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Electric actuators for industrial valves — General requirements

Actionneurs électriques pour robinetterie industrielle — Exigences générales

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 153, *Valves*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Electric actuators for industrial valves — General requirements

1 Scope

This document provides basic requirements for electric valve actuators, used for on-off and control valves. It includes guidelines for classification, design, enclosure and corrosion protection, and methods for conformity assessment.

Combinations of electric actuators and gearboxes when supplied by the actuator manufacturer are within the scope of this document.

This document does not cover solenoid actuators, electro-hydraulic actuators and electric actuators which are integral to the valves.

Other requirements or conditions of use different from those indicated in this document are agreed between the purchaser and the manufacturer/supplier, prior to order.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5210, *Industrial valves — Multi-turn valve actuator attachments*

ISO 5211, *Industrial valves — Part-turn actuator attachments*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
electric actuator
electrically powered device attached to the valve by bolting for the purpose of applying *torque* (3.5) and/or thrust to open and close and/or control a valve

3.2
part-turn actuator
actuator which transmits *torque* (3.5) to the valve for less than one revolution, and does not need to be capable of withstanding operational thrust

Note 1 to entry: In this document, a combination of a *multi-turn actuator* (3.3) plus a part-turn *gearbox* (3.15) is considered as a part-turn actuator

3.3
multi-turn actuator
actuator which transmits *torque* (3.5) to the valve/*gearbox* (3.15) for at least one revolution and can be capable of withstanding thrust

Note 1 to entry: In this document, a combination of a multi-turn actuator plus a multi-turn gearbox is considered as a multi-turn actuator.

3.4
linear actuator
actuator which transmits thrust to the valve for a defined linear *stroke* (3.14)

Note 1 to entry: In this document, a combination of a *multi-turn actuator* (3.3) plus a linear drive is considered as a linear actuator.

3.5
torque
moment of a force, the measure of a force's tendency to produce torsion and rotation about an axis, a turning or twisting force

Note 1 to entry: Torque is expressed in Newton meters.

3.6
rated torque
maximum *torque* (3.5) available for valve operation, as stated by the manufacturer

3.7
rated thrust
maximum thrust for linear output actuators, available for valve operation, as stated by the manufacturer or maximum thrust for multi-turn output actuators, the actuator can withstand, as stated by the manufacturer

3.8
stall torque/thrust
maximum *torque* (3.5)/thrust or a combination of both that an *electric actuator* (3.1) develops when the motor is energized and the *output drive* (3.18) is locked

Note 1 to entry: This is the torque used to design the mechanically loaded parts of the actuator.

[SOURCE: ISO 12490:2011, 4.23, modified — The word "thrust" was added to the term, the phrase "or a combination of both" has been added to the definition.]

3.9
maximum allowable stem torque/thrust
MAST
maximum *torque* (3.5)/thrust that it is permissible to apply to the valve drive train without risk of damage, as defined by the valve manufacturer/supplier

3.10
set thrust
thrust value limited by the thrust limiting device

3.11
set torque
torque (3.5) value limited by the torque limiting device

3.12
cycle
movement of the valve obturator from the fully closed position to the fully open position and back to the fully closed position, or vice versa

[SOURCE: ISO 12490:2011, 4.8, modified — The word "continuous" at the beginning of the definition has been removed.]

3.13
travel
movement of the actuator in driving a valve obturator, defined in terms of output turns, angular or linear distance, a percentage thereof or undefined when relating to general movement(s)

3.14
stroke
travel (3.13) of valve obturator from the fully closed position to the fully open position, or vice versa

EXAMPLE End of stroke is predefined as the fully closed or fully open position.

[SOURCE: ISO 12490:2011, 4.25, modified — The example has been added and the word "movement" has been substituted by "travel".]

3.15
gearbox
gear unit for *torque* (3.5)/speed/orientation change

[SOURCE: ISO 22109:2020, 3.1, modified — The phrase "that can be manually operated by handwheel/lever and/or automated with an actuator" has been deleted.]

3.16
nominal motor current
value, expressed in Ampere (A), indicated by the actuator manufacturer, characterising the motor under specified actuator duty performances

3.17
nominal motor power
value, expressed in Watts (W), indicated by the actuator manufacturer, characterising the motor under specified actuator duty performances

3.18
output drive
actuator output component necessary to transmit *torque* (3.5) and/or thrust to the valve in order to cause operation

3.19
terminal compartment
defined compartment of the actuator for electrical connection of power and/or control and/or signal wiring

3.20
thermal protecting device
temperature sensing device used to stop motor operation at a temperature defined by the manufacturer

4 Classification — Designation

4.1 General

Electric valve actuators are classified per type, duty and action on loss of external electric power as detailed below.

4.2 Type

There are three types of actuators:

— part-turn actuator;

— multi-turn actuator;

— linear actuator.

4.3 Actuator duty classification

The basic design requirements for electric actuators duty classification are given in Table 1.

The electric actuator shall be designed to meet the endurance criteria defined in Table 2, Table 3 or Table 4.

Table 1 — Duty classification

Class	Duty	Definition
A	On-off	The electric actuator is required to drive the valve through its stroke from the fully open position to the fully closed position or vice-versa.
B	Inching/positioning	The electric actuator is required to occasionally drive the valve to any position (fully open, intermediate and fully closed).
C	Modulating	The electric actuator is required to frequently drive the valve to any position between fully open and fully closed.
D	Continuous modulating	The electric actuator is required to continuously drive the valve to any position between fully open and fully closed.

4.4 Action on loss of external electric power

4.4.1 Stay put action

On loss of external power, the actuator remains in the position achieved before loss of power.

4.4.2 Fail-safe action

4.4.2.1 Electric fail-safe action

On loss of external power, the actuator is able to operate the valve to a predefined position using stored electrical energy.

4.4.2.2 Mechanical fail-safe action

On loss of external power, the actuator is able to operate the valve to a predefined position using stored mechanical energy.

5 Design requirements

5.1 Endurance

5.1.1 General

The actuator shall meet the requirements specified in 5.1.2, 5.1.3 and 5.1.4, and satisfy the life endurance test criteria as defined in Annex A.

The endurance of modulating and continuous modulating actuators shall be based on consecutive starts spread over an intermediate travel span of maximum 30 % of the stroke.

NOTE An informative guideline for actuator selection is provided in Annex B.

5.1.2 Part-turn actuators

For part-turn actuators, endurance testing shall meet the requirements specified in Table 2.

Table 2 — Part-turn actuators endurance test requirements (see Annex A)

Rated torque ranges[a] Nm	Class A and B On-Off inching (number of cycles)[b]	Class C Modulating (number of starts)[c]	Class D Continuous modulating (number of starts)[c]
Up to 125	10 000	1 800 000	10 000 000
126 – 1 000	10 000	1 200 000	10 000 000
1 001 – 4 000	5 000	500 000	5 000 000
4 001 – 32 000	2 500	250 000	T.B.A.[d]
Above 32 000	1 000	T.B.A.[d]	T.B.A.[d]

[a] Based on ISO 5211.

[b] One cycle consists of nominal 90° angular travel in both directions (i.e. 90° to open and 90° to close). The actuator is able to transmit 100 % of the rated torque for at least 4,5° at each end of travel or for at least 9° at either opened or closed position in both directions. The average load cannot be below 30 % of the rated torque for the remaining travel (see Annex C). For angular travel other than 90°, the endurance is agreed between the purchaser and the manufacturer or supplier. During testing a deviation of +20 % and −5 % in load is accepted.

[c] One start consists of a movement of at least 1 % in either direction, with a load of at least 30 % of the rated torque.

[d] T.B.A. means to be agreed between manufacturer/supplier and purchaser.

5.1.3 Multi-turn actuators

For multi-turn actuators, endurance testing shall meet the requirements specified in Table 3.

Table 3 — Multi-turn actuators endurance test requirements (see Annex A)

Rated torque ranges[a] Nm	Maximum allowable thrust[a] kN	Class A and B On-Off inching (number of cycles)[b]	Class C Modulating (number of starts)[c]	Class D Continuous modulating (number of starts)[c]
Up to 100	≤40	10 000	1 800 000	10 000 000
101 – 700	≤150	10 000	1 200 000	10 000 000
701 – 2 500	≤325	5 000	500 000	5 000 000
2 501 – 10 000	≤1 100	2 500	250 000	T.B.A.[d]
Above 10 000	>1 100	1 000	T.B.A.[d]	T.B.A.[d]

[a] Based on ISO 5210.

[b] One cycle consists of 25 turns in both directions (i.e. 25 turns to open and 25 turns to close). The actuator is able to transmit 100 % of the rated torque for at least 2,5 turns at the closed position in both directions. The average load cannot be below 30 % of the rated torque for the remaining travel (see Annex C). During testing a deviation of +20 % and −5 % in load is accepted.

[c] One start consists of a movement of at least 1 % of travel in either direction, with a load of at least 30 % of the rated torque.

[d] T.B.A. means to be agreed between manufacturer/supplier and purchaser.

5.1.4 Linear actuators

For linear actuators, endurance testing shall meet the requirements specified in Table 4.

Table 4 — Linear actuators endurance test requirements (see Annex A)

Rated thrust ranges[a] kN	Class A and B On-Off inching (number of cycles)[b]	Class C Modulating (number of starts)[c]	Class D Continuous modulating (number of starts)[c]
Up to 20	10 000	1 800 000	10 000 000
21 – 70	10 000	1 200 000	10 000 000
71 – 150	5 000	500 000	5 000 000
151 – 325	2 500	250 000	T.B.A.[d]
Above 325	1 000	T.B.A.[d]	T.B.A.[d]

[a] Based on ISO 5210.

[b] One cycle consists of a stroke of 40 mm, or of a minimum stroke (H) given in ISO 5210, in both directions (i.e. 40 mm to open +40 mm to close). The actuator is able to transmit 100 % of the rated thrust for at least 10 % of the travel. The average load cannot be below 30 % of the rated thrust for the remaining travel (see Annex C). During testing a deviation of +20 % and –5 % in load is accepted.

[c] One start consists of a movement of at least 1 % of the stroke in either direction, with a load of at least 30 % of the rated thrust.

[d] T.B.A. means to be agreed between manufacturer/supplier and purchaser.

5.2 Environmental conditions

5.2.1 General

The environmental conditions given in 5.2.2 to 5.2.6 shall apply to the design capabilities.

5.2.2 Ambient temperature and humidity

The actuator shall be capable of operation at an ambient temperature range between –20 °C and +60 °C with relative humidity up to 90 % (25 °C).

5.2.3 Altitude

The actuator shall be capable of operation at an altitude at least 1 000 m above sea level.

5.2.4 Enclosure protection

Electric actuators shall have at least enclosure protection type IP 65 in accordance with IEC 60529.

5.2.5 External corrosion protection

Electric actuators shall be protected against external corrosion by proper material selection and/or surface treatment. The actuator manufacturer's technical documentation shall specify the corrosion protection category (or categories) according to Table 5.

Table 5 — Environmental corrosion categories

Corrosion category	Typical environments	
	Exterior	Interior
C2 (low)	Atmospheres with low level of pollution and mostly rural areas	Unheated buildings where condensation can occur, e.g. depots, sport halls.
C3 (medium)	Urban and industrial atmospheres, moderate sulphur dioxide pollution and coastal areas with low salinity	Production rooms with high humidity and some air pollution, e.g. food-processing plants, laundries, breweries

NOTE This table is taken, for reference purposes only, from ISO 12944-2. The actuator corrosion protection can also be achieved by systems/methods which deviate from those specified in ISO 12944-5.

Table 5 *(continued)*

Corrosion category	Typical environments	
	Exterior	Interior
C4 (high)	Industrial areas and coastal areas with moderate salinity	Chemical plants, swimming pools, coastal shipyards
C5-I (very high — industrial)	Industrial areas with high humidity and aggressive atmosphere	Buildings or areas with almost permanent condensation and with high pollution
C5-M (very high — marine)	Coastal and offshore areas with high salinity	Buildings or areas with almost permanent condensation and with high pollution
Immersed in water		
Im 1 (Immersed in fresh water)	River installations, hydro-electric power plants	
Im 2 (Immersed in sea or brackish water)	Harbour areas and offshore structures	
NOTE This table is taken, for reference purposes only, from ISO 12944-2. The actuator corrosion protection can also be achieved by systems/methods which deviate from those specified in ISO 12944-5.		

5.2.6 Vibrations, shock and seismic conditions

Considerations for vibrations, shock and/or seismic conditions are not given in this document. If any of these conditions apply, they shall be agreed between the manufacturer/supplier and the purchaser.

5.3 Actuator attachment

5.3.1 Part-turn actuators

The attachment for part-turn actuators shall comply with ISO 5211.

The output drive of part-turn actuators may be an integral or a removable component to allow it, when necessary, to be machined to suit the driven component of the valve.

The material of the drive component shall be indicated in the manufacturer's/supplier's documentation.

5.3.2 Multi-turn actuators

The attachment for multi-turn actuators shall comply with ISO 5210.

The output drive of multi-turn actuators may be an integral or a removable component to allow it, when necessary, to be machined to suit the driven component of the valve.

The material of the drive component shall be indicated in the manufacturer's/supplier's documentation.

5.3.3 Linear actuators

The attachment for linear actuators shall comply with ISO 5210, unless otherwise agreed between the manufacturer/supplier and the purchaser.

The output drive of linear actuators may be an integral part or a removable component to allow it, when necessary, to be machined to suit the driven component of the valve.

The output drive of linear actuators may include a removable component to allow it, when necessary, to be machined to suit the driven component of the valve.

The material of the drive component shall be indicated in the manufacturer's/ supplier's documentation.

5.4 Primary closing direction

The primary closing direction shall be:

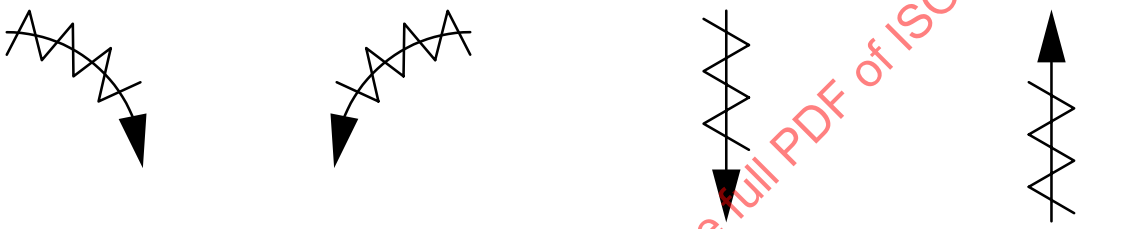
a) for multi-turn and part-turn actuators clockwise (CW), as viewed from the actuator side of the interface when looking towards the valve;

b) for linear actuators, extended to close.

5.5 Fail-safe direction

For actuators with a fixed installed fail-safe function, the fail-safe direction of movement can be either clockwise or counter-clockwise (extend or retract for linear). It shall be clearly and permanently indicated on the actuator housing in accordance with Figure 1 (see Clause 8).

For actuators providing fail-safe function on loss of main electrical power, supplied documentation shall include default fail-safe action/direction, possible configurable options and warnings regarding stored electric or spring energy.



a) Turn clockwise (CW) **b) Turn counter-clockwise (CCW)** **c) Extend** **d) Retract**

Figure 1 — Fail-safe directions

5.6 Electrical connections — Cable entries

All internal electrical components requiring connection to external cables shall be wired to terminals in a defined compartment.

5.7 Self-locking/braking

The physical concept of self-locking only applies to particular types of actuators and is not securing positions under all conditions, for example vibrations. If the position of the actuator is stable with torques/thrust applied to the output, the actuator and/or additional components might need to be designed for these applications.

Braking, locking devices or assemblies might be integral parts of actuators and/or additional components provided by the supplier to the customer/end-user, in order to secure any given position within the stroke or cycle (in particular in the fully closed position).

In order to provide better positioning, and limit overshooting of positions, active braking or other solutions can be necessary to incorporate into the actuator and/or additional components.

5.8 Performance

5.8.1 Power supply tolerances

The actuator shall be able to provide its rated torque, at the specified power supply, within the following supply tolerances:

a) nominal voltage: ±10 %;

b) frequency (for AC supplies): ±2 %;

c) for AC supplies, in respect of waveform and harmonics etc., actuators shall be suitable for operation with power supplies meeting recognised utility supply standards/regulations. For AC supplies operating outside such standards (e.g. VFD, UPS) agreement shall be reached between customer and manufacturer.

5.8.2 Actuator duty performances

5.8.2.1 General

The minimum number of cycles per hour, starts per hour and/or running time per hour, for each actuator duty class shall be as specified in 5.8.2.2, 5.8.2.3 and 5.8.2.4 and are based on an ambient temperature of +40 °C. For other ambient temperatures, the manufacturer/supplier may state de-rating factors or applicable values.

5.8.2.2 Part-turn actuators

For part-turn actuators, duty performances shall meet the requirements specified in Table 6.

Table 6 — Part-turn actuators duty performance

Rated torque range Nm	Class A On-Off (cycles per hour)[a]	Class B Inching (starts per hour)[b]	Class C Modulating (starts per hour)[c]	Class D Continuous (starts per hour)[c]
Up to125	15	120	1 200	3 600
126 – 1 000	10	60	600	1 800
1 001 – 4 000	5	30	300	600
4 001 – 32 000	5	15	60	[d]
Above 32 000	5	5	30	[d]

[a] One cycle consists of nominal 90° angular travel in both directions (i.e. 90° to open + 90° to close), based on an average load of at least 30 % of the rated torque with the ability to transmit 100 % of the rated torque for at least 5 % at each end of travel, with a cumulative operating time not exceeding 15 min in one hour.

[b] One start consists of a movement of at least 1° in either direction, with a load of at least 30 % of the rated torque. The cyclic duration factor (i.e. the ratio between the running period and total period) shall be not less than 25 % (e.g. 1 s running and 3 s resting).

[c] One start consists of a movement of at least 1° in either direction, with a load of at least 30 % of the rated torque.

[d] To be agreed between the manufacturer/supplier and the purchaser.

5.8.2.3 Multi-turn actuators

For multi-turn actuators, duty performances shall meet the requirements specified in Table 7.

Table 7 — Multi-turn actuators duty performance

Rated torque range Nm	Class A On-Off (running time per hour)[a]	Class B Inching (starts per hour)[b]	Class C Modulating (starts per hour)[c]	Class D Continuous modulating (starts per hour)[d]
Up to 100	15 min	30	1 200	3 600
101 – 700	15 min	20	600	1 800
701 –2 500	15 min	15	300	600
2 501 – 10 000	15 min	10	60	[e]
Above 10 000	15 min	5	30	[e]

[a] Based on an average load of at least 30 % of the rated torque with the ability to transmit 100 % of the rated torque for at least 10 % of the time.

[b] For inching, one start duration is defined by at least one revolution, with an average load of 30 % of the rated torque.

[c] For modulating, one start consists of at least 5°, with a load of at least 30 % of the rated torque. The cyclic duration factor (i.e. the ratio between the running period and total period) is not less than 25 % (e.g. 1 s running and 3 s resting).

[d] For continuous modulating, one start consists of at least 5°, with a load of at least 30 % of the rated torque.

[e] To be agreed between the manufacturer/supplier and the purchaser.

5.8.2.4 Linear actuators

For linear actuators, duty performance shall meet the requirements specified in Table 8.

Table 8 — Linear actuators duty performance

Rated thrust range kN	Class A On-Off (cycles per hour)[a]	Class B Inching (starts per hour)[b]	Class C Modulating (starts per hour)[c]	Class D Continuous modulating (starts per hour)[c]
Up to 20	15	30	1 200	3 600
21 – 70	10	15	600	1 800
Above 70	5	10	60	[d]

[a] One cycle consists of a stroke of 40 mm in both directions (i.e. 40 mm to open + 40 mm to close), based on an average load of at least 30 % of the rated thrust with the ability to transmit 100 % of the rated thrust for at least 4 mm of the travel.

[b] One start consists of a movement of at least 1 % of the minimum stroke (as stated in ISO 5210) in either direction, with a load of at least 30 % of the rated thrust. The cyclic duration factor (i.e. the ratio between the running period and total period) is not less than 25 % (e.g. 1 s running and 3 s resting).

[c] One start consists of a movement of at least 1 % of the minimum stroke (as stated in ISO 5210) in either direction, with a load of at least 30 % of the rated thrust.

[d] To be agreed between the manufacturer/supplier and the purchaser.

5.8.3 Operating time and speed

For part-turn actuators, the units for the operating time shall be provided in seconds per travel (s/90°).

For multi-turn actuators, the values for the operating speed shall be provided in revolutions per minute (r/min).

For linear actuators, the values for the operating speed shall be provided in millimetres per second or millimetres per minute (mm/sec or mm/min).

For variable speed actuators, the values for the maximum and minimum speed shall be provided by the manufacturer/supplier.

5.9 Basic design requirements

5.9.1 Motors

Actuator motors are designed by the manufacturer as an integral part of the actuator in order to achieve the performance defined in 5.8.

As such, they do not fall within the scope of IEC 60034-1.

There is no direct relation between nominal motor power (kW) and actuator rated torques/thrusts.

Actuator performance is defined as rated output torque/thrust at a speed and voltage as stated by the manufacturer. Motor power and actuator output performance may not be directly proportional.

Asynchronous motor windings shall be protected against overheating by a suitable thermal protecting device. For other types of motors, the protecting device is not mandatory.

5.9.2 Gearing lubricant

The lubricant provided for the actuator shall meet endurance requirements as detailed under 5.1 without loss of lubricant or replacing lubricant.

The method of lubrication (grease, oil and/or self-lubricating materials) shall be under the responsibility of the manufacturer/supplier and shall be suitable for the range of environmental conditions in 5.2 when mounted in any orientation.

5.9.3 Manual operation

The actuator shall be provided with a means for manual operation (e.g. by hand-wheel, lever, socket wrench) or similar device. When requested, manual operation may be omitted.

In general, the actuator drive mechanism shall be designed so that the manual operating element cannot be driven by the motor. For part-turn and linear actuators, the motor may drive the manual operating element if the manufacturer:

— assures that the applicable standards and regulations are met. The manufacturer shall identify the relevant standards and/or regulations available; and

— ensures that the design eliminates risk of damage or injury.

The sizing of the operating device shall be in accordance with an internationally recognized design code or standard.

Unless otherwise specified, the manual operating element shall be rotated clockwise to close the valve. The closing direction shall be clearly visible and permanently marked where the operating device is connected to the drive. In addition, marking of the opening direction is allowed.

5.9.4 Travel limitation

The actuator shall include means of de-energising the motor in response to reaching set open and close positions.

Travel limiting devices shall be independently adjustable to set the open and closed valve positions.

The correct setting of such devices shall not be lost, even under loss of power and/or with manual operation.

The repeatability deviation in reaching these positions, during successive operations, shall be:

— within 1 % of the travel for linear actuators and multi-turn actuators;

— maximum 1° for part-turn actuators.

If the travel limiting device can be connected electrically to an external circuit, its electrical rating shall be stated in the technical documentation.

5.9.5 Torque/thrust limitation

A device which can be adjustable for limiting actuator output torque (or thrust) to set torque(or set thrust), acting in both directions, shall be incorporated. For small size part turn/linear actuators up to 125 Nm/20 kN, a torque/thrust limitation device is not mandatory.

NOTE The torque/thrust limiting device can be by-passed during unseating of the valve or during emergency action.

After the torque/thrust limiting device has operated, a means to prevent unwanted operation of the actuator in the same travel direction may be required.

If the torque/thrust limiting device can be connected electrically to an external circuit, its electrical rating shall be stated in the technical documentation.

The repeatability deviation in reaching these torques/thrusts, during successive operations under the same conditions, shall be within ±10 % of the torque/thrust for actuators.

5.9.6 Structural integrity

Mechanically loaded parts shall be designed to accommodate the maximum anticipated in-service load, including design torque/thrust, and shall take into account the following:

— torque/thrust at maximum supply voltage;

— torque/thrust at stall condition.

Mechanically loaded parts shall be designed in accordance with a documented methodology, including acceptance criteria. Acceptance criteria shall include analysis of stress, strain (and fatigue where applicable) encountered during operation at maximum torque/thrust output. Alternatively, acceptance criteria may be satisfactory documented previous experience including validation testing.

5.9.7 End stop adjustment for part-turn and linear actuators

When specified by the purchaser, part-turn and linear actuators may be supplied with two integral mechanical end stops (one for each end position). These can be fixed or independently adjustable (minimum adjustment range ±2 % of the travel).

5.9.8 Noise

The noise value of the actuator on its own shall not be greater than sound pressure levels of 80 dB(A) in the condition of no-load running, using a noise dosimeter at a 1 m distance faced to the actuator.

6 Optional equipment

6.1 General

When specified, the options described in 6.2 to 6.8 may be fitted to the actuator subject to agreement between the manufacturer/supplier and the purchaser. If the options can be connected electrically to an external circuit, the electrical rating shall be stated in the technical documentation.

6.2 Anti-condensation heater

Use a suitable device to inhibit condensation inside the electric control housing.

6.3 Position transmitter

A position transmitter which operates whether the actuator is in electrical or manual mode. The transmitter shall enable continuous indication of the valve obturator position at a remote location. It may be of analogue or digital type.

6.4 Actuator running transmitter

A device which provides remote indication that the actuator output is travelling.

6.5 Additional position and/or torque signalling

Use additional means of signalling specific positions of travel and/or torque limiter operation for remote indication and/or control purposes.

6.6 Local control station

Use an integrally or remotely mounted panel providing means of local control of the actuator (open-stop-close). It may include a lockable selecting device (local-off-remote) and/or status indication.

6.7 Local position indication

Actuators may be equipped with a means of indicating valve position. This can be achieved electrically or mechanically and shall show, as a minimum, when the valve is fully open/closed and mid-travel.

6.8 Actuator electrical controls

6.8.1 General

Actuator electrical controls provide comprehensive functionality for control of the actuator. This may include the local control station (as described in 6.6).

The controls may be an integral part of the actuator or be installed separately.

All electrical connections, necessary for local and remote control and indication, shall be shown on the actuator wiring diagram (See Clause 9).

Optional integral control equipment can include actuator availability monitoring, stall torque protection and response to "ESD (emergency shut down)" command and, for 3-phases applications, phase sensitive protection.

6.8.2 Positioner

An integrally mounted analogue or digital device, which provides positioning control. The input signal may be analogue by a voltage or a current, internally or externally powered, or digitally sourced.

Positioner type, signal type and range shall be subject to agreement between manufacturer/supplier and purchaser.

6.8.3 Controller

When specified the actuator controls may include a device to perform control functions as required.

6.8.4 Speed control

An integrally mounted device, which affects valve operating time by means of direct actuator motor operating speed control or "stop-start" (pulsing) action. The speed range/ratio and speed control position/direction shall be subject to agreement between manufacturer/supplier and purchaser.

6.8.5 Field bus system interface

An integrally mounted field control device, which provides connectivity with host control system for actuator control, status indication and monitoring.

The field control device shall meet the specified field bus system.

NOTE Typical protocols/buses include the following: Modbus, Profibus, Profinet, Devicenet, Foundation Filedbus, Hart, or Proprietary BUS. Proprietary systems specified by the manufacturer/supplier or purchaser can also be used.

6.8.6 Torque transmitter (analogue or digital)

A device which enables the indication of actuator output torque at the display of the actuator and/or at a remote location. The torque transmitter accuracy shall be stated in the technical documentation.

6.8.7 Actuator performance data logger

An internally mounted device which records data relating to the performance/operation of the valve, actuator and control system for analysis purposes.

The data to be logged shall be subject to agreement between the manufacturer/supplier and the purchaser.

A means of accessing/viewing the logged data shall be provided by the manufacturer/supplier.

Connection device/analysis software, etc., not integral to the actuator shall be made available by the manufacturer/supplier.

7 Type and production test

7.1 General

The manufacturer/supplier shall validate electric actuators according to this document by:

a) carrying out all the type tests (see 7.2 and Annex A) to ensure all fitness for purpose criteria are met;

b) controlling the production process (see 7.3) to ensure the required performance levels are continuously maintained;

c) the manufacturer/supplier may provide a copy of the report from a previously conducted test, or it shall be done by carrying out the corresponding type test.

7.2 Type tests

The type tests shall correspond to all design requirements stated in Clause 5.

Type test shall be carried out on actuators that are representative of the current production.

Type tests results shall be recorded in a test report, detailing the type, quantity and sizes of the actuators tested and the test equipment and measuring devices used.

To qualify a range of actuators, of the same design principle and of the same classification/designation (as per Clause 4), manufactured under the same process and from the same or equivalent materials, the type tests may be carried out on a limited number of representative sizes by applying the following rules.

a) When an actuator having a nominal output torque/thrust, T, is qualified, all actuators having nominal output torques/thrust between 50 % T (= T/2) and 200 % T (= 2 T) are qualified.

b) When a part-turn actuator with an operating time, *t*, is qualified, all actuators having an operating time higher than *t* are also qualified.

c) When a multi-turn or linear actuator with an operating speed, *z*, is qualified, all actuators having an operating speed lower than *z* are also qualified.

d) The affected type tests shall be repeated when the design or the production process has been modified which could impact the functional performances.

The type test shall be carried out by the manufacturer/supplier, or by an independent body (third party).

A full report of these tests shall be retained by the manufacturer/supplier as evidence of conformance.

The type tests to be performed shall be those given in Table 9.

7.3 Control of production process

The manufacturer/supplier shall have a quality system capable of ensuring that manufactured products comply with the performance requirements of this document.

The production verifications to be performed shall be those given in Table 9.

For actuator/gearbox combinations provided by the actuator manufacturer/supplier, combination type and production tests are not compulsory. Verification of combination torque/thrust shall be available but may be derived via calculation based on gearbox performance data.

For actuator/linear drive combinations provided by the actuator manufacturer/supplier where the linear drive is not an integral part of the electric actuator, combination output thrust production tests are not compulsory. Verification of combination thrust shall be available but can be derived via calculation based on linear drive performance data.

Gearbox performance criteria shall be verified by either test and/or calculation and by agreement between actuator and/or gearbox manufacturer/supplier and purchaser.

Table 9 — Type tests and production tests

Item	Requirement	Clause	Type tests	Production tests
1	Enclosure protection	5.2.4	Verify test reports of manufacturer.	Random tests
2	External corrosion protection	5.2.5	Verify test reports of manufacturer.	Yes, visual, with random inspections
3	Checking sense of rotation	5.4	Yes	Yes
4	Operating time/output speed/velocity	5.8.3	Validate manufacturer's design values.	Yes
5	Checking of manual operation	5.9.3	Yes	Yes
6	Setting of travel limiting device	5.9.4	Validate manufacturer's design values.	Yes[a]
7	Repeatability deviation of travel limiting	5.9.4	Validate manufacturer's design values.	Yes[a]
8	Setting of torque limiting device	5.9.5	Validate manufacturer's design values.	Yes
9	Calibration of torque/thrust limiting device	—	Validate manufacturer's design values.	Yes[a]
10	Repeatability deviation of torque limiting	5.9.5	Validate manufacturer's design values.	Yes[a]

[a] When specified by the purchaser.

[b] Functional tests may be performed at sub-assembly/component level.

Table 9 *(continued)*

Item	Requirement	Clause	Type tests	Production tests
11	Structural integrity	5.9.6	Validate manufacturer's design values.	—
12	Checking of electric wiring	5.6	Yes	Yes
13	Endurance	5.1	Endurance test	—
14	Checking of noise	5.9.8	Yes	Yes[a]
15	Optional equipment	6	Refer to manufacturer's technical documentation and product file, in full conformity with applicable directives.	Functional test with accessories according to supply[b]
16	Marking	8	See Clause 8.	Yes
17	Documentation	9	See Clause 9.	See Clause 9.

[a] When specified by the purchaser.

[b] Functional tests may be performed at sub-assembly/component level.

8 Marking

8.1 General

Each actuator shall be marked legibly and indelibly.

8.2 Mandatory marking

a) manufacturer/supplier's name and/or trademark;

b) manufacturer's model designation;

c) actuator commission and/or serial number and reference to year of manufacture (e.g. WW/YY or MM/YY);

d) voltage, current type and frequency (when applicable);

e) wiring diagram number;

f) nominal motor power (kW);

g) nominal motor current (A);

h) actuator rated torque (Nm)/thrust (kN);

i) enclosure protection (IP designation);

j) actuator operating time or speed and, for variable speed applications, rated speed range;

k) fail-safe action (when applicable);

l) other mandatory marks (when applicable).

8.3 Optional marking

a) hazardous protection;

b) duty classification (as per 4.3);

c) cyclic duration factor;

d) ambient temperature range;

e) a reference to this document (i.e. ISO 22153);

f) actuator attachment designation (ISO 5210 or ISO 5211);

g) angular travel (for part-turn actuators only);

h) corrosion category (e.g. C2);

i) gear case lubrication type;

j) motor insulation class;

l) manufacturer's wiring diagram identification.

9 Documentation

9.1 General

The language of the relevant documentation shall be agreed between the manufacturer/supplier and the purchaser.

9.2 Mandatory documentation

a) transport and storage instructions;

b) wiring diagram;

c) installation, commissioning, operating and maintenance instructions;

d) electrical datasheets.

9.3 Optional documentation

a) detailed overhaul instructions;

b) itemized spare parts list;

c) list of recommended spare parts;

d) production test certificate (as per 7.3).

10 Packaging

Actuators shall be packed and cushioned and/or fixed in boxes in order to prevent movement. The packing shall be suitable for the environmental and structural demands of shipment method and storage. As a minimum, the outside of the packaging shall be marked to identify the manufacturer and product within. The marking shall be indelible and waterproof.

Annex A
(normative)

Endurance test procedure

A.1 General

Actuators complying with this document shall be type-tested in agreement with Annex A.

A.2 Test equipment

The test rig shall allow the attachment of the actuator and shall be suitably designed to allow the full travel of the actuator. It shall provide means of applying a measurable torque/thrust.

The test rig shall be equipped with following calibrated devices, as a minimum:

a) suitable electric multimeter device;

b) an operating cycle counter;

c) an instrument for measuring the applied torque/thrust and the operating travel.

A.3 Test conditions

The test shall be conducted at room temperature (between 15 °C and 30 °C), under the conditions given in 5.2. The testing power supply shall be properly documented in the test documentation of the manufacturer.

A.4 Test procedure

The operating time and cycles shall be as specified by the manufacturer, in accordance with 5.1 and 5.8.2.

A.5 Acceptance criteria

At the end of the test, results shall comply with the following criteria.

a) The final torque/thrust values shall not be less than 90 % of the initial values.

b) The final operating stroke/number of turns/angular travel shall remain between 98 % and 102 % of the initial value.

Annex B
(informative)

Actuator selection guidelines

B.1 General

Actuated valve malfunctions are often due to the under sizing of actuators. The initial material cost saving is usually insignificant, compared with the costly production losses and/or danger presented to personnel and to plant equipment.

Conversely, it is even more important that excessive safety factors are not applied to valve torques/thrusts which can result in selected actuators being capable of twisting/shearing/bending/buckling valve stems and possibly transmitting a feedback signal that does not correspond to the valve position. This is usually associated with critical valve applications, e.g. ESD valves.

It is therefore essential that the correct size of actuator is selected together with any associated ancillary equipment.

To obtain all the information, it can be necessary to question the end user, the contractor/designer, the valve manufacturer, the actuator manufacturer and ancillary equipment manufacturers.

The aim of these guidelines is to provide a clear understanding of the torque/thrust requirements and of the parameters that affect the correct actuator selection. Relevant questions need to be answered regarding the valve operating service, the actuator working parameters/environment, ancillary equipment and local regulations.

B.2 Selection parameters

B.2.1 General

Determine the appropriate torques/thrusts, strokes and operating speeds taking into account the following parameters.

B.2.2 Valve parameters

a) valve manufacturer, type, size, function and operating characteristics;

b) valve torque/thrust characteristics (seating/unseating, dynamic torque/thrust, when applicable);

c) maximum allowable stem torque/thrust limitation (MAST).

d) maximum torque and/or thrust that it is permissible to apply to the valve drive train;

e) safety factors;

f) valve travel;

g) operating conditions: media type, media temperature, maximum sizing pressure, frequency of operation and specified operating time and applicable tolerances.

B.2.3 Actuator parameters

a) actuator type, as indicated in 3.2, 3.3 or 3.4;