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Petroleum and natural gas industries — Drilling and production equipment —

Part 3: Running tools, pulling tools and kick-over tools and latches for side-pocket mandrels

Industries du pétrole et du gaz naturel — Équipement de forage et de production —

Partie 3: Outils de mise en place, de dépose, de déviation et de verrouillage pour raccords à poche latérale

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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 17078-3 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 4, *Drilling and production equipment*.

ISO 17078 consists of the following parts, under the general title *Petroleum and natural gas industries — Drilling and production equipment*:

— *Part 1: Side-pocket mandrels*

— *Part 2: Flow-control devices for side-pocket mandrels*

— *Part 3: Running tools, pulling tools and kick-over tools and latches for side-pocket mandrels*

— *Part 4: Practices for side-pocket mandrels and related equipment*

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Introduction

This part of ISO 17078 has been developed by users/purchasers and suppliers/manufacturers of running tools, pulling tools, kick-over tools, and latches used for the installation and retrieval of flow control and other devices in side-pocket mandrels intended for use in the worldwide petroleum and natural gas industry. This part of ISO 17078 is intended to provide requirements and information to all parties who are involved in the specification, selection, manufacture, testing and use of these latches and related tools. Further, this part of ISO 17078 addresses supplier/manufacturer requirements that set the minimum parameters with which suppliers/manufacturers must comply to claim conformity with this part of ISO 17078.

This part of ISO 17078 has been structured to support varying requirements in environmental service classes, design validation, product functional testing and quality control grades. These variations allow the user/purchaser to select the necessary grade for a specific application.

Well environmental service classes. One environmental service class is provided for running tools, pulling tools and kick-over tools, and four environmental service classes are provided for latches. These variations provide the user/purchaser with a range of choices from which to select products to meet varying environmental conditions.

Design validation grades. There are two design validation grades for running tools, pulling tools, kick-over tools and latches that provide the user/purchaser with a range of technical and performance requirements. This ensures that the products supplied according to this part of ISO 17078 will meet the requirements and that the user/purchaser is able to compare these requirements with his or her preference or application and determine whether additional requirements are placed on the supplier/manufacturer.

It is important that users of this part of ISO 17078 be aware that requirements in addition to those outlined herein can be needed for individual applications. This part of ISO 17078 is not intended to inhibit a supplier/manufacturer from offering, or the user/purchaser from accepting, alternative equipment or engineering solutions. This can be particularly applicable where there is innovative or developing technology. Where an alternative is offered, it is the responsibility of the supplier/manufacturer to identify any variations from this part of ISO 17078 and provide details.

Product functional testing grades. There are two product functional testing grades for running tools, pulling tools, kick-over tools and latches that provide the user/purchaser with a range of choices for confirming that products manufactured under this part of ISO 17078 meet the design specifications.

Quality control grades. There are two quality grades for running tools, pulling tools, kick-over tools and latches that provide the user/purchaser with the choice of requirements to meet specific preferences or applications. Additional quality upgrades can be specified by the user/purchaser as supplemental requirements.

In addition to this document, ISO 17078-1 provides requirements for side-pocket mandrels used in the petroleum and natural gas industries. ISO 17078-2 provides requirements for flow-control devices for side-pocket mandrels. ISO 17078-4 provides supplemental aids and guidelines for using these tools.

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Petroleum and natural gas industries — Drilling and production equipment —

Part 3:
Running tools, pulling tools and kick-over tools and latches for side-pocket mandrels

1 Scope

This part of ISO 17078 provides requirements and guidelines for running tools, pulling tools, kick-over tools and latches used for the installation and retrieval of flow control and other devices to be installed in side-pocket mandrels for use in the petroleum and natural gas industries. This includes requirements for specifying, selecting, designing, manufacturing, quality control, testing and preparation for shipping of these tools and latches. Additionally, it includes information regarding performance testing and calibration procedures.

The processes of installation, retrieval, maintenance and reconditioning of used running, pulling and kick-over tools and latches are outside the scope of this part of ISO 17078. Centre-set and tubing-retrievable mandrel applications are not covered.

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

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

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 9000, *Quality management systems — Fundamentals and vocabulary*

ISO 15156 (all parts), *Petroleum and natural gas industries — Materials for use in H_2S-containing environments in oil and gas production*

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ISO 17078-1:2004*, Petroleum and natural gas industries — Drilling and production equipment — Side-pocket mandrels*

ISO 17078-2:2007*, Petroleum and natural gas industries — Drilling and production equipment — Flow-control devices for side-pocket mandrels*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ASME BPVC-VIII:2007, *BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1* [1)]

ASME BPVC-IX:2007, *BPVC Section IX-Welding and Brazing Qualifications*

ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

ASTM D1415, *Standard Test Method for Rubber Property — International Hardness* [2)]

ASTM D2240, *Standard Test Method for Rubber Property — Durometer Hardness*

ASTM E18, *Standard Test Methods for Rockwell Hardness of Metallic Materials*

SAE AMSH6875:1998, *Heat Treatment of Steel Raw Materials* [3)]

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9000 (for quality-system-related terms not given below) and the following apply.

3.1
acceptance
agreement/acknowledgement that latches and related tool component(s) and/or assembly(ies) can be used without restriction

NOTE Adapted from ISO 17078-1:2004, definition 3.1.

3.2
bluing
application of blue indicating fluid used to determine interference between parts

3.3
certificate of conformance
documentation declaring that a specific running, pulling or kick-over tool or latch meets the requirements of this part of ISO 17078 and the requirements of the functional specification

3.4
center-set mandrel US
centre-set mandrel GB
mandrel
device used to contain a flow-control device in the centre of a tubing string

1) American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990, USA.

2) American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohoken, PA 19428-2959, USA.

3) SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, USA.

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3.5
coating
application of a thin film of one material on the surface of another material for various purposes

[ISO 17078-2]

3.6
conveyance
delivery or retrieval system for a flow-control device and associated equipment

3.7
critical length
linear distance in a side-pocket mandrel between the top of the orienting sleeve slot and the face of the pocket, measured perpendicular to the face of the pocket

3.8
date of manufacture
date of manufacturer's final acceptance of finished products

NOTE The date is day-month-year in the format DD-MM-YYYY.

[ISO 17078-1]

3.9
design family
group of products whose configurations, sizes, materials and applications are sufficiently similar that identical design methodologies can be used to establish the design parameters for each product within the family

[ISO 17078-1]

3.10
design method
method, procedure or equations used by the supplier/manufacturer to design a running, pulling or kick-over tool or a latch product

3.11
design validation
process of proving a design by testing to demonstrate conformity of the product to design requirements

3.12
design verification
process of examining the result of a given design or development activity to determine conformity with specified requirements

3.13
deviation
wellbore inclination in degrees from true vertical

3.14
end connections
threads integral to the running, pulling and kick-over tools, male or female, used to connect these tools to the tool string and to connect latches to the flow-control device

3.15
environmental service grade
environmental service class
category of environmental conditions for which the latches and related tools are designed to be used

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3.16
flow-control device
device installed in a side-pocket mandrel to control flow of fluids between a well's casing annulus and tubing

3.17
full life cycle
expected period of time that the product functions according to supplier's/manufacturer's specifications

NOTE Adapted from ISO 17078-1:2004, definition 3.17.

3.18
functionality
definition or description of the performance with associated properties, characteristics and limits of a running, pulling or kick-over tool or a latch

NOTE Adapted from ISO 17078-2:2007, definition 3.21. This definition also differs from that given in ISO 17078-1.

3.19
heat
〈cast lot〉 material originating from a final melt

NOTE For re-melted alloys, a heat is defined as the raw material originating from a single re-melted ingot.

[ISO 17078-2]

3.20
interface compatibility
capability of a component to fit with other associated components and to perform a defined function in conjunction with them

3.21
job lot
group or quantity of piece parts, subassemblies or assemblies that are grouped or processed together during the manufacturing process

[ISO 17078-1]

3.22
kick-over tool
device used to orient or align a pulling or running tool for installation or retrieval of a flow-control device into or out of a side-pocket mandrel

NOTE See Figures E.3 and E.4.

3.23
latch
retention mechanism for a flow-control device that is landed in the side-pocket mandrel

NOTE See Figure E.5.

3.24
model
running, pulling or kick-over tool or latch that has unique components and functional characteristics that differentiate it from other products of the same type

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3.25
operating environment
set of environmental conditions to which the product is exposed during its service life

NOTE Environmental conditions can include temperature, pressure, liquid composition and properties, gas composition and properties, solids, etc.

[ISO 17078-1]

3.26
operational parameter
requirement and/or restriction that the product is exposed to during its service life

EXAMPLE Operating environment, method(s) or condition(s) of installation and retrieval of latches and related tools, exposure to well treatment chemicals/fluids, etc.

[ISO 17078-1]

3.27
product functional testing
process, method(s) and/or test(s) used by the supplier/manufacturer to demonstrate that a particular running, pulling or kick-over tool and/or latch has been manufactured to fully meet the functional and manufacturing requirements for that product

3.28
pulling tool
device used to connect to and retrieve a flow-control or other device from a side-pocket mandrel

NOTE See Figure E.2.

3.29
quality control
process and/or method(s) used by the supplier/manufacturer to ensure the quality of the materials and manufacturing process(es)

[ISO 17078-2]

3.30
rated pressure
maximum differential pressure, at the rated temperature, to which the latches and related tools are designed to be subjected in normal operation

3.31
rated temperature
maximum temperature, at a specified pressure, to which the latches and related tools are designed to be subjected in normal operation

3.32
running tool
device used to connect to and install a flow control or other device into a side-pocket mandrel

NOTE See Figure E.1.

3.33
side-pocket mandrel
tubing-mounted device that accepts a flow-control or other device in a bore that is offset from and essentially parallel with the through-bore of the tubing product

NOTE This parallel bore includes sealing surfaces and latching profiles.

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3.34
significant design change
change to the design identified by the supplier/manufacturer that may affect the performance of the product in the intended service condition

3.35
supplier/manufacturer
company, organization or entity that designs, manufactures and/or markets latches and related tools

3.36
technical specification
parameters stating the operating limit(s) relating to the design, assembly and testing of the component parts or assemblies

NOTE Adapted from ISO 17078-1:2004, definition 3.43. This definition also differs from that given in ISO 17078-2.

3.37
test pressure
maximum pressure at test temperature, as specified by the pertinent test procedure

NOTE This definition differs from those given in ISO 17078-1 and ISO 17078-2.

3.38
test temperature
temperature, as specified by the pertinent test procedure, at which the test is conducted

[ISO 17078-2]

3.39
tool string
assembly of components required to install or retrieve a flow-control device

3.40
traceability
〈job lot〉 ability for individual components to be designated as originating from a job lot that identifies the included heat(s)

NOTE Adapted from ISO 17078-2:2007, definition 3.49. This definition also differs from that given in ISO 17078-1.

3.41
tubing mass
mass per length of tubular product

NOTE Under the International System of Units, the SI, “mass” is the appropriate term for a quantity denominated in kilograms or pounds-mass, and “weight is the appropriate term for a force denominated in newtons or pounds-force.

3.42
tubing-retrievable mandrel
device used to contain a flow-control device where the tubing must be pulled to install or retrieve the flow-control device

3.43
type
latch or related tools or other components that are distinguished by a particular method of operation

3.44
user/purchaser
company, organization or entity that purchases, installs and uses latches and related tools

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3.45
validated design family
design family whereby the validation of one or more representative design(s) and product(s) permits the entire design family to be treated as validated by association, see 6.4

3.46
welding
method for joining two metallic substances through a process of melting and re-solidification

NOTE The term “welding” covers welding, brazing or soldering operations.

3.47
wireline
equipment and associated technique(s) used to install and retrieve latches and related tools in a well using a continuous length of solid line (slick line) or stranded wire, appropriate spooling equipment at the surface and mass and specialized tools attached to the well (downhole) end of the wire

3.48
yield strength
stress level measured at a specific test temperature beyond which the material plastically deforms and will not return to its original dimensions

NOTE The yield strength is expressed in units of force per unit area.

4 Symbols and abbreviated terms

ANSI American National Standards Institute

ASME American Society of Mechanical Engineers

ASTM American Society for Testing and Materials

AWS American Welding Society

HAZ heat affected zone

NDE non-destructive testing method

PQR procedure qualification record

WPQ welder performance qualification

WPS weld procedure specification

5 Functional specification

5.1 General

The purpose of the functional specification is to provide the user/purchaser guidance in specifying and defining the functional requirements for running tools, pulling tools, kick-over tools and latches.

The user/purchaser shall prepare a functional specification to order products that conform to this part of ISO 17078 and specify the following requirements and operating conditions as appropriate, 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.

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Exceptional conditions can require running tools, pulling tools, kick-over tools and latches that are outside of the scope of this part of ISO 17078. In such cases, the user/purchaser and the supplier/manufacturer shall develop a mutually acceptable design and evaluation programme that meets the intent and spirit of this part of ISO 17078.

5.2 Functional characteristics

The following are the functional characteristics of running, pulling and kick-over tools and of latches. The user/purchaser shall specify, as applicable:

a) running, pulling and kick-over tools, and latches:

   1) side-pocket mandrel type, size and supplier/manufacturer;

   2) side-pocket mandrel drift diameter;

   3) side-pocket mandrel depth(s);

   4) latch type;

   5) tubing size and mass (mass per unit of length) [4];

   6) tubing restrictions, e.g. nipples;

   7) well deviation at side-pocket mandrel depth;

b) flow-control device:

   1) size and/or type and/or model of the flow-control device to be secured in the side-pocket mandrel;

   2) special porting configuration requirements (e.g. fluted latch, flow through latch);

   3) special attachment orientation (e.g. bottom latch, integral top latch);

c) conveyance method:

   1) wireline;

   2) coiled tubing;

   3) tractors;

   4) other conveyance method(s);

d) critical factors:

   1) extraordinary jarring force requirements;

   2) indication of a non-standard condition from an impression block or other sensor;

   3) other factor(s) as defined by the user/purchaser;

4) Under the International System of Units, the SI, “mass” is the appropriate term for a quantity denominated in kilograms or pounds-mass, and “weight” is the appropriate term for a force denominated in newtons or pounds-force.

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e) compatibility:

1) definition of the equipment types and/or specifications with which compatibility of the latches and related tools is to be ensured;

2) side-pocket mandrel critical length;

3) orienting sleeve slot width and geometry;

4) flow-control device connection compatibility with latch;

5) tool guard/deflector/discriminator dimensions;

6) mandrel pocket geometry compatibility with latch profile;

7) other pertinent information.

NOTE Refer to the typical figures in Annex E.

5.3 Well parameters

5.3.1 Well fluid parameters

The well fluid parameters to which the running tools, pulling tools, kick-over tools and latches will be exposed during their full life cycle shall be provided as follows.

a) Fluid type, chemical composition, specific gravity, etc. of:

— produced fluids (liquid, hydrocarbon gas, CO_2, H_2S, etc.);

— lift gas (hydrocarbon gas, CO_2, etc.);

— injection fluids (water, steam, CO_2, chemical, etc.);

— completion fluids;

— cementation fluids;

— treatment/stimulation fluids/chemicals.

b) Presence of extraneous components and content details (sand, scale, paraffin, corrosion products, etc.)

5.3.2 Allowable well operations

Expected well intervention(s) including its (their) parameters, such as the following, shall be stated:

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

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

c) sand consolidation operations;

d) wireline operations, e.g. pressure surveys, impression blocks, paraffin cutters, perforation tools, swab cups;

e) coiled tubing operations;

f) cementing operations.

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5.3.3 Corrosion information

If the user/purchaser has access to the corrosion property data of the operating environment based on historical data and/or research, this information shall be made available to the supplier/manufacturer. The user/purchaser may indicate to the supplier/manufacturer which material(s) has/have the ability to perform as required within the subject well's corrosion environment.

5.4 Operational parameters

The user/purchaser shall specify appropriate installation, testing and operational parameters to which the running tools, pulling tools, kick-over tools and latches will be subjected. These shall include but are not limited to:

a) minimum and maximum operating temperatures;

b) maximum gas or liquid injection rates;

c) maximum internal-to-external differential pressure across the flow-control device;

d) installation, testing and operational procedures;

e) deployment and retrieval method(s).

5.5 Environmental service grades (class designation)

The user/purchaser shall specify one of the following environmental service grades for latches. If no grade is specified, grade E4 will be provided. The user/purchaser shall specify the characteristics of the “unique” service. Environmental service grade requirements for each product type are detailed in the applicable annex. Running, pulling and kick-over tools are provided to grade E4 unless specified otherwise. See Table C.1 for the specific requirements.

— E4: Standard service

— E3: Stress cracking service

— E2: Weight loss service

— E1: Unique service

5.6 Design validation grades

The user/purchaser shall specify one of the following design validation grades. This part of ISO 17078 provides two design validation grades as stipulated in 6.5 and as specified in Annexes A to D. These design validation grades are V2 (basic level) and V1 (highest level). If no design validation grade is specified, grade V2 is supplied. Design validation grade V1 might not be available for all products.

5.7 Product functional testing grades

The user/purchaser shall specify one of the following product functional testing grades for latches. If no product functional testing grade is specified for latches, grade F2 shall be deemed acceptable. Running, pulling and kick-over tools are limited to grade F1. Functional testing grade requirements are detailed in the applicable annex.

— F2: Basic level of product functional testing

— F1: Highest level of product functional testing

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5.8 Quality grades

The user/purchaser shall specify one of the following quality grades. If no quality grade is specified, grade Q2 shall be deemed acceptable. This part of ISO 17078 provides two quality grades, the requirements of which are specified in 7.4.

— Q2: Basic level of quality control

— Q1: Highest level of quality control

5.9 Additional testing

The user/purchaser shall specify additional design validation testing and/or product functional testing that is deemed necessary for a specific application. These requirements shall be in addition to those included herein.

6 Technical specification

6.1 General requirements

The purpose of the technical specification is to guide the supplier/manufacturer to specify and define the technical requirements for running tools, pulling tools, kick-over tools and latches that are to be designed and manufactured to meet the functional specifications produced by the user/purchaser.

The supplier/manufacturer shall prepare the technical specification to meet the requirements defined in the user/purchaser's functional specification as defined in Clause 5. The supplier/manufacturer shall also provide the product data sheet defined in 7.2.4.

6.2 Technical requirements

The following are technical requirements for running tools, pulling tools, kick-over tools and latches.

a) The running, pulling and kick-over tools shall provide for installation and retrieval of the latch when it is connected to an associated flow-control device. The latch and flow-control device shall be installed in, or retrieved from, the side-pocket mandrel.

b) The running tool shall secure the latch to the kick-over tool until the latch and associated flow-control device are secured in the side-pocket mandrel. The pulling tool shall release the locking mechanism of the latch and secure it to the kick-over tool to allow retrieval. The kick-over tool shall orient and/or position the running and pulling tools within the side-pocket mandrel.

c) The latch shall secure the flow-control device in the side-pocket mandrel where it shall remain until human intervention defines otherwise. While located in the side-pocket mandrel, the latch shall perform as per its specific technical specification.

6.3 Design criteria

6.3.1 General

The supplier/manufacturer shall use the following design criteria in designing the running tools, pulling tools, kick-over tools and latches. The assumptions, calculations and/or other design criteria shall be detailed in the design file for that product.

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6.3.2 Materials

Materials and/or the service shall be stated by the supplier/manufacturer and shall be suitable for the class of service and the environment specified in the functional specification. All materials used shall comply with the supplier's/manufacturer's written specifications. This applies to metallic and non-metallic components.

Material substitutions in qualified equipment are allowed without validation testing provided the supplier's/manufacturer's selection criteria are documented. The properties of the substituted materials shall be equal to or uniformly greater than those of the materials used to qualify the design. The substituted materials shall meet all other requirements of this part of ISO 17078.

Should the supplier/manufacturer determine that another material will equally or better meet the user's/purchaser's specified material or corrosion prevention requirements for the application, agreement shall be obtained before any change in materials from those indicated by the user/purchaser.

6.3.3 Metals

The supplier's/manufacturer's specifications shall define:

a) chemical-composition limits;

b) heat treatment conditions;

c) mechanical-property limits:

- tensile strength;
- yield strength;
- elongation;
- hardness.

The mechanical properties for traceable metal components shall be verified by tests conducted on a material sample produced from the same heat of material. The material sample shall experience the same heat treatment process as the component it qualifies. Material subsequently heat-treated from the same heat of material shall be hardness-tested after processing to confirm compliance with the hardness requirements of the supplier's/manufacturer's specifications. The hardness results shall verify through documented correlation that the mechanical properties of the material tested meet the properties specified. The heat treatment process parameters shall be defined in a heat treatment procedure. Hardness testing is the mechanical property test required after stress relieving.

Material test reports provided by the material supplier or the supplier/manufacturer are acceptable documentation when the test specimen conforms to the chemical composition, heat treatment condition and mechanical properties of the specification.

Each welded component shall be stress-relieved as specified in the supplier's/manufacturer's written specifications and in accordance with the ASME Boiler and Pressure Vessel Code, paragraphs UCS 56 and UHA 32, Section VIII, Division 1, Subsection C (ASME BPVC-VIII:2007).

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6.3.4 Non-metals

The supplier's/manufacturer's written specifications for non-metallic compounds shall include handling, storage and labelling requirements, including the cure date, batch number, compound identification and shelf life appropriate to each compound, and shall define those characteristics critical to the performance of the material, such as:

a) compound type;

b) mechanical properties, as a minimum:

- tensile strength (at break);
- elongation (at break);
- tensile modulus (at 50 % or 100 %, as applicable);

c) compression set;

d) durometer hardness.

The supplier/manufacturer shall have documented procedures and evaluations that verify the material used is validated (or tested) as suitable for use in the specific configuration, environment and application. These evaluations shall include the combination of pressure, temperature, geometric seal design and its application, and the fluids compatible with the intended application.

6.3.5 Environmental service class

The supplier/manufacturer shall meet the environmental service class as specified by the user/purchaser. Details of the design requirements of each environmental service classification are specified in Annexes A to C.

6.3.6 Functional requirements

6.3.6.1 General

The following functional requirements shall be met in the design criteria for running, pulling and kick-over tools and latches.

6.3.6.2 Tool passage requirements

The latch installed in the side-pocket mandrel shall perform per the functional specification and shall not compromise well intervention operations as specified in 5.3 and 5.4.

6.3.6.3 Operating parameter requirements

The running tools, pulling tools, kick-over tools and latches shall perform in accordance with the operating parameters and characteristics as stated in the functional specification.

6.3.6.4 Side-pocket mandrel damage prevention

During the running and pulling operations, the latches and related tools shall not damage the side-pocket mandrel in a way that would limit its functionality. If the latch must pass (drift) through the side-pocket mandrel's polished seal bore, it shall not damage the polished bore. The latch “no-go” interface with the side-pocket mandrel's pocket “no-go” shall be designed to prevent damage sufficient to impede the passage of a flow-control device into or out of the pocket and/or to damage the packing of the flow-control device as it is being installed or removed from the pocket. Damage to the “no-go” surface that causes damage to the packing shall be cause for a design refinement.

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6.3.6.5 Interchangeability

Components and subassemblies of each type, model, and size of running, pulling and kick-over tool and latch shall be designed, manufactured and identified to provide interchangeability within the manufacturer's product line.

6.3.6.6 Compatibility

The supplier/manufacturer shall provide documentation of specific side-pocket mandrels and flow-control devices that are compatible with the running tools, pulling tools, kick-over tools and latches. The level of documentation will depend on the design validation grade and/or product functional testing grade selected by the user/purchaser as defined in the applicable annex.

6.3.7 Dimensions

Dimensional tolerances of components or subassemblies shall be such that cumulative tolerances will not preclude proper operation as described in the design validation requirements.

6.3.8 Packing, O-rings and seals

6.3.8.1 Seal bore dimensions for latches

Design of packing, O-rings and seals for latches that are intended to be used in side-pocket mandrel seal bores shall meet the requirements of the seal bore dimensions as detailed in ISO 17078-1. Elastomeric components used as trash barriers are exempt from this requirement.

6.3.8.2 Allowable elastomeric materials

The supplier/manufacturer shall provide elastomeric materials that are compatible with the environmental service grade specified by the user/purchaser. The supplier/manufacturer shall document the process used for selecting compatible elastomeric materials.

6.3.8.3 Design validation testing

Design validation testing of packing, O-rings and seals for latches and related tools shall meet the requirements for design validation testing as detailed in ISO 17078-2. Elastomeric components used as trash barriers are exempt from this requirement.

6.3.9 Good design practice

Good design practices shall be integrated in the design, except when the stated design requirements preclude their use as required for functionality. Examples of good design practices are as follows.

a) Round or bevel all exterior protrusions to prevent handling difficulties as the running tools, pulling tools, kick-over tools and latches are lowered into or retrieved from the well.

b) Design to prevent possible unseating of the flow-control device as other devices are pulled through the side-pocket mandrel.

c) Design fishing necks for all devices and components that could require independent retrieval from the well.

d) Design retrievable components to meet all functional requirements and to minimize damage to any permanently installed component.

e) Design emergency release mechanisms where applicable.

f) Design the product so that the installation process will not cause damage to the flow-control device.

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6.3.10 Design methods

Running, pulling and kick-over tools and latches may be designed using the following:

a) finite element analysis for strength of material issues;

b) computational fluid dynamics for flow characteristics;

c) proprietary equations;

d) standard equations;

e) experimental stress analyses;

f) experimental flow analysis;

g) proof test analysis.

This part of ISO 17078 does not dictate the specific methods, equations or procedures for design purposes. The design method(s) that are used shall be documented in written supplier's/manufacturer's procedures.

All pressure-containing parts shall be designed to satisfy the supplier's/manufacturer's test pressures and to meet the conditions defined in the functional specification. The assumptions, calculations and/or other design criteria shall be detailed in the design file for that product.

All flow and associated erosion characteristics pertinent to the design that are calculated by computational fluid dynamics shall be validated through testing, the use of appropriate equations, flow analysis modelling or other means in accordance with this part of ISO 17078 and recognized industry practices in regard to flow validations.

6.4 Allowable design changes

6.4.1 General

All design changes shall be documented and reviewed by the supplier/manufacturer against the design validation and product functional testing documents to determine if the change is a significant change. A significant design change is a change to the design identified by the supplier/manufacturer that affects the performance of the product in the intended service condition. A design that undergoes a significant change becomes a new design requiring design validation as described in 6.5 and product functional testing as described in 6.6.

All design changes and modifications shall be identified, documented, reviewed and approved before their implementation and shall meet the applicable validation test requirements of this part of ISO 17078. Justifications for design changes that are identified as being non-significant shall be documented. The supplier/manufacturer shall, as a minimum, consider the following for each design change:

a) stress levels of the modified or changed components;

b) material changes;

c) functional changes.

Any changes in the design of a running, pulling or kick-over tool or a latch shall be made following the procedures of 6.4.

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6.4.2 Scaling of design acceptance

6.4.2.1 Validated design family

Running tools, pulling tools, kick-over tools and latches of the same design family as defined in 3.9 shall use the same documented design validation test results. Design changes that affect the load-bearing capacity of a product require validation testing. Documentation of design changes shall be maintained in the product's design file.

6.4.2.2 Design change limits

The supplier/manufacturer shall document the following for products that have been verified within a design family.

a) Summary of all records of validated designs and/or products from the design family.

b) Trend analyses or scatter diagrams as appropriate to demonstrate that the performance generated by the design methods and analyses are sufficiently consistent to permit other designs to be verified by association.

c) Limits to the design variables within the validated design family. These shall be defined such that outside of these limits, similar designs cannot be considered to be verified by association and are therefore not part of the validated design family.

For running tools, pulling tools, kick-over tools or latches with unique or multiple features that do not constitute a significant change of the design, the new feature(s) shall be tested in accordance with the supplier's/manufacturer's documented requirements for design validation of that feature. Acceptance criteria and evaluation results shall be documented.

6.4.3 Supplemental features validation test

Running tools, pulling tools, kick-over tools and latches with features that are not tested during the validation testing shall be tested in accordance with the supplier's/manufacturer's documented requirements to validate proper operation of that feature. Testing procedures, acceptance criteria and results shall be documented.

6.5 Design verification and validation requirements

6.5.1 General

The supplier/manufacturer shall use these design verification and validation procedures to ensure that each running, pulling and kick-over tool and latch design family fulfils the functional requirements.

6.5.2 Design verification

Design verification shall be performed according to the supplier's/manufacturer's defined procedures.

6.5.3 Design validation

Design validation shall be performed on each design family of running tool, pulling tool, kick-over tool and latch to ensure that the device meets the supplier's/manufacturer's technical specifications.

If a design validation grade V1 running, pulling or kick-over tool or latch is to be provided, the supplier/manufacturer shall produce a scaled drawing of the specific device and those components with which it is claimed to interface. Use all required tolerances for the specific tool being provided, and, as a minimum, dimensional drawings for the compatible components. See Figures E.1 to E.5 for example drawings of these tools.

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6.6 Product functional testing requirements

The supplier/manufacturer shall follow the product functional testing requirement(s) and/or process(es) that are defined in the annexes to demonstrate that each of the running tools, pulling tools, kick-over tools and latches that are produced fully meet the design specifications.

Some applications could require additional product functional testing. These shall be specified by the user/purchaser in the functional specification.

7 Supplier/manufacturer requirements

7.1 General

The supplier/manufacturer shall meet the following requirements in designing, manufacturing, testing and delivering the running tools, pulling tools, kick-over tools and latches that are covered by this part of ISO 17078.

This clause contains the detailed requirements for verifying and validating that each product manufactured meets the requirements of the functional specifications in Clause 5 and the technical specifications given in Clause 6. As a minimum, each of the following topics shall be addressed.

7.2 Documentation and data control

7.2.1 General

The supplier/manufacturer shall establish and maintain documented procedures to control all documents and data that relate to the requirements of this part of ISO 17078. These documents and data shall be maintained to demonstrate conformance to specified requirements. All documents and data shall be legible and shall be retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss. Documents and data may be in the form of any type of media, such as hard copy or electronic media. All documents and data shall be available for viewing and shall be auditable by the user/purchaser.

7.2.2 Design documentation

All design documents, data, design validation test results and initial product functional test results, as listed below, shall be maintained for 5 years after the last date of manufacture.

The design validation test results shall be clearly identified as grade V2 or V1. The product functional test results shall be clearly identified as grade F2 or F1. Design documents shall include, as appropriate, the following.

a) Functional and technical specifications.

b) Supplier's/manufacturer's quality manual.

c) Required grade of QC (quality control) documentation as specified in 5.8.

d) One complete set of drawings, written specifications and design calculations and standards.

e) Instructions providing methods for the safe installation and use of the running tools, pulling tools, kick-over tools and latches. This document shall state the operations that are permitted and shall preclude those operations that can lead to failure and/or non-compliance with the functional and performance requirements.

f) Material type, yield strength and connection identification for the actual end connection(s) provided with the running tools, pulling tools, kick-over tools and latches (where applicable).

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g) Welding procedure specification (WPS).

h) Weld procedure qualification record (PQR).

i) Welder/welding operator performance qualification (WPQ).

7.2.3 Product functional test documentation

7.2.3.1 General

The supplier/manufacturer shall have available a completed test file containing all the supplier's/manufacturer's required product functional testing procedures and product functional test grade testing records, with verified acceptance of each. The file shall further contain test results and/or calculations that confirm the performance of the product(s) that have been tested.

7.2.3.2 Specific product functional testing documentation requirements

There are two sets of requirements for documentation of product functional tests, one for each of the product functional testing grades, F2 and F1. These are identified in Annexes A to C.

7.2.4 Product data sheet

Each order shall be supplied to the user/purchaser with a product data sheet for each line item on each order as required in the quality grade.

NOTE The intent of this is to require a separate product data sheet for each unique product or products that are part of a specific design family.

It shall contain at least the following, as applicable:

— name and address of supplier/manufacturer;

— supplier/manufacturer assembly number;

— supplier/manufacturer product name;

— product type;

— operational parameters, in accordance with 5.4;

— metallic materials;

— non-metallic materials;

— overall length;

— temperature range for rated pressure;

— rated pressure;

— top connection(s);

— conveyance method;

— maximum conveyance outside diameter, inclusive of running/pulling equipment, as applicable;

— retrieval method;

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— quality grade;

— design validation grade;

— product functional testing grade;

— technical/operations manual reference number.

7.2.5 Technical/operations manual

A technical/operations manual shall be available for products supplied per this part of ISO 17078 and shall contain at least the following information:

— manual reference number and revision level;

— product data sheet;

— operational procedures;

— pre-installation inspection procedures;

— storage recommendations;

— representative drawing (technical information drawing) showing major dimensions (outer dimensions, inner dimensions, lengths, masses [weights] and other relevant parameters);

— special precautions and handling;

— list of devices for which compatibility is claimed.

7.3 Product identification requirements

7.3.1 General

The supplier/manufacturer shall clearly identify and mark each running, pulling and kick-over tool and latch according to the requirements given in 7.3.2.

7.3.2 Product identification

Each product furnished to this part of ISO 17078 shall be permanently identified using low stress marking devices, which include interrupted dot or rounded cold, die stamp, vibratory method or laser etching. The supplier's/manufacturer's specifications shall define the method(s) and location of the markings. The following information, as a minimum, shall be marked on each running, pulling and kick-over tool and latch:

— supplier's/manufacturer's name or mark;

— date (month and year) of manufacture;

— supplier's/manufacturer's part number and unique traceable serial number;

— environmental class for latches only.

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7.4 Quality control requirements

7.4.1 General

The requirements for the quality grades are specified in 7.4.2 to 7.4.9.

7.4.2 Quality control personnel qualifications

All personnel performing quality control activities directly affecting material and product quality shall be qualified in accordance with the supplier's/manufacturer's documented requirements.

7.4.3 Manufacturing non-conformance

The supplier/manufacturer shall establish and maintain documented procedures to ensure that an assembly or component that does not conform to specified requirements is prevented from unintended use or installation. This control shall provide for identification, documentation, evaluation, segregation (when applicable) and disposition of non-conforming assemblies or components.

The responsibility for review and authority for the disposition of non-conforming assemblies or components shall be defined by the supplier/manufacturer. Non-conforming assemblies or components may be

a) reworked to meet the specified requirements,

b) accepted, with or without repair, by approval of the supplier's/manufacturer's authorized personnel, if the assembly or component does not violate design validation requirements, or

c) rejected or scrapped.

Repaired and/or reworked assemblies or components shall be inspected in accordance with the appropriate quality grade.

7.4.4 Component dimensional examination

Components and assemblies shall be dimensionally inspected to ensure proper function and compliance with design criteria and technical specifications. The frequency of these examinations shall be performed as detailed in the functional test requirements and the supplier's/manufacturer's written requirements.

7.4.5 Traceability

The supplier/manufacturer is responsible for traceability, documentation and the product condition at the time of shipment to the user/purchaser.

All components, weldments, subassemblies and assemblies of equipment supplied in accordance with this part of ISO 17078 shall be traceable to a job lot, for which components and weldments shall also identify the heat(s) or batch lot(s) included. All components and weldments in a multi-heat or batch job lot shall be rejected if any heat or batch does not comply with specified requirements. Individual component identification shall be maintained to facilitate traceability until the supplier's/manufacturer's final inspection is completed.

7.4.6 Quality grade selection

7.4.6.1 General

This part of ISO 17078 provides two grades of quality control for running tools, pulling tools, kick-over tools and latches. The user/purchaser shall specify, in the functional specification, the grade of quality control and/or additional requirements when desired.

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Products shall be supplied to quality grade Q2 unless the user/purchaser specifies grade Q1. The user/purchaser may also specify additional quality/certification requirements that shall be applied to equipment supplied to this part of ISO 17078.

7.4.6.2 Grade Q2 — Basic level or grade of quality control

The following are the requirements for grade Q2, the basic level of quality control.

a) Documentation

No documentation is required for grade Q2. The user/purchaser may request a certificate of conformance for the running, pulling or kick-over tools and/or latches that are supplied.

b) Inspection

Dimensional inspection shall be performed on components, subassemblies and assemblies at a minimum sampling rate of 5 % from each job lot, or a minimum of one device.

7.4.6.3 Grade Q1 — Highest level or grade of quality control

The following are the requirements for grade Q1, the highest level of quality control.

a) Documentation

The documentation shall include a certificate of conformance for the running tools, pulling tools, kick-over tools and latches in the job lot. It shall also contain a mill test report for all components except common hardware items, as specified here. In addition, it shall contain the results of all product functional tests run on this job lot of running, pulling and kick-over tools and/or latches.

Examples of common hardware items that may be excluded:

— roll pins;

— copper gaskets;

— snap rings;

— coating materials;

— valve cores;

— set screws;

— other, as applicable.

b) Inspection

Dimensional inspection shall be performed on 100 % of all components, subassemblies and assemblies from each job lot.

7.4.7 Measuring/testing equipment calibration

7.4.7.1 General

Measuring and testing equipment shall meet or exceed the measurement accuracy required by the acceptance criteria for that evaluation or test.

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7.4.7.2 Measuring and testing equipment

Measuring and testing equipment used for acceptance shall be identified, inspected, calibrated and adjusted at specific intervals in accordance with documented procedures, ISO/IEC 17025 and this part of ISO 17078, and shall be traceable to the applicable national or international standards agency no less stringent than the aforementioned requirements. Technologies for inspections with verifiable accuracies equal to or better than those listed in this part of ISO 17078 may be applied with appropriate documentation and when approved by qualified personnel. Calibration intervals for measuring and testing equipment shall be established based on repeatability and degree of usage. Calibration intervals shall be a maximum of three months until a recorded calibration history can be established. Intervals may be lengthened or shortened based on documented repeatability, amount of usage and calibration history. The calibration interval shall not be increased by more than twice the previous interval, while not exceeding one year.

Calibration standards used to calibrate measuring equipment shall be checked and approved at least once a year by an independent outside agency with traceability to the applicable national or international standards agency.

Pressure measuring devices also shall be:

a) readable to at least $\pm$ 0,5 % of full scale range, or less as required to perform the specified measurements;

b) calibrated to maintain $\pm$ 2 % accuracy of full scale range, or less as required to perform the specified measurement(s);

c) used only within the calibrated range;

d) calibrated with a master pressure measuring device or a dead weight tester.

7.4.8 Elastomeric materials and seal design

7.4.8.1 General

All packing, O-rings and seal materials for running tools, pulling tools, kick-over tools and latches shall be inspected according to the following (7.4.8.2 to 7.4.8.5) requirements.

7.4.8.2 Elastomeric materials

Each elastomeric component shall comply with the supplier's/manufacturer's written specifications. Suppliers/manufacturers providing equipment to this specification shall be responsible for the following.

a) Tolerances

The tolerances of O-rings shall be in compliance with ISO 3601-1. Other packing elements shall meet dimensional tolerances of the supplier's/manufacturer's written specifications. Sampling procedures for inspection and the basis for acceptance or rejection of a batch lot shall be in accordance with ISO 2859-1. General Inspection Level II shall be required and shall be at a 2,5 AQL (sampling level) for O-rings and a 1,5 AQL for other packing elements.

b) Hardness

The durometer hardness of O-rings shall be measured in accordance with ASTM D2240 or ASTM D1415. The preferred method is to conduct the hardness test on a test specimen from each batch and cure cycle rather than testing individual seals. In the event that such tests are to be conducted on individual seals, sampling procedures for inspection and the basis for acceptance or rejection of a batch lot shall be in accordance with those cited in 7.4 for O-rings or other packing elements, respectively.

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c) Visual inspection

O-rings shall be visually inspected in accordance with ISO 3601-3. Other packing elements shall be visually inspected according to the supplier's/manufacturer's written inspection procedures. The inspection shall include such items as lip damage, flashing, breaks, cracks or other visible damage. Sampling procedures for inspection and the basis for acceptance or rejection of a batch lot shall be in accordance with those cited in 7.4.8.2 for O-rings or other packing elements, respectively.

d) Handling and storage

Materials used for sealing devices such as O-rings or other packing elements require special handling and storage procedures. The supplier/manufacturer shall have written specifications that include handling and storage requirements, including shelf life, appropriate for each specific material compound.

7.4.8.3 Other materials

Non-metals other than elastomers shall comply with the supplier's/manufacturer's written specifications.

7.4.8.4 Traceability

Traceability requirements shall be documented by the supplier/manufacturer and shall be sufficient to ensure that all piece parts are manufactured from materials that satisfy the supplier's/manufacturer's written specifications. Traceability of piece parts is required only until the parts are used in subassemblies or assemblies. The traceability of subassemblies or assemblies is not required by this specification.

7.4.8.5 Sealing device design validation testing

Design validation testing shall be performed in accordance with the requirements specified in ISO 17078-2.

7.4.9 Material certifications

7.4.9.1 General

Supplier's/manufacturer's mill test certificate of original material or supplier's/manufacturer's certification of test results are acceptable, provided the certificate or certification includes test results for mechanical properties and chemical composition for that heat of material.

Raw material used in the manufacture of components shall meet the following requirements:

a) certificate of conformance stating that the raw material meets the supplier's/manufacturer's documented specifications;

b) material test report so that the supplier/manufacturer can verify that the raw material meets the supplier's/manufacturer's documented specifications.

If the material is altered by subsequent processes that change its properties, then acceptance will be based on either hardness in accordance with ISO 6506-1, ISO 6507-1 or ISO 6508-1, or by mechanical properties in accordance with ISO 6892 or ASTM A370 from the heat of material in question. These tests will be completed using the heat treatment cycle for which the material is to be qualified. If the initial test specimen fails, then two additional tests shall be successfully performed in order to qualify the material. The material shall be rejected if the results of either of two additional tests do not meet specified requirements. If hardness is used for final acceptance, then hardness-strength correlations will be documented by the supplier/manufacturer for that type of material.

Acceptance of all materials shall be indicated either on the materials or in the records traceable to the materials.

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7.4.9.2 Mechanical and physical properties (as applicable)

7.4.9.2.1 Metallic materials

Mechanical property test procedures and practices shall be in accordance with ISO 6892 or ASTM A370 for the metallic materials used for traceable components.

7.4.9.2.2 Elastomers and non-metallic materials

Mechanical property test procedures for elastomeric and non-metallic compound types shall be in accordance with all of the above in 7.4.

7.5 Heat treatment requirements

The following are heat treatment requirements.

a) Heat treating of production parts shall be performed with heat treating equipment that has been calibrated and surveyed.

b) Each furnace shall be surveyed within one year prior to heat treating operations. When a furnace is repaired or rebuilt, a new survey shall be required before heat treating.

c) Batch type and continuous type heat treating furnaces shall be calibrated in accordance with one of the following procedures:

   1) procedures specified in SAE AMSH6875:1998, Section 5.

   2) supplier's/manufacturer's written specifications, including acceptance criteria or other industry standards which are no less stringent than the procedures identified above.

7.6 Welding requirements

7.6.1 General

The supplier's/manufacturer's welding control system shall include requirements for monitoring, updating and controlling the qualifications of welders/welding operators and the use of welding procedure specifications. Instruments utilized to verify temperature, voltage and amperage shall be serviced and calibrated in accordance with the supplier's/manufacturer's written procedures.

All welding procedures, welders and welding operators shall be qualified in accordance with the ASME Boiler and Pressure Vessel Code, Section IX (ASME BPVC-IX:2007). Base metals that are not classified under the ASME P-number grouping shall be qualified as unassigned metals in accordance with ASME BPVC-IX:2007, QW-424.1.

7.6.2 Welding consumables

Welding consumables shall conform to AWS or supplier's/manufacturer's written specifications. The supplier/manufacturer shall have a written procedure for selection, storage and control of welding consumables. Materials of low hydrogen type shall be stored and used as recommended by the consumable manufacturer to retain their original low hydrogen properties.

7.6.3 Welding procedures/qualification records

Welding shall be performed in accordance with welding procedure specifications written and qualified in accordance with ASME BPVC-IX:2007, Article II. The WPS shall describe all the essential and nonessential variables as defined in ASME BPVC-IX. The procedure qualification record shall record all essential variables as defined in ASME BPVC-IX of the weld procedure used for the qualification test(s).

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7.6.4 Hardness testing

The test weldment for hardness testing shall have the same type of post-weld heat treatment as the final product. For running tools, pulling tools, kick-over tools and latches, environmental service classification E2, hardness tests across the weld, base material and heat affected zone (HAZ) cross-section shall be performed in accordance with ASTM E18 and recorded as part of the PQR. Maximum hardness values for environmental class E2 service shall not exceed ISO 15156 or NACE MR0175 requirements.

7.6.5 Welder/welding operator performance qualification

Welders and welding operators shall be qualified in accordance with ASME BPVC-IX:2007, Article III. Records of welding performance qualifications (WPQ) testing shall include all welding parameters as detailed in ASME BPVC-IX.

7.7 Non-destructive examination (NDE) requirements

Non-destructive examinations are not required by this part of ISO 17078, except as indicated herein. If NDE examinations are conducted for supplier's/manufacturer's internal procedures or because of user/purchaser written requests, the NDE procedures defined in ISO 17078-1 shall be followed.

Where NDE is used on running tools, pulling tools, kick-over tools and latches, the supplier/manufacturer shall prepare written specifications for allowable relevant indications.

7.8 Storage and shipping preparation

7.8.1 General

The supplier/manufacturer shall comply with the following requirements for storage and shipping of running tools, pulling tools, kick-over tools and latches.

7.8.2 Draining, cleaning and/or drying

The processes for draining, cleaning and/or drying of running tools, pulling tools, kick-over tools and latches, after they have been tested, shall be specified in the supplier's/manufacturer's written procedures. The minimum standard shall be that the products shall be free of any foreign liquids and/or matter.

7.8.3 Threaded end connections and packing

All threaded end connections and packing shall be protected as specified in the supplier's/manufacturer's written procedures.

7.8.4 Permanent marking prior to coating

Prior to coating, all permanent marking that is required by this part of ISO 17078 shall be completed. No markings shall affect the operation of any component of a running tool, pulling tool, kick-over tool or latch. All markings shall be made according to, and located based on, the supplier's/manufacturer's written procedures. No coating is allowed on or in active threads or on the sealing surface, other than coating, plating or other surface treatments that are supplier-/manufacturer-specified for those surfaces.

7.9 Allowable changes after manufacturing

Any change to a previously validated and tested product, over and above settings, adjustments and redress, etc., as defined in the technical/operations manual, becomes a design change and shall require full design validation and product functional testing to qualify it to this part of ISO 17078.

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7.10 Reconditioning and repair of used running, pulling and kick-over tools and latches

Reconditioning and repair of used running, pulling and kick-over tools and/or latches is outside the scope of this part of ISO 17078. However, this process is used in industry. See ISO 17078-4 for a discussion of this topic.

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Annex A
(normative)

Requirements for running and pulling tools

A.1 General

This annex presents the design validation and product functional testing requirements for each design validation grade and product functional testing grade, as well as the environmental class, for running and pulling tools.

A.2 Environmental class

The supplier/manufacturer shall select materials to meet this environmental service class requirement. For running and pulling tools, only standard service E4 is covered in this part of ISO 17078. If sour or other services are required, they may be addressed by agreement between the user/purchaser and the supplier/manufacturer. Class E4 applies to service in fluids that have an H_2S partial pressure less than those listed for stress cracking in ISO 15156 or NACE MR0175 and no CO_2 content as defined by industry typical analysis. Materials used for this service are typically low alloy steels such as 4130, 4135 and 4140, and other materials may be acceptable for this service if approved by the user/purchaser.

A.3 Design validation testing

A.3.1 General

Running or pulling tools of each design, type and size shall meet the acceptance criteria of all applicable design validation requirements for that grade before the product design can be presented for sale to, or use by, users/purchasers as meeting the requirements of this part of ISO 17078. All validation testing shall conform to the requirements of Clause 7 and A.3.2.

A.3.2 Design validation requirements

A.3.2.1 Design validation requirements — Grade V2

The design validation requirements for Grade V2 for running and pulling tools are defined in D.2.2.

A.3.2.2 Design validation requirements — Grade V1

A.3.2.2.1 General

The supplier/manufacturer shall perform the validation test for each size, type and model of tool in accordance with D.2.3.

A.3.2.2.2 Additional design validation requirements for running tools

One running tool and an associated latch shall be used for each separate combination of running tools and latches for which appropriate interface is claimed.

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Add bluing to the latch. Axially connect the running tool to the latch, without the running tool shear pin, and rotate. Remove the running tool and identify contact points. The location of the contact points shall meet the design requirements as specified by the supplier/manufacturer. Document the “bluing” test procedures and results in the design documentation.

A.3.2.2.3 Additional design validation requirements for pulling tools

One pulling tool and an associated latch shall be used for each separate combination of pulling tools and latches for which appropriate functionality is claimed.

Secure the pulling tool to the latch and activate the emergency release tool in accordance with the supplier's/manufacturer's written specifications. To pass, the pulling tool shall be freely removed from the latch. Document the emergency release test results in the design documentation.

A.3.3 Product functional testing

A.3.3.1 General

This part of ISO 17078 specifies one grade (F1) of functional testing for running and pulling tools.

A.3.3.2 Product functional testing for running tools

The following are the grade F1 product functional testing requirements for running tools.

Functional testing shall be performed on each running tool manufactured.

a) Conduct a dimensional inspection to verify that the tool meets the designed dimensional tolerance requirements as specified by the supplier/manufacturer.

b) Document the results of the dimensional inspection according to the supplier's/manufacturer's written documentation requirements.

A.3.3.3 Product functional testing for pulling tools

The following are the grade F1 product functional testing requirements for pulling tools.

Functional testing shall be performed on each pulling tool manufactured.

a) Demonstrate the ability to engage and disengage the pulling tool from a latch, in accordance with the supplier's/manufacturer's written procedures.

b) Demonstrate the ability of a latch's dogs to cycle from full closed to full open and to return unassisted and unencumbered to the closed position after the latch's dogs are released, in accordance with the supplier's/manufacturer's written procedures.

c) Conduct a dimensional inspection of all component parts prior to assembly to verify that the tool meets the designed dimensional tolerance requirements as specified by the supplier/manufacturer.

d) Document the results of the dimensional inspection according to the supplier's/manufacturer's documentation requirements.

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Annex B
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Requirements for kick-over tools

B.1 General

This annex presents the design validation and product functional testing requirements for each design validation grade and product functional testing grade, as well as the environmental class, for kick-over tools.

B.2 Environmental classes

The supplier/manufacturer shall select materials to meet this environmental service class requirement. For kick-over tools, only standard service E4 is covered in this part of ISO 17078. If sour or other environmental classes are required, they may be addressed by agreement between the user/purchaser and the supplier/manufacturer. Class E4 applies to service in fluids that have an H_2S partial pressure less than those listed for stress cracking in ISO 15156 or NACE MR0175, and no CO_2 content as defined by industry typical analysis. Materials used for this service are typically low alloy steels such as 4130, 4135 and 4140. Other materials may be acceptable for this service when approved by the user/purchaser.

B.3 Design validation testing

B.3.1 General

Kick-over tools of each design, type and size shall meet the acceptance criteria of all applicable design validation requirements for that grade before the product design can be presented for sale to, or use by, users/purchasers as meeting the requirements of this part of ISO 17078. All validation testing shall conform to the requirements of Clause 7 and B.3.2.

B.3.2 Design validation requirements

B.3.2.1 Design validation requirements — Grade V2

The supplier/manufacturer shall perform the validation test of each size, type and model of tool as defined in D.2.2.

B.3.2.2 Design validation requirements — Grade V1

B.3.2.2.1 General

The supplier/manufacturer shall perform the validation test of each size, type and model of tool in accordance with D.2.3.

B.3.2.2.2 Additional design validation requirements for kick-over tools

B.3.2.2.2.1 General

The following define additional test requirements for grade V1 status.

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B.3.2.2.2.2 Wireline kick-over tool test

This test shall be conducted with the side-pocket mandrel installed in a 45° inclined position with the pocket located at the top, side and bottom of the mandrel or in the 12 o'clock, 3 o'clock and 6 o'clock positions. A minimum 3,05 m (10 ft) pup joint shall be connected on the upper end of the mandrel as well as a minimum 1,83 m (6 ft) joint on the lower end. A lubricator stack shall be installed on the upper end of the top pup joint. Side-pocket mandrels that do not have an orienting profile shall be tested at a minimum 15° angle from vertical inclination.

In each orientation, a dummy flow-control device with an appropriate latching mechanism shall be inserted into the mandrel pocket, latched in the pocket and retrieved from the pocket using each of the kick-over tools that are claimed by the supplier/manufacturer to be compatible with the side-pocket mandrel. The supplier's/manufacturer's procedures shall be used. The kick-over tools shall be run into and out of the mandrels using wireline tools and methods. The flow-control device shall be successfully inserted into, and retrieved from, the side-pocket mandrel.

B.3.2.2.2.3 Premature activation test

Insert each of the kick-over tools into the bottom of the mandrel body without pup joints or other threaded accessories to verify that the tool, when inserted into the mandrel, does not engage the kick-over finger or hang up in the mandrel body at any point below the orienting sleeve. This test shall be conducted repeatedly with the mandrel in a fixed (12 o'clock) position and the kick-over tool oriented and held at 10° increments from the top (12 o'clock) position to the bottom (6 o'clock) position. The kick-over tool device shall not hang up or be activated prematurely to pass this test.

B.3.2.2.2.4 Activation force test for kick-over tools

One kick-over tool, pulling tool and latch shall be used for each separate combination of pulling tools and latches for which appropriate kick-over tool activation is claimed. Determine the force required to trigger the kick-over tool. Perform this action a minimum of seven times.

The acceptance criteria shall be that the average force (average of the seven tests) required to trigger the kick-over tool shall be less than or equal to the force specified by the supplier/manufacturer.

B.3.2.2.2.5 Catcher tests for kick-over tools

One kick-over tool, pulling tool and latch shall be used for each separate combination of pulling tools and latches for which appropriate device catcher operation is claimed. This test shall be conducted with the same set-up as defined in B.3.2.2.2.2. The mandrel shall be positioned at the maximum deviation of the supplier's/manufacturer's stated performance. Place a latch attached to the flow-control device in the catcher of the kick-over tool and run the assembly completely through the mandrel and retrieve.

The acceptance criteria shall be that the latch and flow-control device in the catcher shall not hang up in mandrel.

B.3.2.2.2.6 Additional design validation documentation requirements

The following additional specific design documentation shall be provided.

a) Record the configuration of the tool string and the number of jarring strokes required for each insertion and retrieval test as used in B.3.2.2.2.2.

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b) Record the mass(es) and length(s) of the flow-control device(s) used in the testing in each of the above additional tests. [5)]

c) Record the maximum deviation angle as used and the test results in B.3.2.2.2.5.

d) Record the results of the activation force test in B.3.2.2.2.4.

e) Document the average force required to trigger the kick-over tool in the design documentation.

B.4 Product functional testing of kick-over tools

B.4.1 General

This part of ISO 17078 specifies one grade of functional testing for kick-over tools.

B.4.2 Functional testing for kick-over tools

Functional testing shall be performed on each kick-over tool manufactured.

a) Ensure that the kick-over tool activates in accordance with the supplier's/manufacturer's written procedures and specifications.

b) Measure the kick-over tool activation height and demonstrate that it meets the design “kick” height as specified by the supplier/manufacturer.

c) Conduct a dimensional inspection of the component parts and the final assembly to verify the tool meets the designed dimensional tolerance requirements as specified by the supplier's/manufacturer's written procedures and specifications.

d) Document the results of the kick-over activation test and the dimensional inspection according to the supplier's/manufacturer's documentation requirements.

5) Under the International System of Units, the SI, “mass” is the appropriate term for a quantity denominated in kilograms or pounds-mass, and “weight” is the appropriate term for a force denominated in newtons or pounds-force.

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Annex C
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Requirements for latches

C.1 General

This annex presents the design validation and product functional testing requirements for each design validation grade and product functional testing grade, as well as the environmental classes for latches.

C.2 Environmental classes

C.2.1 General

The supplier/manufacturer shall select the materials to meet these environmental service class requirements. Carbon and low alloy steels, such as 10XX series carbon steel and 41XX series low alloy steels, and 200 series stainless steels, shall not be used for latches.

Table C.1 — Environmental service (E) classes

Environmental service (E) classes		Characteristics
Class E4:	Standard service	Non-sour service
Class E3:	Stress cracking service	H_2S (sour) service [a]
Class E2:	Weight loss service	CO_2 service [b]
Class E1:	Unique service	Special service requirements defined by the user/purchaser

[a] In accordance with ISO 15156 or NACE MR0175.

[b] There are no published International Standards for CO_2 service. Each individual situation shall be evaluated on a case-by-case basis.

C.2.2 Class E4 — Standard service

This class applies to service in fluids that have an H_2S partial pressure less than those listed for stress cracking in ISO 15156 or NACE MR0175 and no CO_2 content as defined by industry typical analysis. The standard materials used for this service are 303 stainless steel, 304 stainless steel, 316 stainless steel and 17-4 ph stainless steel. Other materials may be acceptable for this service if they have been shown to operate successfully in this environment.

C.2.3 Class E3 — Stress cracking service [or H_2S (sour) service]

This class applies to service in fluids that have an H_2S partial pressure greater than those listed for stress cracking in ISO 15156 or NACE MR0175 and no CO_2 content as defined by industry typical analysis. Materials used for this service shall be compatible with ISO 15156 or NACE MR0175. Stainless steel 303 shall not be used. Welding processes used for this service shall meet ISO 15156 or NACE MR0175 requirements.

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C.2.4 Class E2 — Weight loss service

This class applies to service in fluids that have an H_2S partial pressure less than those listed for stress cracking in ISO 15156 or NACE MR0175 but do have CO_2 present. Examples of acceptable materials for this service are appropriate stainless steels and nickel-based alloys. Other materials may be acceptable for this service if they comply with grade E2 requirements.

C.2.5 Class E1 — Unique service (to be defined by user/purchaser)

This class may be used by the user/purchaser to specify unique service requirements that are not otherwise covered in this part of ISO 17078. The user/purchaser and supplier/manufacturer shall define requirements for environments that may contain both H_2S and CO_2 and/or for other unique environments.

C.3 Design validation testing

C.3.1 General

Latches of each design, type and size shall meet the acceptance criteria of all applicable design validation requirements for that grade before the product design can be presented for sale to, or use by, users/purchasers as meeting the requirements of this part of ISO 17078. All validation testing shall conform to the requirements of Clause 7 and C.3.2 and C.3.3.

C.3.2 Design validation requirements — Grade V2

The supplier/manufacturer shall perform the validation test of each size, type and model of latch in accordance with D.2.2.

C.3.3 Design validation requirements — Grade V1

C.3.3.1 General

The supplier/manufacturer shall perform the validation test of each size, type and model of latch in accordance with D.2.3.

C.3.3.2 Additional design validation operational testing

Conduct operational testing with one or more set(s) of latches and associated components. All pressure testing shall be performed at ambient temperature.

The test procedure shall be as follows.

a) Install the latch in a test device that supports a locking mechanism similar to the one in a side-pocket mandrel for the latch being tested. Apply a pressure differential that will create a load against the locking mechanism. This testing shall demonstrate the ability of the latching mechanism to withstand the forces as claimed by the supplier/manufacturer.

b) After stabilization, the hold time for the pressure shall be at least 15 min. Pressure variations shall not exceed 1 % of the original applied test pressure. Once the hold time has elapsed, release the pressure.

c) Retrieve the latch from the side-pocket mandrel or test device using the supplier's/manufacturer's specified procedures.

d) Document the number of jarring strokes and jarring forces required for each insertion and retrieval process.

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The acceptance criteria shall be as follows.

— The latch locking mechanism shall function as designed and claimed by the supplier/manufacturer.

— To pass the tolerance accumulation study, it shall be demonstrated in the worst cases of both the go and the no-go positions that the full length of both seal stacks are no closer than 0,16 cm (1/16 in) to the edge of the seal bores of the side-pocket mandrel.

— Insertion and retrieval actions shall not exceed those specified by the supplier/manufacturer.

The documentation requirements shall be as follows.

— Identify the supplier/manufacturer, part number and serial number for the side-pocket mandrel used for the scaled drawing or tolerance accumulation study.

— Identify the supplier/manufacturer, part number and serial number of each test component.

C.4 Product functional testing of latches

C.4.1 General

This part of ISO 17078 specifies two grades of functional testing. The user/purchaser shall specify the grade of functional testing required. If the user/purchaser does not specify the grade, products shall be supplied to grade F2.

The grades of functional testing are classified as follows.

a) Grade F2 applies to equipment that satisfies the requirements of this part of ISO 17078, including the testing required for grade F2.

b) Grade F1 applies to equipment that satisfies the requirements of this part of ISO 17078, including the testing required for grade F1.

C.4.2 Functional testing — Grade F2

The following are the functional testing requirements for grade F2 for latches.

a) Conduct the test on 5 % of any job lot, with a minimum of one tool per job lot.

b) For ring latch type products, actuate the latch ring to its back position and release. It shall move back to the correct position without assistance.

c) For cam latch products, rotate to the retracted position and release. It shall move back to the correct position without assistance.

d) For other latch type products, use the supplier's/manufacturer's written test procedures.

C.4.3 Functional testing — Grade F1

The following are the functional testing requirements for grade F1 for latches.

a) Conduct the test on 100 % of all job lots.

b) Conduct the tests defined for grade F2.

c) Conduct a dimensional inspection of all component parts prior to assembly to verify the tool meets the designed dimensional tolerance requirements as specified by the supplier/manufacturer. The results of the dimensional inspection shall be documented according to the supplier's/manufacturer's documented requirements.

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Annex D
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Side-pocket mandrel tool interface evaluations

D.1 Scope

The supplier/manufacturer shall perform the validation test of each size, type and model of tool. All tools required to land, retrieve and secure a flow-control device in a side-pocket mandrel (running tool, pulling tool, kick-over tool and latch) shall be installed and pulled from a representative side-pocket mandrel or test device with the supplier's/manufacturer's specified tools and procedures.

These tests shall be conducted using each of the latches, running tools, pulling tools, kick-over tools and the side-pocket mandrel that are claimed to be compatible.

D.2 Validation requirements

D.2.1 General

The following subclauses give the interface requirements for design validation grades V2 and V1. Interface validation requirements for V1 are also included below.

D.2.2 Design validation requirements — Grade V2

D.2.2.1 General

The following shall be performed for all products that are supplied per user's/purchaser's requirements to design validation grade V2.

D.2.2.2 Design validation requirements — Method 1

The following are the design validation requirements for grade V2.

a) Tests as defined by the supplier's/manufacturer's written procedures shall be performed to validate compatibility with all other components for which interface compatibility is claimed.

b) Acceptance criteria and documentation requirements shall be as defined by the supplier/manufacturer.

D.2.2.3 Design validation requirements — Method 2

As an alternative, a specific product shall be qualified as grade V2 when all the following criteria are satisfied.

a) The product shall have a minimum of two years of verifiable service, with a minimum of 20 devices.

b) This service shall be documented using the supplier's/manufacturer's written documentation procedures, which shall include corrective actions and operational non-conformances completed and documented, and product design changes documented and approved by a qualified person.

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D.2.3 Design validation requirements — Grade V1

D.2.3.1 General

The following shall be performed for all products that are supplied per the user's/purchaser's selection of design validation V1. Each combination of tools, latches and mandrels shall successfully complete, individually, the tolerance accumulation study, drift test and insertion/retrieval test to the defined acceptance criteria.

D.2.3.2 Tolerance accumulation study

Conduct a tolerance accumulation study, using the dimensions and their tolerances from the drawings for all interacting components, to ensure appropriate interactions as per the supplier's/manufacturer's written specifications.

D.2.3.3 Drift test

Create a tool string including a knuckle joint connected to the kick-over tool, spacer bar if required, running tool, latch and flow-control device. Push the kick-over tool completely through the side-pocket mandrel and out the other end into the lower pup-point.

D.2.3.4 Insertion/retrieval test

The insertion/retrieval tests shall be conducted with the side-pocket mandrel installed in a horizontal position, in a vise, with the pocket located at the top, side and bottom of the mandrel or in the 12 o'clock, 3 o'clock and 6 o'clock positions. In each orientation, a dummy flow-control device with an appropriate latching mechanism shall be inserted into the mandrel pocket, latched in the pocket and retrieved from the pocket using the supplier's/manufacturer's procedures and acceptance criteria.

The tool string shall consist of a knuckle joint directly connected to the kick-over tool with bars and jars of appropriate mass. The side-pocket mandrel shall have a pup joint of a 1,22 m (4 ft) minimum length attached to the upper and lower mandrel connection. Conduct these tests with the heavier of a dummy or a flow-control device. Side-pocket mandrels that do not have an orienting profile shall be tested at a minimum 15° angle from vertical inclination.

D.2.3.5 Acceptance criteria

Acceptance for the tolerance accumulation study, drift and insertion/retrieval tests for each orientation shall be as specified below.

a) Tolerance accumulation study

Demonstrate that, in the worst cases, the tolerances allow proper installation and retrieval of the flow-control device in the side-pocket mandrel.

b) Drift test

During the drift test, the kick-over tool assembly shall pass unencumbered completely through the side-pocket mandrel.

c) Insertion/retrieval test

During the test, the installation and retrieval assembly shall function and orient correctly during installation/retrieval of a flow-control device.

— The flow-control device shall clear the face of the pocket during installation.

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— Insertion forces shall not damage the tool string components in any way to preclude their proper operation.

— The flow-control device shall be pulled out of the mandrel pocket.

— The flow-control device shall clear the catcher during retrieval, if a catcher is used.

— Retrieval forces shall not damage the tool string components in any way to preclude their proper operation.

D.2.3.6 Documentation requirements

The following documentation is required in addition to the requirements of 7.2.1 and 7.2.2.

a) Identify the supplier/manufacturer, part number and serial number of each test component, and record the configuration of the tool string.

b) Document the detailed results of the tolerance accumulation study, drift test and installation/retrieval tests in the design documentation.

c) Record the mass(es) and length(s) of the flow-control device(s) used in the testing. [6)]

6) Under the International System of Units, the SI, “mass” is the appropriate term for a quantity denominated in kilograms or pounds-mass, and “weight” is the appropriate term for a force denominated in newtons or pounds-force.

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Annex E
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Figures

Each of Figures E.1 to E.5 is representative of a product type. They are not precision design drawings.

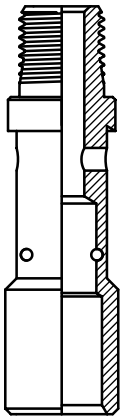

Figure E.1 — Running tool

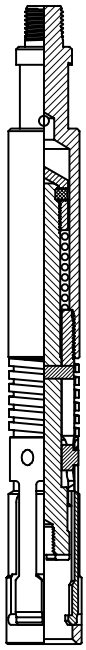

Figure E.2 — Pulling tool

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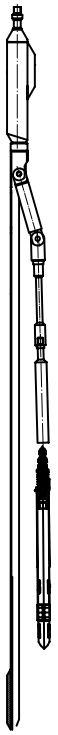

Figure E.3 — Kick-over tool without catcher

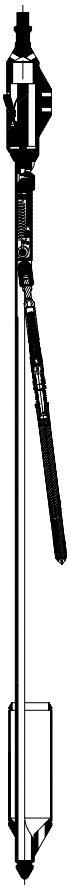

Figure E.4 — Kick-over tool with catcher

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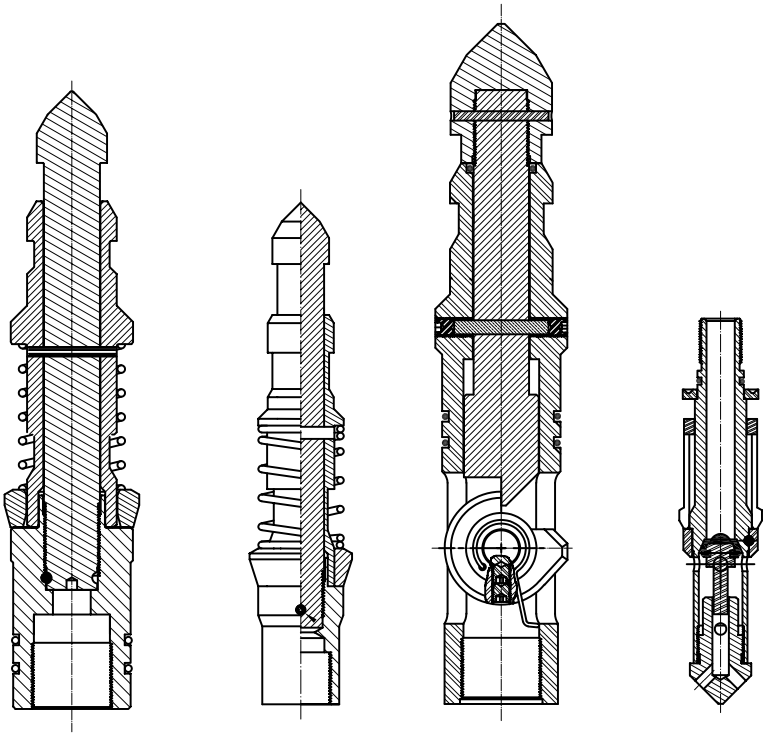

Figure E.5 — Latches

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