INTERNATIONAL STANDARD

ISO 22153

First edition
2020-01

Electric actuators for industrial valves — General requirements

Actionneurs électriques pour robinetterie industrielle — Exigences générales

Reference number
ISO 22153:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ..... **v**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Classification — Designation **3**
4.1 General 3
4.2 Type 4
4.3 Actuator duty classification 4
4.4 Action on loss of external electric power 4
4.4.1 Stay put action 4
4.4.2 Fail-safe action 4

5 Design requirements **4**
5.1 Endurance 4
5.1.1 General 4
5.1.2 Part-turn actuators 5
5.1.3 Multi-turn actuators 5
5.1.4 Linear actuators 5
5.2 Environmental conditions 6
5.2.1 General 6
5.2.2 Ambient temperature and humidity 6
5.2.3 Altitude 6
5.2.4 Enclosure protection 6
5.2.5 External corrosion protection 6
5.2.6 Vibrations, shock and seismic conditions 7
5.3 Actuator attachment 7
5.3.1 Part-turn actuators 7
5.3.2 Multi-turn actuators 7
5.3.3 Linear actuators 7
5.4 Primary closing direction 8
5.5 Fail-safe direction 8
5.6 Electrical connections — Cable entries 8
5.7 Self-locking/braking 8
5.8 Performance 9
5.8.1 Power supply tolerances 9
5.8.2 Actuator duty performances 9
5.8.3 Operating time and speed 10
5.9 Basic design requirements 11
5.9.1 Motors 11
5.9.2 Gearing lubricant 11
5.9.3 Manual operation 11
5.9.4 Travel limitation 11
5.9.5 Torque/thrust limitation 12
5.9.6 Structural integrity 12
5.9.7 End stop adjustment for part-turn and linear actuators 12
5.9.8 Noise 12

6 Optional equipment **12**
6.1 General 12
6.2 Anti-condensation heater 12
6.3 Position transmitter 13
6.4 Actuator running transmitter 13
6.5 Additional position and/or torque signalling 13
6.6 Local control station 13

6.7 Local position indication 13
6.8 Actuator electrical controls 13
6.8.1 General 13
6.8.2 Positioner 13
6.8.3 Controller 13
6.8.4 Speed control 13
6.8.5 Field bus system interface 14
6.8.6 Torque transmitter (analogue or digital) 14
6.8.7 Actuator performance data logger 14

7 Type and production test 14
7.1 General 14
7.2 Type tests 14
7.3 Control of production process 15

8 Marking 16
8.1 General 16
8.2 Mandatory marking 16
8.3 Optional marking 16

9 Documentation 17
9.1 General 17
9.2 Mandatory documentation 17
9.3 Optional documentation 17

10 Packaging 17

Annex A (normative) **Endurance test procedure 18**

Annex B (informative) **Actuator selection guidelines 19**

Annex C (informative) **Load profiles 21**

Bibliography 24

Foreword

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

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.