

SPECIFICATION

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# **Specification for Pressure Regulators**



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1.0	September 2022	First Edition

# Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

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# Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industrywide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).



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# Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of pressure regulators for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.



#### JIP33 Specification for Procurement Documents Technical Specification

This specification is to be applied in conjunction with the supporting procurement data sheet, information requirements specification (IRS) and quality requirements specification (QRS) as follows.

#### **IOGP S-739:** Specification for Pressure Regulators

This specification defines the technical requirements for the supply of the equipment.

#### IOGP S-739D: Procurement Data Sheet for Pressure Regulators

The procurement data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The procurement data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the procurement data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

#### **IOGP S-739L:** Information Requirements for Pressure Regulators

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.



#### IOGP S-739Q: Quality Requirements for Pressure Regulators

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS is in accordance with ISO/IEC Directives, Part 2.

The procurement data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order);
- c) purchaser defined requirements (procurement data sheet, IRS, QRS);
- d) this specification.



# 1 Scope

# 1.1

This specification defines the requirements for the design, sizing, materials, inspection, testing, marking, preparation for shipment and preservation for of pressure regulators in production, transportation, refining, petrochemical, distribution and storage facilities.

This specification is applicable to self-acting pressure regulators and pilot-operated pressure regulators.

NOTE Self-acting pressure regulators are also referred to as direct-acting pressure regulators.

# 1.2

This specification can be used for pressure regulators in the following applications:

- back pressure applications (controlling the upstream pressure);
- pressure-reducing applications (controlling the downstream pressure);
- differential pressure applications; and
- tank blanketing applications (maintaining positive pressure on a tank).

#### 1.3

This specification is applicable to pressure regulators up to and including ASME class 300 in services that are not prone to plugging or fouling.

#### 1.4

The following exclusions apply to this specification:

- pressure regulators in hydraulic circuits;
- pressure/vacuum relief valves (PV valves);
- pneumatic filter regulators;
- pressure regulators with special requirements that are part of a proprietary OEM package;
- breathing air regulators;
- gas cylinder pressure regulators; and
- NFPA governed pressure regulators in fire water applications.

# 2 Normative references

The following publications are referred to in this document, the procurement data sheet (IOGP S-739D) or the IRS (IOGP S-739L) in such a way that some or all of their content constitutes requirements of this specification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.



ANSI/FCI 70-3, Regulator Seat Leakage

ANSI/ISA 75.01.01, Industrial-Process Control Valves - Part 2-1: Flow capacity - Sizing equations for fluid flow under installed conditions

ANSI/ISA 75.05.01, Control Valve Terminology

ANSI/ISA 75.17, Control Valve Aerodynamic Noise Prediction

ANSI/ISA 75.19.01, Hydrostatic Testing of Control Valves

ANSI/NACE MR0103/ISO 17945, Petroleum, petrochemical and natural gas industries — Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments

ANSI/NACE MR0175/ISO 15156 (all parts), *Petroleum, petrochemical, and natural gas industries* — *Materials for use in H*<sub>2</sub>S-containing environments in oil and gas production

API Standard 6ACRA, Age-hardened Nickel-based Alloys for Oil and Gas Drilling and Production Equipment

ASME B16.5, Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24 Metric/Inch Standard

ASME B16.34, Valves — Flanged, Threaded, and Welding End

ASME BPVC, Section V, Nondestructive Examination

ASTM A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications

ASTM A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

ASTM A194/A194M, Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

ASTM A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

ASTM A217/A217M, Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service

ASTM A276/A276M, Standard Specification for Stainless Steel Bars and Shapes

ASTM A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service

ASTM A350/A350M, Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components

ASTM A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts

ASTM A352/A352M, Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service

ASTM A453/A453M, Standard Specification for High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Stainless Steels



ASTM A479/A479M, Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

ASTM A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes

ASTM A578/A578M, Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications

ASTM A609/A609M, Standard Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof

ASTM A705/705M, Standard Specification for Age-Hardening Stainless Steel Forgings

ASTM A995/A995M, Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts

ASTM A1014/A1014M, Standard Specification for Precipitation-Hardening Bolting (UNS N07718) for High Temperature Service

ASTM A1082/A1082M, Standard Specification for High Strength Precipitation Hardening and Duplex Stainless Steel Bolting for Special Purpose Applications

ASTM B564, Standard Specification for Nickel Alloy Forgings

EN 10204, Metallic products – Types of inspection documents

IEC 60534-1, Industrial-process control valves – Part 1: Control valve terminology and general considerations

IEC 60534-2-1, Industrial-process control valves – Part 2-1: Flow capacity – Sizing equations for fluid flow under installed conditions

IEC 60534-4, Industrial-process control valves - Part 4: Inspection and routine testing

IEC 60534-5:2004, Industrial-process control valves – Part 5: Marking

IEC 60534-8-3, Industrial-process control valves – Part 8-3: Noise considerations – Control valve aerodynamic noise prediction method

IEC 60534-8-4, Industrial-process control valves – Part 8-4: Noise considerations – Prediction of noise generated by hydrodynamic flow

IOGP S-563, Material Data Sheets for Piping and Valve Components

IOGP S-705, Supplementary Specification to API Recommended Practice 582 for Welding of Pressure Containing Equipment and Piping

IOGP S-715, Supplementary Specification to NORSOK M-501 Coating and Painting for Offshore, Marine, Coastal and Subsea Environments

IOGP S-716, Specification for Small Bore Tubing and Fittings

ISO 9712, Non-destructive testing — Qualification and certification of NDT personnel

ISO 10474, Steel and steel products — Inspection documents



ISO 12944-1, Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 1: General introduction

ISO 12944-2, Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments

ISO 12944-5, Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 5: Protective paint systems

ISO 12944-6, Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 6: Laboratory performance test methods

# 3 Terms, definitions and acronyms

#### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions are given in IEC 60534-1 or ANSI/ISA 75.05.01 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at https://www.iso.org.obp
- IEC Electropedia: available at http://www.electropedia.org/

#### 3.1.1

#### pressure-containing part

part whose failure to function as intended results in a release of contained fluid into the environment

Note 1 to entry: Includes as a minimum the body, bonnet, stem, gland flange, bolting and body/bonnet gasket that pass through the pressure boundary.

#### 3.1.2

#### pressure-controlling part

part intended to control the flow of fluids

Note 1 to entry: Includes as a minimum the plug and seat.

#### 3.1.3

#### diaphragm

flexible part used to separate one chamber subjected to pressure into two or more volumes with different pressure, whose functions are to detect the feedback of the controlled variable and/or to provide the thrust to move the control member

Note 1 to entry: Diaphragms used as pressure controlling parts are not included (see definition 3.1.2).

#### 3.1.4

#### free-machining steel

steel to which elements such as sulfur, selenium and lead have been added intentionally to improve machineability

#### 3.1.5

#### droop

difference between the desired (expected) outlet pressure and actual outlet pressure at the maximum published flow rate expressed as percentage of set pressure

Note 1 to entry: This definition is applicable to pressure reducing regulators.



#### 3.2 Acronyms

- CAS conformity assessment system
- EDS element data sheet
- MDS material data sheet
- MT magnetic particle testing
- NDE non-destructive examination
- PMI positive material identification
- ppmw parts per million weight
- PT penetrant testing
- QSL quality specification level
- RT radiographic testing
- UT ultrasonic testing
- VT visual testing

#### 4 General

#### 4.1

Pressure regulators with constant venting to atmosphere shall not be used for corrosive, hydrocarbon and toxic fluids.

#### 4.2

Set points of pressure regulators shall be provided with a mechanism that prevents inadvertent changes to the setpoint.

#### 4.3

The pressure regulator design and pressure-temperature ratings shall be in accordance with ASME B16.34 for the specified pressure class.

# 5 Design

# 5.1

Exhaust and vent ports shall prevent ingress of water, bugs, debris and ice formation.

#### 5.2

Internal components of pressure regulators shall be rated for the specified design pressure.

# 5.3

Body flange dimensions shall be in accordance with ASME B16.5.



# 5.4

The normal flow direction of pressure regulators shall be marked with an arrow in accordance with one of the following options:

- permanently cast on the regulator body;
- engraved on the regulator body; or
- on a stainless steel plate riveted to the regulator body.

# 5.5

Pressure regulator pressure sensing tubing and fittings shall be in accordance with IOGP S-716.

# 6 Sizing, noise and seat leakage

#### 6.1 Sizing

The pressure regulator flow coefficient shall be calculated in accordance with IEC 60534-2-1 or ANSI/ISA 75.01.01.

# 6.2 Noise

#### 6.2.1

Aerodynamic noise calculations for gas, steam or vapour shall be performed in accordance with IEC 60534-8-3 or ANSI/ISA 75.17.

# 6.2.2

Hydrodynamic noise calculations for liquids shall be performed in accordance with IEC 60534-8-4.

# 6.3 Seat leakage

Pressure regulator seat leakage shall conform to IEC 60534-4 or ANSI/FCI 70-3.

# 7 Performance requirements

#### 7.1

The droop of self-acting pressure regulators shall be within 15 % of the set pressure at maximum flow.

# 7.2

The droop of pilot-operated pressure regulators shall be within 5 % of the set pressure at maximum flow.

# 8 Material requirements

#### 8.1 General

# 8.1.1

Material selection shall be based on the specified service, pressure-temperature envelope and piping material.



# 8.1.2

Pressure-containing and pressure-controlling part materials shall be selected from Table 1 through Table 7.

# 8.1.3

Materials shall comply with the material standards and IOGP S-563 material data sheets referenced in Table 1 through Table 7 for the listed components and any applicable additional requirements in this specification.

# 8.1.4

Free machining steel shall not be used.

# 8.1.5

Supports, plugs and fittings welded directly to the regulator body shall be of the same material type as the body.

# 8.1.6

Metallic gaskets, pilot internals and process-wetted springs shall be corrosion resistant material equal or better than 316 stainless steel.

# 8.1.7

Asbestos and asbestos-containing materials shall not be used.

#### 8.1.8

Cadmium plating shall not be used.

#### 8.1.9

Mating surfaces of sliding elements and threaded components shall be designed to avoid galling (e.g. have different hardness values or an anti-galling coating).

#### 8.1.10

Galvanized bolting and components shall not be used in continuous service at temperatures greater than 200 °C (392 °F).

#### 8.2 Materials

#### 8.2.1

If Table 1 through Table 7 do not list an MDS for a particular material grade, the materials shall be supplied in accordance with the material standard without additional requirements.

#### 8.2.2

Materials for actuator components shall conform to the requirements specified in Table 8.



# Table 1 — Normal temperature carbon steel – Sweet service, -29 °C (-20 °F) to 425 °C (800 °F)

Material selection	MDS <sup>a</sup>	Pressure-containing parts		Pressure-controlling parts	
		Body/ Bonnet	Bolting	Seat ring <sup>c</sup>	Control member °
ASTM A105	IC004	Ab			
ASTM A216 WCB	IC006	Ab			
ASTM A216 WCC	IC006	Ab			
ASTM A182 F6A	IM104			А	А
ASTM A479 UNS S41000	IM107			А	А
ASTM A276 T410 / ASTM A276 T420	IM107/IM127			А	А
ASTM A217 CA 15	IM106			А	А
ASTM A564 Gr. 630 UNS S17400	IU607				А
ASTM A705 Gr. 630 UNS S17400	IU604				А
ASTM A182 F316/316L	IS104			А	А
ASTM A276 316/316L	IS107			А	А
ASTM A479 316/316L	IS107			А	А
ASTM A351 CF3M/CF8M	IS106				А
ASTM A193 B7 / ASTM A194 2H	IX110/IX120		А		
ASTM A193 B7M / ASTM A194 2HM	IX110/IX120		А		
ASTM A320 L7 / ASTM A194 7	IX100/IX109		А		
ASTM A320 L7M / ASTM A194 7M	IX100/IX109		А		
Key	•		•		•

A Acceptable material

<sup>a</sup> The MDS requirements from IOGP S-563 apply.

<sup>b</sup> The corrosion allowance is 3 mm.

<sup>c</sup> For pressure controlling parts, the MDS requirements shall apply for QSL-3 and QSL-4 only.



# Table 2 — Normal temperature carbon steel – Sour service, -29 °C (-20 °F) to 425 °C (800 °F)

Material selection	MDS <sup>a</sup>	Pressure-containing parts		Pressure-controlling parts			
		Body/ Bonnet	Bolting	Seat ring $^{\rm c}$	Control member °		
ASTM A105	IC004S	Ab					
ASTM A216 WCB	IC006S	Ab					
ASTM A216 WCC	IC006S	Ab					
ASTM A479 UNS S20910 XM-19	IS407S			A	А		
ASTM A564 Gr. 630 UNS S17400	IU607S			A	А		
ASTM A705 Gr. 630 UNS S17400	IU604S			А	А		
ASTM A182 F316/316L	IS104S			А	А		
ASTM A276 316/316L	IS107S			A	А		
ASTM A479 316/316L	IS107S			A	А		
ASTM A351 CF3M/CF8M	IS106S				А		
ASTM A193 B7M / A194 2HM	IX110S / IX120S		А				
ASTM A320 L7M / A194 7M	IX100S / IX109S		A				
Key       A Acceptable material							
<sup>a</sup> The MDS requirements from IOGP S-563 ap	oply.						

<sup>b</sup> The corrosion allowance is 3 mm.

<sup>c</sup> For pressure controlling parts, the MDS requirements shall apply for QSL-3 and QSL-4 only.



Table 3 — Low temperature carbon steel – Sweet service,	-46 °C	(-50 °F	) to 315 °C (	(600 °F)
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Material selection	MDS <sup>a</sup>	Pressure-containing parts		Pressure-controlling parts	
		Body/ Bonnet	Bolting	Seat ring $^\circ$	Control member °
ASTM A350 LF2 Class 1	IC104	Ab			
ASTM A352 LCC	IC106	Ab			
ASTM A479 UNS S20910 XM-19	IS107			А	А
ASTM A182 F316/316L	IS104			А	А
ASTM A276 316/316L	IS107			А	А
ASTM A479 316/316L	IS107			А	А
ASTM A351 CF3M/CF8M	IS106				A
ASTM A182 F51	ID144			А	А
ASTM A276 UNS S31803	ID147			A	A
ASTM A995 Gr. 4A	ID146				А
ASTM B564 UNS N06625	IN104			А	А
ASTM A320 L7 / A194 7	IX100 / IX109		А		
ASTM A320 L7M / A194 7M	IX100 / IX109		А		
Key A Acceptable material	·	<u>.</u>	·	·	·

<sup>a</sup> The MDS requirements from IOGP S-563 apply.

<sup>b</sup> The corrosion allowance is 3 mm.

<sup>c</sup> For pressure controlling parts, the MDS requirements shall apply for QSL-3 and QSL-4 only.



# Table 4 — Low temperature carbon steel – Sour service, -46 °C (-50 °F) to 315 °C (600 °F)

Material selection	MDS <sup>a</sup>	Pressure-containing parts		Pressure-controlling parts		
		Body/ Bonnet	Bolting	Seat ring $^{\circ}$	Control member <sup>c</sup>	
ASTM A350 LF2 Class 1	IC104S	Ab				
ASTM A352 LCC	IC106S	Ab				
ASTM A182 FXM-19	IS404S					
ASTM A479 UNS S20910 XM-19	IS107S			А	А	
ASTM A182 F316/316L	IS104S			A	А	
ASTM A276 316/316L	IS107S			А	А	
ASTM A479 316/316L	IS107S			A	А	
ASTM A351 CF3M/CF8M	IS106S				А	
ASTM A182 F51	ID144S				А	
ASTM A276 UNS S31803	ID147S				А	
ASTM A995 Gr. 4A	ID146S				А	
ASTM B564 UNS N06625	IN104S					
ASTM A320 L7M / A194 7M	IX100S / IX109S		A			
Key						

A Acceptable material

с

<sup>a</sup> The MDS requirements from IOGP S-563 apply.

<sup>b</sup> The corrosion allowance is 3 mm.

For pressure controlling parts, the MDS requirements shall apply for QSL-3 and QSL-4 only.



# Table 5 — Austenitic stainless steel type 316, -198 °C (-325 °F) to 540 °C (1 000 °F)

Material selection	MDS a	Pressure-containing parts		Pressure-controlling parts					
		Body/ Bonnet	Bolting	Seat ring <sup>b</sup>	Control member <sup>b</sup>				
ASTM A182 F316/316L	IS104	A		A	A				
ASTM A276 316/316L	IS107			A	А				
ASTM A479 316/316L	IS107			A	А				
ASTM A351 CF3M/CF8M	IS106	A			A				
ASTM A193 B8M/B8MA / ASTM A194 8M/8MA	IS109		А						
Key A Acceptable material									
<sup>a</sup> The MDS requirements from IOGP S-563	<sup>a</sup> The MDS requirements from IOGP S-563 apply.								

For pressure controlling parts, the MDS requirements shall apply for QSL-3 and QSL-4 only.

#### Table 6 — 22Cr duplex stainless steel, -46 °C (-50 °F) to +260 °C (+500 °F)

Material selection	MDS <sup>a</sup>	Pressure-containing parts		Pressure-controlling parts		
		Body/ Bonnet	Bolting	Seat ring <sup>b</sup>	Control member <sup>b</sup>	
ASTM A182 F51	ID144	А		А	А	
ASTM A995 Gr. 4A	ID146	A		A	A	
ASTM A276 UNS S32750 / UNS32760	ID257			A	A	
ASTM A193 B8MLCuNA / ASTM A194 GRADE 8MLCuNA	-		А			
ASTM A193 B8MLCuN-CLASS 1B / ASTM A194 GR 9CA	-		A			
ASTM A320 L7 / ASTM A194 7	IX100/IX109		А			
ASTM A320 L7M / ASTM A194 7M	IX100/IX109		A			
ASTM A453 GR 660 Class D	IU100		А			
ASTM A1014 UNS N07718 / API 6ACRA (120K)	IN120S		A			
ASTM A1082 UNS S32750, S32760	ID260		А			
Key	•	•	•	•		

Key

b

A Acceptable material

<sup>a</sup> The MDS requirements from IOGP S-563 apply.

<sup>b</sup> For pressure controlling parts, the MDS requirements shall apply for QSL-3 and QSL-4 only.



# Table 7 — 25Cr duplex stainless steel, -46 °C (-50 °F) to +300 °C (+570 °F)

Material selection	MDS <sup>a</sup>	Pressure-containing parts		Pressure-controllin parts	
		Body/ Bonnet	Bolting	Seat ring <sup>b</sup>	Control member <sup>b</sup>
ASTM A182 F53/F55	ID244	A		А	А
ASTM A995 Gr. 6A	ID246	А		А	А
ASTM A276 UNS S32750 / UNS32760	ID257			А	А
ASTM A193 B8MLCuNA / ASTM A194 GRADE 8MLCuNA	-		А		
ASTM A193 B8MLCuN-CLASS 1B / ASTM A194 GR 9CA	-		А		
ASTM A453 GR 660 Class D	IU100		А		
ASTM A1014 UNS N07718 / API 6ACRA (120K)	IN120S		А		
ASTM A1082 UNS S32750, S32760	ID260		А		
ASTM A1082 UNS S32750, S32760 (strain hardened)	ID259		А		
Key         A Acceptable material         a The MDS requirements from IOGP S-563 ap	oply.				

# Table 8 — Material requirements for actuator components

Item	Material			
Actuator casing	Same as regulator body material or manufacturer standard material compatible with the specified process fluid and environment			
Actuator diaphragm material	Manufacturer standard material compatible with the specified process fluid			
Stroke adjustment components and actuator shafts exposed to external environment	Onshore: manufacturer to specify Offshore and marine coastal: 316 stainless steel or better			
Actuator bolts/nuts/washers	316 stainless steel or low alloy steel with coating <sup>a</sup>			
<sup>a</sup> The coating systems shall be in accordance with Clause 10				

The coating systems shall be in accordance with Clause 10.



# 8.3 Welding and post weld heat treatment

# 8.3.1

Welding and post weld heat treatment of pressure-containing parts and attachment welding to pressurecontaining parts shall be performed in accordance with IOGP S-705.

# 8.3.2

Corrosion resistant weld overlay shall comply with IOGP S-563, IO001.

# 8.4 Sour service

When sour service is specified, materials and fabrication shall comply with ANSI/NACE MR0175/ISO 15156 (all parts) or ANSI/NACE MR0103/ISO 17945 and the additional metallurgical, manufacturing, testing and certification requirements stated in the applicable MDS and EDS in IOGP S-563.

# 9 Inspection and testing

# 9.1 Mandatory inspection and testing

#### 9.1.1

100 % inspection and routine testing (production testing) shall be carried out in accordance with 9.1.3 through 9.1.6.

# 9.1.2

When "Hold" or "Witness" interventions are required by the ITP, acceptance testing shall be performed in accordance with Table 9.

Test	Extent of acceptance testing for pressure classes up to and including ASME 300 class	Acceptance criteria (reference in this specification)		
Visual inspection 100 %		9.1.3		
Dimensional check	Dimensional check 100 %			
Hydrostatic test	Hydrostatic test 20 % (minimum 1 pressure regulator per type <sup>a</sup> per size per rating)			
Set pressure/functional test 20 % (minimum 1 pressure regulator per type <sup>a</sup> per size per rating)		9.1.6		
Positive material identification for body/bonnet and control member	20 % (minimum 1 pressure regulator per type ª per size per rating)	9.1.7		
<sup>a</sup> The type is defined to be either direct-acting or pilot operated.				

#### Table 9 — Acceptance testing



# 9.1.3 Visual inspection

A visual inspection shall be performed to verify compliance of the following with the purchase order documentation:

- make/model number;
- tube entry size and orientation;
- tag plate, name plate and marking;
- flow direction marking;
- material grade for body/bonnet;
- coating and paint colour;
- flange size, rating and surface finish;
- supply of accessories;
- correlation of heat number with material certificates.

#### 9.1.4 Dimensional check

A dimensional check shall be performed to verify the following:

- face-to-face or center-to-face dimensions;
- dimensional information for regulators with an actuator;
- bolt circle diameter, number of bolts and flange thickness.

#### 9.1.5 Hydrostatic testing

#### 9.1.5.1

A hydrostatic shell test shall be carried out for pressure-containing components in accordance with IEC 60534-4 or ANSI/ISA 75.19.01.

NOTE Pneumatic shell testing in lieu of hydrostatic testing is allowed for gas applications.

#### 9.1.5.2

The hydrostatic test medium shall be filtered, potable water with a chloride content not exceeding 200 mg/l (200 ppmw), reduced to 50 mg/l (50 ppmw) for austenitic and duplex stainless steels.

#### 9.1.5.3

On completion of hydrostatic testing, regulators shall be drained of test fluids.

#### 9.1.6 Set pressure or functional testing

Set pressure or functional testing shall be performed.



# 9.1.7 Positive material identification (PMI)

PMI shall be performed on alloy steel, stainless steel, nickel alloy and non-ferrous alloy pressure regulators with extent according to Table 9 and acceptance criteria defined in the PMI procedure.

#### 9.1.8 Non-destructive examination

NDE shall be performed in accordance with Annex A.

# 9.2 Supplementary inspection and testing

#### 9.2.1

Seat leakage tests shall be performed in accordance with IEC 60534-4 or ANSI/FCI 70-3.

# 9.2.2

When water is used as the testing medium for seat leakage testing, it shall comply with 9.1.5.2.

# **10** Surface protection

# 10.1

Offshore and marine coastal coating systems shall be in accordance with IOGP S-715.

# 10.2

Onshore and non-marine coating systems shall be selected in accordance with ISO 12944-5.

# 10.3

Onshore and non-marine coating systems shall be qualified to ISO 12944-6.

# 10.4

Coating under insulation shall be in accordance with IOGP S-715.

# 11 Marking, tagging and nameplate

# 11.1

Tag plates shall be marked with the pressure regulator tag number.

# 11.2

Tag plates shall be 316 stainless steel.

# 11.3

Tag plates shall be affixed with 316 stainless steel rivets, screws or wire.

# 11.4

Tag plate information shall be stamped or engraved.



# 11.5

Markings shall be in accordance with IEC 60534-5:2004, Table 1, with item 19 mandatory.

# 11.6

Additional markings for set pressure shall be provided.

# 12 Preparation for shipment and preservation

# 12.1

Inside and outside surfaces of regulators and threaded surfaces of accessories shall be protected from atmospheric corrosion during shipment and storage.

# 12.2

Open ports and connections shall be blanked off prior to packaging using covers or plugs made of hard plastic or a metal compatible with the port/flange material.

# 12.3

The mating surfaces of flanges shall be protected from damage during shipment and storage.

# 12.4

Packing shall prevent moisture, water and foreign matter entering the regulator body and components.



# Annex A (normative) Requirements for non-destructive examination

# **A.1**

NDE of regulators shall be in accordance with Table A.1 for quality levels QSL-1, QSL-2, QSL-3 and QSL-4.

NOTE QSL-1 is the default quality level. QSL-2 to QSL-4 are optional levels specified by the purchaser. Higher QSL levels correspond to more stringent inspection requirements. The inspection requirements vary by type of material product form and regulator part being inspected.

# A.2

The extent, method and acceptance criteria for the NDE inspection codes used in Table A.1 shall be as specified in Table A.2.

# A.3

NDE activities shall be conducted after any final heat treatment or post-weld heat treatment.

# A.4

NDE of pilot castings for pressure containing parts shall be in accordance with IOGP S-563.

# A.5

NDE personnel shall be qualified to ASNT SNT-TC-1A or ISO 9712, Level 2 or Level 3.

# A.6

NDE personnel certification shall be performed by an independent third-party certification body or authorized qualifying body in accordance with the ASNT Central Certification Program (ACCP) or ISO 9712.

# A.7

Visual inspection and dimensional check after assembly shall be in accordance with Table 9.

# **A.**8

Production weld inspection shall be in accordance with Table A.1.

# A.9

Personnel shall have a training record demonstrating competence in the use of the specific PMI tester or ferrite meter used for testing.



#### Table A.1 — NDE requirements

Part	QSL-1		QSL-2	QSL-2		QSL-3		QSL-4	
	Cast	Forged <sup>d</sup>	Cast	Forged <sup>d</sup>	Cast	Forged <sup>d</sup>	Cast	Forged <sup>d</sup>	
Regulator body, bonnet, casing of actuator <sup>e</sup>	VT1	VT2	VT1 + RT1 <sup>a, e</sup> + MT1 <sup>e</sup> or VT1 + RT1 <sup>a, e</sup> + PT1 <sup>e</sup>	VT2 + MT1 ° or VT2 + PT1 °	VT1 + RT1 <sup>a</sup> + MT1 <sup>e</sup> or VT1 + RT1 <sup>a</sup> + PT1 <sup>e</sup>	VT2 + UT2 +MT1 ° or VT2 + UT2 + PT1 °	VT1 + RT1 <sup>a, c</sup> + UT1 + MT1 or VT1 + RT1 <sup>a, c</sup> + UT1 + PT1	VT2 + UT2 + MT1 or VT2 + UT2 + PT1	
Control members <sup>b</sup>	VT1	VT2	VT1	VT2	VT1 + MT1 <sup>e</sup> or VT1 + PT1 <sup>e</sup>	VT2 + MT1 ° or VT2 + PT1 °	VT1 + MT1 or VT1 + PT1	VT2 + MT1 or VT2 + PT1	
Pressure- containing welds	VT3 + RT2 or VT3 + UT3			VT3 + RT2 + MT1 or VT3 + RT2 + PT1 or VT3 + UT3 + MT1 or VT3 + UT3 + PT1					
Fillet and attachment welds to pressure- containing parts	VT3				VT3 + MT <sup>-</sup>	1 or VT3 + PT1			

NOTE 1 See Table A.2 for specification of the examinations referred to in this table.

NOTE 2 All the NDE activities listed above for a specific part and product form or forms shall be conducted. All parts shall be inspected, unless a reduced inspection frequency is specified.

NOTE 3 Qualification and NDE requirements for pilot casting shall be according to IOGP S-563 and the applicable material data sheet in IOGP S-563 as referenced in the material selection Table 1 through Table 7.

<sup>a</sup> RT1 may be replaced by UT4 by agreement.

<sup>b</sup> MT or PT to be performed prior to coating, or overlay.

<sup>c</sup> RT1 plus UT1 may be replaced by RT3.

<sup>d</sup> Requirements for examination of bar, plate and tubular products shall be as for forgings.

<sup>e</sup> 5 % or minimum (QSL-1 and QSL-2) and 10 % or minimum (QSL-3), 1 part per component batch to be examined. If defects outside acceptance criteria are detected, two or more parts shall be tested, and if any of these two fails, all items represented shall be examined.



# Table A.2 — NDE extent, method and acceptance criteria

Examination	NDE	Extent	Method	Acceptance	
RT1	RT casting <sup>a</sup>	Areas defined by ASME B16.34 for special class valves, at abrupt changes in sections and at the junctions of risers, gates or feeders to the casting	ASME <i>BPVC</i> , Section V, Article 2	ASME <i>BPVC</i> , Section VIII, Div. 1, Appendix 7	
RT2	RT weldments	100 % where practicable	ASME <i>BPVC</i> , Section V, Article 2	ASME <i>BPVC,</i> Section VIII, Div. 1, UW-51 for linear indications ASME <i>BPVC</i> , Section VIII, Div. 1, Appendix 4 for rounded indications	
RT3	RT casting <sup>a</sup>	100 % ASME <i>BPVC</i> , Section V, Article		ASME BPVC, Section VIII, Div. 1, Appendix 7	
UT1	UT casting <sup>a</sup>	Remaining areas not covered by RT1	ASME BPVC, Section V, Article 5	ASTM A609/A609M, Table 2, Quality Level 2	
UT2	UT forging	All surfaces	ASME BPVC, Section V, Article 5	ASME <i>BPVC,</i> Section VIII, Div.1, UF-55 for angle beam and ASME B16.34 for straight beam	
UT3	UT weldments	100 % of full penetration welds	ASME BPVC, Section V, Article 4	ASME BPVC, Section VIII, Div. 1, Appendix 12	
	UT overlay weld	100 % of overlay weld surface	ASME <i>BPVC</i> , Section V, Article 4 (straight beam method)	ASTM A578/A578M, Level C	
	MT casting <sup>a</sup>	All accessible external and internal surfaces	ASME BPVC, Section V, Article 7	ASME <i>BPVC</i> , Section VIII, Div. 1, Appendix 7	
NAT4	MT forgings	All surfaces	ASME BPVC, Section V, Article 7	ASME BPVC, Section VIII, Div. 1, Appendix 6	
	MT welds	100 % of weld surface	ASME BPVC, Section V, Article 7	ASME BPVC, Section VIII, Div. 1, Appendix 6	
	MT machined surfaces including weld bevels	100 % of machined surface	ASME BPVC, Section V, Article 7	ASME <i>BPVC,</i> Section VIII, Div. 1, Appendix 6	
PT1	PT casting <sup>a</sup>	All accessible external and internal surfaces	ASME BPVC, Section V, Article 6	ASME <i>BPVC</i> , Section VIII, Div. 1, Appendix 7	
	PT forgings	All surfaces	ASME BPVC, Section V, Article 6	ASME BPVC, Section VIII, Div. 1, Appendix 8	
	PT welds	100 % of weld surface	ASME BPVC, Section V, Article 6	ASME BPVC, Section VIII, Div. 1, Appendix 8	
	PT weld overlay	As per applicable EDS	As per applicable EDS	As per applicable EDS	



# Table A.2 (continued)

Examination	NDE	Extent	Method	Acceptance		
PT1 (continued)	PT bolting surface area	100 % of bolting surface	ASME BPVC, Section V, Article 6	ASME BPVC, Section VIII, Div. 1, Appendix 8		
	PT machined surfaces including weld bevels	100 % of machined surface	ASME BPVC, Section V, Article 6	ASME BPVC, Section VIII, Div. 1, Appendix 8		
VT1	VT castings <sup>a</sup>	As per applicable MDS	As per applicable MDS	As per applicable MDS		
VT2	VT forgings	As per applicable MDS	As per applicable MDS	As per applicable MDS		
VT3	VT weldments	100 % accessible surfaces	ASME BPVC, Section V, Article 9	Undercut not to reduce the thickness in the area (considering both sides) to below the minimum thickness		
	VT weld overlay	As per applicable EDS	As per applicable EDS	As per applicable EDS		
NOTE Where the table refers to MDS or EDS, NDE shall comply with the requirements in the applicable MDS or EDS in IOGP S-563 as referenced in the material selection Table 1 through Table 7. Where no MDS or EDS is referenced in the material selection tables, the material standard shall apply without additional requirements.						
<sup>a</sup> NDE requirements for pilot casting shall be according to IOGP S-563 and the applicable material data sheet in IOGP S-563 as referenced in the material selection Table 1 through Table 7.						



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- [2] ASTM E415, Standard Test Method for Analysis of Carbon and Low-Alloy Steel by Spark Atomic Emission Spectrometry
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- [5] ISO/IEC 17000, Conformity assessment Vocabulary and general principles
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