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Petroleum and natural gas industries — Drilling and production equipment —

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

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

Partie 4: Pratiques pour raccords à poche latérale et équipement associé

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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 17078-4 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*

Introduction

This part of ISO 17078 has been developed by users/purchasers and suppliers/manufacturers of subsurface side-pocket mandrels, flow-control devices used in side-pocket mandrels (hereafter called flow-control devices), and associated latches and installation tools that are used in conjunction with side-pocket mandrel flow-control devices. This equipment is intended for use in the worldwide petroleum and natural gas industry. This part of ISO 17078 is intended to provide supporting information, guidelines and practices to all parties who are involved in the specification, selection, manufacture, testing and use of side-pocket mandrels, flow-control devices and associated latches and installation tools.

In addition to this part of ISO 17078, ISO 17078-1 provides requirements for side-pocket mandrels used in the petroleum and natural gas industry. ISO 17078-2 provides requirements for flow-control devices. And, ISO 17078-3 provides requirements for latches and installation tools that are used in conjunction with side-pocket mandrel flow-control devices. Other pertinent side-pocket mandrel-related information can be found in API standards listed in the bibliography.

It is necessary that users of this part of ISO 17078 be aware that requirements above those outlined in this part of ISO 17078 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.

Petroleum and natural gas industries — Drilling and production equipment —

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

1 Scope

This part of ISO 17078 provides informative documentation to assist the user/purchaser and the supplier/manufacturer in specification, design, selection, testing, calibration, reconditioning, installation and use of side-pocket mandrels, flow-control devices and associated latches and installation tools. The product-design and manufacturing-related requirements for these products are included within the other parts of ISO 17078.

The content and coverage of several industry documents are compiled and refined within ISO 17078 (all parts).

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 14313, *Petroleum and natural gas industries — Pipeline transportation systems — Pipeline valves*

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

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

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

ISO 17078-3:2009, *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*

ANSI/ASME B16.5, *Pipe Flanges and Flanged Fittings*

ANSI/ASME B16.34, *Valves Flanged, Threaded and Welding End*

ANSI/ASME B31.8, *Gas Transmission and Distribution Piping Systems*

ANSI/API MPMS 14.31-1990, Dimensioning and Tolerancing

GPA 8185-90, *Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluid, Part 1, General Equations and Uncertainty Guidelines*, American Gas Association, Report No. 3

ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Pressure Vessels, Division 1, *Rules for Construction of Pressure Vessels*

ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Pressure Vessels, Division 2, *Alternative Rules*

3 Terms and definitions

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

NOTE For quality-system-related terms used in this part of ISO 17078 and not defined below, reference can be made to ISO 9000 for additional definitions.

3.1
acceptance
flow-control device, component(s) and/or assembly(s) accepted for use

3.2
acceptance criteria
measures or conditions that shall be met for a test to be successful

3.3
ager
pressure chamber used to externally pressure test a flow-control device for a specified period of time and/or number of cycles

3.4
coating
application of a film of material on the surface of another material for different purposes

3.5
compatibility testing
testing to confirm that various side-pocket mandrels and related products fit and work together

3.6
critical length
linear distance in a side-pocket mandrel between orienting sleeve no-go and face of pocket, measured perpendicular to face of pocket

3.7
design verification grade
levels of design requirements for side-pocket mandrels and associated equipment in accordance with ISO 17078-1, ISO 17078-2, and ISO 17078-3

3.8
dome
chamber that contains an internal pressure that is applied to the responsive element, which may be a bellows or piston

3.9
dummy flow-control device
blank device that is installed in a side-pocket mandrel to prevent flow or pressure communication between the casing annulus and the tubing

3.10
gas port
holes in a side-pocket mandrel where gas enters the pocket of the mandrel

3.11
informative
information that is meant to enlighten the user/purchaser or supplier/manufacturer, without containing requirements

3.12
injection pressure operated
injected-gas-pressure-operated flow-control device

3.13
latch
retention mechanism for a flow-control device that is installed in a side-pocket mandrel

3.14
linear mass
mass per length of tubular product

3.15
loading conditions
loading conditions that it is anticipated to apply to the side-pocket mandrel, including, but not limited to, tensile and compressive loads, internal (burst) pressures, external (collapse) pressures, bending stresses, etc.

3.16
manufacturing
process(es) and action(s) performed by an equipment supplier/manufacturer that are necessary to provide finished component(s), assemblies and related documentation that fulfil the requests of the user/purchaser, and to meet the standards of the supplier/manufacturer

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

3.17
model
name and/or description of a device that has unique components and functional characteristics and that distinguish it from other models of the same type

3.18
operating environment
set of environmental conditions that the product is exposed to during its service life, including, but not limited to, such environmental variables as temperature, pressure, liquid composition and properties, gas composition and properties, solids, etc.

3.19
operational parameters
requirements and restrictions to which the product is exposed during its service life

EXAMPLES Operating environment, landing and retrieval of flow-control devices, injection of various well treatment chemicals/fluids, etc.

3.20
product functional testing
process, method(s) and/or test(s) that are used by the supplier/manufacturer to demonstrate that a particular device has been manufactured to fully meet the functional and manufacturing requirements for that product as defined by the appropriate ISO specifications

3.21
production pressure operated
production-pressure-operated flow-control device

3.22
quality control grade
process and/or method(s) used by the supplier/manufacturer to assure the quality of the materials, manufacturing process(es) and traceability as defined in the appropriate ISO specifications

3.23
rated pressure
specified pressure, at a specified temperature, at which the flow-control device is designed to operate

3.24
rated temperature
specified temperature, at a specified pressure, at which the flow-control device is designed to operate

3.25
reconditioning
inspection, repair and test of used products to establish a minimum level of assurance of performance to defined standards

3.26
Système International (French)
SI
system of units used by preference in the ISO International Standards documents

3.27
side-pocket mandrel
tubing-conveyed device that accepts a flow-control or other device in a bore that is offset and essentially parallel with the through bore of the tubing product

NOTE This bore includes sealing surfaces and latching profiles.

3.28
supplier/manufacturer
company, organization or entity that designs, manufactures and/or markets flow-control device products

3.29
technical specifications
parameters stating the operating limit(s) relating to the design, assembly and testing of the component parts or assemblies

3.30
test pressure
maximum rated pressure at test temperature, as specified by the pertinent test procedure

3.31
test temperature
temperature at which the test is conducted, as specified by the pertinent test procedure

3.32
user/purchaser
company, organization or entity that purchases, installs and uses flow-control devices

3.33
wireline
equipment and associated technique(s) used to install and retrieve flow-control devices in a well using a continuous length of solid line (slick line) or stranded wire, appropriate spooling equipment at the surface and a specialized tool string attached to the end of the wire

4 Abbreviations and symbols

4.1 Abbreviations

Abbreviations used within this part of ISO 17078 are defined as follows:

— ANSI American National Standards Institute

— ASME American Society of Mechanical Engineers

— IPO Injection pressure operated

— NORM naturally occurring radioactive material

— P&ID piping and instrumentation diagram

— PPO Production pressure operated

— RP Recommended practice

— SC Standard conditions, assumed to be 101 kPa (14,73 psia) and 15,5 °C (60 °F)

4.2 Symbols

Symbols used within this part of ISO 17078 are defined as follows:

A_b effective bellows area, expressed in square centimetres (square inches)

A_p area based on the nominal port diameter, expressed in square centimetres (square inches)

A_s area based on the diameter where the stem contacts the seat, expressed in square centimetres (square inches)

C_v flow coefficient

F_k specific heat factor, equal to k/1,40

k ratio of specific heats of lift gas

P_{trc} measured or calculated gauge pressure required to close the flow-control device and prevent flow at 15,5 °C (60 °F)

NOTE 1 Referred to as the flow-control-device test-rack closing pressure at standard temperature, expressed in gauge kilopascals (pounds per square inch). A special fixture is required to generate this value as the upstream pressure is reduced until the flow-control device is closed.

P_{tro} measured or calculated gauge pressure applied over the area $(A_b - A_s)$, required to initiate flow through a flow-control device with zero gauge pressure downstream at 15,5 °C (60 °F)

NOTE 2 Referred to as the flow-control-device test-rack opening pressure at standard temperature, expressed in gauge kilopascals (pounds per square inch).

P_{vc} measured or calculated upstream gauge pressure when the downstream pressure is equal to the upstream pressure and near-zero gas flow rate at 15,5 °C (60 °F)

NOTE 3 Referred to as the flow-control-device closing pressure at standard temperature, expressed in gauge kilopascals (pounds per square inch).

P_{vcT} measured or calculated upstream gauge pressure when the downstream pressure is equal to the upstream pressure and near-zero gas flow rate at a known temperature

NOTE 4 Referred to as the flow-control-device closing pressure at a known temperature, expressed in gauge kilopascals (pounds per square inch).

P_{voT} measured or calculated gauge pressure applied over the area ($A_b - A_s$), required to initiate flow through a flow-control device with zero gauge pressure downstream at a known temperature

NOTE 5 Referred to as the flow-control-device opening pressure at a known temperature, expressed in gauge kilopascals (pounds per square inch).

$R_{p,crt}$ critical-pressure ratio factor, the pressure ratio factor at which the velocity of fluid exceeds the local speed of sound

NOTE 6 Critical flow occurs when $F_k \times R_{p,crt}$ equals or exceeds the pressure ratio. The value is determined in accordance with ISO 17078-2:2007, Annex H.

5 Guidelines for application of side-pocket mandrels and related equipment

5.1 General

Guidelines to assist users/purchasers and suppliers/manufacturers in the application of side-pocket mandrels and related products are included in the annexes as referenced in 5.2 to 5.9.

5.2 Interface compatibility issues

The user/purchaser may use the guidelines in Annex A to understand the limits of compatibility testing as used in ISO 17078-1, ISO 17078-2 and ISO 17078-3.

5.3 Test facility for flow-control-device performance testing

The user/purchaser or supplier/manufacturer may use the guidelines in Annex B to assist in set-up of sites for performance testing of flow-control devices.

5.4 Set-up and calibration of flow-control devices

The user/purchaser or supplier/manufacturer may use the guidelines in Annex C to assist in set-up and/or calibration of flow-control devices.

5.5 Pre-installation and post-removal inspection, testing, and maintenance

The user/purchaser or supplier/manufacturer may use the guidelines in Annex D to assist in pre- and post-removal inspection, testing and maintenance of side-pocket mandrels and related devices, such as flow-control devices, running, pulling, and kick-over tools and latches.

5.6 Reconditioning side-pocket mandrels and related products

The user/purchaser or supplier/manufacturer may use the guidelines in Annex E to assist in reconditioning of side-pocket mandrels and related devices, such as flow-control devices, running, pulling, and kick-over tools and latches.

5.7 Reconditioning shops and shop personnel

The user/purchaser or supplier/manufacturer may use the guidelines in Annex F to assist in set-up and staffing of facilities for set-up, calibration and/or reconditioning of side-pocket mandrels and related devices, such as flow-control devices, running, pulling, and kick-over tools and latches.

5.8 User/purchaser functional specification templates

The user/purchaser may use the guidelines and blank templates in Annex G (and also provided as separate revisable electronic files) to assist in compiling and providing the information that is required when ordering side-pocket mandrels and related products, such as flow-control devices, running, pulling, and kick-over tools and latches. However, use of these templates is not required. They are offered as a convenience for the user/purchaser. If one or more of these templates is used, it shall be used as specified in Annex G.

5.9 Supplier/manufacturer product data sheets

The supplier/manufacturer may use the guidelines and blank templates in Annex H (and also provided as separate revisable electronic files) to assist in compiling and providing the information that is required when providing side-pocket mandrels and related products, such as flow-control devices, running, pulling, and kick-over tools and latches. However, use of these templates is not required. If one or more of these templates is used, it shall be used as specified in Annex H.

Annex A
(informative)

Interface compatibility issues

A.1 General

This annex presents guidelines for interface compatibility issues between side-pocket mandrels and related equipment. It is the responsibility of the user/purchaser to assure compatibility between the various tools if components are selected from different suppliers/manufacturers.

A.2 Interface compatibility

A.2.1 General

Each component in a gas-lift or side pocket equipment system, including the side-pocket mandrel, flow-control device and the tools used for installation and retrieval (running, pulling, and kick-over tool, and latch) shall be dimensionally compatible with each other to work correctly. Normally, dimensional compatibility between components is only assured within the product line of a particular supplier/manufacturer, unless a supplier/manufacturer runs specific tests to demonstrate compatibility with components from a different supplier/manufacturer with which compatibility is claimed. Examples of such tests are provided in this International Standard (all parts).

If a user/purchaser chooses to use equipment from different suppliers/manufacturers, the user/purchaser can require that dimensional compatibility between the components be proven. A recommended way to do this is to require that the suppliers/manufacturers demonstrate dimensional compatibility by performing interface validation tests.

A.2.2 Validated compatibility

All components are made by one supplier/manufacturer, and that supplier/manufacturer proves, through ISO-specified design validation compatibility testing, that all of its components fit and work together.

A.2.3 Claimed compatibility

Components are provided by different suppliers/manufacturers, but each supplier/manufacturer has proven compatibility with each component for which compatibility is claimed. The ISO-specified functional compatibility tests are a recommended way to do this.

A.2.4 Unconfirmed compatibility

Components are provided by several different suppliers/manufacturers that do not claim interface compatibility. In this case, interface compatibility of all components should be demonstrated by functional testing before installation. The ISO-specified functional compatibility tests are a recommended way to do this.

A.2.5 Degree of assurance by different design validation grades

For most components, the ISO standards provide differing “degrees of assurance” by the design validation grades V3, V2, and V1 for side-pocket mandrels, flow-control devices, latches and associated tools. Each user/purchaser shall be aware of the requirements of each grade and specify the grade necessary to assure the interface compatibility that is required. For some components, grade V1 requires a tolerance-accumulation study with all required tolerances, including the specific design tolerances of the side-pocket mandrel, the flow-control device and the latch. It is unlikely that this requirement can be met in cases where components are provided by different suppliers/manufacturers.

Annex B
(informative)

Test facilities for flow-control device performance testing

WARNING — The use of this part of ISO 17078 can involve hazardous operations and equipment. This part of ISO 17078 does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this part of ISO 17078 to establish appropriate skill levels for personnel performing the procedures and the applicability of safety and health practices.

B.1 Scope

This annex provides recommendations for test facilities used in performance testing of flow-control devices. It outlines the equipment required for testing flow-control devices to determine

a) the flow-control device flow coefficients, C_v;

b) the pressure-drop ratio factor, X_t;

c) the gas-lift flow-control-device performance curves.

B.2 Test facility

B.2.1 General guidelines

B.2 outlines the testing facility necessary to perform flow-control device testing. The type of testing anticipated requires a high-volume, high-pressure source of gas. It is suggested that the gas storage device be at least 2,83 m^3 (100 ft^3) and the pressure be at least 10 432 kPa (1 500 psi).

Applicable codes and practices should be followed when constructing the facility. The piping, flow-control devices and surge vessels that comprise the gas-lift flow-control-device testing system are subjected to high-pressure gas. Therefore, the fabrication, testing, and flow-control device selections shall adhere to the established codes governing piping systems and vessels.

Surge or other vessels with diameters exceeding 152 mm (6 in) shall adhere to ANSI/ASME BPVC, Section VIII, Divisions 1 and 2. These provide requirements for design, fabrication, inspection and certification of applicable vessels.

The specifications for piping, including materials, wall thickness and related pressure ratings, shall be in accordance with ANSI/ASME B31.8, *Gas Transmission and Distribution Piping Systems* and addenda. Piping material shall be specified as Grade B; flanges shall be in accordance with ANSI/ASME B16.5, *Pipe Flanges and Flanged Fittings: NPS 1/2 through 24"* and any addenda; flow-control devices shall be in accordance with ANSI/ASME B16.34, *Valves Flanged, Threaded and Welding End*.

Other components are covered by ISO 14313.

NOTE For the purposes of this provision, API Spec 6D is equivalent to ISO 14313.

These components may be used; however, it is possible that they are not interchangeable with ANSI/ASME flanges, so caution should be used if attempting to mix equipment covered by different codes.

All testing shall be performed by personnel who have been qualified as having the required skills and abilities to conform to the requirements of this part of ISO 17078.

All testing procedures, fluids, approved testing results, equipment and personnel shall be documented for each series of testing performed. This documentation shall be available for review by the user/purchaser for a minimum of three years after completion of the processing.

B.2.2 Calibration

Measuring and testing equipment used for acceptance shall be identified, inspected, calibrated and adjusted at specific intervals in accordance with the documented specifications of ISO/IEC 17025, this part of ISO 17078 or an applicable national or international standards agency that is no less stringent than the requirements included herein.

NOTE For the purposes of this provision, ANSI/NCSL Z540-3 is equivalent to ISO/IEC 17025.

Measuring and testing equipment shall be used only within the calibrated range.

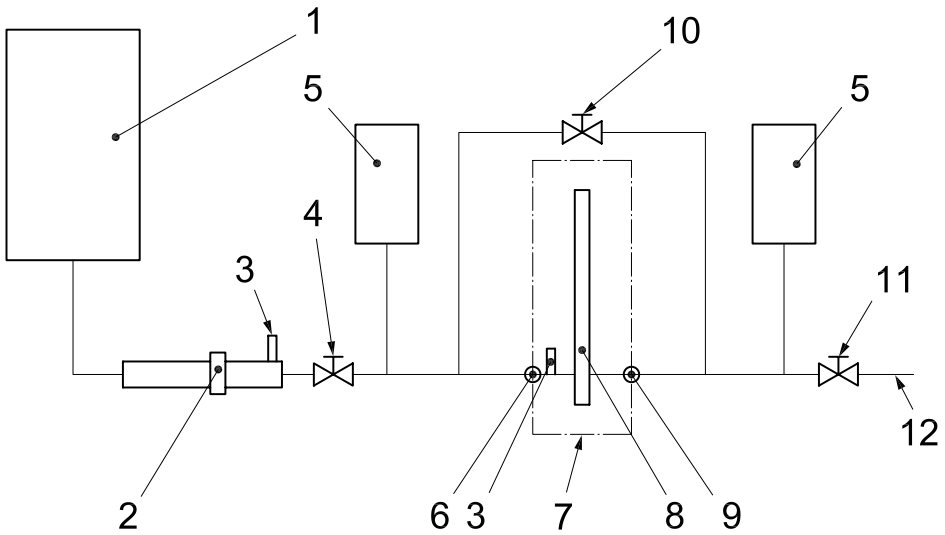
Technologies for inspections with verifiable accuracies equal to or better than those listed in this part of ISO 17078 may be applied with appropriate documentation and when approved by qualified personnel.

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 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 cannot be increased by more than twice the previous interval, not to exceed one year.

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

B.2.3 General description

The flow test system shall be defined in a P&ID diagram and shall include, as a minimum, items shown in Figure B.1.



Key

1 gas source
2 flow-measuring (flow meter) device
3 temperature sensor (temperature tap)
4 upstream control valve
5 pressure surge protection
6 upstream pressure taps
7 test section
8 test specimen
9 downstream pressure taps
10 equalizing flow-control valve
11 downstream control valves
12 exhaust

Figure B.1 — Basic flow-test system schematic

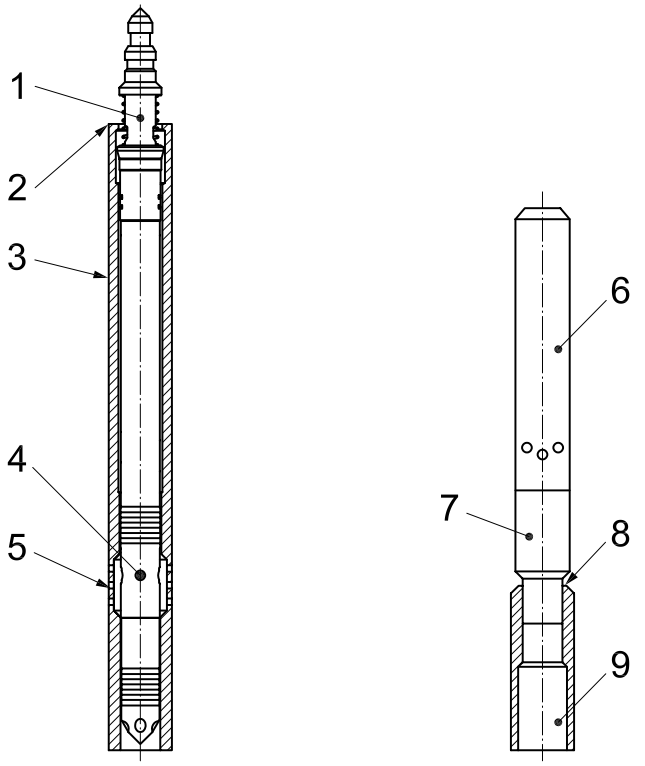
B.2.4 Test specimen — Wireline-retrievable flow-control devices

B.2.4.1 Test specimen

The test specimen includes the fully assembled test flow-control device including the supplier/manufacturer's recommended reverse check valve and a latch that is compatible with the flow-control device. This assembly is installed and latched in a compatible receptacle. Replacement of the external V-ring packing stacks with an alternate method of sealing is permissible.

The flow-control-device receptacle shall be compatible with the flow-control device and latch; it shall provide a means to seal above and below the flow-control-device inlet ports. The inlet port area of the receptacle and the minimum annular flow area between the receptacle and flow-control-device inlet port shall be recorded.

The test specimen consists of the components shown in Figure B.2.



a) Wireline-retrievable test specimen **b) Tubing-retrievable test specimen**

Key

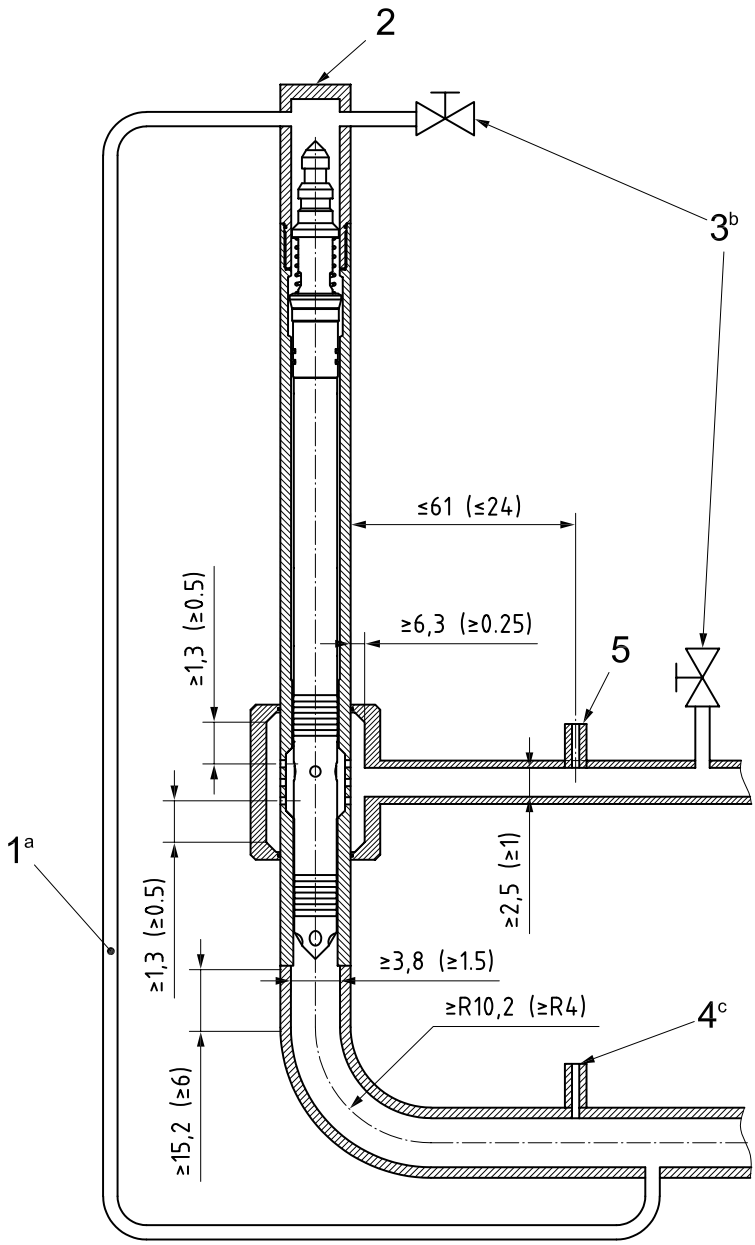
1 standard latch securely threaded to assembled valve
2 upper and lower section of pocket may be modified
3 fully assembled test valve
4 annular flow area
5 inlet port area
6 fully assembled test valve
7 reverse flow valve
8 standard attachment configuration
9 compatible with test configuration

Figure B.2 — Test specimen — Wireline-retrievable and tubing-retrievable flow-control devices

B.2.4.2 Test section — General

The test section includes the test specimen and all fixtures located between the upstream and downstream pressure measurement devices. The flow path through the test section shall not pass through any chokes, close-radius elbows or tees, and shall be free of internal obstructions. Elbows shall have a minimum radius of 10,16 cm (4 in). Figure B.3 shows an example of a test section that complies with these provisions.

Dimensions in centimetres (inches)



Key

1 pressure equalizing line
2 safety cap
3 bleed valves
4 downstream pressure and optional temperature sensors
5 upstream pressure sensor

a Recommended when using safety cap.
b Bleed to atmosphere prior to removing safety cap or test specimen.
c The location of pressure and temperate sensors shall be located no more than 61 cm (21 in) from test specimen.

Figure B.3 — Example test section

B.2.4.3 Upstream test section

The test section upstream of the test specimen shall extend no more than 60,96 cm (24 in) from the test specimen and shall have a minimum inside flow diameter of at least 2,54 cm (1 in). The upstream test section shall be plumbed to the test specimen such that an unobstructed annular chamber exists surrounding the inlet ports of the test specimen. This chamber shall extend no less than 1,27 cm (0,5 in) above and below the inlet ports of the test specimen and shall have an annular width of at least 0,64 cm (0,25 in).

B.2.4.4 Downstream test section

The test section downstream of the test specimen shall extend no more than 60,96 cm (24 in) from the test specimen and shall have an inside diameter of at least 3,81 cm (1,5 in). The downstream test section shall be aligned such that the centrelines of the specimen and section are parallel and concentric. The downstream test section shall have a straight extension of at least 15,24 cm (6 in) length beginning at the test specimen.

B.2.5 Upstream and downstream control valves

Upstream and downstream control valves are used to control or throttle the pressures acting on the test section. Both control valves shall be of sufficient flow rate and pressure capacity to exceed the flow rate and pressure capacity of the test system.

B.2.6 Pressure surge protection

B.2.6.1 General

Pressure surge protection is recommended on both the upstream and downstream side of the test section. The purpose of the pressure surge protection is to dampen the effects of a pressure surge that could possibly occur as a result of flow-control-device performance. Pressure surge has the potential to cause serious damage to pressure-measuring devices and transducers, and seriously hamper the ability to control and monitor a test.

B.2.6.2 Surge tanks

Surge tanks can be used to gain an amount of surge protection. These tanks shall be plumbed into the test system outside the test section such that they are each independently in full pressure communication with the upstream and downstream pressures acting on the test section. Optional control valves may be placed in the plumbing that connects the pressure surge tanks to the test system. The volume of the pressure surge tanks shall be no less than 0,057 m^3 (2 ft^3). It is recommended that the downstream pressure surge tank have twice the volume of the upstream pressure surge tank.

B.2.6.3 Alternative methods

Alternative surge protection systems that reduce pressure surges in the test specimen to no more than 69 kPa/s (10 psi/s) are also permitted.

B.2.7 Flow measurement methods and accuracy

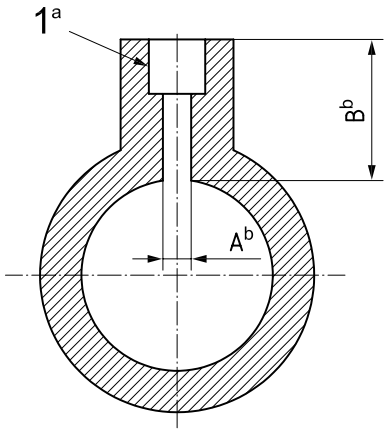
The flow measurement instrument and/or method may be any device that meets the specified accuracy.

Flow rate shall be determined within an error not exceeding ±5 % of actual flow rate. The resolution and repeatability of the method shall be within ±0,5 % of actual flow rate. The measuring instrument shall be selected and maintained to achieve the specified accuracy. The ANSI/API MPMS 14.31-1990 or GPA 8185-90 Part 1 methods of flow-rate calculation, along with a certified meter run, satisfy these provisions.

B.2.8 Pressure taps

B.2.8.1 General

Two pressure taps are required. The locations of these two pressure taps define the upstream and downstream pressures acting on the test system. The locations of these two taps define the beginning and end of the test section. The geometry of the tap shall conform to the dimensions given in Figure B.4.



Key

1 hole edge

[a] Hole edge shall be clean and sharp or slightly rounded, free from burrs, wire edges, or other irregularities. In no case shall any fittings protrude inside the pipe.

[b] Dimensional requirements.

Size of pipe mm (in)	**A not exceeding** mm (in)	**A not less than** mm (in)	**B**
$\leqslant$ 51 (2)	6,3 (1/4)	3,2 (1/8)	2,5 $\times$ A
51 to 76 (2 to 3)	9,5 (3/8)	3,2 (1/8)	2,5 $\times$ A
102 to 203 (4 to 8)	12,7 (1/2)	3,2 (1/8)	2,5 $\times$ A

Figure B.4 — Recommended geometry of pressure tap

B.2.8.2 Location and orientation

The upstream and downstream pressure taps shall be located as near to the test specimen as possible, but shall be no more than 60,96 cm (24 in) from the test specimen. When located on a horizontal run, the upstream and downstream taps shall be located above a horizontal plane extending through the centreline of the pipe. The tap centreline shall be perpendicular to the pipe centreline.

B.2.9 Pressure measurement and reporting

The upstream and downstream test-section pressure measurement shall be visually displayed and recorded continuously to the operators that are controlling the test pressures at the test section. A means shall be provided to produce a hardcopy report of the pressures measured at both the upstream and downstream pressure taps of the test section.

B.2.10 Temperature taps, location and orientation

B.2.10.1 General

Two temperature taps are required. One temperature tap shall be located on the upstream side of the test section and the other shall be located near the flow-rate measurement device. An optional downstream temperature tap may be located on the downstream side of the test section.

B.2.10.2 Location and orientation

The upstream temperature tap shall be located within the upstream side of the test section. The temperature tap used for flow-rate measurement shall be located as recommended by the supplier/manufacturer of the flow-rate measurement device. There is no requirement for the location of the optional downstream temperature tap; however, it is recommended that it be located within the downstream side of the test section. When located on a horizontal run, the temperature taps shall be located above a horizontal plane extending through the centreline of the pipe.

B.2.11 Temperature measurement, accuracy, and reporting requirements

The devices used to measure gas temperature shall not have an error exceeding ±1,1 °C (±2 °F) of the actual value. The gas temperature shall be measured at the flow-rate measurement device and on the upstream portion of the test section. A means shall be provided to produce a hardcopy report of the temperatures measured at both the flow-rate measurement device and at the upstream portion of the test section.

B.2.12 Equalizing valves

The method of accomplishing the tests can require that the upstream and downstream pressures be equalized prior to testing. The equalizing valve shall be positioned between the upstream and downstream test section and shall allow the possibility of bypassing the test specimen.

B.2.13 Gas supply

Air, nitrogen or other inert gas shall be used as the basic fluid in this test procedure. Vapours that can approach their condensation points at the vena contract of the specimen are not acceptable. Care shall be taken to avoid formation of liquids or solids in the gas supply during the test.

B.2.14 Documentation

Test documentation shall meet the requirements of ISO 17078-1:2004, 7.2.

Annex C
(informative)

Set-up and calibration of flow-control devices

C.1 General

This annex presents guidelines that may be followed for set-up and calibration of flow-control devices. The provisions in C.3 and C.4, when implemented in the order shown, provide a history of accurately evaluating and calibrating flow-control devices. Other procedures may also achieve adequate results.

C.2 Facility

The facility used for set-up and calibration of flow-control devices shall meet the requirements specified in this annex.

C.3 Flow-control device set-up/calibration practices

The following practices can be used for set-up/calibration of IPO, PPO, and pilot-operated flow-control devices. The supplier/manufacturer operating manuals for specific equipment shall address the following issues as pertinent for each particular product.

— Verify flow-control device integrity by performing visual inspection and validating pre-set test-rack opening/closing pressures, if pertinent.

— Prepare the flow-control device for testing by removing the reverse flow valve assembly and packing, if necessary.

— Set the required test-rack opening/closing pressures, as appropriate.

— Age the flow-control device.

— Fine-tune the test-rack opening/closing pressures.

— Re-age the flow-control device, if necessary.

— Validate that the test-rack opening/closing pressures have not changed.

— Finalize the flow-control device assembly and marking.

C.4 Example procedure for a 2,54 cm (1 in) IPO flow-control device

The following example of set-up/calibration practices is based on a 2,54 cm (1,0 in), wireline-retrievable, IPO flow-control device. The procedure steps and elements included herein are provided for illustration and the specific procedure for each valve being tested is required to match that design and technology.

a) Perform visual inspection of flow-control device.

b) Remove the reverse flow valve assembly and packing.

c) Validate test-rack opening pressure if this pressure is predefined.

d) Remove the tail plug; use caution as pressure can be trapped between the tail plug and the valve core. Use the appropriate supplier/manufacturer's procedure to charge the bellows to the recommended pressure, or a pressure of 344,7 kPa (50 psi) greater than the design setting pressure, P_{vot}, required. Do not exceed the rated pressure of the flow-control device. Check the valve core for visible leakage.

e) Place the flow-control device in a water bath for 15 min. The water bath shall be at the reference temperature specified by the supplier/manufacturer's or user/purchaser's procedure.

f) Remove the flow-control device from the water bath and insert it in a tester.

CAUTION — Do not hold the flow-control device by the dome as that will heat the dome and cause incorrect set pressures.

g) Apply gas pressure to open the flow-control device; measure and record the pressure required to open the valve. If it takes longer than 30 s to apply and measure the opening pressure, remove the flow-control device from the tester and return it to the water bath to stabilize the temperature and repeat this process.

h) Inspect all elastomeric seals used for the pressure sealing of the tail plug. If metallic gaskets are used, replace the gaskets. Inspect the sealing surfaces of the tail plug to ensure that all surfaces are smooth and clean of debris. Install tail plugs appropriately to ensure the sealing of the dome area.

i) Place the flow-control device in the pressure chamber, or ager, with the flow-control device in the vertical position in the chamber and with the tail plug end up. Follow the supplier/manufacturer's written procedure, or use the procedure given in C.4 j).

j) Increase the pressure on the ager chamber to 34 473,8 kPa (5 000 psig) and hold for a minimum of 5 min. Release the pressure and repeat the pressure/hold cycle two more times. Bleed down the chamber and remove the flow-control device. Remove the tail plug from the flow-control device and place it in the water bath for a minimum period of 15 min.

k) Remove the flow-control device from the water bath and insert it in the tester. Do not hold the flow-control device by the dome as that heats the dome and causes incorrect set pressures. Apply gas pressure to open the flow-control device. Compare the initial recorded pressure to the new opening pressure. If the pressure declines more than 172,4 kPa (25 psi), repeat the ageing cycle in C.4 d). If it increases by more than 172,4 kPa (25 psi), the flow-control device can be defective; it shall be inspected to determine the cause of the pressure increase.

l) Adjust the dome pressure in accordance with the supplier/manufacturer's written procedure to achieve the proper opening pressure, P_{vot}. If it takes longer than 30 s to obtain the desired opening pressure, remove the flow-control device from the tester and return it to the water bath for 15 min and repeat step C.4 j).

m) Inspect all elastomeric seals used for the pressure sealing of the tail plug. If metallic gaskets are used, replace the gaskets. Inspect the sealing surfaces of the tail plug to ensure that all surfaces are smooth and clean of debris. Install tail plugs appropriately to ensure the sealing of the dome area.

n) Place the flow-control device in the pressure chamber or ager, with the flow-control device in the vertical position in the chamber and with the tail plug end up. Follow the supplier/manufacturer's written procedures, or use the procedure given in C.4 o).

o) Increase the pressure on the chamber to 34 473,8 kPa (5 000 psig) and hold it for a minimum of 5 min. Release the pressure and repeat the pressure/hold cycle two more times. Bleed down the chamber and remove the flow-control device. Remove the tail plug from the flow-control device and place it in the water bath for a minimum period of 15 min.

p) Remove the flow-control device from the water bath and install it in a tester and check the test-rack opening/closing pressures. If the test-rack pressure has changed by more than 34,5 kPa (5 psi) and is above the required test-rack opening, repeat C.4 e) through C.4 h) until the pressure does not change more than 34,5 kPa (5 psi). If it is below the required test-rack opening, proceed to C.4 q).

q) Adjust the test-rack pressure if it is too low. Remove the tail plug; use caution as pressure can be trapped between the tail plug and the valve core. Use the appropriate supplier/manufacturer's procedure to charge the bellows to the recommended pressure or to a pressure of 344,7 kPa (50 psig) greater than the design setting pressure, P_{vot}, required. Do not exceed the rated pressure of the flow-control device. Inspect the valve core for visible leakage. Repeat C.4 e) through C.4 h).

r) Install the lower packing; inspect the flow-control device housing for any sharp surfaces. Assemble the checked flow-control device in accordance with the supplier/manufacturer's recommended procedure. Install the upper packing. Inspect the reverse flow check and check seal for proper fit and smooth movement, and to ensure that it is free from debris.

s) Mark the OD of the flow-control device with the P_{vot}, measured setting depth and port size in accordance with ISO 17078-2:2007, 7.3. Record the pressure setting, port size and measured setting depth of each flow-control device.

Annex D
(informative)

Pre-installation and post-removal inspection and testing

D.1 General

This annex presents guidelines for pre-installation and post-removal inspection and testing of side-pocket mandrels and related equipment, including flow-control devices, running, pulling, and kick-over tools and latches. Pre-installation inspection consists of steps that are performed before the equipment reaches the well site and steps that can be performed at the well site. Post-removal inspections may be performed both at the well site and in a shop.

D.2 Guidelines for pre-installation inspection and testing

It is strongly recommended that these guidelines be followed for pre-installation inspection and testing of side-pocket mandrels and related equipment. For the equipment to be acceptable for installation, visual inspections shall indicate satisfactory equipment integrity and measurements shall satisfy completion design specifications.

D.2.1 Inspections/tests conducted prior to well site

The following inspections and testing shall be performed before the equipment is delivered to the well site.

— Verify that the flow-control device has been set up, calibrated and marked in accordance with requirements of this annex.

— Secure the latch to the flow-control device using the supplier/manufacturer's guidelines and recommended grade of thread-locking compound.

— Install flow-control device and latch assembly with proper tools in side-pocket mandrel in accordance with the supplier/manufacturer's recommended installation practices.

— Pressure-test using the lower pressure-testing limit of the supplier/manufacturer of the side-pocket mandrel or flow-control device to validate pressure integrity.

— Mark the side-pocket mandrel with the following information using a permanent marker: well identification and measured depth.

D.2.2 Visual inspection of the product

Visual inspection shall include checking for damage of equipment after shipping to the well site, proper marking and confirmation that the equipment matches the original purchase order and the bill of lading. Each person performing a visual examination shall have passed a defined and documented visual examination within the past year. This pre-installation inspection shall include, as a minimum,

— bends, dents, pits, scratches;

— thread condition, protectors, proper lubricants;

— corrosion;

— required markings;

— sealing surfaces on flow-control devices;

— latch-ring movement;

— kick-over activation.

D.2.3 Drift/outside diameter inspection

Pre-installation drift/outside diameter inspection, using calibrated tools, shall include, as a minimum,

— internal drift testing of side-pocket mandrels;

— external diameter check.

D.2.4 Pressure testing

Pre-installation pressure testing shall include, as a minimum, the mandrel connection with tubing.

IMPORTANT — Do not exceed mandrel pressure test limits.

D.3 Post-removal inspection and testing

D.3.1 Operations conducted when equipment is pulled

The following operations shall be performed when the equipment is first pulled from the well at the well site.

— As each side-pocket mandrel is removed from the well, mark it using a permanent marker with the well identification, mandrel number and measured depth of the mandrel.

— Check for NORM contamination. If contamination is identified, handle in accordance with the prevailing local codes and laws.

— Coat threads with a thread preservative and place closed thread protectors on all threads.

— Record any visual observations regarding tubing, side-pocket mandrels, threads, corrosion, deposits, etc.

— Record any damage created during pulling or handling.

— Send to the shop for post-removal inspections and testing.

D.3.2 Visual inspection

The post-removal inspection performed and recorded shall include the following items, as a minimum.

— Inspect threads.

— Inspect side-pocket mandrel for scale deposits, corrosion products, erosion and plugging.

— Extract flow-control device from side-pocket mandrel, noting any excessive force.

— Mark mandrel number on flow-control device. Verify that the measured depth on flow-control device matches the depth on side-pocket mandrels.

— Inspect the packing.

— Inspect the flow-control device and latch for corrosion, erosion, plugging, bending, pitting or other damage.

D.3.3 Pressure testing

The post-removal inspection shall include, as a minimum, a test of P_{tro} or P_{trc}, as appropriate, of the flow-control device, using the defined reference temperature. Compare the value with that marked on the flow-control device.

These observations shall be recorded.

Annex E
(informative)

Reconditioning side-pocket mandrels and related equipment

E.1 General

This annex presents guidelines for reconditioning side-pocket mandrels and related equipment, including flow-control devices, running/pulling tools, kick-over tools and latches. Reconditioning shall include review, test and repair of used products to establish a minimum level of assurance of performance to the supplier/manufacturer's defined standards in the expected service.

E.2 Reconditioning side-pocket mandrels

These guidelines and practices may be followed for reconditioning used side-pocket mandrels. Reconditioned side-pocket mandrels shall not be represented as new side-pocket mandrels in accordance with ISO 17078-1.

E.2.1 General guidelines

The installation of reconditioned side-pocket mandrels may be favourable to the operator under certain field operational considerations. This annex identifies some items of importance and offers possible procedures for implementation when performing reconditioning of side-pocket mandrels. It is not the intent of this annex to suggest the use of used side-pocket mandrels or to provide specific requirements for this process.

Personnel performing these processes shall be experienced and familiar with the products' details and the procedures required in this process. The supplier of this service is expected to have a detailed written procedure of the steps required and their acceptance criteria. The requirements of ISO 17078-1:2004, Clause 7, are applicable to all products reconditioned in accordance with this part of ISO 17078.

E.2.2 Product tracking

Tracking procedures shall be used to ensure that proper documentation and safety are observed. The receiving procedure shall identify the important aspects necessary for historical records as well as the initial condition of each mandrel. Procedures may include, but are not limited to,

— inspecting for NORM contamination in accordance with the appropriate company and local procedures and standards;

— identifying and recording for future reference the following for each mandrel and tool at each step of the processing: the supplier/manufacturer, user name, stocking location, field, well, condition of receipt, serial number and any other comments or observations.

E.2.3 Visual inspection of outer mandrel body

Identify any faulty condition of the side-pocket mandrel body and connection ends that can decrease their performance capability. Each person performing a visual examination shall have passed a defined and documented visual examination within the past year. These inspections shall be performed by persons who have a validated working knowledge of the product.

Check for damage, such as deep tong marks, erosion, and corrosion, that can impair the suitability of the side-pocket mandrel body and connection ends for successful reconditioning.

If required by the user/purchaser, use ultrasonic or magnetic particle tests to further ensure that no hidden defects remain undetected by the visual inspection. These tests shall meet the specifications and acceptance criteria of ISO 17078-1:2004, 7.7.7 or 7.7.8.

E.2.4 ID drift evaluation

Drift ID clearance and mandrel straightness shall be verified. The drift evaluation shall be performed according to the requirements of ISO 17078-1.

E.2.5 Internal inspections

E.2.5.1 General

Visually inspect the mandrel ID for damage to the profiles or changes that can cause an operational problem. Adequate lighting shall be provided to illuminate the internal areas being evaluated. Any flow-control device shall be removed from the side pocket using the supplier/manufacturer's procedure and tools prior to initiation of this examination. Some critical areas for detailed observation are described in E.2.5.2 to E.2.5.5.

E.2.5.2 Positioning (orienting) sleeve

Inspect the area around the positioning sleeve for corrosion and erosion. Inspect the orienting-sleeve kick-over-tool guiding surface for damage that can prevent proper operation of the kick-over tool.

E.2.5.3 Ends/body pipe transition

Inspect the areas where the ends of the side-pocket mandrel transition to the body for corrosion and erosion. Specific attention should be given to the area below the side pocket as large injection volumes can have caused erosion in that area. Examine the welded areas for imperfections that can cause possible performance problems.

E.2.5.4 Pocket and deflector

Inspect the welded areas around the pocket and deflector area for corrosion, erosion, pitting and weld imperfections. Additionally, inspect for sharp edges, debris and burrs that can damage packing during flow-control-device installations. The use of a bore scope greatly assists in the inspections of this area.

E.2.5.5 Seal bores

Inspect for surface corrosion, abrasions and imperfections that can cause damage to the flow-control-device packing system or can prevent proper sealing. A bore scope that is small enough for insertion into the pocket seal area greatly assists the proper evaluations.

E.2.6 Tubing connections

All connections should be thoroughly cleaned and inspected for any damage. Proper gauging of threads by applicably trained and/or licensed thread inspectors is advisable.

E.2.7 Loading and testing

Functionally test a side-pocket mandrel for pressure, sealing and internal drifting to the specifications set forth by the original supplier/manufacturer.

CAUTION — Over-pressurizing can cause serious safety hazards.

As a guideline, the following procedures are suggested. The procedures have been found effective when all are performed in the order shown in E.2.7 a) through k).

Install the appropriately sized flow-control device and latch into the side-pocket mandrel using the supplier/manufacturer's recommended installation procedures. The running tool should always be fully pinned to ensure that the latch profile of the pocket is capable of retaining the flow-control device and that it engages the side-pocket-mandrel latch shoulder properly. Drift-test the mandrel ID in accordance with this part of ISO 17078.

a) Testing procedures shall include adequate safety guidelines that shall be implemented prior to any testing. Install test fixtures into both ends of the mandrel.

b) Fill the mandrel with water while tilting it slightly to ensure that the maximum amount of air is displaced. Once the mandrel is filled, apply the internal hydrostatic test to the supplier/manufacturer's rated pressure (recording all pressures and temperatures) as given in E.2.7 c).

c) Increase the internal pressure slowly to a minimum of 13 790 kPa (2 000 psi) and hold for a minimum of 1 min after stabilization.

d) Increase the internal pressure to the original supplier/manufacturer's pressure rating and hold for 5 min after stabilization; then relieve the pressure.

e) If the side-pocket mandrel leaks at a location other than at a gas port, it shall be subjected to further repair and testing.

f) If the mandrel leaks at a gas port, pull the flow-control device and replace it with a device that has new sealing elements and packing. Record any packing damage on the flow-control device. The pocket may be washed with water and brushed with a clean, soft wire brush to remove debris prior to the insertion of the flow-control device. The side-pocket mandrel shall be retested.

g) If the side-pocket mandrel does not pass the second test, it is permanently rejected and shall be permanently marked as such.

h) If necessary, remove the flow-control device using the original supplier/manufacturer's pulling procedures.

i) Drain all water from the side-pocket mandrel.

j) Lubricate the threads with the proper substance in accordance with the thread supplier/manufacturer's specifications.

k) Place proper thread protectors on the end connections.

E.2.8 Marking and identification

Stencil and permanently mark the mandrel with an “R” and the date, located in the area of the supplier/manufacturer's part number or serial number to identify the mandrel as reconditioned.

E.2.9 Storage and shipping preparation

Handling, storage and shipping shall be in accordance with ISO 17078-1.

E.2.10 Final documentation

Establish a documentation process that properly identifies and tracks each side-pocket mandrel from the original receipt to the details of its shipment. This process should include all testing results and approvals. The supplier/manufacturer in charge of reconditioning shall retain this documentation for not less than five years after the shipment of the mandrel.

E.3 Reconditioning flow-control devices

E.3.1 General

These guidelines and practices may be followed for reconditioning used flow-control devices. Reconditioned flow-control devices shall not be represented as new flow-control devices, in accordance with ISO 17078-2.

E.3.2 Replacement component compatibility

Replacement component parts shall be selected to permit interchangeability within one type or model. Dimensions and dimensional tolerances of the components of the flow-control devices being reconditioned shall facilitate proper operation of the assembled device.

E.3.3 Material requirements

For replacement parts, the minimum material selection shall meet ISO 17078-2:2007, Annex B, environmental service grade requirements.

E.3.4 Disassembly and assembly of used flow-control devices

E.3.4.1 General

In E.3.4 are defined the minimum procedures for reconditioning of IPO and PPO flow-control devices. All flow-control devices being reconditioned shall have an opening pressure, P_{vo}, check for bellows condition, and shall be fully disassembled, cleaned, and have components inspected visually for replacement or repair.

E.3.4.2 Disassembly procedure

The following procedures are recommended.

— Use a donut or encapsulated tester to determine the “as received” test-rack opening pressure for comparison with the opening pressure, P_{vo}, stamped on the flow-control device. If depressured or abnormally pressured, it can be necessary to replace the bellows of the flow-control device; or the fault can be a leaky tail-plug gasket or seal. The flow-control device shall be identified and separated for special handling so the reconditioning technician can carefully check for bellows leakage during the hydrostatic ageing test. At this point, a preliminary check can be made on the stem-seat seal by observing whether the flow-control device can hold pressure for a short inspection period of 5 s.

— Disassemble the flow-control device according to the defined flow-control-device procedures, or documented procedures of the supplier/manufacturer. These procedures shall include

  — inspection of seals, rough sealing surfaces and debris deposits,

  — prevention of the loss of any internal bellows-protection fluids during disassembly,

CAUTION — Some dampening fluids can be hazardous.

  — prevention of the application of torque to the bellows during disassembly/assembly.

— Clean the bellows subassembly to remove debris. Use caution not to damage the bellows. Discard any bellows that is deformed, smashed or otherwise damaged and changed from its permanent set.

— Examine the stem for damage and replace if necessary. Inspect the seat and replace if necessary. Carbide stem and seat components being relapped should be kept together. Rework of seats should not be done, as the original flow-control-device characteristics, such as stem travel, flow rates and load rates, can be modified.

— Clean all parts, and inspect all threads and sealing surfaces. Visually inspect all parts for fluid cutting, cracks or abrasion. Reject any damaged parts.

E.3.4.3 Assembly procedure

The recommended procedure is as follows.

— Assemble the flow-control device according to the defined flow-control-device procedures or documented procedures used by the supplier/manufacturer. Special care should be given to the prevention of loss of any internal bellows-protection fluids.

CAUTION — Bellows fluids can be hazardous.

— All elastomeric materials shall be replaced with new components. Replacement seals should meet the requirements in ISO 17078-2:2007, Clause 7. This includes, but is not limited to, O-rings and gaskets. Valve cores shall be replaced with new ones.

— Attach the stem to the bellows assembly using an appropriate thread-locking compound. Ensure that no torque is applied to the bellows.

E.3.5 Testing reconditioned flow-control devices

All reconditioned flow-control devices shall, as a minimum, successfully pass testing requirements in accordance with grade F3 product functional testing requirements in accordance with ISO 17078-2.

E.3.6 Marking and identification

Permanently mark the flow-control device with an “R” in the area of the supplier/manufacturer's part number and serial number to indicate that it has been reconditioned.

E.4 Reconditioning running, pulling and kick-over tools, and latches

These guidelines may be followed for reconditioning used running, pulling, and kick-over tools and latches. Reconditioned tools and latches shall not be represented as new tools and latches in accordance with ISO 17078-3.

E.4.1 Replacement component compatibility

Replacement component parts shall be selected to permit interchangeability within one type or model. Dimensions and dimensional tolerances of the components of the tools and latches being reconditioned shall facilitate proper operation of the assembled device.

E.4.2 Material requirements

For replacement parts, the minimum material selection shall meet the requirements of the ISO 17078-3 environmental service grade.

E.4.3 Disassembly and assembly of running, pulling, and kick-over tools and latches

E.4.3.1 General

In E.4.3 are defined the minimum procedures for the reconditioning of running, pulling and kick-over tools, and latches. All tools and latches being reconditioned shall be fully disassembled and cleaned, and have components inspected visually for replacement or repair.

E.4.3.2 Disassembly procedure

Disassemble the tool or latch in accordance with the defined procedures or documented procedures of the supplier/manufacturer. These procedures shall include the following.

— Inspect seals, rough sealing surfaces and debris deposits.

— Check for straightness of all parts.

— Clean the subassembly to remove debris.

— Clean all parts, and inspect all threads and sealing surfaces. Visually inspect all parts for fluid cutting, cracks or abrasion. Reject any damaged parts.

E.4.3.3 Assembly procedure

Assemble the tool or latch according to the defined procedures or documented procedures used by the supplier/manufacturer.

Replacement seals shall meet the requirements in ISO 17078-3. This includes, but is not limited to, O-rings and gaskets.

E.4.3.4 Testing reconditioned tools and latches

All reconditioned tools and latches shall, as a minimum, successfully pass testing requirements in accordance with the grade F2 product functional testing requirements in accordance with ISO 17078-3.

E.4.3.5 Marking and identification

Mark the tool or latch in accordance with E.3.6.

Annex F
(informative)

Reconditioning shops and shop personnel

F.1 General

This annex presents requirements for establishing and operating set-up and reconditioning shops for side-pocket mandrels and related equipment, including flow-control devices, latches and other associated equipment. It also presents guidelines for the qualification of shop personnel.

F.2 Set-up/reconditioning shop principles

Set-up/reconditioning shops for side-pocket mandrels, flow-control devices, latches and related equipment shall adhere to the general principles listed below.

a) The workshop/work area shall be identifiable and distinct from other work spaces to the degree necessary to avoid confusion, contamination or unsafe operations, e.g. grinding, sanding, welding, etc.

b) Within the workshop/work area, there shall be clearly distinct clean and dirty work spaces.

c) Storage of side-pocket mandrels and related equipment shall be segregated between work not yet started, work in process, and work completed.

d) Tools and equipment shall be maintained and stored in good working order.

e) The layout of the workshop shall enhance a safe, systematic and ergonomic working environment.

f) The flow-control calibration equipment shall be in accordance with Annex C and ISO 17078-2.

g) Supplier/manufacturer's written documents and guidelines for processes, equipment and procedures relevant to the workshop's functional duties shall be used.

h) Records shall be maintained to conform to the supplier/manufacturer's documented requirements that validate the reconditioning performed, and such records shall be maintained for a minimum of five years after product shipment from the facility.

F.3 Detailed recommendations for set-up/reconditioning shops

F.3.1 Safety

The supplier/manufacturer's written safety procedures shall be followed when performing all of the tasks outlined below.

F.3.2 Equipment

F.3.2.1 General

Equipment requirements for set-up and testing shall be as defined in the following ISO references and the supplier/manufacturer's written procedures for measurement accuracy:

— ISO 17078-1:2004, Annex C, for side-pocket mandrel product functional testing;

— ISO 17078-2:2007, Annex D, for flow-control-device product functional testing and Annex C of this part of ISO 17078 for flow-control-device set-up/calibration procedures;

— ISO 17078-3:2009, Annex C, for latch product functional testing.

A calibration process shall be in place to maintain this accuracy.

F.3.2.2 Equipment for side-pocket mandrels

A test stand, consisting of the following equipment, shall be used for set-up and testing of side-pocket mandrels:

— dummy flow-control device with latch;

— tools for insertion and retrieval of a flow-control device from the side-pocket mandrel;

— hydrostatic pressuring device for pressurizing the test system;

— devices for measuring and recording test pressures;

— devices for external and internal drift testing.

F.3.2.3 Equipment for flow-control devices

F.3.2.3.1 General

The equipment in F.3.2.3.2 to F.3.2.3.5 shall be used for set-up and testing of flow-control devices.

F.3.2.3.2 Test block/bench (including gauges) for flow-control devices

The test block/bench shall be capable of measuring the calibration pressure of flow-control devices to within the accuracy stated in the individual flow-control-device set-up procedures. Required equipment includes a high-pressure source of air or nitrogen, pipe work, gauges, fittings and adapters necessary to enclose flow-control devices in a manner detailed in the individual flow-control-device supplier/manufacturer's procedures. The test block/bench shall also be capable of

— testing ball/seat leakage rates;

— testing back check integrity.

F.3.2.3.3 Charging system

A system consisting of various adapters, fittings, pipe work and gauges in accordance with the supplier/manufacturer's guidelines and practices shall be available. In addition, a nitrogen supply is required for pressure-charging nitrogen-charged flow-control devices. This shall be placed sufficiently close to the test block to minimize the amount of manual handling required.

F.3.2.3.4 Ager

The flow-control-device ager is a vessel capable of containing flow-control devices singly or in multiples in an upright position, or in a position inclined at not more than 45° from vertical, and withstanding the appropriate internal pressures for ageing as set out in the flow-control-device ageing procedures. The ager vessel shall be fitted with required measuring equipment as defined in ISO 17078-2:2007, Annex M.

F.3.2.3.5 Temperature control (and/or constant temperature bath)

For the set-up of nitrogen-charged flow-control devices, it is necessary to verify and record either the ambient temperature of the workshop or the temperature of a water bath used to maintain the flow-control device at a constant temperature during the set-up process. The workshop technician shall be qualified by passing documented training on the tasks that it is necessary to perform and understanding of the basic test principles, including the significance of how temperature affects the accuracy of the flow-control-device set-up procedure, calibrations, marking, test reporting and traceability.

F.3.2.4 Equipment for latches

The equipment and tools required for latches are identified in F.3.2.5, F3.2.6 and F.3.2.7.

F.3.2.5 Hand tools

The workshop shall be equipped with the hand tools that are required for the assembly, disassembly and set-up of the flow-control devices that are being worked on. Strap wrenches that do not mark the housings of the flow-control devices shall be used to avoid damage. Certain specific tools shall be identified in the individual flow-control-device workshop procedures. Other tools shall be general mechanical workshop tools that are of appropriate size and quality.

F.3.2.6 Storage

Storage facilities shall be sufficient to segregate clean, dirty, finished and unfinished work. Requirements for specialized storage shall be called out in the individual flow-control-device workshop procedures.

F.3.2.7 Equipment-cleaning facility

A cleaning bath, brush wheel and abrasives shall be used to remove grease and other forms of debris from the accessible surfaces prior to reconditioning of flow-control devices.

Environmental consideration shall be given to the selection, use and disposal of all solvents, greases, etc. used in the set-up and reconditioning of flow-control devices. An emergency response plan shall be in place to deal with any spillage. Consideration shall be given to the effects of used equipment that can have been subjected to hazardous environment, such as NORMs, H_2S, etc.

Material safety data sheets or other similar documentation shall be available in the workshop area and shall be reviewed by qualified workshop personnel.

F.4 Documentation

The shop shall have documentation designed to provide the desired quality assurance for all processes provided and shall be demonstrated as fully implemented. The documentation shall address the following as a minimum:

a) calibration of all measuring devices including, but not limited to, pressure-measuring devices and thermometers, to the accuracy stated herein and in the supplier/manufacturer's procedures;

b) maintenance of workshop equipment to a level appropriate to achieve and maintain the workshop procedures;

c) reference to safety procedures, which may be listed in a separate safety procedures manual;

d) equipment storage procedures, which shall address segregation of clean/dirty work, inventory management and any special procedures for items with a specified shelf life, e.g. elastomers;

e) equipment marking, labelling, packaging and shipping procedures;

f) goods receipt and inspection, in particular, procedures for preventing NORM-contaminated products from entering the workshop, can be necessary;

g) work order or job instructions for control of workflow from project initiation through final equipment dispatch;

h) technical manuals and product-assembly instructions and processes.

F.5 Shop personnel

Appropriately trained and qualified shop technicians shall be in place to undertake set-up and reconditioning of side-pocket mandrels and related equipment. The technicians shall use appropriate safety clothing and equipment for the tasks. The technicians shall also be trained in basic safety and workshop procedures.

There shall be a documented and fully implemented shop personnel training programme that includes the applicable processes, requirements, and procedures. Records shall be kept of training and completed examinations to the requirements necessary for the facility to identify persons as competent and qualified to perform their assigned functions.

Annex G
(informative)

User/purchaser functional templates for side-pocket mandrels and related equipment

G.1 Purpose

The templates given in Tables G.1 to G.3 may be used by the user/purchaser to help specify the functional requirements of the side-pocket mandrels and related equipment, including flow-control devices, running/pulling tools, kick-over tools or latches being purchased. A separate revisable electronic version of these templates can be accessed by clicking on the table title.

The functional specifications and requirements are defined in

— ISO 17078-1:2004, Clause 5, for side-pocket mandrels;

— ISO 17078-2:2007, Clause 5, for flow-control devices;

— ISO 17078-3:2009, Clause 5, for latches.

It is possible that not all the requirements of the requirements text are included in these templates.

G.2 General

The templates given in Tables G.1 to G.3 may be used by the user/purchaser to help specify certain information for side-pocket mandrels, flow-control devices and related tools. Different or additional information may be requested by the supplier/manufacturer, or may be provided by the user/purchaser at their discretion. A separate template sheet can be required for each side-pocket mandrel in a “string” of mandrels, or for each flow-control device, if a wide range of conditions is expected.

G.3 Disclaimer

This part of ISO 17078 makes no claim that the information identified on these templates is sufficient to adequately define the functional specifications for a side-pocket mandrel, flow-control device or related tool.

G.4 Side-pocket mandrel functional specification template

Table G.1 — User/purchaser side-pocket mandrel functional specification template

(Click on table title to access separate revisable electronic version)

User/purchaser functional specification template for side-pocket mandrels				
Purchaser information				
Prepared by				
Company				
Date of preparation (dd-mm-yyyy)				
Date of delivery (dd-mm-yyyy)				
Engineering units				
Specification of engineering units	SI units		US customary units	
	NOTE Supply one set of units.			
Side-pocket mandrel functional characteristics				
Size (nominal OD) and/or type of latch being used	mm		in	
Type of flow-control device being placed in side-pocket (e.g. valve, dummy, other)				
Make/model of flow-control device				
Required nominal seal bore size	mm		in	
Anticipated loading conditions (tension, compression, burst, collapse, etc.)				
Top tubular connection (size, linear mass)	mm	in	kg/m	lb/ft
Top tubular connection (connection type, box or pin)				
Bottom tubular connection (size, linear mass)	mm	in	mm	lb/ft
Bottom tubular connection (connection type, box or pin)				
Environmental conditions				
Produced fluid composition (specific gravity, % CO_2, % N_2, % H_2S, ppm chlorides)				
Injection fluid composition (specific gravity, % CO_2, % N_2, % H_2S, water content, or attach chemical composition)				
Injection pressure at mandrel (min./max.)	kPag		psig	
Flowing production pressure at mandrel (min./max.)	kPag		psig	
Injection temperature at mandrel (min./max.)	°C		°F	
Static temperature at mandrel (min./max.)	°C		°F	
Produced fluid temperature at mandrel (min./max.)	°C		°F	
Pressure differential anticipated at mandrel (min./max.)	kPag		psig	
Expected liquid production rate (min./max.)	m^3/day		bbls/day	
Expected injection rate (min./max.)	m^3/day		MCF/day	
Presence of solids? (indicate sand, scale, paraffin, etc.)				

Table G.1 (*continued*)

User/purchaser functional specification template for side-pocket mandrels				
Well physical parameters				
Casing (size, drift ID)	mm	mm	in	in
Casing (linear mass, connection type)	kg/m	lb/ft		
Casing restrictions?				
Liner (size, drift ID)	mm	mm	in	in
Liner (linear mass, connection type)	kg/m	lb/ft		
Liner top depth		m		ft
Liner restrictions?				
Tubing (size, drift ID)	mm	mm	in	in
Tubing (linear mass, connection type)	kg/m	lb/ft		
Tubing restrictions above lowest mandrel (e.g. subsurface safety valves, nipple profiles) (ID, depth)	mm	m	in	ft
Mandrel depths (MD)		m		ft
Max deviation (dogleg severity) and depth at which this occurs	degrees from vertical	m		ft
Acidizing? (if so, composition and additives used, treating pressure at mandrel, procedure, etc.)				
Expected/allowable well operations				
Fracturing? (if so, proppant description, schedule, treating pressure at mandrel, procedure, chemicals used, carrier fluid, etc.)				
Through-tubing intervention methods being used (electric line, wireline (slick line), coiled tubing, snubbing, etc.)				
Equipment that may be run (pass) through mandrel(s), including OD, configuration, etc.				
Sand consolidation?				
Corrosion prevention				
Any special materials being used in the well completion to prevent/control corrosion?				
Any planned chemical treatments to inhibit corrosion? If so, type, pressure at mandrel(s), and chemical composition?				
Selection of grades and classification				
Environmental service grade (See ISO 17078-1:2004, Annex A)	E1 Standard	E2 Sulfide stress cracking	E3 CO_2 service	E4 Special
Design validation grade (See ISO 17078-1:2004, Annex B)	V3 Basic	V2 Intermediate	V1 Highest	
Product functional testing grade (See ISO 17078-1:2004, Annex C)	F3 Basic	F2 Intermediate	F1 Highest	
Quality control grade (See ISO 17078-1:2004, Annex D)	Q3 Basic	Q2 Intermediate	Q1 Highest	

G.5 Flow-control device functional specification template

Table G.2 — User/purchaser flow-control device functional specification template

(Click on table title to access separate revisable electronic version)

User/purchaser functional specification template for flow-control devices		
Purchaser information		
Prepared by		
Company		
Date of preparation (dd-mm-yyyy)		
Date of delivery (dd-mm-yyyy)		
Engineering units		
Specification of engineering units	SI units	US customary units
	NOTE Supply one set of units.	
Functional characteristics — Functional items being defined		
Flow-control device function (See ISO 17078-2:2007, Clause 5)		
Type of flow-control device, IPO, PPO, etc.		
Flow-control-device body material(s)		
Metallurgy of seat or insert material		
Elastomers (O-rings, other as required)		
Seal material on reverse flow check		
Packing type and material		
TRO/PVC range (min./max.)	kPag	psig
Coating for scale, erosion, etc.		
Size: nominal outside diameter	mm	in
Port size range (min./max.)	mm	in
Port type		
Opening method for shear/dump/kill valves (shear screws, tensile bar, atmospheric chamber, burst disk)		
Bellows material		
Bellows protection method		
Maximum spring load rate	kg/cm	lb/in
Minimum flow-control-device stem travel	mm	in
Minimum and maximum flow rate when fully open	m^3/day	MCF/day
Back check flow-control device(s) type and number		
Choke type, if applicable		
Functional characteristics — Flow-control device settings		
TRO or PVC	kPag	psi
Setting temperature	°C	°F
Port size	°mm	in
Choke size	mm	in
Opening pressure at temperature for shear/dump/kill valves	kPa	psi

Table G.2 (*continued*)

User/purchaser functional specification template for flow-control devices		
Functional characteristics — Latch information		
Latch size	mm	in
Latch type and/or model		
Elastomer material		
Functional characteristics — Mandrel information		
Nominal seal bore size in which flow-control device is being installed	mm	in
Mandrel model		
Latching profile		
Well parameters — Fluid, gas, and injected media information		
Produced fluids – oil API gravity		°API
Produced fluids – water cut		%
Produced fluids – water-specific gravity		
Produced fluids – formation GOR	m^3/m^3	ft^3/bbl
Produced fluids – CO_2 content		%
Produced fluids – H_2S content		ppm
Produced fluids – chloride content		ppm
Injection fluid – type (gas, water, steam, chemical)		
Injection fluid – CO_2 content		%
Injection fluid – H_2S content		ppm
Injection fluid – chloride content		ppm
Injection fluid – corrosion inhibition material		
Injection fluid – hydrate inhibition material		
Injection fluid – other materials with injection fluid		
Completion fluid material		
Completion fluid density	kg/m^3	lb/gal
Extraneous components – sand, scale, paraffin		
Expected/allowable well operations — Well intervention information		
Acidizing – composition		
Acidizing – pressure	kPa	psi
Acidizing – temperature	°C	°F
Acidizing – velocity	m/s	ft/s
Acidizing – exposure time of flow-control device		min
Acidizing – other chemicals added with acid		
Fracturing – proppant description		
Fracturing – fracture fluid velocity	m/s	ft/s
Fracturing – proppant/fluid ratio	kg/m^3	lb/gal
Sand consolidation operations		
Special corrosion information		

Table G.2 (*continued*)

User/purchaser functional specification template for flow-control devices				
Operational parameters — Expected parameter information				
Hydrostatic head at flow-control device (FCD)	kPag		psig	
Injection pressure – min./max.	kPag		psig	
Production pressure – min./max.	kPag		psig	
Operating temperature – min./max.	°C		°F	
Gas injection rate – min./max.	m^3/day		mcf/day	
Liquid injection rate – min./max.	m^3/day		bbl/day	
Fluid production rate – min./max.	m^3/day		bbl/day	
Max pressure differential across back check	kPa		psi	
Max internal to external pressure differential across flow-control device	kPa		psi	
Installation, testing, and operational procedures				
Flow-control-device deployment and retrieval method				
Specification of flow-control-device environmental, design verification, product validation, and quality control grades (circle desired grades)				
Environmental service grade	E4 Standard	E3 Stress cracking	E2 Weight loss	E1 Unique
Design validation grade	V3 Basic	V2 Intermediate	V1 Highest	
Product functional test grade	F3 Basic	F2 Intermediate	F1 Highest	
Quality control grade	Q2 Basic		Q1 Highest	

G.6 Running, pulling, and kick-over tool, and latch functional specification templates

Table G.3 — User/purchaser running, pulling, and kick-over tool, and latch functional specification templates

(Click on table title to access separate revisable electronic version)

User/purchaser functional specification template for running, pulling, and kick-over tools and latches				
Purchaser information				
Prepared by				
Company				
Date of preparation (dd-mm-yyyy)				
Date of delivery (dd-mm-yyyy)				
Type of device				
Type of device for which this form is developed	Running tool	Pulling tool	Kick-over tool	Latch
Engineering units				
Specification of engineering units	SI units		US customary units	
	NOTE Supply one set of units.			
Running, pulling, kick-over tool and/or latch functional characteristics				
Side-pocket mandrel type, size, manufacturer				
Side-pocket mandrel drift diameter	mm		in	
Side-pocket mandrel depths	m		ft	
Latch type				
Tubing size	mm		in	
Tubing mass	kg/m		lb/ft	
Tubing restrictions, e.g. nipples				
Maximum hole deviation	degrees from vertical			
Flow-control device				
Flow-control-device special porting configuration requirements (e.g. fluted latch, flow-through latch)				
Flow-control-device special attachment orientation (e.g. bottom latch, integral top latch)				
Conveyance method				
Conveyance method (e.g. wireline, coiled tubing, tractors, others)				
Mitigating factors				
Mitigating factors [e.g. factors that can limit application of effective jarring forces, indication of non-standard condition from impression block, other factor(s)]				

Table G.3 (*continued*)

User/purchaser functional specification template for running, pulling, and kick-over tools and latches		
Compatibility of tool with side-pocket mandrel and flow-control device		
Side-pocket mandrel critical length	mm	in
Orienting-sleeve geometry		
Orienting-sleeve slot width, if applicable	mm	in
Connection of latch to flow-control device – description of threads		
Side-pocket mandrel tool guard/deflector/discriminator – drift ID	mm	in
Description of side-pocket mandrel pocket geometry with which it is necessary that the latch profile be compatible (e.g. describe compatible mandrel series or compatible latch series, or provide detailed engineering drawings of pocket profile)		
Provide any other pertinent information.		
Well parameters — Fluid, gas, and injected media information		
Produced fluids – oil API gravity		°API
Produced fluids – water cut		%
Produced fluids – water-specific gravity		
Produced fluids – formation GOR	m^3/m^3	ft^3/bbl
Produced fluids – CO_2 content		%
Produced fluids – H_2S content		ppm
Produced fluids – chloride content		ppm
Injection fluid – type (gas, water, steam, chemical)		
Injection fluid – CO_2 content		%
Injection fluid – H_2S content		ppm
Injection fluid – chloride content		ppm
Injection fluid – corrosion inhibition material		
Injection fluid – hydrate inhibition material		
Injection fluid – other materials delivered with injection fluid		
Completion fluid material		
Completion fluid density	kg/m^3	lb/gal
Extraneous components – sand, scale, paraffin		

Table G.3 (*continued*)

User/purchaser functional specification template for running, pulling, and kick-over tools and latches				
Expected/allowable well operations — Well intervention information				
Acidizing – composition				
Acidizing – pressure	KPa		psi	
Acidizing – temperature	°C		°F	
Acidizing – velocity	m/s		ft/s	
Acidizing – exposure time of flow-control device			min	
Acidizing – other chemicals included with acid				
Fracturing – proppant description				
Fracturing – fracture fluid velocity	m/s		ft/s	
Fracturing – proppant/fluid ratio	kg/m^3		lb/gal	
Sand consolidation operations				
Special corrosion information				
Operational parameters — Expected parameter information				
Hydrostatic head at flow-control device	kPag		psig	
Injection pressure – min./max.	kPag		psig	
Production pressure – min./max.	kPag		psig	
Operating temperature – min./max.	°C		°F	
Gas injection rate – min./max.	m^3/day		MCF/day	
Liquid injection rate – min./max.	m^3/day		bbl/day	
Fluid production rate – min./max.	m^3/day		bbl/day	
Max. pressure differential across back check	kPa		psi	
Max. pressure differential acting to unseat latch	kPa		psi	
Installation, testing, and operational procedures				
Flow-control-device deployment and retrieval method				
Specification of flow-control-device environmental, design verification, product validation, and quality control grades (circle desired grades)				
Environmental service grade	E4 Standard	E3 Stress cracking	E2 Weight loss	E1 Unique
Design validation grade	V2 Basic		V1 Highest	
Product functional test grade	F2 Basic		F1 Highest	
Quality control grade	Q2 Basic		Q1 Highest	
Additional testing requirements				
Specify additional design validation testing and/or product functional testing that is deemed necessary for a specific application.				

Annex H
(informative)

Supplier/manufacturer product data sheet templates for side-pocket mandrels and related equipment

H.1 Purpose

The templates given in Tables H.1 to H.3 may be used as a product data sheets by the supplier/manufacturer to help specify the technical requirements of the side-pocket mandrels and related equipment, including flow-control devices, running/pulling tools, kick-over tools or latches being provided. A separate revisable electronic version of these templates can be accessed by clicking on the table title.

The functional specifications and requirements are defined in

— ISO 17078-1:2004, Clause 5, for side-pocket mandrels;

— ISO 17078-2:2007, Clause 5, for flow-control devices;

— ISO 17078-3:2009, Clause 5, for latches.

It is possible that not all the requirements of the requirements text are included in these templates.

H.2 Scope

The templates given in Tables H.1 to H.3 may be used by the supplier/manufacturer to help specify certain information for a side-pocket mandrel, flow-control device or related tool. Different or additional information may be requested by the user/purchaser, or may be provided by the supplier/manufacturer at their discretion.

H.3 Disclaimer

This part of ISO 17078 makes no claim that the information identified on this template is sufficient to adequately define the product data requirements for a side-pocket mandrel, flow-control device, or related tool.

H.4 Side-pocket-mandrel product data sheet template

Table H.1 — Supplier/manufacturer side-pocket-mandrel product data sheet template

(Click on table title to access separate revisable electronic version)

Supplier/manufacturer functional specification template for side-pocket mandrels		
Supplier/manufacturer information		
Prepared by		
Company		
Date of preparation (dd-mm-yyyy)		
Date of delivery (dd-mm-yyyy)		
Engineering units		
Specification of engineering units	SI units	US customary units
	NOTE Supply one set of units.	
Side-pocket mandrel specifications		
Supplier/manufacturer side-pocket mandrel part number		
Side-pocket mandrel type designation		
Side-pocket mandrel make/model		
Type of side-pocket mandrel – round or oval		
Special mandrel porting configuration and flow path, if applicable		
OD – max. drift diameter	mm	in
OD – min. (minor) diameter	mm	in
OD – drift (for dual wells)	mm	in
ID	mm	in
ID – drift	mm	in
Flow-control-device nominal OD	mm	in
Nominal ID of upper seal bore	mm	in
Nominal ID of lower seal bore	mm	in
Overall side-pocket mandrel length	mm	in
Critical length from top of orienting slot to face of pocket	mm	in
Test pressure (external)[a]	kPag	psig
Test pressure (internal)[a]	kPag	psig
Tensile strength (EOEC)[b]	kg	lb
All compatible[c] latch types		
All compatible[c] running tool types and ODs		mm (in)
All compatible[c] pulling tool types and ODs		mm (in)
All compatible[c] kick-over tool types and ODs		mm (in)

Table H.1 (*continued*)

Supplier/manufacturer functional specification template for side-pocket mandrels				
Material				
Hardness				Rockwell C
Casing – minimum size recommended			mm, kg/m	in, lb/ft
Casing – minimum size recommended (dual)			mm, kg/m	in, lb/ft
Thread type				
Thread size				
Thread configuration				
Thread mass (weight)			kg/m	lb/ft
Number of full thread recuts available			top	bottom
Specification of side-pocket-mandrel environmental, design verification, product validation, and quality control grades (circle desired grades)				
Environmental service grade	E1 Standard	E2 Sulfide stress cracking	E3 CO_2 service	E4 Special
Design validation grade	V3 Basic	V2 Intermediate	V1 Highest	
Product functional testing grade	F3 Basic	F2 Intermediate	F1 Highest	
Quality control grade	Q3 Basic	Q2 Intermediate	Q1 Highest	

[a] Test is conducted at ambient temperature with ends closed. Higher operating temperatures may lower this value.

[b] Calculations are based on no internal or external pressure, ambient temperature, and the critical cross-section of the side-pocket mandrel. This value is exclusive of end connections (EOEC) that may reduce the tensile strength.

[c] Compatible as proven by testing, by supplier/manufacturer, per ISO 17078-1:2004, Annex B and C.

H.5 Flow-control-device product data sheet template

The template given in Table H.2 may be used as a product data sheet by the supplier/manufacturer to help specify the technical requirements of the flow-control device being supplied to the user/purchaser. The associated technical requirements are defined in ISO 17078-2:2007, Clauses 6 and 7.

Table H.2 — Supplier/manufacturer flow-control-device product data sheet template

(Click on table title to access separate revisable electronic version)

Supplier/manufacturer functional specification template for flow-control devices		
Supplier/manufacturer information		
Prepared by		
Company		
Date of preparation (dd-mm-yyyy)		
Date of delivery (dd-mm-yyyy)		
Engineering units		
Specification of engineering units	SI units	US customary units
	NOTE Supply one set of units.	
Flow-control-device technical specifications		
Nomenclature of flow-control device		
Supplier/manufacturer's flow-control-device part number		
Flow-control-device (FCD) type (e.g. IPO, PPO, pilot, orifice, etc.)		
OD maximum	mm	in
Upper seal bore[a]	mm	in
Lower seal bore[a]	mm	in
Overall flow-control-device length[b]	mm	in
Orifice/port size	mm	in
Bellows cross-section area	mm^2	in^2
Port/bellows (A_p/A_b) ratio		
Maximum dome charge pressure	kPag	psig
Minimum dome charge pressure	kPag	psig
Maximum rated pressure of flow-control-device assembly	kPag	psig
Maximum back check valve differential pressure	kPa	psi
Elastomers/packing rated pressure at maximum temperature	kPag	psig
Elastomers/packing rated pressure at minimum temperature	kPag	psig
Elastomers/packing maximum temperature	°C	°F
Elastomers/packing minimum temperature	°C	°F
Elastomers/packing material		
FCD activation mechanism, e.g. nitrogen, spring, combination, shear, etc.		
Stem/seat material		
Check valve sealing characteristic, e.g. metal-to-metal or metal-to-non-metallic		
Check activation system: e.g. flow activated, spring loaded (positive)		

Table H.2 (*continued*)

Supplier/manufacturer functional specification template for flow-control devices				
Flow-control-device environmental, design verification, product validation, and quality control grades				
Latch connection on flow-control device				
Compatible latch types				
Side-pocket-mandrel porting configuration				
Bellows metallurgy				
Flow-control-device base metallurgy				
Environmental service grade	E4 Standard	E3 Stress cracking	E2 Weight loss	E1 Unique
Design validation grade	V3 Basic	V2 Intermediate	V1 Highest	
Product functional test grade	F3 Basic	F2 Intermediate	F1 Highest	
Quality control grade	Q2 Basic	Q1 Highest		
Other defining information				

[a] Nominal dimension(s) that the FCD is designed to accommodate.

[b] Unless FCD has an integral latch, the length is without latch or latch thread make-up.

H.6 Running, pulling, and kick-over tool, and latch product data sheet template

Table H.3 — Supplier/manufacturer running, pulling, and kick-over tool, and latch product data sheet template

(Click on table title to access separate revisable electronic version)

Supplier/manufacturer functional specification template for running, pulling, and kick-over tools and latches				
Supplier/manufacturer information				
Prepared by				
Company				
Date of preparation (dd-mm-yyyy)				
Date of delivery (dd-mm-yyyy)				
Engineering units				
Specification of engineering units	SI units		US customary units	
	NOTE Supply one set of units.			
Device designation				
Type of device being described (e.g. running tool, pulling tool, kick-over tool, or latch)				
Supplier/manufacturer's part number				
Nomenclature of assembly				
Technical/operations manual reference number				
Mechanical properties				
Metallic material list				
Hardness of engagement surface of tool (e.g. dogs, kick-over trigger, fishing neck)				HRC
Non-metallic material list				
Overall length		mm		in
Maximum OD		mm		in
Fish neck OD		mm		in
Top connection – thread type				
Bottom connection – thread type				
Storage temperature (min./max.)	°C	°C	°F	°F
Operating temperature (min./max.)	°C	°C	°F	°F
Operational properties				
Compatible conveyance method(s)				
Compatible retrieval method(s)				
Maximum tensile load rating		kg		lb
Running, pulling, and kick-over tool and latch environmental, design verification, product validation, and quality control grades				
Environmental service grade	E4 Standard	E3 Stress cracking	E2 Weight loss	E1 Unique
Design validation grade	V2 Basic		V1 Highest	
Product functional test grade	F2 Basic		F1 Highest	
Quality control grade	Q2 Basic		Q1 Highest	
Other defining information				

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