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Guidelines for the Specification of Electric Valve Actuators

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Preface

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Contents

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1 Scope

This standard provides general requirements for the development of specifications for electric actuators.

2 Purpose

The purpose of this standard is to provide a guide to assist the user in specifying electric valve actuators.

This standard is not intended to address the range of compact, light duty low torque electric actuators typically rated for less than 5.65 Nm (50 inch-lbs).

3 Definitions

For general definitions, refer to Annex A.

3.1 Actuator design categories

3.1.1 Versions

3.1.1.1 intrusive:
this version requires opening of the electrical enclosure for commissioning or troubleshooting activities such as setting of mechanical travel limit and torque switches, adjusting position feedback, and internal signal monitoring.

3.1.1.2 non-intrusive:
this version does not require opening of the electrical enclosure for commissioning or troubleshooting activities. Microprocessor-based controls, including status and diagnostics, are accessible externally to the actuator.

3.2 Actuator motion

3.2.1 part-turn:
an actuator which transmits torque to the valve for less than one revolution. It does not have to be capable of withstanding thrust. A combination of a multi-turn actuator plus a part-turn gearbox may be considered a part-turn actuator.

3.2.2 multi-turn:
an actuator which transmits torque to the valve/gearbox for at least one revolution. It may be capable of withstanding thrust. A combination of a multi-turn actuator plus a multi-turn gearbox may be considered a multi-turn actuator.

3.2.3 linear:
an actuator which transmits thrust to the valve for a defined linear stroke. A combination of a multi-turn actuator plus a linear drive may be considered a linear actuator.

4 Design requirements

4.1 General requirements

4.1.1 Actuator for linear motion type valves

Electric actuators shall include the electrical enclosure, electric motor, reduction gearing, valve stem drive nut/bushing, travel limiting devices, torque overload measurement device, control circuitry, gear case, and

automatic declutchable handwheel. The actuator may also include second stage gearing. Self-locking design of the valve/actuator assembly is to be considered based on application requirements.

All components of the actuator drive train shall be designed with adequate heat capacity for the actuator being operated at the specified motor duty cycle, travel times, and torque requirements.

4.1.2 Actuator for rotary motion type valves

Electric actuators shall include the electrical enclosure, electric motor, reduction gearing, drive coupling between the final drive gear and the valve stem, final drive gear assembly, torque overload measurement device, travel limiting devices, control circuitry, gear case(s), and automatic declutchable handwheel. Self-locking design of the valve/actuator assembly is to be considered based on application requirements.

All components of the actuator drive train shall be designed with adequate heat capacity for the actuator being operated at the specified motor duty cycle, travel times, and torque requirements.

4.1.3 Design life

The manufacturer shall have a documented design and test program to establish actuator design life and enable proper selection of actuators based on specified user parameters, including, but not limited to: cycles, seating/unseating torque, and thrust. Typically, actuators are designed to have a life of 10,000 open/close/open cycles or 1,000,000 output drive sleeve turns.

4.2 Mechanical

4.2.1 Gearing and lubrication

The actuator gear mechanism shall be totally enclosed and lubricated. The method of lubrication (grease, oil, and/or self lubricating materials) shall be under the responsibility of the manufacturer/supplier and shall suit the specified ambient conditions. The actuator gear mechanism may have a lost motion hammer blow effect and shall be capable of mounting in any orientation.

4.2.2 Bushings/Drive nuts

The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft of the driven device. The material shall be non-galling per the manufacturer’s recommendation. Typically, threaded stem nuts are a bronze alloy and drive bushings for gearbox input shafts are steel.

4.2.3 Travel stops

When required, part-turn actuators shall be supplied with two integral mechanical end stops typically one for each end position. These may be fixed or independently adjustable.

4.2.4 Manual override

As a general rule, actuators shall be furnished with a manual override to open or close the valve in the event of loss of electric power. For safety reasons, it is strongly recommended that a manual declutch mechanism be included. Engaging the declutch mechanism changes the operation from motor to manual (handwheel) operation. The declutch mechanism may be provided with a locking device to prevent unauthorized manual operation. Energizing the motor shall return the actuator to motor operation. In most applications, the handwheel should not turn while in motorized operation as a safety precaution. It should be noted that some compact electric actuator designs do not offer a declutch mechanism and may have handwheels which turn while in electric operation. The manufacturer is responsible to ensure that

operation of either type can be accomplished safely, and the user should exercise extreme caution when operating an electric actuator which permits the handwheel to turn while operating electrically.

4.2.5 Output mounting interface

4.2.5.1 Part-turn actuators

The valve mounting attachment for part-turn actuators should generally comply with ISO 5211:2001, Industrial valves – Part-turn actuator attachments, or MSS SP-101-1989 (R 2001), Part-Turn Valve Actuator Attachment – Flange and Driving Component Dimensions and Performance Characteristics. The output drive of part turn actuators may be integral or removable and must permit machining of the driven component.

4.2.5.2 Multi-turn actuators

The valve mounting attachment for multi-turn actuators shall comply with ISO 5210:1991, Industrial valves – Multi-turn valve actuator attachments, or MSS SP-102-1989 (R 2001), Multi-Turn Valve Actuator Attachment – Flange and Driving Component Dimensions and Performance Characteristics. The output drive of multi-turn actuators may be integral or removable and must permit machining of the driven component.

4.2.5.3 Linear actuators

The dimensions of the interfaces shall comply with those given in ISO 5210 or MSS SP-102, unless otherwise agreed between the manufacturer/supplier and the purchaser.

4.3 Electrical

4.3.1 Anti-condensation protection

The actuator must be delivered with a suitable electrical / electronic device to inhibit condensation inside the actuator housing, properly connected to the power / control circuitry**.**

4.3.2 Power supply

The actuator should be able to provide its rated torque within the following power supply tolerances:

Nominal voltage: ± 10%
Frequency (for AC supply): ± 2%

4.3.3 Electrical connections

All internal electrical components requiring connection to external cables shall be wired to suitable terminals, in a terminal compartment provided with the appropriate number and size of cable entries, in accordance with acceptable electrical standards. In general, when power, control, and signaling wires have different types of potential, two cable entries are required as a minimum.

4.4 Motors

4.4.1 Duty

The motor shall be suitable for use with power sources specified and with Class F insulation and a device embedded within the motor winding to prevent damage due to overload. Standard duty rating on actuators is 15 minutes. Other motor ratings such as 30 minutes and “continuous duty” may be available. Duty ratings will be affected by elevated ambient temperature.

4.4.2 Torque

Actuator motors are designed by the actuator manufacturer as an integral part of the actuator in order to achieve the defined performances. There is no direct relationship between nominal motor torque values and actuator rated torques.

4.4.3 Starters

The mechanical reversing contactors shall be mechanically and electrically interlocked to prevent simultaneous energizing of the open and closed contactors. The control module should also contain an auto reversal delay to inhibit high current surges caused by rapid motor reversals. The reversing contactor as standard should be rated for a minimum of 60 motor starts per hour.

Optional solid state reversing contactors should be electrically interlocked and be available for high rate modulating service and rated for minimum of 1200 starts per hour.

4.4.4 Thermal protection

Motor windings shall be protected against overheating by a suitable thermal protecting device. Typical devices include thermostats, thermistors, and thermal contacts.

4.5 Environmental protection

4.5.1 Enclosure

4.5.1.1 Explosionproof

Electric actuators intended for use in hazardous areas shall be designed and certified in accordance with the applicable requirements of IEC, NEC, CSA, FM (Factory Mutual), or local codes. User shall refer to these codes for specific information regarding agency approvals.

4.5.1.2 Submersible

Electric actuators intended for use in a submersible service shall be designed in accordance with NEMA 6 or IP68. User shall refer to these codes for specific information regarding submersible conditions.

4.5.1.3 Weatherproof

Electric actuators should have at least enclosure protection of type NEMA 4X or IP65. User shall refer to these codes for specific information regarding weatherproof conditions.

4.5.2 Materials/Paint/Coatings

Actuators shall be protected against external corrosion by proper material selection and/or surface treatment. Standard materials and coatings may vary among electric actuator manufacturers. The purchaser must advise the manufacturer if additional special material or painting/coating is required due to service conditions.

4.5.3 Fire protection

Electric actuators may be provided with fire protection as required by the purchaser. Intumescent coatings, fire resistant blankets, or boxes are designed to allow operation of the electric actuator for a predetermined time period in the event of fire, provided power is maintained. The purchaser shall advise the specific temperature and operating duration requirements.

4.5.4 Ambient temperature

Ambient temperature range is normally from -22° to +158° F. Severe applications such as arctic, desert, and tropical may require special consideration.

4.5.5 Relative humidity

Relative humidity range is 0-95%.

4.5.6 Seismic and vibration

If seismic or excessive vibration requirements exist, they should be addressed by the purchaser and manufacturer.

4.6 Controls

4.6.1 Travel limitation

The actuator shall include a means of de-energizing the motor in response to reaching set open and close position. This may be by mechanical, electro-mechanical, or electronic device.

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. If the device can be connected electrically to an external circuit, the electrical rating should be stated in the technical documentation.

4.6.2 Torque/Thrust limitation

A device shall be provided for limiting actuator output torque (or thrust), acting in both directions. The device may be bypassed during the initial movement of the valve. After the torque/thrust limiting device has operated, means to prevent unwanted operation of the actuator in the same travel direction may be required. If the device can be connected electrically to an external circuit, the electrical rating should be stated in the technical documentation.

4.6.3 Local Control Capabilities

4.6.3.1 Pushbuttons/Control stations and selector switches

A local-off-remote switch and an open-stop-close mechanism should be included for local control. When specified, these devices shall be padlockable.

4.6.3.2 Indication lights

As a minimum, “fully open” and “fully closed” indication lights should be provided. Indication lights may be LED or incandescent. Additional lights may be required for specific applications, for example, “in travel,” “fault," “alarm,” “moving,” “intermediate position,” or other specified indications. Typically, red and green lights are used to indicate end of travel.

4.6.3.3 Mechanical position indicator

When specified, actuators should be equipped with an indicating arrangement or device to clearly depict the actuator position.

4.6.3.4 LCD display

Multi-character LCD displays may be included to indicate position and diagnostic information.

4.6.4 Remote control capabilities

4.6.4.1 Open/Close capability

Actuators shall be provided with an integrally mounted device to receive an analog or digital signal to provide position control.

4.6.4.2 Digital communication

Actuators shall be provided with an integrally-mounted device providing connectivity with host control system for actuator control, status indication, and monitoring. The control device shall meet the appropriate recognized protocol or BUS system standards. The units should be certified by the appropriate organization. Typical protocols/buses include

a) Modbus

b) Profibus

c) Devicenet

d) Foundation Fieldbus

e) Proprietary BUS. Proprietary systems specified by the manufacturer/supplier or purchaser may also be used.

4.6.5 Remote indication

4.6.5.1 Limit switches and relay contacts

Limit switches (LS) or relay contacts (RC) may be used to indicate various positions between the fully opened and fully closed position. Contact ratings should be considered. Typically these LS/RC are used for remote indication or interlocking purposes.

4.6.5.2 End of travel indication

A means of providing specific actuator travel for remote indication and/or status indication shall be provided.

4.6.5.3 Analog position feedback

A means of providing specific position of the actuator for remote indication and/or control purposes for example, 4-20 mA or 1-5 Volts, shall be provided.

4.6.5.4 Torque sensing

A method for limiting output torque (or thrust), acting in both directions, shall be incorporated. The device may be bypassed during the initial movement of the valve. After the torque/thrust limiting device has operated, means to prevent unwanted operation of the actuator in the same travel direction may be required. This method may include means for remote indication.

5 Sizing

5.1 Criteria

The actuator should be sized to assure proper operation of the device at the specified process conditions such as differential pressure, temperature, flow direction, and flow characteristics.

5.1.1 Safety factor torque and thrust

It is the responsibility of the valve manufacturer (or supplier) to provide operating torque values throughout the stroke, in each direction. Design criteria such as temperature variance, pressure, and flow characteristics must be considered. Any relevant safety margins and the maximum torque/thrust that can be applied to the valve without causing damage must be included.

5.1.2 Seating method

It is the responsibility of the valve manufacturer (or supplier) to advise whether the valve seating method is “position” or “torque” in both the open and close directions. As an example, a wedge gate valve would be “torque seated” in the close position and “position seated” in the open position.

5.1.3 Operating time

The cycle or stroke time shall be stated in the specification or data sheet. When not specified, operating times are generally provided as 10-12 inches of linear stroke per minute or 5 seconds per inch of valve bore (part-turn).

5.1.4 Voltage/Frequency variation

Actuator torque output must be considered when power supply drops below 90% of nominal voltage. Typically, actuator output torques are derated at less than 90% of nominal supply voltage.

5.1.5 Other considerations

Actuator sizing may be impacted by other factors, including but not limited to the following:

a) Required actuator run time

b) Valve stem diameter

c) Frequency of operation - starts per hour

6 Marking/Tagging

Each actuator shall have a securely fastened tag including the following minimum information:

a) Manufacturer’s/supplier’s name and/or trademark

b) Model type and designation

c) Serial number

d) Motor duty classification and cyclic duration factor

e) Voltage, current type, frequency, and nominal motor power (HP or KW)

f) Full load current (FLA)

g) Rated torque or thrust

h) Operating time or speed

i) Enclosure classification

7 Testing

Each actuator shall be performance tested and individual test certificates should be available. The test should simulate a torque load and as a minimum, the following parameters should be recorded:

a) Current at maximum torque

b) Torque at maximum torque setting

c) Actuator output speed or operating time

d) An insulation breakdown test should be available, when requested.

8 Documentation

The following minimum documentation shall be available, but may need to be requested prior to order placement:

a) Actuator installation, commissioning, and operating instructions

b) Electric wiring diagram

c) Dimensional (outline) drawings

d) Storage instructions

e) Drawings with itemized components

f) Certifications

g) Factory test reports or as required in the purchase order

h) Final configuration and settings

Annex A — General definitions

A.1 Acme stem pitch:
The distance from a point on stem thread to corresponding point on next thread.

A.2 Acme stem lead:
Distance that stem thread advances axially in one stem nut turn. The lead and pitch are the same on single lead threads; the pitch is double for double lead threads, etc.

A.3 Accessories:
Devices attached to the actuator for various control functions such as positioners, pilot valves (relays), solenoid valves, air sets, manual override, limit switches/valve position monitoring, partial stroke testing devices, and position indicator.

A.4 Actuator:
A powered device which supplies force and motion to position a valve, damper, or other similar device's closure member at the open, closed or intermediate position.

A.5 Adaption:
Loosely used term to describe the interface hardware between the valve and the actuator.

A.6 Ambient temperature:
The air temperature surrounding the actuator. The ambient temperature is not necessarily the same as the exterior temperature of the main valve body closest to the flow.

A.7 Analog:
Using physical variables such as temperature, flow, or pressure to represent and correspond with numerical variables that occur in process. Typical analog signal is 4-20 mA.

A.8 Breathers and drains:
A system for cooling the motor and for draining excess moisture from a motor enclosure. This type of enclosure is not suitable for explosion proof applications. This type of enclosure is rarely used in most of today's actuators, but is still found in many of the older electric actuator specifications.

A.9 Contactor:
A two-state (on-off) device for repeatedly establishing and interrupting an electric power (motor) circuit. See also reversing contactor.

A.10 Cycle:
For the purpose of this document, a cycle is defined as the actuator moving from full open to full close and back.

A.11 Declutchable handwheel:
A device using a clutch mechanism which must be manually engaged to operate the actuator without requiring an electrical power supply. The declutch assembly should automatically disengage when power is applied to the actuator. The handwheel should not move when disengaged to prevent injury.

A.12 Diagnostics:
A broad, general term referring to information which can be retrieved from an actuator by various means and methods which may include troubleshooting, component availability/status, and historical data.

A.13 Digital controls:
A control package which utilizes digital signals transmitted from a remote control facility to the actuator location via a 2-wire communication network. A BUS or protocol is used to communicate commands from the remote operation location.

A.14 Electric actuator:
A device that converts electrical energy into motion (linear or rotary).

A.15 Environment:
Ambient conditions (including temperature, pressure, humidity, radioactivity, and corrosiveness of the atmosphere) surrounding the actuator. Also, the mechanical effects and seismic vibration transmitted through the piping or heat radiated toward the actuator from the valve body.

A.16 Explosion proof:
A generic term often used to describe actuators operating in hazardous locations which are designed and built to withstand an *internal explosion* without creating an external explosion or fire. Specifications must define the hazardous area classification and the certifying body (i.e. FM Class 1, Groups C&D, Div 2).

A.17 Failure mode:
A characteristic of a particular valve and its actuator, which upon loss of actuating energy supply, will cause a driven device to be fully closed, fully open or remain in the last position, whichever position is defined as necessary to protect the process. Fail-safe action may involve the use of auxiliary controls connected to the actuator.

A.18 Fail-in-place or fail-in-last position:
A condition wherein the driven device stays in its last or current position when the actuating energy source is removed.

A.19 Flow:
Movement of fluid generated by pressure differences.

A.20 Full load amperes:
Also called full load current. Abbreviated FLA or FLC. Approximate amperes drawn by an actuator motor in a running condition – typically 15 minute duty without overheating motor. Variable load conditions, power supply, valve position, and flow characteristics make specifying full load amperes difficult.

A.21 Hammerblow device:
See also lost motion device. This mechanical device allows the motor to reach full speed before engaging the drive nut/stem. This device should not be included on actuators used for modulating service.

A.22 Handwheel/Manual override:
A manual hydraulic or mechanical override device, to stroke a valve or to limit its travel.

A.23 Handwheel:
A mechanical manual override device, using a rotary wheel, to stroke a driven device to limit its travel.

A.24 Hazardous location:
An area where a potential for fire or explosion exists due to the presence of flammable gases, liquids or vapors, combustible dusts or fibers and flyings in sufficient quantities to produce and explosion or ignitable mixture.

A.25 Inching service:
A method of moving an actuator to a mid travel position in which the operator uses a discreet signal as opposed to an analog or digital signal to move the actuator. The reversing contactor must have the “seal in” circuit disabled for inching service. See also “Jog”.

A.26 Ingress protection (IP):
A set of IEC standards which define the degree of protection an enclosure provides. Generally a 2-digit number, the first digit refers to protection against physical contact (fingers, tools, dust, etc.), and the second digit designates the ingress protection against liquids.

First digit Contact & solid objects		Second digit Liquids	
0	No protection	0	No protection
1	Objects > 50mm	1	Water dripping
2	Objects > 12 mm	2	Dripping water when tilted 15°
3	Objects > 2.5 mm	3	Spraying water
4	Objects > 1 mm	4	Splashing water
5	Dust protected	5	Low pressure jets
6	Totally protected against dust	6	Strong water jets
		7	Effects immersion
		8	Submersion

A.27 Jog:
A control function that provides for the momentary operation of an electric actuator for the purpose of accomplishing a small movement of the valve. See also inching.

A.28 Limit switch (or travel limit switch):
An adjustable electric device which trips when the actuator has reached a predetermined position. The operator may determine the result of the limit switch trip (i.e., make contact/break contact).

A.29 Linear actuator
An actuator which transmits thrust to the valve for a defined linear stroke. A combination of a multi-turn actuator plus a linear drive can be considered a linear actuator.

A.30 Local controls:
Controls which are mounted integrally or otherwise physically attached directly to the actuator and typically include reversing contactor and control circuit transformer. It may also refer to a local pushbutton/selector switch.

A.31 Locked rotor:
This occurs when the voltage circuits to the electric motor are energized but the rotor is not turning.

A.32 Locked rotor current:
Also called locked rotor amps, LRC or LRA. The locked rotor current of a motor is a steady-state current taken from line with rotor locked and with rated voltage applied to the motor.

A.33 Locking gear ratio:
Those gear ratios which provide mechanical locking to prevent spurious movement due to motor inertia, weight of the closure element, or flow pressure against the closing element. As actuator output speeds increase, fewer locking gear ratios are generally available.

A.34 Lost motion device:
See also hammer blow device. This mechanical device allows the motor to reach full speed before engaging the drive nut/stem. This device should not be included on actuators used for modulating service.

A.35 Mechanical limit stop:
A mechanical device to limit the output of the actuator travel. See also limit switch.

A.36 Modulating service:
An operating methodology wherein the actuator moves to a specified position upon receipt of a command signal. The command signal is often tied to input derived from flow meters, tank levels, pumps or compressors.

A.37 Motor:
A device which converts electric, pneumatic, or fluid power into mechanical force and motion, generally a rotary motion.

A.38 Motor control:
A device to start and/or stop and reverse a motor in response to push-button or automatic control signals.

A.39 Motor control center:
A group of motor controls concentrated in a large panel such as a control room.

A.40 Motor duty rating:
The manufacturer's rated limitation on the time a motor can be energized without causing damage to unit, the generally accepted limit is 15 minutes; however, other time ratings may be available for modulating or continuous duty operation.

A.41 Mounting position:
The location and orientation of an actuator relative to the piping, either parallel or perpendicular.

A.42 Multi-turn:
An actuator which transmits torque to the valve/gearbox for at least one revolution. It may be capable of withstanding thrust. A combination of a multi-turn actuator plus a multi-turn gearbox can be considered a multi-turn actuator.

A.43 Nameplate:
A plate attached to the actuator bearing the name of the manufacturer and a listing of actuator specifications.

A.44 On-off or open-close:
Function of a valve actuator to drive a valve to the open or close position (contrast to modulating).

A.45 Operator:
A term often used incorrectly to describe and actuator. An operator, in general industrial terms, is a person turning the handwheel or pressing controls which allow the actuator to work.

A.46 Part-turn:
A term used for an actuator which transmits torque to the valve for less than one revolution. It does not have to be capable of withstanding thrust. A combination of a multi-turn actuator plus a part-turn gearbox can be considered a part-turn actuator.

A.47 Position indicator:
A pointer, dial, scale, flag, or beacon used to externally show the position of the closure member; typically in terms of units of opening or degrees of rotation.

A.48 Position seating:
A method of seating a valve in either the open or close position based on the valve's position rather than the valve's seating torque.

A.49 Positioning service:
For electric actuators, this type of service allows the user to send the actuator to a predetermined position using either an analog or digital signal. Unlike modulating service, this signal is not tied to an outside device such as flow meter, level meter, pump, or compressor. Generally speaking, positioning service for electric actuators is understood to be different than similar terminology used in control valves.

A.50 Potentiometer:
A device for measuring an unknown voltage or potential difference by balancing, wholly or in part, by a known potential difference produced by the flow of known currents in a network of circuits of known electrical constants. Used to provide valve position indication.

A.51 Protocol:
The computer (digital) code used to convert digital data transmitted or received into useable information. Some protocols are proprietary (copyrighted or patented) and may not be used without the permission of the owner. Other protocols are considered open and available for use in the public domain.

A.52 Pushbutton station (local control station):
A device consisting of pushbuttons, knobs and/or switches, along with indicator lights, providing the operator the ability to start, stop, open, and close the valve and may have capability of selecting local or remote operation.

A.53 Quarter-turn actuator:
A type of part-turn actuator which limits travel to 90°.

A.54 Remote controls:
Operating controls located away from the actuator regardless of distance.

A.55 Reversing contactor (starter):
An electro-mechanical or solid state device that switches power voltage to the actuator motor causing rotation in open or closed direction. Reversing contactors are mechanically interlocked to prevent energizing more than one coil at a time. Contactors can be mounted integral to the actuator (local) or remotely in a motor control center (MCC).

A.56 Rim pull:
The amount of input force, expressed in Newtons (N) (pounds (lbs)), which is required at the rim of the handwheel, when combined with any reduction gearing in the actuator package to produce sufficient output force to move the actuator.

A.57 Peat:
The portion of a valve against which the closure presses to achieve an effective seal.

A.58 Stem connector:
The device that connects the actuator stem to the valve stem. Commonly known as coupling, stem nut, or drive coupling.

A.59 Stroke:
The movement of the valve from full open to full close or vice versa. One-half of a cycle.

A.60 Stroke time:
The time required for the valve to travel from full open to full close or vice versa.

A.61 TENV:
Abbreviation for totally enclosed non-ventilated. A type of motor not equipped for cooling by means external to the enclosure and sealed for use in harsh environments.

A.62 Topworks:
A nonstandard term for actuators and accessories.

A.63 Torque:
The moment of a force; the measure of a force's tendency to produce torsion and rotation about an axis, equal to the vector product of the radius vector from the axis of rotation to the point of application of the

force and the force vector. A turning or twisting force. Usually expressed in foot/pounds, pound/feet, inch/pounds, or Newton meters.

A.64 Torque seated:
A method of seating a valve in either the open or close position based on the valve's torque rather than the valve's position.

A.65 Travel:
The movement of the closure member from the closed position to an intermediate or rated full open position.

A.66 Travel cycle:
Travel of the closure member from its closed position to the rated travel opening and its return to the closed position.

A.67 Travel indicator:
A device that is used for the visual verification of valve position.

A.68 Travel time:
The time required for one-half a travel cycle (i.e., close to open).

A.69 2-Wire controls:
A generic term for digital controls.

A.70 Weatherproof:
A generic term for actuators which are suitable for use in areas exposed to the environment and whose operation will not be impaired by such exposure. The closest industry accepted standard is NEMA 4.

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