

Specification for 1-Phase and DC Multi-Turn Output Electric Actuators

General

The actuators shall be suitable for use on a nominal _volt, 1 phase, _Hz power supply or direct current power supply and are to incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure. As a minimum, the actuators should meet the requirements set out in EN15714-2 and ISA SP96.02

To maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc. must be carried out without the removal of any actuator covers and possible without mains power over an Infrared or *Bluetooth*® wireless interface. Sufficient commissioning tools must be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools must not form an integral part of the actuator and must be removable for secure storage / authorised release. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool. Provision shall be made to disable *Bluetooth*® communications or only allow a *Bluetooth*® connection initiated by an Infrared command for maximum security.

Actuator Sizing

The actuator must be sized to guarantee valve closure at the specified differential pressure and temperature. The safety margin of motor power available for seating and unseating the valve must be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. For linear operating valves, the operating speed shall be such as to give valve closing and opening at approximately 12 inches per minute unless otherwise stated in the data sheet. For 90° valve types the operating time will be specified and the optimal actuator and second stage gearbox combination shall be selected to meet sizing requirements.

Environmental

Actuators must be suitable for indoor and outdoor use with a standard corrosivity category, C4 medium durability as per ISO 12944. The actuator must be capable of functioning in an ambient temperature ranging from -30°C to +70°C (-22°F to +158°F), up to 100% relative humidity. Actuators for hazardous area applications must meet the area classification, gas group and surface temperature requirements specified in the data sheet.

Enclosure

Actuators shall be O-ring sealed, watertight to IP66/IP68 20m for 10 days, NEMA 4, 6. The motor and all other internal electrical elements of the actuator must be protected from ingress of moisture and dust when the terminal cover is removed for site cabling. The terminal compartment must maintain the same ingress protection rating with the terminal cover removed. The actuator enclosure must allow for temporary site storage without the need for electrical supply connection. All external fasteners shall be suitable for the actuator corrosivity category and installation environment indicated on the datasheet.

Motor

The motor must be an integral part of the actuator, designed specifically for valve actuator applications. 1-phase actuators must utilise capacitors to run and start the motor. DC actuators must use a permanent magnet DC motor. The motor shall be a low inertia, high torque design and class F insulated. Resulting in class B temperature rise with a time rating of 15 minutes at 40°C (104°F) at an average load of at least 33% of maximum valve torque. Temperature shall be limited by thermostat device embedded in the motor end windings and integrated into the actuator control. Electrical and mechanical disconnection of the motor shall be possible without draining the lubricant from the actuator gearcase.

Motor Protection

Protection must be provided for the motor as follows:

- Stall - the motor must be de-energised within 8 seconds in the event of a stall when attempting to unseat a jammed valve.
- Over temperature - thermostat will cause tripping of the motor. Auto-reset on cooling

Gearing

The actuator gearing must be totally enclosed in an oil-filled gearcase suitable for operation at any angle. Grease lubrication is not permissible. All drive gearing and components must be of metal construction and incorporate a lost-motion hammer-blow feature. For rising spindle valves the output shaft must be hollow to accept a rising stem and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gearcase for inspection or disassembly without releasing the stem thrust or taking the valve out of service. For 90° operating type valves, drive gearing shall be selected as self-locking to prevent the valve back-driving the actuator.

Hand Operation

A handwheel must be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to electrical operation automatically by starting the motor. The handwheel or selection lever must not move on restoration of motor drive. Provision shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.

Clockwise operation of the handwheel must give clockwise movement of the actuator output drive. The actuator handwheel drive must be mechanically independent of the motor drive and must permit valve operation in a reasonable time with a manual force not exceeding 400N through stroke and 800N for seating/unseating of the valve.

Manual handwheel operation shall include a lost-motion hammer-blow feature for unseating the valve.

Drive Interface

The actuator shall be furnished with an easily detachable drive coupling, for machining to suit the valve stem or gearbox input shaft. The drive coupling must be positioned in the detachable base of the actuator. Thrust bearings shall be sealed for life and the base must be capable of withstanding five times the rated thrust of the actuator.

Local Controls

The actuator must incorporate integral local controls for Open/Close operation and include a Local/Stop/Remote mode selector switch. Mode selection must be lockable in any one of the following three positions: local control plus stop only, stop (no electrical operation), remote control plus stop only. It must be possible to select maintained or non-maintained local control.

The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator installation orientation.

Torque and Limits

Torque and stroke limitation to be adjustable as follows:

- Position setting range – multi-turn: 2.5 to 8,000 turns, resolution to 7.5° of actuator output.
- Position setting range – part-turn: 90° +/-10°, resolution determined by gearbox ratio and stroke
- Torque setting: 40% to 100% rated torque.

Position measurement – absolute position measurement must be incorporated within the actuator. The technology must be capable of reliably measuring position even in the case of a single fault. The design must be simple with the minimum amount of moving parts (no more than 5). Technologies such as LEDs or potentiometers for position measurement are considered unreliable and therefore not preferred.

Measurement of torque must be from direct measurement of force at the output of the actuator. Methods of determining torque using data derived from the motor such as motor speed, current, flux etc. are not acceptable.

A means for automatic “torque switch bypass” to inhibit torque off during valve unseating and “latching” to prevent torque switch hammer under maintained or repeated control signals shall be provided.

The electrical circuit diagram of the actuator shall not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

Remote Valve Position and Status Indication

Four contacts must be provided which can be selected to indicate any position of the valve. Provision must be made for the selection of a normally closed or normally open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated.

The contacts must be rated for 5mA to 5A, 120VAC, 30VDC.

As an alternative to providing valve position indication, any of the four contacts shall be configurable to signal one of the following:

- Valve opening, closing or moving
- Thermostat tripped
- Motor tripped on torque in mid travel, motor stalled
- Remote selected, Local selected, Stop selected
- Actuator being operated by handwheel
- Actuator fault

Provision shall be made in the actuator design to support an additional eight contacts with the same configurable functionality.

A configurable monitor relay must be provided as standard, which can be used to indicate either Availability or Fault. The relay must be spring return type with a Normally Open / Normally Closed contact pre-wired to the terminal block.

The Monitor (availability or fault) relay, being energised from the control transformer will de-energise during any one or more of the following conditions:

Available Mode

- Loss of main or customer 24VDC power supply
- Actuator control selected to local or stop
- Motor thermostat tripped
- Actuator internal fault

Fault Mode

- Loss of main or customer 24VDC power supply
- Motor thermostat tripped
- Actuator internal fault

Provision shall be made in the actuator design to support the addition of a contactless transmitter to output a 4-20mA analogue signal corresponding to valve travel and / or torque for remote indication when required. The transmitter will auto range to the set limits.

Local Position Indication

The actuator display must include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With mains power connected, the display must be backlit to enhance contrast at all ambient light levels and must be legible from a distance of at least 5m (16ft). A power save mode shall be available to switch off the display backlight during long periods of inactivity.

Red, green and yellow LEDs corresponding to open, close and intermediate valve positions must be included on the actuator display when power is switched on. The yellow LED must be fully programmable for on/off, blinker and fault indication. The digital display must be maintained and updated during handwheel operation when mains power to the actuator is isolated.

The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration and graphical datalogger information. The text display shall be selectable between English and other languages such as: Spanish, German, French, and Italian. Provision shall be made to upload a different language without removal of any covers or using specialised tools not provided as standard with the actuator.

Datalogger graphical displays and trend graphs must be available on the local LCD for the following functions:

- Torque versus Position
- Number of Starts versus Position
- Number of starts per hour
- Dwell Time
- Average temperature

The main display must include configurable a minimum of four different home-screens that include the following information:

- Position and status
- Position and torque (analogue)
- Position and torque (digital)
- Position and demand (positioning)

An optional environmental cover to protect the display from high levels of UV radiation or abrasive materials must be available and shall be fitted without the need for any special tooling.

The local controls and display must be rotatable through increments of 90 degrees to suit valve and actuator installation orientation.

Integral Starter and Transformer

The reversing starter, control transformer and local controls must be integral to the valve actuator and suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It must have the necessary voltage tapping and be adequately rated to provide power for the following functions:

- Energising of the contactor coils.
- 24VDC output for remote circuits (maximum 5W/VA)
- Supply for all the internal electrical circuits.

1-phase units must have an alternative 120VAC output for remote circuits available as a replacement for 24VDC.

Remote Control Facilities

The necessary control, wiring and terminals must be contained within the actuator enclosure. Open and close external interlocks must be made available to inhibit local and remote valve opening / closing control. It must be possible to configure the interlocks to be active in remote control only. Remote control signals fed from an internal 24VDC (or 120VAC) supply and/or from an external supply between 20V and 60VDC or 40V and 120VAC, must be suitable for any one or more of the following methods of control:

- Open, Close and Stop control
- Open and Close maintained or “push to run” (inching) control
- Overriding Emergency Shut-Down; to close (or open) valve from a normally closed or open contact
- Two-wire control; energise to close (or open), de-energise to open (or close)

Additionally, provision shall be made for a separate ‘drive enable’ permissive input to prevent any unwanted electrical operation.

It must be possible to reverse valve travel without the necessity of stopping the actuator or moving through an intermediate stop control position. The motor starter must be protected from excessive current surges during rapid travel reversal. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses up to 2kV.

Operation by distributed control system must be possible utilising one or more of the following network systems:

- Profibus
- Modbus
- Foundation Fieldbus
- DeviceNet
- Pakscan
- HART

Monitoring Facilities

Facilities to indicate actuator availability and monitor operation must be included as standard.

Actuator text display indication of the following status/alarms:

- Closed Limit, open limit, moving open, moving closed, stopped
- Torque trip closing, torque trip opening, motor stalled
- ESD active, interlock active
- Thermostat trip, 24V supply lost, local control failure
- Configuration error, position sensor failure, torque sensor failure
- Battery low, battery discharged, power loss inhibit

Integral datalogger to record and store the following operational data:

- Opening last / average torque against position
- Closing last / average torque against position
- Opening motor starts against position
- Closing motor starts against position
- Total open / closed operations
- Maximum recorded opening and closing torque values
- Event recorder logging operational conditions (valve, control and actuator)

The event log must include time and date information for each stored event.

Logged data must be accessible via non-intrusive *Bluetooth*® communication and visible on the actuator display. An intrinsically safe portable tool must be provided to extract datalogger and actuator configuration files from the actuator. The portable tool must permit *Bluetooth*® connection with a PC to perform file transfer. The actuator manufacturer must supply PC software to enable extracted actuator files to be viewed and analysed.

Wiring and Termination

Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and power. Each wire shall be clearly identified at both ends. The terminals shall be embedded in a terminal block of high tracking resistance compound.

The terminal compartment must be separated from the inner electrical components of the actuator by means of a watertight seal. A minimum of four threaded cable entries with provision for an additional four extra conduit entries must be available to accommodate wiring connections.

All wiring supplied as part of the actuator must be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable. A durable terminal identification card showing a plan of terminals must be attached to the inside of the terminal box cover indicating:

- Serial number
- External voltage values
- Wiring diagram number
- Terminal layout

The code card must be suitable for the contractor to inscribe cable core identification alongside terminal numbers.

Commissioning Kit

Each actuator must be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

Local Control Station

The actuator manufacturer must be able to supply a compatible control station device that facilitates local control of the actuator up to 100m from the installed actuator location. The control station must replicate all of the features and functionality of the actuator HMI and shall be powered solely from the connected host actuator. Data extraction must be possible from the control station via non-intrusive *Bluetooth®* communication in the same manner as direct extraction from the actuator HMI. Provision shall be made to enable control arbitration between the control station and the connected host actuator.

All electrical components of the control station are to be housed in a double-sealed enclosure with suitable ingress protection rating for outdoor installation and use. Operating temperature range shall be -50°C to +70°C (-58°F to +158°F), up to 100% relative humidity. For hazardous area applications, the enclosure shall meet the area classification, gas group and surface temperature requirements specified in the data sheet.

Performance and Test Certificate

Each actuator must be performance tested by the manufacturer and individual test certificates are to be supplied free of charge. Test certificates must be retained by the manufacturer for the serviceable life of the product. The test certificate must include details of the equipment specification such as:

- Serial number
- Test date
- Manufacturing site address
- Customer
- Customer order number (where applicable)
- Actuator size
- Mounting flange
- Enclosure type
- Lubricant
- Paint coating
- Power supply
- Operating speed
- Motor insulation class
- Drive close direction
- Gear ratio for second stage gearbox (where applicable)
- Electrical optional extras
- Catalogue performance

The test equipment should simulate a typical valve load. The following parameters must be recorded and clearly stated on the certificate:

- Torque at maximum torque setting in both directions
- Current at maximum torque setting in both directions
- Flash test statement
- Test power supply voltage
- Torque at stall torque in both directions
- Current at stall torque in both directions