Specification for 1-Phase and 3-Phase Multi-Turn Output Modular Electric Actuators with Integral Controls

General

The actuators shall be suitable for use on a nominal _volt, _ phase, _Hz power supply and are to incorporate motor, gearing, reversing starter, local control facilities and connection terminals 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.

Standard actuator commissioning of torque and position limits shall be carried out through physical adjustment of a mechanical switch mechanism interface. The switch mechanism shall include switches wired to the integral starter to adequately control the motor of the actuator.

Actuator Sizing

The actuator shall 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 shall 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 10-12 inches per minute unless otherwise stated in the data sheet. For 90° valve types the operating time will be specified.

One actuator frame size (matching external dimensions) shall be available covering output speeds from 9 to 192 rpm for a given torque range, to avoid over sizing and unnecessary weight load on the valve stem, flange and yoke assembly. An increase of actuator size caused by higher actuator output speed is not acceptable to avoid weight over sizing of actuators. Actuators must be selected to provide sufficient torque required for safe valve operation. Actuator rated output torque must be available at 90% of nominal build voltage.

To enable correct sizing of applicable electric equipment, actuator supplier must disclose load value (Amps) at rated actuator torque. A locked rotor / stall current figure must also be provided to ensure maximum potential starting conditions can be accommodated. Actuator shall be capable of opening and closing the valve against full differential pressure within specified time on valve data sheet.

Environmental

Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from -30°C (-22°F) to 70°C (140°F), up to 100% relative humidity. Actuators shall be built with suitable alternative seals, lubrication and bearings should a lower ambient temperature range be required.

Enclosure

Actuators shall be O-ring sealed, watertight to IP68 8m for 96hrs, NEMA 4 & 6. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed for site cabling. If required, the actuator manufacturer should ensure the ingress protection rating of the actuator is maintained whilst the terminal compartment is removed. The actuator shall be able to complete 10 operations during submersion.

Motor

The motor must be an integral part of the actuator, designed specifically for valve actuator applications. It shall be a low inertia high torque design, capable of delivering rated torque when power is turned on. All motors shall be of high starting torque type to facilitate 'unseating' of the valve. Each motor shall have a rating plate marked in accordance with IEC 34.1 as far as applicable.

Standard isolating duty actuators shall include class F insulated motors with a class B temperature rise, giving a time rating of 15 minutes at 40°C (104°F), with an average load of at least 33% of maximum valve torque. Temperature shall be limited by three thermostats embedded in the motor stator windings and wired to the terminal connections for use in the control circuit. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gearcase.

Modulating duty actuators shall include class H insulated motors with a class B temperature rise, giving a minimum cyclic duration factor of 25% at 40°C (104°F), with an average load of at least 30% actuator rated torque. Provision for increased cyclic duration factor must be available if required.

1-phase motors shall operate with a starting and running capacitor. Capacitors and associated circuitry shall be included within the actuator enclosure to facilitate safe operation of the motor.

Gearing

The actuator gearing shall 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. To ensure immediate drive output response, modulating duty actuators should not include a hammer blow feature. For rising spindle valves the output shaft shall 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 permit opening of the gearcase for inspection or disassembly without releasing the stem thrust or taking the valve out of service. For 90° operating type of valves, drive gearing shall be self-locking to prevent the valve back-driving the actuator.

Hand Operation

A handwheel shall 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 shall 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 shall provide closing movement of the valve unless otherwise stated in the data sheet. For linear valve types, the actuator handwheel drive must be mechanically independent of the motor drive and should permit valve operation in a reasonable time with a manual force not exceeding 400N through stroke and 800N for seating or unseating of the valve.

It must be possible to deliver the actuator rated torque to the valve through the handwheel mechanism. Position limit indication shall remain active in manual operation as well as motor operation, thus allowing a signal to be provided when the set position has been reached. Intermediate position shall remain available during manual operation provided this feature is supplied within the selected actuator.

Drive Interface

The actuator shall be furnished with an easily detachable drive bush for machining to suit the valve stem or gearbox input shaft. The drive bush shall be detachable from the actuator base. Thrust bearings shall be sealed for life and the base shall be capable of withstanding five times the rated thrust of the actuator. The actuator shall have an appropriate mounting flange per ISO 5210 or MSS SP-102.

Wiring and Termination

The terminal compartment shall be separated from the inner electrical components of the actuator by means of a plug and socket arrangement. All field wiring connections must be wired through the plug and socket. The terminal compartment must provide sufficient space to accommodate the maximum possible number of incoming wires.

Three threaded cable entries must be provided for motor power and feedback connections with provision for an additional two extra threaded cable entries where necessary. Each cable entry shall be correctly sealed by cable glands or blanking plugs during site installation. Cable glands shall be chosen by the contractor responsible for wiring during the commissioning phase.

Internal actuator wiring shall be tropical grade PVC insulated stranded cable of appropriate size for control and motor power circuits. Each wire shall be clearly identified. Each actuator shall provide an adequately sized internal and external connection for grounding.

External conduit connections between components are not acceptable unless they are provided from the actuator manufacturer as an approved option. A detailed wiring diagram and terminal plan shall be provided with every unit. The terminal plan shall be suitable for the contractor to inscribe cable core identification alongside terminal numbers.

Position and Torque Switching

Position and torque limitation to be adjustable as follows:

- Position setting range – multi-turn: 2.5 to 1,500 turns, by means of a mechanical drive mechanism suitable for high vibration and temperature environments. An option for increased operating range up to 15,000 turns must be available.
- Torque setting: 40% to 100% rated actuator torque.

Measurement of torque shall be derived by direct measurement of reactive force on the motor shaft. Methods of determining torque-using data derived from the motor such as motor speed, current, flux, etc. are not acceptable.

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

A means for automatic “torque switch bypass” to inhibit torque trip during valve unseating shall be provided as part of the integral controller.

Integral Starter and Transformer

The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation. The starter shall be mechanically and electrically interlocked, suitable for isolating and soft modulating duty. All starters shall be rated appropriately for the respective motor size. The controls supply transformer shall be fed from two of the incoming three phases or one phase for single phase actuators and must incorporate overload protection. It shall have the necessary tapping and be adequately rated to provide power for the following functions:

- Energising of the contactor coils
- 24V DC or 110V AC output for remote controls (maximum 5W/VA)
- Supply for all the internal electrical circuits

Motor Protection

Protection shall be provided for the motor as follows:

- ☐ Stall - the motor shall be de-energized 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.
- ☐ Single phasing - lost phase protection.
- ☐ Direction – phase rotation correction.

Local Controls

The actuator shall incorporate local controls for electrical operation and shall consist of a selector switch for Open/Close and a selector switch for Local/Stop/Remote mode selection. The mode selector must be lockable in any one of the following three positions: local control plus stop, stop only (no electrical operation) and remote control plus stop. It shall 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 shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.

Remote Control Facilities

The necessary control, wiring and terminals shall be provided integral to the actuator enclosure.

Remote control signals fed from an internal 24V DC (or 110VAC) supply and/or from an external supply between 20V and 60 VDC or 40V and 120VAC, to 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 open/close (or stop) valve from a normally closed or open contact
- ☐ Two-wire control, energise to close (or open), de-energise to open (or close)

It shall be possible to reverse valve travel without the necessity of stopping the actuator. The motor starter shall 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 of up to 2kV.

Provision shall be made for operation by distributed control system utilising the following fieldbus systems:

- ☐ Profibus
- ☐ Modbus
- ☐ Foundation Fieldbus
- ☐ HART

Local Position and Status Indication

The actuator shall include clearly visible LED status indication for the following functions:

- ☐ Open Position Limit
- ☐ Close Position Limit
- ☐ Intermediate Position
- ☐ Fault

The open LED shall be configurable to red or green to suit site requirements. The close LED shall be green or red and must be different to the open LED. The intermediate position LED shall be yellow and flash during movement. Fault shall indicate with a flashing or solid red LED.

Remote Valve Position and Status Indication

Two potential free switches shall be provided in the actuator control module with provision for four additional potential free switches as an option. Each switch shall be Normally Open (N/O) contact form and configurable for one of the following functions:

- Valve open, valve closed, valve moving
- Torque trip open, torque trip close, torque trip
- Thermostat trip, motor stall
- Remote selected, Local selected, Stop selected
- Actuator being operated by handwheel
- ESD active

Provision shall be made for additional position or torque limit switches derived directly from a mechanical drive mechanism. Each four-wire switch must be sealed to IP67 and provide Normally Open (N/O) and Normally Closed (N/C) contact form.

Provision shall be made in the design for an additional four mechanical switches independently configurable to intermediate or end travel positions. Each two-wire switch must be sealed to IP67. Normally Open (N/O) or Normally Close (N/C) contact form shall be available through configuration of the switch.

All switches shall be rated for 30 - 250Vac, 5A and 30 - 250Vdc, 0.5A.

The actuator must support the addition of a potentiometer or 4-20 mA current signal output that is proportional to valve travel. Both devices shall automatically span the operating travel of the valve.

Commissioning Kit

Each actuator shall be supplied with a commissioning kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period.

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 and record the following 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