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Industrial valves — Part-turn valve actuation

Robinetterie industrielle — Actionnement des appareils de robinetterie à fraction de tour

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

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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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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.

Introduction

The purpose of this document is to provide increased reliability and safety in automated on-off valve operation by defining and standardizing valve torque nomenclature used in actuator selection. The content is derived from Reference [15].

Industrial valves — Part-turn valve actuation

1 Scope

This document applies to part-turn actuated valve assemblies comprising valve (e.g. ball valve, butterfly valve, and plug valve), actuator and, when required, a mounting kit supplied as a package.

It defines the design considerations necessary for automating valves, the responsibilities for the information required and tasks to be completed, to ensure suitable actuator and mounting kit sizing, selection and assembly on the valve.

It applies to pneumatic, hydraulic, electro-hydraulic and electric actuators. An actuator coupled to a gearbox, as defined in ISO 5211, is included in the scope of this document. Lever or manual gearbox operated valves are excluded.

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 273, *Fasteners — Clearance holes for bolts and screws*

ISO 5211:2017, *Industrial valves — Part-turn actuator attachments*

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

ISO 22153:2020, *Electric actuators for industrial valves — General requirements*

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

MSS SP-101:2014, *Part-Turn Valve Actuator Attachment — FA Flange and Driving Component — Dimensions and Performance Characteristics*

ASME B18.2.8, *Clearance Holes for Bolts, Screws, and Studs*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
actuator
device designed for attachment to a general-purpose industrial valve in order to provide for the operation of the valve

Note 1 to entry: The device is designed to operate using motive energy which may be electrical, pneumatic, hydraulic, etc., or any combination of these. Movement is limited by travel or torque.

[SOURCE: ISO 5211:2017, 3.1]

3.2
breakaway angle
amount of *valve stem* (3.22) rotation before the *obturator* (3.9) breaks sealing contact with the seat

Note 1 to entry: The breakaway angle can be significant to *actuator* (3.1) sizing when more than 5° of rotation.

3.3
breakaway torque
maximum torque required to operate a valve at maximum pressure differential

Note 1 to entry: Breakaway torque is a general term that applies to the valve break to open torque and the valve break to close torque.

3.4
MAST
maximum allowable stem torque
maximum torque that can be applied to the *valve stem* (3.22) or coupling, as defined by the manufacturer, without causing permanent deformation or mechanical damage that prevents sealing or operation

3.5
cycle
movement of the valve *obturator* (3.9) 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.]

3.6
DN
NPS
nominal size
alphanumeric designation of size that is common for components used in a piping system, used for reference purposes, comprising the letters DN or NPS followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connections

Note 1 to entry: The number following DN or NPS does not represent a measurable value and is not used for calculation purposes except where specified in a product standard.

[SOURCE: ISO 5208:2015, 2.7]

3.7
intermediate support
mechanical component (e.g., bracket, spool, adapter flange) being part of a *mounting kit* (3.8) that allows the attachment between a valve and *actuator* (3.1)

3.8
mounting kit
components that can include combinations of the following: intermediate support, coupling, drive key(s), dowel pin(s) and fasteners

3.9
obturator
part of a valve, such as a ball, clapper, disc, gate or plug that is positioned in the flow stream to permit or prevent flow

[SOURCE: ISO 14313:2007, 4.19, modified — The term “closure member” has been removed.]

3.10
differential pressure
Δp
pressure difference across the upstream and downstream sides of the *obturator* (3.9) seals when it is in the fully closed, partially open, or fully open position

3.11
maximum rated pressure
maximum pressure that can safely be applied in the pressure-containing parts of a pneumatic or hydraulic *actuator* (3.1) as defined by the actuator manufacturer

3.12
maximum supply pressure
maximum available pressure to supply at a pneumatic or hydraulic *actuator* (3.1) pressure inlet port as defined by the purchaser

3.13
minimum operating pressure
minimum required pressure to supply at a pneumatic or hydraulic actuator pressure inlet port to operate the *actuator* (3.1) as defined by the actuator manufacturer

3.14
minimum supply pressure
minimum available pressure to supply at a pneumatic or hydraulic *actuator* (3.1) pressure inlet port as defined by the purchaser

3.15
sizing safety factor
SSF
numerical value that is multiplied to the valve operating torque that is used when selecting an *actuator* (3.1)

3.16
stroke
travel of the valve *obturator* (3.9) from the fully closed to the fully open position, or vice versa

Note 1 to entry: End of stroke is predefined as the fully closed or fully open position.

[SOURCE: ISO 12490:2011, 4.25, modified — The Note 1 to entry has been added and the word "movement" has been substituted by "travel".]

3.17
travel
movement of the *actuator* (3.1) in driving a valve *obturator* (3.9), defined in terms of output turns, angular or linear distance, a percentage thereof or undefined when relating to general movements(s)

[SOURCE: ISO 22153:2020, 3.13]

3.18
valve dynamic torque
T_d
torque generated by flow of media through valve and around the *obturator* (3.9)

[SOURCE: Reference [14]]

3.19
C_t
valve dynamic torque coefficient
dimensionless coefficient used to determine the flow induced torque on the *obturator* (3.9) as a function of valve geometry, flow rate, and valve position

[SOURCE: Reference [14]]

3.20
valve operation time
period between when the signal is given for the valve to operate, starting from the fully open position and ending at the fully closed position or vice versa

3.21
valve response time
period between when the signal is given for the valve to operate until the *obturator* (3.9) starts to move

Note 1 to entry: With electric *actuators* (3.1), a valve response time is not relevant.

3.22
valve stem
part of the valve transmitting the driving torque to the *obturator* (3.9)

Note 1 to entry: This concept also referred to as valve shaft or valve spindle in product standards, is collectively identified herein as valve stem.

3.23
valve travel time
period between when *obturator* (3.9) starts to move starting from the fully open position and ending to the fully closed position or vice versa

3.24
valve torque
required input torque at the valve stem at the moment there is relative movement between the *obturator* (3.9) and seat(s)

Note 1 to entry: This torque can vary depending on the valve starting position and internal pressure.

4 Abbreviated terms

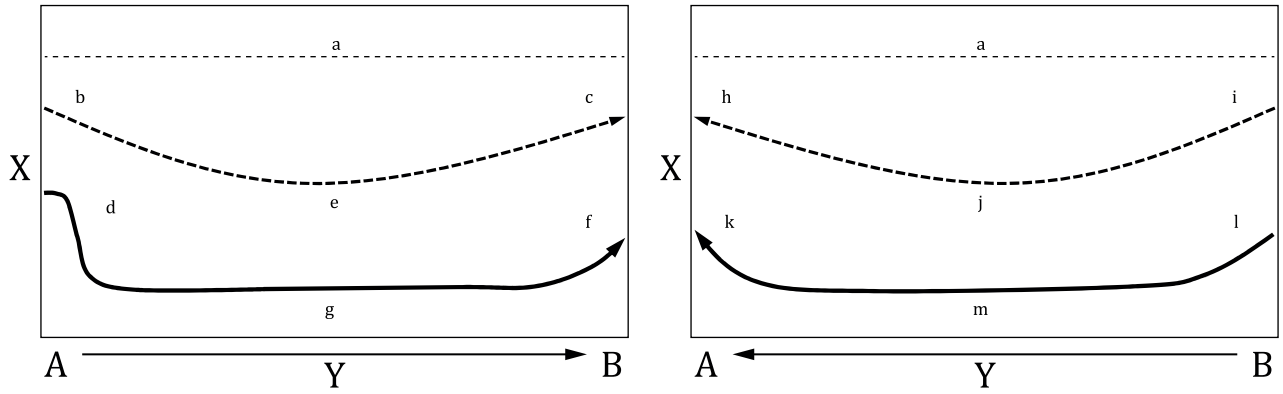
For the purposes of this document, the abbreviated terms given in Table 1 apply.

Abbreviated terms are preceded by the letter V when referring to the valve, and the letter A when referring to the actuator.

EXAMPLE VBTO is valve break to open, and ABTO is actuator break to open, with the exception for MAST where letters V and A are not used. See Figure 1.

Table 1 — Abbreviated terms

Abbreviated term	Term
BTO	break to open
RTO	run to open
ETO	end to open
BTC	break to close
RTC	run to close
ETC	end to close
MAST	maximum allowable stem torque



a) Valve opening **b) Valve closing**

Key

A	closed	a	Maximum allowable stem torque.
B	open	b	Break to open torque.
Y	valve position	c	End to open torque.
X	torque	d	Break to open torque.
———	valve	e	Run to open torque.
- - - - -	actuator	f	End to open torque.
		g	Run to open torque.
		h	End to close torque.
		i	Break to close torque.
		j	Run to close torque.
		k	End to close torque.
		l	Break to close torque.
		m	Run to close torque.

NOTE Figure 1 is an example. Actuator torque output and valve torque varY by type and design.

Figure 1 — Valve and actuator torque versus position

5 Responsibilities

5.1 General

Assignment of the responsibilities by role in the sizing, selection, assembling and construction of an automated valve shall be as defined in this clause. Each role can be performed by an independent entity or roles may be combined. For example, the actuator supplier could also be the mounting kit supplier and assembly contractor. Even when roles are combined, the responsibilities of this document shall be fulfilled.

Required information shall be provided by each defined role in the assembly sizing data sheet which shall be in accordance with Annex A.

NOTE In 5.2 to 5.5, the numbers in parenthesis are the corresponding row number in the assembly sizing data sheet in Annex A.

5.2 Purchaser

Following the processes described in this document, the purchaser receives the actuated valve assembly and required documentation. The purchaser of the automated part-turn valve assembly, or

their nominated agent, shall define requirements for the components of an automated valve assembly in a specification and/or purchase order. The purchaser shall provide the following information:

a) the assembly contractor's name;

b) the specified ambient temperatures (7);

c) the required level of ingress protection IP code according to IEC 60529 for the actuator, and the required external corrosion protection for the actuator and mounting kit, C2 through CX and Im 1 through Im 3 according to ISO 12944-2 (8-9);

d) the specified valve type: ball, butterfly, plug, etc. (10);

e) the specified actuator type: pneumatic, hydraulic/electro-hydraulic, or electric (11);

f) the required fail position for the valve upon loss of power source (e.g. supply pressure and/or electricity) to the actuator (12);

g) the specified valve operation time(s) (13);

h) the minimum and maximum supply pressure if specifying a pneumatic or hydraulic actuator, or the supply voltage if an electro-hydraulic or electric actuator (15);

i) the specified type of valve connection to the pipe and the valve assembly configuration with respect to the pipeline and flow direction (16-17);

j) the process conditions including the media, flow rates, operating temperatures and pressures (18-25);

k) the sizing safety factor, SSF, to multiply to valve torque when selecting the actuator, typically a value between 1,1 and 1,5 (26);

l) the specified application and fluid characteristics (27-33) that identify the applicable on-demand correction factors. The purchaser shall specify on-demand correction factors to be used if different than the default values in this document (6.2 and Table 2).

5.3 Valve supplier

The valve supplier selects the valve to meet the purchaser's specification. The supplier of the valve sends the valve to the assembly contractor, and the supplier shall provide the following information to the actuator supplier, mounting kit supplier, and assembly contractor:

a) name of the valve manufacturer and a description of the valve type and characteristics (34-44);

b) breakaway valve torque data as a function of valve configuration, size, differential pressure, and travel, including applicable on-demand correction factors (45-50);

Valve dynamic torque, T_d, generated by flow around or through the obturator can be greater than the breakaway torque. Valve dynamic torque is calculated using Formula (1). Additional friction from bearings and packing are added to the valve dynamic torque to determine the valve operating torque at intermediary travel positions. In general, dynamic torque should be considered when valve size is DN 600 (NPS 24) and larger, and when flow velocity is greater than 5,3 m/s.

$$T_d = C_t \times \Delta p \times d_{vp}{}^3 \quad (1)$$

where d_{vp} is the valve minimum flow port size or diameter.

c) breakaway angles as a function of valve configuration and size (51);

d) the maximum allowable stem torque (MAST) for the valve (52);