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Petroleum, petrochemical and natural gas industries — Lubrication, shaft-sealing and control-oil systems and auxiliaries —

Part 4: Self-acting gas seal support systems

Industries du pétrole, de la pétrochimie et du gaz naturel — Systèmes de lubrification, systèmes d'étanchéité, systèmes d'huile de régulation et leurs auxiliaires —

Partie 4: Systèmes de soutien pour les étanchéités au gaz auto-actionnées

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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 10438-4 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for the petroleum, petrochemical and natural gas industries*, Subcommittee SC 6, *Processing equipment and systems*.

ISO 10438 consists of the following parts, under the general title *Petroleum, petrochemical and natural gas industries — Lubrication, shaft-sealing and control-oil systems and auxiliaries*:

— *Part 1: General requirements*

— *Part 2: Special-purpose oil systems*

— *Part 3: General-purpose oil systems*

— *Part 4: Self-acting gas seal support systems*

Introduction

ISO 10438 is based on API Std 614, 4th edn., April 1999, divided into four parts as follows:

— *Part 1: General requirements* is based on Chapter 1 of API Std 614;

— *Part 2: Special-purpose oil systems* is based on Chapter 2 of API Std 614;

— *Part 3: General-purpose oil systems* is based on Chapter 3 of API Std 614;

— *Part 4: Self-acting gas seal support systems* (this part) is based on Chapter 4 of API Std 614.

Users of this part of ISO 10438 should be aware that further or differing requirements might be needed for individual applications. This part of ISO 10438 is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly appropriate where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this part of ISO 10438 and provide details.

This part of ISO 10438 requires the purchaser to specify certain details and features.

A bullet (•) at the beginning of a clause or subclause indicates that either a decision is required or further information is to be provided by the purchaser. This information or decision should be indicated on suitable data sheets; otherwise it should be stated in the quotation request (inquiry) or in the order.

Petroleum, petrochemical and natural gas industries — Lubrication, shaft-sealing and control-oil systems and auxiliaries —

Part 4: Self-acting gas seal support systems

1 Scope

This part of ISO 10438 specifies requirements for support systems for self-acting gas seals (dry gas seals) as described in ISO 10439, for use in the petroleum, petrochemical and natural gas industries as well as in other industries by agreement. It is intended to be used in conjunction with ISO 10438-1. ISO 10438 in its entirety specifies requirements for lubrication systems, oil-type shaft-sealing systems, self-acting gas seal systems, control-oil systems and other auxiliaries for general- or special-purpose applications. These systems can serve equipment such as compressors, gears, pumps and drivers.

None of the parts of ISO 10438 is applicable to internal combustion engines.

NOTE Annex A provides schemas of typical dry-gas seal support systems.

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 10438-1:2003, *Petroleum, petrochemical and natural gas industries — Lubrication, shaft-sealing and control-oil systems and auxiliaries — Part 1: General requirements*

API RP 520, Parts I and II, *Sizing, selection and installation of pressure-relieving devices in refineries*

API Std 526, *Flanged steel pressure relief valves*

3 Terms, definitions and abbreviated terms

For the purposes of this part of ISO 10438, the terms, definitions and abbreviated terms given in ISO 10438-1 apply.

4 System selection

Annex A provides schemas of typical system components and diagrams of typical complete dry-gas seal support systems and modules. These schemas and diagrams illustrate the general philosophy and requirements of this part of ISO 10438 and are included to assist the purchaser in the selection of an appropriate system. The purchaser and the vendor shall agree upon a mutually acceptable system.

5 Basic design

5.1 The self-acting gas seal support system (including auxiliaries) covered by this part of ISO 10438 shall be designed and constructed for a minimum service life of 20 years and at least 3 years of uninterrupted operation. It is recognized that this is a design criterion.

- **5.2** The purchaser shall specify the vendor responsible for each portion of the design, scope of supply, installation and performance of the gas seal system. If the purchaser is not the end user, then the end user shall approve the vendors specified (see Annex B).

- **5.3** The purchaser shall specify the equipment's normal operating conditions.

5.4 Unless otherwise specified, the lube oil console (when supplied) and the dry-gas seal module shall be separate.

5.5 The dry-gas seal module shall be designed to serve the full range of equipment operating conditions specified. These conditions may include but are not limited to the following:

a) settling-out pressures;

b) process relief valve settings;

c) shop test and field run-ins;

d) start-up conditions;

e) gas composition.

In order to eliminate the possibility of liquid entering the self-acting seal, all gas streams into the seal should be provided at a temperature 20 K above their dew point. For most systems, the discharge temperature of the compressor gas stream provides this dew point margin.

- **5.6** The purchaser shall specify the maximum sealing pressure.

5.7 Valved vents, drains and piping shall be furnished to permit draining, cleaning and refilling of idle components while the equipment is in operation.

- **5.8** The purchaser shall specify when and where double block-and-bleed valves are required for isolating a component and how they are to be arranged (for further guidance, see ISO 10438-2:2003, Figure A.23).

5.9 Filters, drain traps and other pressure vessels within the scope of the pressure design code shall conform to the code.

5.10 The system shall perform on the test stand and on its permanent foundation within the specified acceptance criteria. After installation, the performance of the system shall be the joint responsibility of the purchaser and the vendor.

- **5.11** The vendor shall advise the purchaser of, and both parties shall mutually agree upon, any special provisions that are necessary to ensure that an adequate supply of seal gas and seal buffer gas or seal separation gas is maintained in the event of complete failure of the seal gas supply system. These provisions may include backup gas bottles and special arrangements for start-up. Provisions shall be adequate for block-in vent or purge situations as applicable. The purchaser will specify the required block-in time. The purchaser and the vendor shall mutually agree upon the system and its components.

NOTE The seal and support system might need to be purged at start-up.

5.12 Block valves which interrupt the gas flow to the equipment shall not be installed in gas supply lines downstream of the filters unless the block valves are part of a component block and bypass arrangement.

6 Piping and tubing

6.1 The vendor shall furnish the dry gas seal module, including mounted appurtenances, located within the confines of the base area. All connections on the module for interconnecting piping to the equipment, shall be flanged.

NOTE This is to keep work areas and walkways as free as possible from obstructions. The intent is to use tubing within the limits of the module such that the module will protect the tubing from external loads.

The interconnecting system between the module and equipment should be rigid pipe. The interconnecting system is provided by the vendor as defined in accordance with 5.2.

6.2 Unless otherwise specified, the piping for each utility, such as for instrument air and nitrogen supply, shall be manifolded to a common connection.

6.3 Unless otherwise specified, self-acting gas seal modules designed for working gauge pressures below 6,2 MPa (62 bar, 900 psi) shall have the gas flow lines manufactured from stainless steel tubing, or stainless steel piping.

6.4 Unless otherwise specified, self-acting gas seal modules with working gauge pressures greater than 6,2 MPa (62 bar, 900 psi) shall have gas flow lines manufactured from stainless steel piping.

6.5 Instrument valves within the self-acting gas seal module on tubing lines shall be tubing valves.

6.6 Control valves shall have steel bodies and stainless steel trim. Valves shall be removable without removing piping or tubing.

7 Gas filters

7.1 General

7.1.1 The filter element material shall be designed for the maximum process gas temperature and shall be compatible with the process gas.

7.1.2 Unless otherwise specified, filters in flammable or toxic services shall have bolted covers.

7.1.3 Unless otherwise specified, the filter housings shall be stainless steel.

7.2 Particulate filter sizing

7.2.1 For differential pressure control systems, filters shall be sized for a clean pressure drop of 21 kPa (3 psi) at twice the gas flow calculated at maximum labyrinth design clearance and at the design differential pressure.

7.2.2 For flow control systems, filters shall be sized for a clean pressure drop of 1 kPa (4 in of water) at 10 times normal flow. They shall function to a differential of 25 kPa (100 in of water).

7.3 Coalescing filter sizing

When the gas contains liquids or moisture, coalescing filters shall be provided. The coalescing filter shall have an efficiency of 98,7 % on particles greater than 3 µm ($\beta_3 \geqslant 75$). If the knockout rates exceed 50 % of the coalescing capacity of the element, a mechanical separator shall be installed ahead of the filter assembly.

NOTE It is sometimes advantageous to use filter designs that use the same cartridge in order to avoid having different type cartridges as spare parts. The cost of a possible oversized filter and operation is a consideration with respect to the benefit of standardization.

8 Transfer valves

8.1 For flammable or toxic service there shall be no leakage into the isolated system (such as the standby filter). When an isolation system is designed such that total shutoff of flow will adversely affect the seal, the vendor shall provide cautionary warning signs of such on the self-acting gas seal module.

NOTE Four individual block valves or a combination of block valves and transfer valves might be required for positive isolation to transfer filters.

8.2 Transfer valves shall have steel bodies. Valve stems, plugs or balls shall be made of stainless steel.

8.3 When specified, when zero leakage (bubble tight) transfer valves are supplied, a strainer with a 0,25 mm mesh (100 mesh) screen shall be provided.

NOTE This will prevent particulate damage to the valve seat and help to maintain performance.

9 Condensate traps

9.1 One condensate drain trap per coalescing filter shall be provided if condensate could be present at the coldest operating temperature in seal gas and or seal buffer gas. Gas downstream of the filter and trap shall be kept free of liquid.

NOTE For some services, heat tracing and/or drain traps at supply piping low points downstream to the control valve can be required.

9.2 Non-repairable float traps may be used for services below 3,1 MPa (31 bar, 450 psi) gauge pressure if approved by the purchaser.

9.3 A mechanical float-type trap may be used for gas gauge pressures less than or equal to 6,8 MPa (68 bar, 1 000 psi).

Level transmitter control-type traps should be used when gas fouling would interfere with the operation of mechanical float-type traps.

9.4 For gauge pressures greater than 6,8 MPa (68 bar, 1 000 psi), snap-acting level transmitter/controllers and separate control valves shall be used.

9.5 All low points upstream to filters shall have drain valves.

9.6 Traps configured as specified in 9.3 and 9.4 shall be furnished with reflex-type gauge glasses. The inlet piping shall enter the seal traps above the condensate level of the traps.

9.7 Unless otherwise specified, drain lines for traps on the module shall be manifolded and a flange connection supplied at the edge of the module.

10 Instrumentation, control and electrical systems

10.1 General

Instrumentation shall be in accordance with ISO 10438-1 except as modified in 10.2 to 10.5.

10.2 Instruments specific to self-acting gas seal system

10.2.1 Unless otherwise specified, the support structure of the self-acting gas seal module shall be fabricated from carbon steel and painted.

10.2.2 Vents shall be sized to prevent overpressurization of the bearing housings in the event of a failure of the seal.

10.3 Alarms and shutdowns

10.3.1 General

The vendor shall furnish and mount the primary alarm and shutdown contacts specified by the purchaser. As a minimum, those listed in Table 1 shall be provided. The alarm setting shall precede the shutdown setting. The arrangement shall be one of three arrangements defined in 10.3.2, 10.3.3 and 10.3.4 or an alternative arrangement as specified by the purchaser. The detail arrangement should be jointly developed between the purchaser and the vendor or vendors of the self-acting gas seals and the served equipment.

Table 1 — Conditions requiring alarms and shutdowns for each shaft end

Condition	Alarm	Shutdown
Low seal gas, seal buffer gas or separation gas differential pressure or flow	X	
High primary vent pressure or flow	X	X
High differential pressure for each filter set	X	

10.3.2 Arrangement 1

Both shutdowns and alarms shall be initiated by locally mounted direct-acting switches, connected though normally energized, fail-safe circuits. The shutdown circuit wiring shall be completely independent from the alarm circuit wiring and shall be mechanically protected.

10.3.3 Arrangement 2

10.3.3.1 Shutdown functions shall be initiated by local direct-acting switches connected in a normally de-energized circuit.

10.3.3.2 Alarm functions shall comprise locally mounted transmitters (electronic or pneumatic as specified) connected to either separate panel-mounted switches or to a multi-point scanning-type instrument.

10.3.3.3 Where multi-point, scanning-type instruments are used, the alarm setting for each function shall be separately and independently adjustable.

10.3.4 Arrangement 3

10.3.4.1 Each function for which both an alarm and a shutdown have been specified, shall be provided with three separate and independent transmitters (electronic unless otherwise agreed).

10.3.4.2 Each transmitter shall be independently connected to one of three multi-point, electronic, scanning-type instruments.

10.3.4.3 Each multi-point instrument shall provide both alarm and shutdown settings, separately and independently adjustable, for each transmitted input.

10.3.4.4 The shutdown and alarm function outputs from the three multi-point instruments shall be connected through “two out of three” voting logic. The arrangement shall be such that operation of any one alarm or shutdown function will initiate an alarm; operation of two shutdown functions monitoring the same parameter will initiate a separate alarm and shall cause the served equipment to shut down.

10.3.4.5 Alarm functions which are not associated with a shutdown function, shall be provided with one single transmitter. These alarm transmitters may be connected to one of the three-alarm/shutdown multi-point instruments or to a separate multi-point instrument.

NOTE Arrangement 3 has the following advantages:

a) any shutdown or alarm function can be tested at any time with the equipment in service without the need to disarm any part of the system;

b) failure of any one component of the alarm/shutdown system will initiate an alarm but will not result in equipment shutdown;

c) the use of modern, digital instrument technology is facilitated.

10.4 Flow indicators

10.4.1 Unless otherwise specified for flow control systems, the flow indicators shall be the armoured type and have an internal magnetic float or rotameter design. If specified, turbine flow transmitters shall be supplied.

10.4.2 Unless otherwise specified, for differential pressure control systems, an orifice flow meter shall be supplied.

10.4.3 Unless otherwise specified, flow meters in inert separation gas services may be the plastic rotameter design.

10.4.4 When specified, seal gas flow measurement shall be by an electronic device such as a linear mass-flow meter, either venturi or turbine type. The purchaser will specify whether the readout device is to be supplied by the module manufacturer or by the purchaser.

10.5 Relief valves

10.5.1 The vendor shall furnish the relief valves that are to be installed on components or in piping that the vendor is supplying. Other relief valves shall be furnished by the purchaser. Only relief valves for gas service are required to meet the limiting relief valve requirements defined in API RP 520, Parts I and II, and in API Std 526.

10.5.2 The vendor shall determine the size and set pressure of all relief valves associated with the system components.

10.5.3 Relief-valve settings shall take into consideration all possible types of equipment and component failures and the protection of the self-acting gas seal module components and piping.

10.5.4 Unless otherwise specified, relief valves shall have steel bodies.

11 Inspection, testing and preparation for shipment

11.1 General

11.1.1 Inspection, testing and preparation for shipment shall be in accordance with ISO 10438-1 unless otherwise specified in this clause.

11.1.2 When specified, the purchaser's or the vendor's representative, or both, shall indicate compliance in accordance with an inspector's checklist by initialling, dating and submitting the completed checklist to the purchaser before shipment. A suitable form of checklist is shown in Annex C.

11.2 Inspection

Inspection shall be in accordance with ISO 10438-1.

11.3 Testing

11.3.1 General

- **11.3.1.1** Equipment shall be tested in accordance with ISO 10438-1 as well as the requirements given in 11.3.2 and 11.3.3. Other tests may be specified and shall be jointly developed by the purchaser and the vendor.

- **11.3.1.2** When specified, the self-acting gas seal module shall be used during the main equipment's mechanical run test.

11.3.2 Hydrostatic test

The hydrostatic test shall be performed in accordance with ISO 10438-1.

11.3.3 Operational tests

11.3.3.1 A cleanliness test of the self-acting gas seal module shall be conducted at the vendor's shop with the job filter or new test filter (of equal filtration capability) elements installed. A 0,25 mm mesh (100 mesh) screen shall be fastened to the outlet of the module flange for each gas line from the module. The module shall be blown for a period of 5 min with a nominal 680 kPa (6,8 bar, 100 psi) dry filtered gas (dew point not greater than –7 °C (20 °F) and filtered to $\beta_2 \geqslant 10$). The screen shall be inspected for discoloration and cleanliness. Any hard particles or discoloration shall be grounds for rejection. If the dry gas seal module does not meet the cleanliness criteria, then disassembly and mechanical cleaning may be required and the cleanliness test repeated.

11.3.3.2 A gas leak test at 110 % of maximum allowable working pressure shall be performed on the system using a gas mutually agreed to between the purchaser and vendor.

11.3.3.3 Unless otherwise specified, the leak test gas shall be helium for seal gas with a molar mass of 12 or less, and air or nitrogen for seal gas with a molar mass greater than 12.

- **11.3.3.4** When specified, a functional test proposed by the vendor of all operating components, drains and vents in all possible arrangements of installed components and agreed to by the purchaser of the self-acting seal gas module shall be performed at the vendor's shop.

11.4 Preparation for shipment

The self-acting seal gas module shall be prepared for shipment in accordance with ISO 10438-1.

12 Vendor's data

12.1 Proposal

The seal vendor's proposals shall incorporate requirements for the self-acting gas seal module to ensure successful operation of the seal.

12.2 Spare parts

The vendor shall ship the unit with clean filter elements installed.