance with the functional specification;

c) where applicable, the lock mandrel shall not compromise well intervention operations as specified in 5.4.

6.2.2 Characteristics of landing nipples

While in service, the landing nipple shall meet the requirements of the functional specification.