International Association of Oil & Gas Producers

SPECIFICATION S-707

September 2019

Supplementary Specification to ISO 12490 Actuators for On-off Valves

JIP33 JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	AMENDMENTS
0.1	September 2019	Issued for public review

Acknowledgements

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

Foreword

This specification was prepared under a 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 for projects 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 approved specification, building on recognized industry and/or 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 industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages, facilitating improved standardization of major projects across the globe. 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 2014).

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Introduction

The purpose of this specification is to define a minimum common set of supplement requirements for the procurement of Actuators for On-Off Valves in accordance with ISO 12490 First Edition, 2011, Petroleum and natural gas industries — Mechanical integrity and sizing of actuators and mounting kits for pipeline valves, for application in the petroleum and natural gas industries.

This JIP33 standardized procurement 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
Supplementary Technical Specification

It is required to use all of these documents in conjunction with each other when applying this specification, as follows.

IOGP S-707: Specification for Actuators for On-Off Valves

This specification is written as an overlay to ISO 12490, following the clause structure of the parent standard, to assist in cross-referencing the requirements. Where clauses from the parent standard (ISO 12490) are not covered in this specification, there are no supplementary requirements or modifications to the respective clause. The terminology used within this specification follows that of the parent standard and otherwise is in accordance with ISO/IEC Directives, Part 2.

Modifications to the parent standard defined in this specification are identified as *Add* (add to clause or add new clause), *Replace* (part of or entire clause) or *Delete*.

IOGP S-707D: Data Sheet for Actuators for On-Off Valves

This document provides project specific requirements where this specification requires the purchaser to define an application specific requirement. It also includes information required by the purchaser for technical evaluation. Additional purchaser supplied documents are also listed in the data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-707L: Information requirements for Actuators for On-Off Valves

This document defines the information requirements, including format, timing and purpose, for information to be provided by the vendor. It also defines the specific conditions which must be met for conditional information requirements to become mandatory. The information requirements listed in the IRS have references to the source of the requirement.

IOGP S-707Q: Quality requirements for Actuators for On-Off Valves

This document includes a conformity assessment system (CAS) which specifies standardized user interventions against quality management activities at four different levels. The applicable CAS level is specified by the purchaser in the data sheet.

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

Unless defined otherwise in the purchase order, 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 (data sheet, IRS, QRS);

d) this specification;

e) the parent standard.

1 Scope

Replace clause with

This specification defines the requirements for design, selection, mechanical integrity, sizing, manufacture, assembly and integration, testing, inspection and preparation for shipping of actuators and actuator control equipment for on-off valves (including actuators for valves manufactured under ISO 14313 and API Specification 6D).

This specification is applicable to all types of electric, pneumatic, hydraulic and electro-hydraulic actuators, inclusive of mounting kit, installed on piping and pipeline valves.

This specification covers the requirement for actuators installed in oil and gas (offshore and onshore), petrochemical and chemical facilities.

This specification is not applicable to actuators installed on control and choke valves, valves being used for regulation, valves in subsea service, Xmas tree valves, handheld power devices and stand-alone manually operated gearboxes.

This specification covers the factory acceptance testing for the valve and actuator assembly. It does not cover the tests related to the valve body, seat and stem.

2 Conformance

2.3 Compliance with this International Standard

Replace first paragraph with

The supplier shall demonstrate that the quality management arrangements established for the supply of actuators for on-off valves to this specification, conform to ISO 9001, ISO 29001, API Specification Q1 or an equivalent quality management system standard agreed with the purchaser.

Delete NOTE

Replace first sentence of second paragraph with

The supplier shall be responsible for complying with all of the applicable requirements of this specification.

Add note to end of subclause

NOTE Applicable requirements include but are not limited to: design, selection, sizing, materials, fabrication, assembly and integration, testing, inspection, marking, packing, preservation and shipping.

3 Normative references

Add to section

ISO 12490	Petroleum and natural gas industries - Mechanical integrity and sizing of actuators and mounting kits for pipeline valves
API RP 14FZ	Recommended Practice for Design and Installation of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1 and Zone 2 Locations
API RP 500	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2
API RP 551:2016	Recommended practice for Process Measurement

API Specification Q1	Specification for Quality Programs for the Petroleum, Petrochemical and Natural Gas Industry
ASTM E165/E165M	Standard practice for liquid penetrant examination for general industry
ASTM E709	Standard guide for magnetic particle testing
ATEX Product Directive 2014/34/EU	Equipment and protective systems intended for use in potentially explosive atmospheres
EN 13906-1	Cylindrical helical springs made from round wire and bar - Calculation and design - Part 1: Compression springs
EN 15081	Industrial valves - Mounting kits for part-turn valve actuator attachment
EN 15714-1	Industrial Valves - Actuators (Part 1: Terminology & Definition)
EN 15714-2:2009	Industrial Valves - Actuators (Part 2: Electric actuators for industrial valves – Basic requirements)
EN 15714-3:2009	Industrial Valves - Actuators (Part 3: Pneumatic actuators for industrial valves – Basic requirements)
EN 15714-4:2009	Industrial Valves - Actuators (Part 4: Hydraulic actuators for industrial valves – Basic requirements)
IEC 60079 (all parts)	Explosive atmospheres
IEC 60085	Electrical insulation – Thermal evaluation and designation
IEC 61000	Electromagnetic compatibility (EMC)
IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 61511	Functional safety - Safety instrumented systems for the process industry sector
IEEE 1	Recommended Practice - General Principles for Temperature Limits in the Rating of Electrical Equipment and for the Evaluation of Electrical Insulation
IOGP S-716 (HOLD)	Supplementary Specification for Small Bore Tubing and Fittings
ISO 8573-1:2010	Contaminant and purity classes
ISO 9001	Quality Management System - Requirements
ISO-9809 (all parts)	Gas cylinders - Design, construction and testing of refillable seamless steel gas cylinders and tubes
ISO 12944-5	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 5: Protective paint systems
ISO 12944-9	Paint and varnishes - Corrosion protection of steel structures by protective paint systems - Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures
ISO 17637	Non-destructive testing of welds -Visual testing of fusion-welded joints
ISO 22899-1	Determination of the resistance to jet fires of passive fire protection materials
ISO 29001	Petroleum, petrochemical and natural gas industries - Sector specific quality management systems - Requirements for product and service supply organizations
NAMUR NE 4	Mounting of Positioners/ Position Transmitters to Actuators
NAMUR NE 14	Attachment of Pneumatic Part-Turn Actuators to Valves
NAMUR NE 19	Mounting of Solenoid Valves to Part Turn Actuators
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
PED Directive 2014/68/EU	Pressure Equipment Directive

UL 1709 Standard for safety: Rapid rise fire tests of protection material for structural steel

4 Terms and definitions

Replace term with

4.5
breakaway torque/breakaway thrust (break to open (BTO) torque)

4.17
pressure, actuator maximum operating

Add to definition note

and is equal to or greater than the network maximum supply pressure.

4.18
pressure, maximum rated

Add to definition note

and is specified by supplier. This pressure is equal to or greater than actuator maximum operating pressure.

4.19
network pressure, maximum supply

Replace definition with

maximum available network pressure at the control panel inlet.

Replace term with

4.20
pressure, actuator minimum operating

Replace definition with

minimum required pressure at the actuator pressure port to operate the valve, as defined by the purchaser

NOTE This pressure is less than or equal to network minimum supply pressure.

Replace term with

4.21
network pressure, minimum supply

Replace definition with

minimum available network pressure at the control panel inlet for which it shall be possible to move the valve from steady state to normal operating position, as defined by the purchaser

Add new term

4.37
air to end torque/thrust
air torque/thrust at which the actuator spring is fully compressed

Add new term

4.38
air to run torque/thrust
air torque/thrust at which the actuator spring is compressing

Add new term

4.39
air to start (ATS) torque/thrust
air torque/thrust at which the spring starts to compress

Add new term

4.40
breakaway angle or percent of stroke
the point at which the seat breaks/makes sealing contact with the obturator

Add new term

4.41
end to close torque/thrust
torque/thrust required to fully close the valve

NOTE Also called "seating" or "reseating torque".

Add new term

4.42
end to open torque/thrust
torque/thrust required to fully open the valve

Add new term

4.43
network pressure, regulated
pressure that exists at the outlet of the pressure regulator on the control panel

Add new term

4.44
network pressure, design
pressure used to design the network and its components which corresponds to compressor design pressure or HPU design pressure

Add new term

4.45
non-intrusive actuator
type of actuator that does not require opening of the electrical enclosure for commissioning or troubleshooting and the controls are accessible externally to the actuator

Add new term

4.46 on demand valve torque correction factor (ODCF)
correction factor to multiply a net torque value to correct the effect for process characteristics and valve operations

Add new term

4.47
run to close torque/thrust
minimum torque/thrust required to keep the valve moving in closing direction

Add new term

4.48
run to open torque/thrust
minimum torque/thrust required to keep the valve moving in opening direction

Add new term

4.49
sizing safety factor (SSF)
dimensionless factor, expressed as a ratio between valve torque including on demand valve torque correction factor and actuator torque

Add new term

4.50
spring to end torque/thrust
spring torque/thrust at which the actuator spring is fully relaxed

Add new term

4.51
spring to run torque/thrust
spring torque/thrust at which the actuator spring is relaxing

Add new term

4.52
spring to start torque/thrust
spring torque/thrust at which the actuator spring starts to relax

5 Symbols and abbreviated terms

5.2 Abbreviated terms

ATS	air to start
BTO	break to open
CAS	conformity assessment system
ESD	emergency shut down
HTS	hydraulic torque start
IRS	information requirements specification

OCDF on demand valve torque correction factor

PST partial stroke testing

QRS quality requirements specification

SSF sizing safety factor

6 Actuator types and configurations

6.2 Actuator types

6.2.1 Electric

Replace second paragraph with

Electric actuators shall be self-contained units, typically comprised of an electric motor, reduction gearing, mechanically and electrically interlocked reversing contactor starter complete with local controls, drive coupling between the gear and the valve stem, valve stem drive nut/bushing (when needed based on application), limit/torque switches, valve position indicator, de-clutchable handwheel, declutch lever, logic control, fail safe mechanism (when needed based on application) and monitoring facilities.

Replace first sentence of third paragraph with

Electric actuators shall be powered from either an AC or DC electrical source, as specified in the data sheet.

Add to subclause

The actuator shall deliver the rated torque, at the specified power supply, within the tolerances indicated below:

a) Nominal voltage +/-10 %;

b) Frequency variation (AC) +/-5 %.

6.2.2 Pneumatic

Replace second paragraph with

Pneumatic part-turn, multi-turn and linear actuators shall be comprised of pneumatic cylinder(s) or another shape, appropriate gearing (if applicable) and travel stops.

Replace second sentence of third paragraph

Actuators shall be designed for use with compressed air supplied at the tie-in point meeting ISO 8573-1:

– purity classes of class 6 for particle size;

– class 3 for pressure dew point; and

– class 3 for oil concentration.

Add to subclause

Pneumatic actuators shall be single acting spring return, unless otherwise specified in the data sheet.

Add to subclause

For part-turn, single acting actuators with spring return, only passive tie-rod design shall be used, i.e. tension tie-rod design shown in the middle diagram of Figure 6, shall not be used.

6.2.3 Hydraulic

Replace second paragraph with

Hydraulic part-turn, multi-turn and linear actuators shall be comprised of hydraulic cylinder(s) or another shape, appropriate gearing (if applicable) and travel stops.

Replace fourth paragraph with

Actuators shall be designed for use with hydraulic fluid cleanliness in accordance with ISO 4406:1999, class 19/17/14 for medium pressure hydraulic system (pump discharge up to 200 bar g) and class 18/16/13 for high pressure hydraulic system (pump discharge above 200 bar g).

Add to subclause

Hydraulic actuators shall be single-acting spring return, unless otherwise specified in the data sheet.

Add to subclause

Multi-springs are not acceptable in safety applications.

Add to subclause

For part-turn, single-acting actuators with spring return, only passive tie-rod design shall be used, i.e. tension tie-rod design shown in the middle diagram of Figure 6, shall not be used.

Add new subclause heading

6.2.4 Electro-hydraulic actuator

Add new subclause

6.2.4.1

Electro-hydraulic actuators shall be self-contained units, typically comprised of a hydraulic actuator and its associated piping, electrically powered hydraulically pump, hydraulic accumulator, reservoir, hydraulic cylinder, gearing and travel stops, piston, spring (when needed), screen filters at pump suction and reservoir filler caps, dual filters on the distribution system, check valve and relief valve on pump discharge and local gauge.

Add new subclause

6.2.4.2

Actuators shall be designed for use with hydraulic fluid cleanliness in accordance with ISO 4406:1999, class 19/17/14.

6.3 Actuator configuration

6.3.1 Double-acting

Delete entire CAUTION note

Add to subclause

Double acting pneumatic or hydraulic actuators in fail safe applications shall be provided with a backup supply of a minimum three strokes of valve operation within the full operating temperature range.

Add to subclause

In the event of air or hydraulic supply failure, the air receiver or accumulator system shall be sized to deliver:

– a pressure equal to network normal supply pressure at the start of first stroke;

– a pressure not less than network minimum supply pressure at the end of the third stroke.

6.3.2 Single-acting

Add to subclause

For part-turn, single-acting actuators with spring return, only passive tie rod design shall be used, i.e. tension tie rod design shown in the middle diagram of Figure 6, shall not be used.

Add new subclause heading

6.3.3 Other actuator configurations

Add new subclause

6.3.3.1

Quarter turn actuators shall utilize scotch-yoke type, unless otherwise specified in the data sheet.

Add new subclause

6.3.3.2

Rack and pinion type actuators shall be limited to applications where the required torque is less than 339 Nm (3000 lb-inch).

Add new subclause

6.3.3.3

Linear actuators shall be a single acting cylinder with piston, unless otherwise specified in the data sheet.

Add new subclause

6.3.3.4

Spring and diaphragm actuators shall not be used for on-off applications, unless otherwise specified in the data sheet.

Add new subclause

6.3.3.5

With the exception of offshore and coastal environment, vane type actuators shall be used for high cycle applications, unless otherwise specified in the data sheet.

6.4 Action on loss of supply energy

Replace first sentence with

Upon loss of supply energy or control signal or both, the valve shall automatically be driven to, or remain in, a predetermined position, as defined in the data sheet.

7 Design

Replace heading number 7.1 with heading number 7.0

7.0 General

Add to subclause

Actuators shall be designed to operate at the maximum and minimum design temperatures specified in the data sheet.

Add to subclause

Actuators and field instruments supplied as part of the actuator package shall conform to the area classification of Zone 2, IIA T3 or NEC Class 1 Div 2 Group D T3 as a minimum, unless otherwise specified in the data sheet.

Add to subclause

Actuators and field instruments in onshore installations shall be certified by IECEx certifying bodies (ExCBs) in conformance with IEC 60079 or certified by NRTL approved laboratories in conformance with API 500 or other applicable regulations specified in the data sheet.

Add to subclause

Actuators and field instruments in offshore installations shall be certified by IECEx certifying bodies (ExCBs) in conformance with IEC 60079 or certified by NRTL approved laboratories in conformance with API 14 FZ or other applicable regulations specified in the data sheet.

Add to subclause

Actuators, actuator control equipment, junction boxes and enclosures installed outdoors shall meet ingress protection IP66 to IEC 60529 or NEMA 4X to NEMA 250 or equivalent, as a minimum.

Add to subclause

Hazardous area protection methods for electrical actuators and electronic equipment shall be in accordance with the protection method specified in the data sheet.

Add to subclause

Actuators and accessories shall be suitable for continuous use in the environmental conditions of installation locations specified in the data sheet.

Add to subclause

EMC compatibility shall be in accordance with IEC 61000.

Add to subclause

Design life shall be minimum 20 years, unless otherwise specified in the data sheet.

Add to subclause

Endurance type testing shall be performed in accordance with the test procedure specified in EN 15714, Annex A.

Replace Figure 14 with

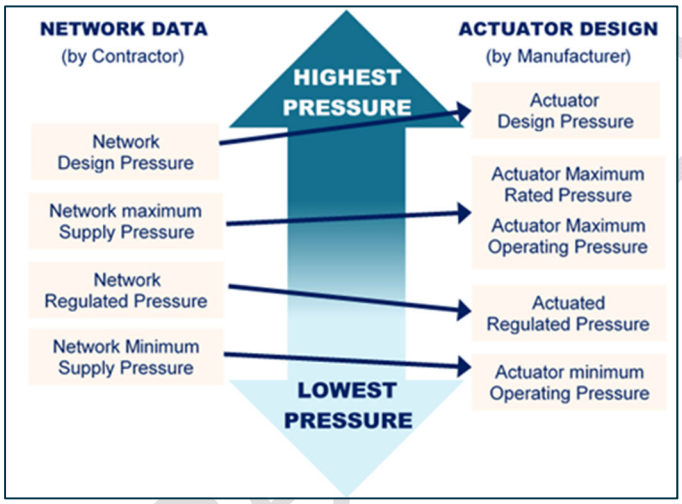

Figure 14 — Relationship between design, supply and rated pressures

Add new subclause heading

7.1 Actuator design requirements

Add new subclause heading

7.1.1 Electric actuators

Add new subclause heading

7.1.1.1 Actuator controls

Add new subclause heading

7.1.1.1.1 General

Add new subclause

7.1.1.1.1.1

The electric actuator design category shall be non-intrusive type.

Add new subclause

7.1.1.1.1.2

The actuator shall be controlled from the control system and locally using push buttons or rotary switches.

Add new subclause heading

7.1.1.1.2 Actuator local control facility

Add new subclause

7.1.1.1.2.1

The actuator shall be provided with a lockable rotary selector switch for selection of local, off and remote modes of operation.

Add new subclause

7.1.1.1.2.2

The actuator shall be provided with momentary push buttons or a rotary switch for open, close and stop functions.

Add new subclause

7.1.1.1.2.3

Unless otherwise specified in the data sheet, the actuator shall be provided with local indication for:

– closed: steady red indication;

– open: steady green indication;

– intermediate position: blinking red/green indication.

Add new subclause

7.1.1.1.2.4

The actuator shall be provided with a local indication to display the valve position.

Add new subclause heading

7.1.1.1.3 Actuator remote control facility

Add new subclause

7.1.1.1.3.1

The actuator shall execute open, close and stop commands from discrete inputs in remote mode.

Add new subclause

7.1.1.1.3.2

The actuator shall provide valve open and close position status output for remote indication.

Add new subclause

7.1.1.1.3.3

The actuator shall provide a common fault status output for remote indication, configurable for phase fault, power supply failure, over load and over torque as a minimum.

Add new subclause

7.1.1.1.3.4

The actuator shall provide a remote and local status output to indicate if control has been selected to the remote or local position.

Add new subclause

7.1.1.1.3.5

The method of indication for 7.1.1.1.3.2, 7.1.1.1.3.3 and 7.1.1.1.3.4, e.g. relay contacts, shall be as specified in the data sheet.

Add new subclause

7.1.1.2 Valve position measurement

Electric actuators should be provided with non-contacting sensors for valve position measurement, independent from valve motive power.

Add new subclause

7.1.1.3 Torque and limit switches

Limit switches at open and close positions and/or torque switches shall be used to stop valve travel.

Add new subclause

7.1.1.4

Actuator duty shall be either Class A (on-off) or Class B (inching) in accordance with EN 15714-2. Duty class will be specified in the data sheet based on the application.

Add new subclause

7.1.1.5

Motor insulation class shall be Class F.

NOTE Higher insulation classes are acceptable.

Add new subclause

7.1.1.6

The actuator shall be designed to meet the life endurance criteria defined in EN 15714-2 for Class A or Class B in Table 1 or Table 2 or Table 3, as per the specified actuator type and duty class.

Add new subclause heading

7.1.1.7 Motor protection

Add new subclause

7.1.1.7.1

The motor shall be protected against loss of one or more phases of the power supply.

Add new subclause

7.1.1.7.2

The motor shall be protected against high current surges.

Add new subclause

7.1.1.7.3

The motor shall be protected against rapid motor reversal.

Add new subclause

7.1.1.7.4

The motor shall be protected against winding overheating.

Add new subclause

7.1.1.7.5

The motor shall be protected against stalling.

Add new subclause

7.1.1.7.6

The motor shall be protected against incorrect power wiring.

Add new subclause

7.1.1.8

The actuator shall provide an internally derived 24 V DC power supply and allow use of an externally derived 24 V DC power supply for control power.

Add new subclause

7.1.1.9

Gearing shall have a built-in lost motion or jammed valve device which enables the motor to attain full speed before applying the hammer blow to start the valve.

Add new subclause

7.1.1.10

A mechanical position indicator shall be provided on the gearbox.

Add new subclause heading

7.1.1.11 Actuator lubrication

Add new subclause

7.1.1.11.1

Actuators and gearbox internals shall be enclosed and packed for life with lubricant or oil.

Add new subclause

7.1.1.11.2

The actuators shall be supplied with a filling nipple and a drain plug.

Add new subclause

7.1.1.12

The actuator control units shall be supplied with a communication module with required protocol, if specified in the data sheet.

Add new subclause

7.1.1.13

A terminal enclosure shall be provided with a minimum of four cable entries. Requirements for additional entries may be specified in the data sheet based on application design requirements.

Add new subclause

7.1.1.14

Ex certified adaptors shall be supplied to suit the specified cable entries.

Add new subclause

7.1.1.15

Power terminals shall be protected by an insulating cover and mechanically separated from the terminals for control, feedback and network signals.

Add new subclause

7.1.1.16

Electric actuators shall be supplied with a separate earth boss on the enclosure, external to the terminal compartment.

Add new subclause heading

7.1.2 Pneumatic actuators

Add new subclause

7.1.2.1

The actuator exhaust port shall point downwards to avoid any water ingress to the actuator.

Add new subclause

7.1.2.2

Vents on the actuator and actuator control equipment shall be provided with bug screen, unless otherwise specified in the data sheet.

Add new subclause

7.1.2.3

The pneumatic actuators shall be designed to meet the endurance criteria specified in EN 15714-3, Table 1.

Add new subclause heading

7.1.3 Specific design requirements for hydraulic actuators

Add new subclause

7.1.3.1

Hydraulic chambers shall have two ports located at extreme ends to allow efficient flushing.

Add new subclause

7.1.3.2

The hydraulic actuators shall be designed to meet the endurance criteria in accordance with EN 15714-4, Table 2.

Add new subclause heading

7.1.4 Specific design requirements for electro-hydraulic actuators

Add new subclause

7.1.4.1

The hydraulic system operating pressures shall be specified by supplier based on the selected design.

Add new subclause

7.1.4.2

A cushioning device within 5 % of the end of the stroke shall be provided to ensure a smooth operation.

Add new subclause

7.1.4.3

When specified, a hand jack shall be provided to allow opening of the valve in the event of a pump failure.

Add new subclause

7.1.4.4

As an alternative to a hand jack, a hydraulic hand pump connection shall be provided for manual operation.

Add new subclause

7.1.4.5

Operation of the hand jack or hand pump shall not interfere with, or prevent, the operation of the valve in the event of a trip demand.

Add new subclause

7.1.4.6

The design shall use manifold systems to minimize leakages and reduce the footprint.

Add new subclause

7.1.4.7

The reservoir shall have a capacity of 1.5 times the total combined displacement of the entire volume of the hydraulic system.

Add new subclause

7.1.4.8

The reservoir shall include provision for collecting and draining any water accumulation.

Add new subclause

7.1.4.9

The motor shall be protected against overload and overcurrent.

Add new subclause

7.1.4.10

The pump drive shall have start/stop control and auto cut in / cut out to maintain the pressure within an operating band.

Add new subclause

7.1.4.11

The pump, drive and drive coupling shall be accessible to the operator and allow for dismantling or removal.

Add new subclause

7.1.4.12

The design shall include isolation valves, de-pressurization valves and drain valves to facilitate the maintenance of the hydraulic system.

7.2 Pressure-containing parts

Add to subclause

All pressure containing parts of actuators shall be designed to withstand the network maximum air or hydraulic supply pressure specified in the data sheet, without rupturing the actuator.

7.3 Bolting and tie rod design

Add to subclause

A passive tie rod design as detailed in Figure 6 shall be applied.

7.5 Springs and modules

Add to subclause

Repairs on the spring shall not be permitted during the manufacturing process.

7.6 Mounting kit

7.6.1

Replace first paragraph with

The design basis shall be stress-based, validated by testing. Alternative design, based on satisfactory documented previous experience, will only be accepted if it can be verified that the components have been loaded to the maximum design load value.

7.6.3

Replace NOTE with

NOTE Valves installed with a horizontal stem can require a means of accurately aligning the actuator with the valve stem such as a spigot between mating parts or fitted bolts and/or dowel pins.

7.6.4

Add to subclause

Intermediate support shall be designed in accordance with the requirements of EN 15081, 4.11 to 4.13 and 5.1.

7.8 Lifting

Add to subclause

For horizontal shaft installations, the actuator lifting points shall be designed to avoid damage to the stem or seals during removal of the actuator.

Add to subclause

Lifting points shall have a design safety factor of 4 for actuators weighing more than 500 kg.

Add to subclause

Lifting points shall have a design safety factor of 2 for actuators weighing less than or equal to 500 kg.

Add to subclause

A warning plate shall be fixed near to the actuator lifting point to indicate that it is not suitable for lifting the valve assembly.

7.9 Handwheels and levers for manual override

Add to subclause

Handwheels shall not be used in safety applications, unless otherwise specified in the data sheet.

Add new subclause heading

7.9.1 Handwheels for electric actuators

Add new subclause

7.9.1.1

Handwheels shall be fitted for all electric actuators in non-safety applications.

Add new subclause

7.9.1.2

The handwheel drive shall be mechanically independent of the motor drive.

Add new subclause

7.9.1.3

A clutch shall engage the handwheel for manual use.

Add new subclause

7.9.1.4

The clutch shall disengage the handwheel in the powered position to prevent handwheel rotation during powered operation.

Add new subclause

7.9.1.5

The clutch shall be lockable by padlock in both manual and powered positions.

Add new subclause

7.9.1.6

Number of handwheel turns, handwheel diameter and handwheel rim force for the selected actuator shall be provided.

Add new subclause

7.9.2 Handwheels for pneumatic/hydraulic actuators

Handwheels shall be fitted to pneumatic and hydraulic actuators, if specified on the data sheet.

7.11 Position indicators

Add to subclause

Position indicators shall be mechanical type extended directly from the shaft for pneumatic and hydraulic actuators.

Add to subclause

The position indicator shall be visible outside the fireproofing envelope, if the actuator is specified with fireproofing.

Add to subclause

The mechanical valve position indicator shall indicate the change in position by color and by "open" and "closed" text.

7.12 Travel stops

Add to subclause

Mechanical type travel stops shall be provided for pneumatic and hydraulic actuators.

Add to subclause

Mechanical type travel stops shall have a locking nut or other arrangement to prevent unintentional adjustments.

7.13 Orientation

Add to subclause

Orientation details shall be confirmed by the purchaser prior to fitting the actuator to the valve.

Add to subclause

Orientation shall be marked on the external components in the drive train with alignment rivets or screws to indicate the "as built" condition.

7.14 Sealing

Replace subclause with

The mounting hardware and kit shall be designed to ensure water cannot accumulate around the stem or packing.

Add new subclause heading

7.17 Shutdown applications

Add new subclause

7.17.1

The emergency shutdown (ESD) signal shall take precedence over local and remote controls, and torque trips.

Add new subclause

7.17.2

For SIL 1 and SIL 2 applications, conformance with IEC 61508 shall be demonstrated.

Add new subclause

7.17.3

SIL calculations and safety analysis reports shall be provided for SIL 1 and SIL 2 applications in accordance with IEC 61508.

Add new subclause

7.17.4

For SIL 3 applications, an independent verification body shall be engaged to perform the SIL calculations and provide the safety analysis report in accordance with IEC 61508.

Add new subclause heading

7.17.5 Partial stroke testing

Add new subclause

7.17.5.1

Partial stroke testing (PST) functionality shall be provided, if specified in the data sheet.

Add new subclause

7.17.5.2

PST shall continuously monitor pressure, travel position and time during the test and abort the test based on pre-defined limits for each parameter.

Add new subclause

7.17.5.3

The emergency shutdown function shall always take precedence, even while performing PST.

Add new subclause

7.17.5.4

The PST travel limit shall be configurable.

Add new subclause

7.17.5.5

The valve signature shall be captured and stored within the positioner for future comparison.

Add new subclause

7.17.5.6

PST shall test the final element and major components such as actuator and solenoid valves.

Add new subclause

7.17.5.7

The digital positioner or controller shall avoid spurious trips by continuously monitoring the travel and pressure when carrying out PST.

Add new subclause heading

7.18 Fire Protection

Add new subclause

7.18.1

If specified in the data sheet, the actuator, accumulator or air receiver shall be fire proofed.

Add new subclause

7.18.2

Fire tested design in accordance with ISO 22899-1 or UL1709 shall be provided.

Add new subclause

7.18.3

Fire proofing shall be applied using one of the following methods:

a) a semi rigid steel frame with fire blanket enclosure;

b) a rigid steel enclosure skin with inner thermal blankets;

c) flexible jackets;

d) intumescent paint.

Add new subclause

7.18.4

The fire proofing design shall allow access for routine maintenance.

8 Sizing

8.1 Information required for actuator sizing

8.1.1 General

Replace third paragraph with

IOGP S-707D (actuators for on-off valves data sheet) shall be used to supply the required data.

8.1.2 Valve torque and/or thrust data

Replace first paragraph with

The following data shall be generated by valve manufacturer:

a) breakaway torque/thrust (break to open torque/thrust, break to close torque/thrust);

b) breakaway angle or percent of stroke;

c) run torque/thrust (run to open torque/thrust, run to close torque/thrust);

d) reseat torque/thrust (end to open torque/thrust, end to close torque/thrust);

e) lowest MAST value of the drive train.

Add to subclause

Re-seating torque/thrust (end to close torque/thrust) shall be equal to 80 % or more than breakaway torque/ thrust (break to open torque or thrust).

Add to subclause

Valve torque/thrust values shall be based on maximum shut-off differential pressure across the valve or maximum static pressure of the line.

Add to subclause

On demand correction factors shall be used by the supplier when evaluating the valve torques to account for the fluid characteristics (e.g. non-lubricating, clean or sticky service, slurries, polymerization service), operational effects (e.g. staying in same position) and temperature effects.

Add new subclause heading

8.1.2.1 Torque validation for electric actuators

Add new subclause

8.1.2.1.1

Stall torque shall be less than the minimum of all drive train elements MAST values (i.e. obturator, stem, stem to obturator connection and mounting kit).

Add new subclause

8.1.2.1.2

Actuator maximum torque or thrust (at the specified voltage and torque/thrust limiting devices activated) shall be less than ISO 5211 flange torque.

Add new subclause

8.1.2.1.3

Actuator output torque (both spring and design torque) shall be greater than valve torque on demand over the full travel in both directions.

Add new subclause

8.1.2.1.4

Valve torque on demand shall be calculated as valve torque x ODCF x SSF. e.g. BTO x ODCF x SSF.

Add new subclause heading

8.1.2.2 Torque validation for pneumatic, hydraulic and electro-hydraulic actuators

Add new subclause

8.1.2.2.1

Maximum air/hydraulic to start torque (ATS max / HTS max) shall be less than the minimum of all drive train elements MAST values (i.e. obturator, stem, stem to obturator connection and mounting kit).

Add new subclause

8.1.2.2.2

Maximum air/hydraulic to start torque (ATS max / hydraulic torque start (HTS) max) shall be less than ISO 5211 flange torque.

Add new subclause

8.1.2.2.3

Spring to start torque (STS) shall be less than ISO 5211 flange torque.

Add new subclause

8.1.2.2.4

Actuator output torque (both spring and air/hydraulic torque) shall be greater than valve torque on demand over the full travel in both directions.

Add new subclause

8.1.2.2.5

Valve torque on demand shall be calculated as valve torque x ODCF x SSF. e.g. BTO x ODCF x SSF.

8.1.4 Valve dimensions

Replace 8.1.4 item c) with

c) dimensions of stem key including depth and length engaged in the coupling;

8.1.5 Electric actuator data

Delete 8.1.5 item h)

8.1.6 Pneumatic/hydraulic actuator data

Replace 8.1.6 item b) with

b) network minimum, normal and maximum air or hydraulic supply pressure;

Delete 8.1.6 item f)

8.2 Sizing method

Add to subclause

If the actuator supply pressure is reduced by a regulator and relief valve system, maximum output torque shall be based on relief valve set pressure plus over pressure effect at full lift.

Add to subclause

A torque summary table for the calculated torques shall be provided during the design phase for the various torques indicated in 8.1.

Add to subclause

The calculated torque shall be validated on the basis of torque testing of production actuators.

Add to subclause

Use of regulators and relief valves to limit the torque delivered by the actuator shall only be used to where it is not possible to provide a drive train with sufficient MAST and yield strength.

Replace clause heading with

9 Instrumentation/regulation/actuator accessories

9.1 Torque limiting settings - Electric actuators

Add to subclause

The torque switch setting shall be adjustable between 50 % and 100 % of the rated torque.

Add to subclause

The torque switch setting shall not cause tripping of the actuator in the event of breakaway torque, end to close torque or mid travel start torque.

9.2 Torque/thrust limiting controls - Pneumatic/hydraulic actuators

Replace second sentence of first paragraph with

The torque/thrust output at the relief valve set pressure, including overpressure effect at full lift, shall be less than the valve MAST.

Add new subclause heading

9.3 Instrumentation and accessories

Add new subclause heading

9.3.1 General

Add new subclause

9.3.1.1

The actuator control equipment design shall include design and selection of minor accessories and components such as speed controllers, check valves and boosters required to achieve the required functionality.

NOTE Major accessories such as the solenoid valves and positioners will be specified in the data sheet.

Add new subclause

9.3.1.2

All accessories, accumulators, air receivers and pneumatic and hydraulic components shall be designed for the network air or hydraulic supply design pressure specified in the data sheet.

Add new subclause

9.3.1.3

Where possible, NAMUR direct mounting shall be provided for positioners, solenoid valves and junction boxes.

Add new subclause

9.3.1.4

Ex certified adaptors and plugs to suit specified cable entries shall be provided for all actuator control equipment.

Add new subclause

9.3.1.5

Earthing of electronic devices mounted on the actuator shall be through the earth boss of each instrument housing.

Add new subclause

9.3.1.6

All accessories shall be accessible for maintenance without removing any part of the actuator.

Add new subclause

9.3.1.7

The supplier shall minimize the number of components used to achieve the functional requirements, such as stroking time, in the pneumatic and hydraulic circuit.

Add new subclause heading

9.3.2 Air filters and regulators

Add new subclause

9.3.2.1

Filters shall be installed on the supply line to the control panel to protect the actuator from entrained particles.

Add new subclause

9.3.2.2

Filters shall be fitted with a drain valve.

Add new subclause

9.3.2.3

The filter and regulator shall be provided as a single unit, if both are supplied.

Add new subclause

9.3.2.4

The adjustment for the regulator setpoint shall be of a tamper-proof design with a lock nut or set screw to prevent adjustment without the use of tools.

Add new subclause

9.3.2.5

The filter regulator shall have sufficient capacity to achieve the required stroking time.

Add new subclause

9.3.2.6

If a pressure regulator is installed to limit the torque, a warning plate with the following text shall be permanently fitted to the actuator.

"Set at XX Bar g (psi)

Do not change the setting"

Add new subclause

9.3.2.7

Filters shall have 25 micron mesh size, unless otherwise specified in the data sheet.

Add new subclause

9.3.2.8

The filter regulator shall have a drain and integral relief facility.

Add new subclause heading

9.3.3 Control panel

Add new subclause

9.3.3.1

The control panel shall be mounted on the pneumatic or hydraulic actuator, unless otherwise specified in the data sheet.

Add new subclause

9.3.3.2

The control panel shall be constructed from SS 316 material of 3 mm (0.12 in.) thickness as a minimum.

Add new subclause

9.3.3.3

When specified in the data sheet, a sunshade shall be provided to cover the top and three sides of the control panel.

Add new subclause

9.3.3.4

Pressure gauges shall be supplied for the regulated pressure, unless, otherwise specified in the data sheet.

Add new subclause

9.3.3.5

Pressure gauges for the incoming supply shall be supplied, if specified in the data sheet.

Add new subclause

9.3.3.6

The control panel shall be fitted with earth bosses catering for the number of devices to be earthed.

Add new subclause

9.3.3.7

The control panel shall be provided with an earth boss suitable for up to 16 mm^2 (0.025 $in.^2$) to connect the control panel to plant earth.

Add new subclause

9.3.3.8

A hydraulic control panel shall be provided with a filter and integrated check and relief valves.

Add new subclause heading

9.3.4 Tubing and compression fittings

Add new subclause

9.3.4.1

Tubing and fittings shall conform to IOGP S-716. (HOLD)

NOTE Only relevant technical requirements from IOGP S-716 are applicable relating to the tubing and fittings materials specified in the data sheet.

Add new subclause

9.3.4.2

Tubes shall be supported as per API 551, Table 18.

Add new subclause

9.3.4.3

If tubes are supported by clamps, clamps shall be of self-draining type.

Add new subclause

9.3.4.4

Clamp material shall be same as the tube material specified in the data sheet.

Add new subclause heading

9.3.5 Air receivers / accumulators

Add new subclause heading

9.3.5.1 Air receivers

Add new subclause

9.3.5.1.1

Blowdown valves shall be provided with a backup air receiver, if specified in the data sheet.

Add new subclause

9.3.5.1.2

Air receivers shall be provided with two valve manifolds for mounting pressure instruments, drain valve, check valve and block valve for supply line, if specified in the data sheet.

Add new subclause heading

9.3.5.2 Accumulators

Add new subclause

9.3.5.2.1

The hydraulic accumulator shall be bladder type, unless otherwise specified in the data sheet.

Add new subclause

9.3.5.2.2

Hydraulic accumulators shall be sized as per 6.3.1 using adiabatic expansion of nitrogen gas.

Add new subclause

9.3.5.2.3

The accumulator system shall consists of an accumulator, nitrogen bottles, pressure gauges, combined piston position transmitter/level gauge, rupture disc, check valve and necessary isolation valve and drain valves.

Add new subclause

9.3.5.2.4

Nitrogen bottles shall be designed and tested in accordance with ISO 9809.

Add new subclause

9.3.5.2.5

Nitrogen bottles shall have a pre-charging arrangement which includes soft-seated valves and pressure gauges.

Add new subclause

9.3.5.2.6

Nitrogen pre-charge pressures shall be provided at ambient temperature, and 5 °C (41 °F) below, and 5 °C (41 °F) above the ambient temperature, using an isothermal expansion process.

Add new subclause

9.3.5.2.7

Multi-vessel accumulators shall be designed in three separate standalone units with block and drain valves to allow servicing of one accumulator unit while the remaining two units are in duty.

Add new subclause

9.3.5.2.8

Blast load calculations shall be prepared for the accumulator skid, if specified in the data sheet.

Add new subclause heading

9.3.6 Speed control

Add new subclause

9.3.6.1

Speed control shall be provided for both opening and closing strokes, unless otherwise specified in the data sheet.

Add new subclause

9.3.6.2

All adjustable components used for speed control shall be tamper-proof.

Add new subclause

9.3.6.3

When a quick exhaust valve is used for speed control, it shall be directly installed on the actuator port.

Add new subclause heading

9.3.7 Air lock relay (lockup valve)

Add new subclause

9.3.7.1

An air lock relay shall be provided when "fail lock" position is specified in the data sheet.

Add new subclause

9.3.7.2

The air lock relay shall be set above the network minimum air supply pressure or minimum operating pressure, whichever is higher.

Add new subclause heading

9.3.8 Solenoid valves

Add new subclause

9.3.8.1

Solenoid valves shall be 24 V DC supply, direct acting, spring return and auto rest type with low power consumption (<8 W), unless otherwise specified in the data sheet.

Add new subclause

9.3.8.2

The solenoid coil insulation rating shall conform to IEC 60085 or IEEE 1.

Add new subclause

9.3.8.3

The solenoid coil maximum ambient temperature rating shall be minimum 50 °C (90 °F) or as specified in the data sheet.

Add new subclause

9.3.8.4

The solenoid valve shall have a pull-in time of less than 100 ms and drop-out time of less than 70 ms.

Add new subclause

9.3.8.5

Solenoid coils shall have a stated design life ("useful life") equal to 20 years of continuous energized operations.

Add new subclause

9.3.8.6

When a solenoid valve and positioner are installed on the same application, the solenoid valve shall be installed between the positioner signal output and the actuator.

Add new subclause

9.3.8.7

When more than one solenoid valve is used in the same application, the ESD solenoid valve shall be installed closer to the actuator.

Add new subclause

9.3.8.8

The availability of solenoid valves shall be minimum 10 years in low demand applications without requiring any maintenance.

Add new subclause heading

9.3.9 Position indication

Add new subclause

9.3.9.1

If specified in the data sheet, the valve position indication shall be obtained through a position transmitter or limit switches.

Add new subclause

9.3.9.2

Limit switches shall be magnetic or inductive proximity type.

Add new subclause

9.3.9.3

The limit switch shall be set at one of the following from closed/open position.

– 3° for quarter turn actuators;

– 3 % for linear actuators.

Add subclause

9.3.9.4

Proximity switches shall be installed within a junction box with terminals for connection to field wiring.

Add new subclause heading

9.3.10 Digital positioners and controllers

Add new subclause

9.3.10.1

A digital positioner or controller shall be used to get valve diagnostics and PST, unless otherwise specified in the data sheet.

Add new subclause heading

9.3.10.2 Diagnostics

Add new subclause

9.3.10.2.1

The digital positioner or controller shall have a self-diagnostic feature to monitor the status of "Valve not moved in accordance with commanded position within set time".

Add new subclause

9.3.10.2.2

The digital positioner or controller shall have a diagnostic feature to monitor the status of "Valve moved away from commanded position".

Add new subclause

9.3.10.2.3

The digital positioner or controller shall have a self-diagnostic feature to monitor the status of "Loss of power, air and hydraulic supply".

Add new subclause

9.3.10.2.4

The digital positioner or controller shall have a feature to monitor "Valve profiling in the event of a trip and partial stroke testing".

Add new subclause

9.3.10.2.5

The digital positioner or controller shall have a predictive diagnostics function to alert advance warning of a malfunction.

10 Materials

10.1 Material Specification

Replace first sentence with

Specifications for metallic pressure-containing parts and springs shall be issued by the supplier and shall address, as a minimum, the following:

Add to subclause

The minimum material requirement for various pneumatic/hydraulic actuator components shall be as per Table 6, unless otherwise specified in the data sheet.

Add to subclause

The minimum material requirement for various electric actuator components shall be as per Table 7.

Add to subclause

Aluminium alloys used for electrical actuator housings shall have a magnesium content less than 6 %

Add to subclause

Material requirements for components of electro-hydraulic actuators shall be in accordance with Table 6 and Table 7.

Add to subclause

The supplier may choose an equivalent alternate or higher grade material.

Add new table

Table 6 — Material requirements for pneumatic/hydraulic actuator components

Sl. No.	Item	Material
1	Actuator cylinder/covers/spring housing	Carbon steel or nodular cast iron with coating and painting as per section 14 (onshore) Carbon steel with coating and painting as per section 14 or SS 316 (offshore)
2	Stroke adjustment components, piston rods and shafts exposed to external environment	13 % Cr or equivalent (onshore) SS 316 or better (offshore)
3	Coupling/stem extension (connection between actuator and valve shaft)	13 % Cr, 4 Ni stainless steel (onshore) SS 316 or better (offshore)
4	Mounting kit (connection between valve and actuator)	Carbon steel with coating and painting as per section 14 or SS 316
5	Tie rods/bolts/nuts/washers	SS 316
6	Actuator/valve connection bolts, NUTS, washers, dowel pins/keys	SS 316
7	Brackets for mounting accessories like limit switch box, junction box	SS 316
8	Hand-wheel	SS 316 or hot dip galvanized carbon steel with coating and painting as per section 14

9	Accumulator or air receiver	SS 316 for offshore applications; Carbon steel with coating and painting
10	Nitrogen bottles	Carbon steel with manufacturer coating and painting system

Add new table

Table 7 — Material requirements for electric actuator components

Sl. No.	Item	Materials
1	Actuator covers/housing	Marine grade aluminium to ISO 3522 with coating and painting as per section 14 or SS 316
2	Power transfer mechanism	Manufacturer qualified coating and paint systems
3	Stroke adjustment components and shafts exposed to external environment	13 % Cr or equivalent (onshore) SS 316 (offshore)
4	Coupling/stem extension (connection between actuator and valve shaft)	13 % Cr, 4 Ni stainless steel (onshore) SS 316 (offshore)
5	Mounting kit (connection between valve and actuator)	Carbon steel with coating and painting as per section 14 or SS 316
6	Actuator/valve connection bolts, nuts, washers, dowel pins/keys	SS 316
7	Brackets for mounting accessories like limit switch box, junction box	SS 316
8	Handwheel	SS 316 or Hot dip galvanized carbon steel with coating and painting as per section 14

10.2 Service compatibility

Add to subclause

Internal corrosion prevention methods shall be polymeric coating or nickel plating in combination with a closed loop breathing system.

Add to subclause

The supplier shall provide a check valve arrangement on the closed loop system to prevent contaminated or salt laden air from entering the actuator.

10.3 Composition limits

10.3.1 Carbon steel

Replace equation (1) with

$$CE = \%C + \frac{\%Mn}{6} + \frac{(\%Cr + \%Mo + \%V)}{5} + \frac{(\%Cu + \%Ni)}{15} \qquad \text{Equation (1)}$$

NOTE The above equation is from International institute of welding.

10.3.2 Austenitic stainless steel

Delete second paragraph

Add new subclause

10.8 Material requirements for tagged instruments

Miscellaneous instrument material requirements shall be in accordance with Table 8, unless otherwise specified in the data sheet.

Add new table

Table 8 — Miscellaneous items material requirements

No.	Item	Materials
1	Solenoid valve (body/housing)	SS 316
2	Proximity switch/housing	SS 316
3	Position transmitters	SS 316
4	Accumulator piston position transmitter/indicator	SS 316
5	Pressure gauges	SS 316
6	Mechanical position indicator	SS 316
7	Pressure transmitter	SS 316

Add new subclause

10.9 Material requirements for bulk (commodity) items

Unless otherwise specified in the data sheet, bulk item material requirements shall be in accordance with Table 9.

Add new table

Table 9 — Bulk items material requirements

No.	Item	Materials
1	Air filter regulator	SS 316
2	Instrument valves	SS 316
3	Instrument manifold	SS 316
4	Tubing relief valves	SS 316
5	Volume booster	SS 316
6	Quick exhaust valves	SS 316
7	Check valves	SS 316
8	Junction box	SS 316

11 Welding

11.1 Welding of pressure-containing parts

Delete "or EN 287-1" in first paragraph

11.2 Structural welding

Delete "or EN 287-1" in first paragraph

11.3 Impact testing

Impact testing for qualification of the WPS is not required for non-impact-tested base materials.

Replace third paragraph with

A set of three weld metal impact specimens oriented with the notch perpendicular to the surface of the material, shall be taken from the weld metal (WM) and from the heat affected zone (HAZ) as specified in the applicable design code.

Delete fourth paragraph

Delete Figure 16

Delete Figure 17

11.5 Repair

Replace second paragraph with

Repair of defects shall be performed in accordance with a documented and qualified procedure specifying requirements for defect removal, welding, heat treatment, NDE and reporting as applicable.

12 Quality control

12.2 Measuring and test equipment

NOTE Measuring and test equipment's calibration in accordance with ISO 9001, 7.1.5 or API Q1, 5.8 is to be ensured.

12.3 Qualification of inspection and test personnel

12.3.3 Welding inspectors

Replace subclause with

Personnel performing visual inspection of welding operations and completed welds shall be qualified and certified to ISO 17637, AWS QC1 Certified Welding Inspector or equivalent, or of a manufacturer's documented training programme.

12.4 NDE of repairs

12.4.2 Mechanically loaded parts

Add to subclause

Cracks or longitudinal defects identified by visual inspection shall be subjected to a magnetic particle or dye penetrant examination in addition to any visual inspection.

13 Testing

13.1 General

Replace first sentence with

Each actuator, control panel, accumulator and air receiver shall be tested prior to shipment from the manufacturing facility.

Add to subclause

The endurance test shall be carried on each type of actuator from the current production, if specified in the data sheet.

13.2 Shell test

Replace first paragraph with

The shell test shall be conducted at 1.5 times the design pressure for a duration in accordance with Table 1.

Delete second paragraph

Replace Table 1 with

Table 1 — Minimum duration of shell tests

Test	Test duration
Pneumatic	5 minutes
Hydraulic	10 minutes
Electro- hydraulic	10 minutes

Replace Table 2 with

Table 2 — Minimum duration of piston seal tests

Test	Test duration
Pneumatic	5 minutes
Hydraulic	10 minutes
Electro-hydraulic	10 minutes

13.4 Torque/thrust test - Pneumatic/hydraulic actuators

Replace second paragraph with

Each actuator shall be torque/thrust tested in accordance with the procedure defined in A.1.

Add to subclause

The actuator manufacturer shall produce "As tested" torque table reports.

13.6 Actuator functional test

Replace first sentence with

The actuator and accessories shall be subject to testing at the actuator manufacturer's works, to validate functional ability in accordance with the manufacturer's documented procedures.

Replace second sentence with

The actuator shall be tested with control panel (where applicable) and without the valve prior to despatch to supplier.

Add new subclause heading

13.7 Functional test on assembled units (actuator with associated gear box / valve, control panel and air receiver /accumulator)

Add new subclause

13.7.1

The functional test shall be performed in accordance with Table 10 on the assembled units (valve, gear box and actuator together), control panel and air receiver or accumulator (when supplied) specific to the valve tag.

Add new subclause

13.7.2

All the FAT results shall be included in the test report.

Add new table

Table 10 — Factory acceptance test – Assembled units (valve with actuator), control panel, volume bottle and accumulator

No.	Tests/checks	Electric actuator	Pneumatic/hydraulic actuator	Electro-hydraulic actuator	Acceptance criteria
1	**Visual and conformity checks**	Required, Record results as per Table F.1.a & F.1.b.	Required, Record results as per Table F.1.a & F.1.b.	Required, Record results as per Table F.1.a & F.1.b.	Approved data sheet, Approved GA drawing for valve and actuator, control panel, accumulator, Approved painting procedure, pneumatic/hydraulic schematic
2	**Dimensional checks**	Required, Record results as per Table F.2.a & F.2.b.	Required, Record results as per Table F.2.a & F.2.b.	Required, Record results as per Table F.2.a & F.2.b.	Approved GA drawing for valve and actuator, control panel, accumulator
3	**Actuator shell test**	Not applicable	Required, Record results as per Table F.3.a & F.3.b.	Required, Record results as per Table F.3.a & F.3.b.	Subclause 13.2
4	**Actuator piston seal test**	Not applicable	Required, Record results as per Table F.3.a & F.3.b.	Required, Record results as per Table F.3.a & F.3.b.	Subclause 13.3
5	**Stroke test:** Energize and de-energize the solenoid valve and ensure entire assembly function smoothly and trouble free for three cycles. Record time to ensure that there is no frictional issues on the packing.	Required, Record results as per Table F.3.a & F.3.b.	Required, Record results as per Table F.3.a & F.3.b.	Required, Record results as per Table F.3.a & F.3.b.	Manufacturer's test procedure
6	**Operating time validation test:** Maximum and minimum operating time shall be validated as per data sheet for opening and closing directions when full DP applied across the valve and minimum / maximum network supply pressure or minimum / maximum supply voltage to the actuator.	Required, Record results as per Table F.3.a & F.3.b.	Required, Record results as per Table F.3.a & F.3.b.	Required, Record results as per Table F.3.a & F.3.b.	Approved data sheet
7	**Fail action test:** Verify signal/supply failure conditions to validate failure modes defined in the data sheet.	Required, Record results as per Table F.3.a & F.3.b.	Required, Record results as per Table F.3.a & F.3.b.	Required, Record results as per Table F.3.a & F.3.b.	Approved data sheet
8	**Functional test for accessories (as applicable):** a. Solenoid valves b. Limit switches c. Position transmitters	Required, Record results as per Table F.4	Required, Record results as per Table F.4	Required, Record results as per Table F.4	Manufacturer's test procedure

9	**Partial stroke testing (PST)** - Applicable where PST is requested in the data sheet. Energize the solenoid valves to move the valve to pre-determined position, initiate PST command which shall move the valve to specified % of its fail safe position and then return to normal operating position. Capture the valve signature and store it in the device or other methods of testing as agreed with purchaser.	Applicable	Required, Record results as per Table F.5	Required, Record results as per Table F.5	Annex A, A.2
10	**Functional test for double acting actuator with accumulator:** a. Validate accumulator capacity is suitable for three strokes (300 % capacity) b. Ensure accumulator pressure is not less than minimum network supply pressure.	Not applicable	Required, Record results as per Table F.5	Required, Record results as per Table F.5	Manufacturer's test procedure
11	**Specific functional tests for electric actuator (as applicable)** a. Local open/close b. Remote open/close/stop c. open/close/fault contacts d. Torque switch setting verification e. Open/close limit switch setting verification	Required, Required, Record results as per Table F.5	Not applicable	Required, Required, Record results as per Table F.5	Manufacturer's test procedure
12	**Hand wheel rim operation and rim force verification**, if supplied	Required, record results as per Table F.5	Required, if handwheel is provided, record results as per Table F.5	Required, if handwheel is provided, record results as per Table F.5	Subclause 7.9
13	**Functional test on network interface cards**	Required, If purchased as part of actuator, record results as per Table F.5	Not applicable	Not applicable	Manufacturer's test procedure
14	**Torque validation check for electric actuators**	Required, Record results as per Table F.6, Table F.7, Table F.8	Required, Record results as per Table F.6, Table F.7, Table F.8	Required, Record results as per Table F.6, Table F.7, Table F.8	Subclause 8.1.2.1
15	**Torque validation check for pneumatic, hydraulic and electro-hydraulic actuators**	Required, Record results as per Table F.9, Table F.10, Table F.11	Required, Record results as per Table F.9, Table F.10, Table F.11	Required, Record results as per Table F.9, Table F.10, Table F.11	Subclause 8.1.2.2

Add new subclause heading

13.8 Cleaning and flushing

Add new subclause

13.8.1

Hydraulic actuators, accumulators and control panels shall be flushed after completion of the FAT to meet the cleanliness level specified in 6.2.3.

Add new subclause

13.8.2

Residual water from the valve body shall be completely drained and dried immediately after functional testing.

14 Surface protection

Replace first paragraph with

For offshore and coastal installations, coating for carbon steel actuators, accumulators, air receivers, intermediate supports (including the internal surfaces), couplings and fasteners in contact with the environment shall conform to ISO 12944-9.

Add to subclause

For onshore installations, coating for carbon steel actuators, accumulators, air receivers, intermediate supports (including the internal surfaces), couplings and fasteners in contact with the environment shall conform to ISO 12944-5, with the corrosivity category and durability as specified in the data sheet.

Add to subclause

Aluminium shall be painted using the manufacturer's qualified coating and painting system.

Add to subclause

The external paint color shall be as specified in the data sheet.

15 Marking

Replace first sentence with

Actuators shall be marked in accordance with the requirements of Table 3, Table 4 or Table 11, as applicable.

Add to subclause

The air receiver and the accumulator shall be identified with tag numbers.

Replace Table 3 with

Table 3 — Marking of electric actuators

No.	Marking	Application on
1	Manufacturer's name or trade mark	Name plate
2	Model	Name plate
3	Serial number	Name plate
4	Supply voltage, phase and frequency	Name plate
5	Voltage variation	Name plate
6	Frequency variation	Name plate
7	Hazardous area certification details	Name plate
8	Year of manufacture	Name plate
9	ISO 12490	Name plate
10	Rated torque	Name plate

11	Lubricant type	Name plate
12	Normal output torque	Name plate
13	Maximum output torque	Name plate
14	Motor duty class	Name plate
15	Enclosure IP rating	Name plate
16	Motor power and current (nominal)	Name plate
17	Starting current to nominal current ratio	Name plate

Add to Table 4

Table 4 — Marking of pneumatic/hydraulic actuators

No.	Marking	Application on
8	Rated torque	Name plate
9	Maximum network supply pressure	Name plate
10	Minimum network supply pressure	Name plate
11	Minimum operating pressure	Name plate
12	Fluid type	Name plate
13	Ingress protection	Name plate
14	Hazardous area certification	Name plate
15	Failure position	Name plate
16	Filter regulator set point	Name plate

Add new table

Table 11 — Marking of electro-hydraulic actuators

No.	Marking	Application on
1	Manufacturer's name or trade mark	Nameplate
2	Model	Nameplate
3	Serial number	Nameplate
4	Supply voltage, phase, frequency	Nameplate
5	Voltage variation	Nameplate
6	Frequency variation	Nameplate
7	Rated torque	Nameplate
8	Lubricant	Nameplate
9	Maximum rated pressure	Nameplate
10	Maximum operating pressure	Nameplate
11	Minimum network supply pressure	Nameplate
12	Hazardous area certification details	Nameplate
13	Hydraulic oil specification	Nameplate
14	Year of manufacture	Nameplate

Replace clause heading with

16 Packing, Preservation and preparation for shipping

Add to subclause

Where possible, the valve and the actuator shall be shipped as one complete assembly.

17 Documentation

Add new subclause

17.1

Documentation shall be retained by the supplier, in accordance with Table D.1.

Add new subclause

17.2

Document submission requirements shall be in accordance with IOGP S-707L.

Delete Table 5

Annex D
(normative)
Record retention

Replace Table D.1 with

Table D.1 — Record retention

Description	Electric	Pneumatic / hydraulic	Electro-hydraulic
Design documents / drawings	**Document retention**		
General arrangement drawing (valve with actuator, control panel and accessories)	X	X	X
General arrangement drawing (air receiver and accumulator)		A	A
Cross section drawing with bill of materials (actuator)	X	X	X
Cross section drawing with bill of materials (accumulator)		A	A
Accumulator sizing calculations		A	A
Torque table / calculation	X	X	X
Data sheet (valve, actuator and accessories)	X	X	X
Schematic drawing (pneumatic/hydraulic)	X	X	X
Blast calculation (valve and actuator assembly)		X	X
Pressure vessel design calculations		X	
Blast calculation (accumulator skid)		A	A
Electrical and wiring diagram	X		X
Wiring drawing (accessories)	X	X	X
Actuator testing procedures	X	X	X
Factory acceptance test procedures (valve and actuator assembly)	X	X	X
Safety analysis report/SIL calculations	A	A	A
NDE Procedures (RT, PT, MT,UT)	A	A	A
Safety data sheet for lubricants/oil	X		X
Lifting lug calculations	A	A	A
Surface preparation and coating procedure	X	X	X
Installation manual	X	X	X
Operation manual	X	X	X
Maintenance manual	X	X	X
Welding procedure specification (WPS)	X	X	X
Certificates / reports / records / results	**Document retention**		
Actuator test results	X	X	X
Supplier internal functional test reports on assembled units (actuator with associated gear box, valve, control panel and air receiver/accumulator)	X	X	X
Actuator type test certificates	X	X	X
Hazardous area certification	X	Y	X, Y
Material requirements for pressure-containing parts and bolts exposed to sour service to ISO 15156, all parts (if applicable) (EN 10204, Type 3.1)		A	A

Material test report for pressure-retaining parts, spring and spring canister traceable to the unique serial number (EN 10204, Type 3.1)	A	X	X
Compliance with local directives and regulations. For example, including but not limited to PED, ATEX, ASME, CRN	A	A	A
NDE report (RT, PT, MT, UT)	A	A	A
IP certificate for actuator and accessories	X	X	X
Fire proofing type test certificate	A	A	A
Solenoid coil insulation type test certificate		X	X
Hydraulic cleanliness test report		H	H
Records of test equipment calibration	X	X	X
Weld procedure qualification record (WPQR)	X	X	X
Welder performance qualification (WPQ)	X	X	X
Qualification record of NDE personnel	X	X	X
Coating certificate	X	X	X
Weight certificate	A	A	A
Factory acceptance test results (valve and actuator assembly)	X	X	X

X indicates mandatory
A indicates mandatory, if applicable to specific design
H indicates hydraulic and electro-hydraulic actuators only
Y indicates accessories only

Annex F
(normative)
FAT check sheets on assembled valves

Add new table

Table F.1.a — Visual and conformity check (header)

Client		**Contractor**		**Project reference**	
Valve Tag number		**Valve serial number**		**Actuator serial number**	
Purchase order reference		**Instrument data sheet**		**GA drawing**	
Pneumatic / hydraulic schematic					

Add new table

Table F.1.b — Visual and conformity check (checks)

Checks	Passed		Not applicable	Reference drawing/documents
Valve				
Valve type	☐ Yes	☐ No	☐ N/A	Data sheet / GA drawing
Valve end connection size	☐ Yes	☐ No	☐ N/A	Data sheet / GA drawing
Valve rating	☐ Yes	☐ No	☐ N/A	Data sheet / GA drawing
Valve bore diameter	☐ Yes	☐ No	☐ N/A	Data sheet / GA drawing
Casting quality	☐ Yes	☐ No	☐ N/A	MSS SP-55
Body heat number	☐ Yes	☐ No	☐ N/A	Material certificate
Bonnet heat number	☐ Yes	☐ No	☐ N/A	Material certificate
Actuator				
Actuator type	☐ Yes	☐ No	☐ N/A	Data sheet / GA drawing
Actuator orientation	☐ Yes	☐ No	☐ N/A	Data sheet / GA drawing
Actuator end stops check (open/close)	☐ Yes	☐ No	☐ N/A	
Control panel				
Control panel interface fitting size	☐ Yes	☐ No	☐ N/A	Data sheet / GA drawing / schematic drawing
Control panel components	☐ Yes	☐ No	☐ N/A	Data sheet / GA drawing / schematic drawing
Tubing size / thickness	☐ Yes	☐ No	☐ N/A	Data sheet / GA drawing / schematic drawing
Earth boss for control panel	☐ Yes	☐ No	☐ N/A	Data sheet / GA drawing
Grounding of instruments	☐ Yes	☐ No	☐ N/A	GA drawing

Painting				
Painting type for actuator	☐ Yes	☐ No	☐ N/A	Data sheet
Painting type for volume bottle / accumulator	☐ Yes	☐ No	☐ N/A	Data sheet
Color code for actuator	☐ Yes	☐ No	☐ N/A	Data sheet
Color code for volume bottle / accumulator	☐ Yes	☐ No	☐ N/A	Data sheet
Paint thickness for actuator	☐ Yes	☐ No	☐ N/A	Coating and painting specification
Paint thickness for volume bottle / accumulator	☐ Yes	☐ No	☐ N/A	Coating and painting specification
Cable entries, adaptors, plugs				
Number of cable entries	☐ Yes	☐ No	☐ N/A	As per GA drawing / data sheet
Size of cable entries	☐ Yes	☐ No	☐ N/A	As per GA drawing / data sheet
Adaptors for cable entry	☐ Yes	☐ No	☐ N/A	As per GA drawing / data sheet
Plugs for unused entries	☐ Yes	☐ No	☐ N/A	As per GA drawing / data sheet
Tag / Name plate				
Tag plate for assembly	☐ Yes	☐ No	☐ N/A	As per data sheet / this specification
Tag for accessories	☐ Yes	☐ No	☐ N/A	As per data sheet / this specification
Name plate markings actuator and accessories	☐ Yes	☐ No	☐ N/A	As per this specification
Accessories				
Solenoid valve (make/model/quantities)	☐ Yes	☐ No	☐ N/A	Data sheet
Limit switches (make/model/quantities)	☐ Yes	☐ No	☐ N/A	Data sheet
Position transmitter (make/model)	☐ Yes	☐ No	☐ N/A	Data sheet
Positioner (make/model)	☐ Yes	☐ No	☐ N/A	Data sheet
Air filter regulator (make/model)	☐ Yes	☐ No	☐ N/A	Data sheet
Check and thermal relief valve	☐ Yes	☐ No	☐ N/A	Schematic drawing
Air lock relay	☐ Yes	☐ No	☐ N/A	Schematic drawing
Speed regulator (tamper proof)	☐ Yes	☐ No	☐ N/A	Schematic drawing
Pressure relief valves	☐ Yes	☐ No	☐ N/A	Schematic drawing
Mechanical position indicator	☐ Yes	☐ No	☐ N/A	GA drawing
Visual beacon position indicator	☐ Yes	☐ No	☐ N/A	GA drawing
Handwheel / lever	☐ Yes	☐ No	☐ N/A	GA drawing
ATEX / IECEx / NEC marking	☐ Yes	☐ No	☐ N/A	GA drawing
Marking	☐ Yes	☐ No	☐ N/A	S-707
Remarks:				

Add new table

Table F.2.a — Dimensional check (header)

Client		**Contractor**		**Project reference**	

Valve Tag number		**Valve serial number**		**Actuator serial number**	
Purchase order reference		**Instrument data sheet**		**GA drawing**	

Add new table

Table F.2.b — Dimensional check (checks)

Checks	**Passed**		**Not applicable**	**Reference drawing/documents**
Actuator	☐ Yes	☐ No	☐ N/A	GA drawing
Valve	☐ Yes	☐ No	☐ N/A	GA drawing
Air receiver / accumulator	☐ Yes	☐ No	☐ N/A	GA drawing
Control panel	☐ Yes	☐ No	☐ N/A	GA drawing
Multi vessel accumulator	☐ Yes	☐ No	☐ N/A	GA drawing
Handwheel	☐ Yes	☐ No	☐ N/A	GA drawing
Remarks:				

Add new table

Table F.3.a — Actuator shell, piston seal, stroke test and operating time validation check and signal/supply failure test (header)

Project reference		**Client**	
P.O. reference		**Contractor**	
Valve Tag number		**Valve serial number**	
Actuator serial number		**Pneumatic/hydraulic schematic reference**	
Actuator type	☐ **Electric** ☐ **Pneumatic** ☐ **Hydraulic** ☐ **Electro -hydraulic**		

Add new table

Table F.3.b — Actuator shell, piston seal, stroke test, operating time validation test and signal/supply failure test (checks)

Reference	**Actuator Shell test**				
Table 11, 3)	**Test pressure**	**Duration**	**Passed**	**Failed**	**Acceptance criteria**
			☐	☐	As per subclause 13.2
Reference	**Piston seal test**				
Table 11, 4)	**Test pressure**	**Duration**	**Passed**	**Failed**	**Acceptance criteria**
			☐	☐	As per subclause 13.3
Reference	**Stroke test**				
Table 11, 5)		**Time**	**Passed**	**Failed**	**Acceptance criteria**

		1st	2nd	3rd			
	Air strokes				☐	☐	Manufacturer's test procedure / data sheet
	Spring stroke				☐	☐	Manufacturer's test procedure / data sheet

Reference	**Operating time validation test**				
Table 11, 6)	**Parameters**	**Required value**	**Actual value**	**Checks**	**Acceptance criteria**
	Valve DP			☐ OK ☐ No	
	Minimum network air / hydraulic system pressure			☐ OK ☐ No	
	- Closing time			☐ OK ☐ No	
	- Opening time			☐ OK ☐ No	
	Maximum network air / hydraulic system pressure			☐ OK ☐ No	
	- Closing time			☐ OK ☐ No	
	- Opening time			☐ OK ☐ No	

Reference	**Signal/supply failure test**				
Table 11, 7)	**Check**	**Fail position**	**Passed**	**Failed**	**Acceptance criteria**
	Loss of signal		☐	☐	Data sheet
	Loss of power supply / air supply / hydraulic supply		☐	☐	Data sheet

Add new table

Table F.4 — Functional test on accessories (tests)

Reference	Functional test for accessories				
Table 11, 8)	**Fail close valve**				
a)	**Fail close valve**				
	aa) Solenoid energized				
	Check	**Pass**	**Fail**	**N/A**	**Acceptance criteria**
	Valve open	☐	☐	☐	Pneumatic/hydraulic schematic
	Open limit switch contact to close	☐	☐	☐	Wiring drawing
	Position indication - open	☐	☐	☐	Visual
	Position transmitter output - 100 %	☐	☐	☐	Data sheet
	ab) Solenoid de-energized				
	Check	**Pass**	**Fail**	**N/A**	**Acceptance criteria**
	Valve close	☐	☐	☐	Pneumatic/hydraulic schematic
	Close limit switch contact to close	☐	☐	☐	Wiring drawing
	Position indication - close	☐	☐	☐	Visual
	Position transmitter output - 0 %	☐	☐	☐	Data sheet
b)	**Fail open valve**				
	aa) Solenoid energized				
	Check	**Pass**	**Fail**	**N/A**	**Acceptance criteria**
	Valve close	☐	☐	☐	Pneumatic/hydraulic schematic
	Close limit switch contact to close	☐	☐	☐	Wiring drawing
	Position indication - close	☐	☐	☐	Visual
	Position transmitter output - 0 %	☐	☐	☐	Data sheet
	ab) Solenoid de-energized				
	Check	**Pass**	**Fail**	**N/A**	**Acceptance criteria**
	Valve open	☐	☐	☐	Pneumatic/hydraulic schematic
	Open limit switch contact to close	☐	☐	☐	Wiring drawing
	Position indication - open	☐	☐	☐	Visual
	Position transmitter output - 100 %	☐	☐	☐	Data sheet
NOTE Multiple solenoid valves shall also be tested to ensure functionality					

Add new table

Table F.5 — Partial stoke testing, accumulator functional test, functional test for electric actuator, handwheel and network interface cards checks

Reference	Partial stroke testing	Pass	Fail	Acceptance criteria
Table 11, 9)	Check solenoid valve energized	☐	☐	S-707
	Initiate PST command and check valve moves to specified % towards its fail safe position and returns immediately	☐	☐	S-707
	Store valve signature in the device	☐	☐	S-707
	De-energize solenoid valve for a short duration and re-energize, check valve is moved which ensures that solenoid valve is tested.	☐	☐	Applicable only when using PST controller
	Check open limit switch contact set at 3° or 3 %	☐	☐	
	Check close limit switch contact 3° or 3 %	☐	☐	
	Check position transmitter output (0 to 100 % corresponds to 4 to 20 mA) or (0 to 90° corresponds to 4 TO 20 mA)	☐	☐	

Reference	Accumulator functional test	Required	Results	Pass	Fail	Acceptance criteria
Table 11, 10)	Stroke 1 start at normal or minimum network supply pressure (as per agreement)	bar g	bar g			data sheet
	End of stroke 3 pressure > minimum network supply pressure	bar g	bar g	☐	☐	data sheet
	Accumulator volume (more than or equal to 300 %)	litres	litres		☐	S-707

Reference	Specific functional tests for electric actuator (as applicable)	Pass	Fail	Acceptance criteria
Table 11, 11)	Local open/close	☐	☐	Manufacturer's test procedure
	Remote open/close/stop	☐	☐	
	open/close/fault contacts	☐	☐	
	Torque switch setting verification	☐	☐	
	Open/close limit switch setting verification	☐	☐	

Reference	Hand wheel rim operation and rim force verification, if supplied	Specified value	Actual rim force measured	Pass	Fail	Acceptance criteria
Table 11, 12)	Check handwheel operation for easiness and measure/record rim force	N (lbf)	N (lbf)	☐	☐	S-707

Reference	Functional test on network interface cards	Pass	Fail	N/A	Acceptance criteria
Table 11, 13)	Check configuration	☐	☐	☐	Manufacturer's test procedure
	Loop few electric actuators in loop and check network functionality	☐	☐	☐	

Add new table

Table F.6 — Torque validation and verification on assembled units - Electric actuators (fail lock)

Table 11, point 14)	**Fail lock valve - Torque validation and verification**							
Checks	**Responsibility**	**Torques**						
Valve torques		**Break to open (BTO)**	**Run to open (RTO)**	**End to open (ETO)**	**Break to close (BTC)**	**End to close (ETC)**	**MAST (one minimum value for entire drive train elements)**
Measured values / calculated values	Valve supplier	Measured	Measured	Measured	Measured	Measured	Calculated
Actuator torque		Design torque	Design torque	Design torque	Design torque	Design torque	Stall torque
Measured values / calculated values	Actuator supplier	Measured	Measured	Measured	Measured	Measured	Calculated
On demand correction factor based on fluid characteristics such as non-lubricating, clean or sticky service, operating temperatures, long stand still (ODCF)	Valve supplier	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	
Sizing safety factor (SSF)	Purchaser	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify
Validation	Valve supplier	**Design torque > BTO x ODCF x SSF**	**Design torque > RTO x ODCF x SSF**	**Design torque > ETO x ODCF x SSF**	**Design torque > BTC x ODCF x SSF**	**Design torque > ETC x ODCF x SSF**	**Stall torque < MAST**
Verification during FAT	Purchaser	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No

Add new table

Table F.7 — Torque validation and verification on assembled units - Electric actuators (fail close)

Table 11, point 14)	**Fail close valve – Torque validation and verification**								
Checks	**Responsibility**	**Torques**							
Valve torques		**Break to open (BTO)**	**Run to open (RTO)**	**End to open (ETO)**	**Break to close (BTC)**	**Run to close (RTC)**	**End to close (ETC)**	**MAST (one minimum value for entire drive train elements)**
Measured values / calculated values	Valve supplier	Measured	Measured	Measured	Measured	Measured	Measured	Calculated
Actuator torque		Design torque	Design torque	Design torque	Spring to start (STS)	Spring to run (STR)	Spring to end (STE)	Stall torque
Measured values / calculated values	Actuator supplier	Measured	Measured	Measured	Measured	Measured	Measured	Calculated
On demand correction factor based on fluid characteristics such as non-lubricating, clean or sticky service, operating temperatures, long stand still (ODCF)	Valve supplier	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	
Sizing safety factor (SSF)	Purchaser	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify
Validation	Valve supplier	**Design torque > BTO x ODCF x SSF**	**Design torque > RTO x ODCF x SSF**	**Design torque > ETO x ODCF x SSF**	**STS > BTC x ODCF x SSF**	**STR > RTC x ODCF x SSF**	**STE > ETC x ODCF x SSF**	**Stall torque < MAST**
Verification during FAT	Purchaser	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No

Add new table

Table F.8 — Torque validation and verification on assembled units - Electric actuators (fail open)

Table 11, point 14)	**Fail open valve - Torque validation and verification**							
Checks	**Responsibility**	**Torques**						
Valve torques		**Break to open (BTO)**	**Run to open RTO)**	**End to open (ETO)**	**Break to close (BTC)**	**Run to close (RTC)**	**End to close (ETC)**	**MAST (one minimum value for entire drive train elements)**
Measured values / calculated values	Valve supplier	Measured	Measured	Measured	Measured	Measured	Measured	Calculated
Actuator torque		Spring to start(STS)	Spring to run(STR)	Spring to end(STE)	Design torque	Design torque	Design torque	Stall torque
Measured values / calculated values	Actuator supplier	Measured	Measured	Measured	Measured	Measured	Measured	Calculated
On demand correction factor based on fluid characteristics such as non-lubricating, clean or sticky service, operating temperatures, long stand still (ODCF)	Valve supplier	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	
Sizing safety factor (SSF)	Purchaser	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify
Validation	Valve supplier	**STS > BTO x ODCF x SSF**	**STR > RTO x ODCF x SSF**	**STE > ETO x ODCF x SSF**	**Design torque > BTC x ODCF x SSF**	**Design torque > RTC x ODCF x SSF**	**Design torque > ETC x ODCF x SSF**	**Stall torque < MAST**
Verification during FAT	Purchaser	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No

Add new table

Table F.9 — Torque validation and verification on assembled units – Pneumatic, hydraulic and electro-hydraulic actuators (fail close valves)

Reference	**Fail close valve - Torque validation and verification**								
Table 11, point 15)	**Responsibility**	**Torques**							
Valve torques		**Break to open (BTO)**	**Break to open @ breakaway angle (BTOba)**	**Run to open (RTO)**	**End to open (ETO)**	**Break to close (BTC)**	**Run to close (RTC)**	**End to close (ETC)**	**MAST (one minimum value for entire drive train elements)**
Measured values / calculated values	Valve supplier	Measured	Calculated	Measured	Measured	Measured	Measured	Measured	Calculated
Actuator torque		Air to start (ATS)	Air to run @ breakaway angle (ATRba)	Air to run (ATR)	Air to end (ATE)	Spring to start (STS)	Spring to run (STR)	Spring to end (STE)	Maximum air to start torque (ATSmax)
Measured values / calculated values	Actuator supplier	Measured	Calculated	Measured	Measured	Measured	Measured	Measured	Calculated
On demand correction factor based on fluid characteristics such as non-lubricating, clean or sticky service, operating temperatures, long stand still (ODCF)	Valve supplier	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	
Sizing safety factor (SSF)	Purchaser	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify
Validation	Valve supplier	ATS >	ATRba >	ATR >	ATE >	STS >	STR >	STE >	ATSmax <
		BTO x ODCF x SSF	BTOba x ODCF x SSF	RTO x ODCF x SSF	ETO x ODCF x SSF	BTC x ODCF x SSF	RTC x ODCF x SSF	ETC x ODCF x SSF	MAST
Verification during FAT	Purchaser	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No
The motive force to operate the actuator shall be either air or hydraulic oil. Hence where "air" is indicated in the above table, shall be substituted with "hydraulic oil" based on selected actuator.									

Add new table

Table F.10 — Torque validation and verification on assembled units – Pneumatic, hydraulic and electro-hydraulic actuators (fail open valve)

Table 11, point 15)	**Fail open valve - Torque validation and verification**									
Checks	**Responsibility**	**Torques**								
Valve torques		**Break to open (BTO)**	**Run to open (RTO)**	**End to open (ETO)**	**Break to close (BTC)**	**Run to close (RTC)**	**End to close @ breakaway angle (ETCba)**	**End to close (ETC)**	**MAST (one minimum value for entire drive train elements)**
Measured values / calculated values	Valve supplier	Measured	Measured	Measured	Measured	Measured	Calculated	Measured	Calculated
Actuator torque		Spring to start (STS)	Spring to run (STR)	Spring to end (STE)	Air to start (ATS)	Air to run (ATR)	Air to run @ breakaway angle (ATR ba)	Air to end (ATE)	Maximum air to start torque (ATS max)
Measured values / calculated values	Actuator supplier	Measured	Measured	Measured	Measured	Measured	Calculated	Measured	Calculated
On demand correction factor based on fluid characteristics such as non-lubricating, clean or sticky service, operating temperatures, long stand still (ODCF)	Valve supplier	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	Supplier to specify	
Sizing safety factor (SSF)	Purchaser	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify	Purchaser to specify
Validation	Valve supplier	STS > BTO x ODCF x SSF	STR > RTO x ODCF x SSF	STE > ETO x ODCF x SSF	ATS > BTC x ODCF x SSF	ATR > RTC x ODCF x SSF	ATRba > ETCba x ODCF x SSF	ATE > ETC x ODCF x SSF	ATSmax < MAST
Verification during FAT	Purchaser	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No	☐ OK ☐ No
The motive force to operate the actuator shall be either air or hydraulic oil. Hence where "air" is indicated in the above table, shall be substituted with "hydraulic oil" based on selected actuator.									

Add new table

Table F.11 — Torque validation and verification on assembled units – Pneumatic, hydraulic and electro-hydraulic actuators (other)

Reference	**Other Torque verification / validation**		
	Check	**Pass**	**Fail**
Table 11, point 14)	Spring start torque(STS) < ISO 5211 flange torque	☐	☐
	Maximum air start torque (ASTmax) < ISO 5211 flange torque	☐	☐

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