INTERNATIONAL STANDARD

ISO 22109

First edition
2020-01

Industrial valves — Gearbox for valves

Robinetterie industrielle — Réducteur pour appareil de robinetterie

Reference number
ISO 22109:2020(E)

COPYRIGHT PROTECTED DOCUMENT

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

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,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 69, *Industrial valves*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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.

Industrial valves — Gearbox for valves

1 Scope

This document provides basic requirements for gearboxes to operate industrial valves for manual and automated on/off and modulating duties, this includes manual override gearboxes. It includes guidelines for classification, design and methods for conformity assessment.

It does not cover gear systems which are integral part in the design of valves and subsea gearboxes.

Other requirements or conditions of use different from those indicated in this document are agreed between the purchaser and the manufacturer or supplier (first party), 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
gearbox
self-contained gear unit for torque/thrust/speed/orientation change that can be manually operated by handwheel/lever and/or automated with an actuator

3.2
ambient temperature
temperature of the environment surrounding the *gearbox* (3.1)

3.3
end of travel
predefined position related to a fully open or a fully closed condition

3.4
end stop
mechanical device designed to stop the *gearbox* (3.1) drive train movement

3.5
endurance
lifetime without failure at specified conditions and tested by the type test

3.6
indicating arrangement
device, externally visible, showing the position of the valve obturator

3.7
rated torque
classification defined by the *gearbox* (3.1) manufacturer used to define the maximum gearbox operating torque capability

3.8
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

[SOURCE: ISO 22153:2020, 3.7]

4 Classification

4.1 General

Gearboxes are classified per kind for operation and rotation and/or linear movement as detailed in 4.2 and 4.3.

4.2 Kind of operation

There are three kinds of operation:

— manual: gearbox designed for manual operation only, typically this has only one input, normally by a handwheel;

— automated: gearbox designed for automated operation, typically this has only one input, normally by an actuator for example according to ISO 22153;

— manual override: gearbox designed for overriding automated operation, typically this has two inputs. The primary input is normally an actuator. The secondary input is normally by a handwheel. The secondary input is normally disengaged when the gearbox is being used in automated mode and is engaged when manual operation is required, e.g. on loss of power.

4.3 Kind of rotation

There are two kinds of rotation:

— part-turn: gearbox which transmits torque to the valve for a rotation of less than one revolution;

— multi-turn: gearbox which transmits torque for a rotation of at least one revolution and may be capable of withstanding thrust to the valve.

5 Design requirements

5.1 Endurance

The basic design requirements for automated gearboxes duty classification are given in Table 1.

Table 1 — Automated duty classification

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

The gearbox shall be designed to meet the endurance criteria defined in Table 2 or Table 3.

If the gearbox is provided in an automated version or required for a future automation, it shall be designed to have a minimum endurance in accordance with Table 2 or Table 3.

Gearboxes shall be type-tested in accordance with A.2 to A.5.

Table 2 — Part-turn gearboxes

Rated torque[a] (Nm)	**Manual**	**Automated**		
	On-off (number of cycles)[b]	**Class A and B on-off and inching/positioning** (number of cycles)[b]	**Class C modulating** (number of starts)[c]	**Class D continuous modulating** (number of starts)[c]
Up to 125	500	10 000	1 800 000	10 000 000
126 – 1 000	500	10 000	1 200 000	10 000 000
1 001 – 4 000	500	5 000	500 000	5 000 000
4 001 – 32 000	300	2 500	250 000	T.B.A.[d]
Above 32 000	250	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 gearbox 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 B). 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 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.

Table 3 — Multi-turn gearboxes

Rated torque[a] Nm	Max allowable thrust[a] kN	Manual	Automated		
		On-off (number of cycles)[b]	Class A and B on-off and inching/positioning (number of cycles)[b]	Class C modulating (number of starts)[c]	Class D continuous modulating (number of starts)[c]
Up to 100	≤40	500	10 000	1 800 000	10 000 000
101 - 700	≤150	500	10 000	1 200 000	10 000 000
701 – 2 500	≤325	250	5 000	500 000	5 000 000
2 501 – 10 000	≤1 100	250	2 500	250 000	T.B.A.[d]
Above 10 000	>1 100	150	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 gearbox 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 B). During testing a deviation of +20 % and –5 % in load is accepted.

[c] One start consists of a movement 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.

5.2 Structural integrity

The gearbox shall be capable of withstanding twice the input torque required for achieving the rated output torque/thrust without failure of its external structure.

5.3 Self-locking/braking

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

Braking, locking devices or assemblies might be integral parts of gearboxes 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 gearbox and/or additional components.

5.4 Mechanical advantage

5.4.1 General

Mechanical advantage is the given ratio between the output and input torque. The mechanical advantage is intended as a mean value measured at the rated torque. The mechanical advantage is considered after an appropriated running in as per manufacturer's indication.

5.4.2 Manual gearboxes and manual override gearboxes

The mechanical advantages of manual gearboxes declared by the manufacturer shall be those that occur at rated torque. A tolerance of ±15 % shall be allowed for production units, for gearboxes other than worm gearboxes the tolerance shall be ±7,5 %.

When sizing a manual override gearbox, the torque needed by the valve and the torque required to move the actuator need to be taken into account.

5.4.3 Automated gearboxes

The mechanical advantages of automated gearboxes declared by the manufacturer shall be those that occur at rated torque. A tolerance of ±10 % shall be allowed for production units, for gearboxes other than worm gearboxes the tolerance shall be ±5 %.

5.5 Environmental conditions

5.5.1 General

The following environmental conditions shall apply, unless otherwise agreed between the manufacturer or supplier and purchaser.

The gearbox shall be designed for operation at ambient temperature in a range between -20 °C and +60 °C and with a relative humidity ≥90 % (25 °C).

5.5.2 Altitude

The gearbox shall be designed for operation at an altitude at least 1 000 m above sea level.

5.5.3 Enclosure protection

The gearbox shall have at least an enclosure protection type IP65 according to IEC 60529.

5.5.4 Corrosion protection

Gearboxes shall be protected against corrosion by proper material selection and/or surface treatment. The gearbox manufacturer's technical documentation shall specify the corrosion protection category according to Table 4.

Table 4 may be used to define the corrosion category in order to help actuator manufacturers to define the surface treatment for corrosion protection. Test assessment and test procedures are the responsibility of the manufacturer.

Table 4 — Categories

Corrosion category	Typical environments	
	Exterior	**Interior**
C2 (low)	Atmospheres with low level of pollution, mostly rural areas	Unheated buildings where condensation may 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, dairies
C4 (high)	Industrial areas and coastal areas with moderate salinity	Chemical plants, swimming pools, coastal ship and boatyards
C5 (very high)	Industrial areas with high humidity and aggressive atmosphere and coastal areas with high salinity	Buildings or areas with almost permanent condensation and with high pollution.
CX (extreme)	Offshore areas with high salinity, industrial areas with extreme humidity and aggressive atmosphere, and subtropical and tropical atmospheres.	Industrial areas with extreme humidity and aggressive atmosphere.
Categories for water and soil		
Category	**Examples of environments and structures**	
Im 1 (immersed in fresh water)	River installations, hydro-electric power plants	
Im 2 (immersed in sea or brackish water)	Immersed structures without cathodic protection (e.g. harbour areas with structures like sluice gates, locks or jetties)	
Im 3 (soil)	Buried tanks, steel piles, steel pipes	
Im 4 (immersed in sea or brackish water)	Immersed structures with cathodic protection (e.g. offshore structures)	
NOTE Table 4 is based on ISO 12944-2:2017. The gearbox corrosion protection can also be achieved by systems/methods which deviate from those specified in ISO 12944-5.		

5.5.5 Vibration, shock and seismic conditions

Gearboxes complying with this document are designed without any specific reference to vibrations, shock and/or seismic conditions. If exceptional severe vibration, shock and/or seismic conditions need to be considered, testing shall be agreed between the manufacturer/supplier and the purchaser.

5.6 Gearbox attachment

5.6.1 Part-turn gearboxes

The output interface for part-turn gearboxes shall comply with ISO 5211. The input interface for automated part-turn gearboxes shall comply with ISO 5210. The input interface for manual override part-turn gearboxes shall comply with ISO 5211.

The output drive of part-turn gearboxes may be an integral part or an attached and removable component, to allow it to be machined to suit the shaft of the valve when required. The material of the drive component shall be clearly indicated in the manufacturer or supplier documentation.

5.6.2 Multi-turn gearboxes

The output interface for multi-turn gearboxes shall comply with ISO 5210. The input interface for automated multi-turn gearboxes shall comply with ISO 5210.