

WATER SUPPLIES DEPARTMENT
STANDARD SPECIFICATION E-51-02
ELECTRIC ACTUATOR FOR VALVE AND PENSTOCK

1. GENERAL

1.1 Requirements

This specification covers the requirements of electric actuator for valves and penstocks. While the term “valves” is used throughout the specification, the various requirements are equally applicable to penstocks. The actuator shall be supplied with motor, drive mechanism and gearing, integral reversing starter, setting tools and software for torque and position limit switches, local control facilities, terminals for remote control and indication connections etc. as specified.

1.2 Standards

Equipment supplied shall comply with the latest version of the relevant British Standard Specifications and International Standards.

1.3 Electricity Supply

The motorised valve actuator shall be suitable for electricity supply of 380V 3-phase 50 Hz with voltage variation within +6% and –6% and frequency variation within 49 Hz to 51 Hz.

2. DESIGN AND CONSTRUCTION

2.1 Lost Motion Control

The actuator shall incorporate a device which enables the motor to attain the full speed before taking up the load, thus creating a lost motion “hammer-blow” effect to assist valve unseating.

The lost-motion device shall not be incorporated in the actuator for modulating control.

2.2 Actuator Enclosure

The actuator shall have a double-sealed enclosure for complete protection from dust and moisture. The cable terminal compartment shall be sealed and separated from the inner electrical components of the actuator.

A Type Test Certificate from an independent approved Testing Authority to endorse the enclosure rating of IP68 to BS EN 60529 and 3 metre submersion for 48 hours shall be submitted with the offer. The actuator casing including the end-cap shall be of die

cast metal of robust construction. The reversing starter, control transformer and local controls shall be integral with the actuator, suitably housed to prevent the build-up of condensation.

2.3 Handwheel

A handwheel of suitable size shall be provided for safe and efficient manual operation. The manual operation shall be independent of the motor drive and gear i.e. the motor operation shall not cause the handwheel to rotate, and the operation of the handwheel shall not cause the motor to rotate. The changeover from motor operation to handwheel operation shall be accomplished by a padlockable declutching device.

The handwheel shall require a maximum of 360 N on the rim for seating or unseating load or of 270 N for running load. The handwheel shall have an arrow and the word "OPEN" or "CLOSE" indicating the required direction of rotation.

2.4 Local Electrical Control

Local selector and control switches shall be provided on the actuator for selection of "Local/Remote" control modes and local open/stop/close functions.

2.5 Position Indicator

The actuator shall be fitted with a local indicator showing the valve position in terms of the percentage opening.

2.6 Drive Coupling

The actuator shall have output drive coupling conforming to BS EN ISO 5210 for interfacing with the driven equipment such that the actuator can be removed without disturbing the valve position. The coupling shall have a sealed bearing and shall withstand the thrust reaction experienced in valve operation.

2.7 Performance on Loss of Supply

The actuator shall "stay put" on loss of power supply.

2.8 Actuator Protection

Protection shall be provided to cut out the motor under the following conditions:

- (a) Over-travel of the valve in both directions as sensed by the position and/or torque limit switches.
- (b) Overheating as sensed by a winding embedded thermostat.
- (c) Single phasing of 3-phase main supply.
- (d) Phase rotation discrimination unless automatic motor rotation correction is incorporated.

2.9 Labels

Labels on the actuators shall be of stainless steel or other non-tarnishing weather resistant material having a black background and bare metal lettering.

The following information shall be provided on the label for each actuator:

- (a) actuator size and type
- (b) serial number
- (c) power supply ratings
- (d) output speed
- (e) torque rating
- (f) enclosure protection rating

3. ELECTRICAL COMPONENTS

3.1 Starter

Reversing contactor type starter to BS EN 60947-4-1, utilisation category AC4, intermittent duty class 0.3, 30 operating cycles per hour shall be provided. For valve specified for modulating control duties, the operating cycles shall be 240 per hour.

The starter forward and reverse contactors shall be mechanically and electrically interlocked to prevent inadvertent short-circuit or excessive current surges during travel reversal. Where solid state controls are employed, provision shall be made to prevent inadvertent valve operation due to noise and transients in the system.

The circuit associated with remote control and monitoring functions shall be able to withstand a lightning impulse of 1.1 kV.

3.2 Actuator Motor

The actuator motor shall be of class F insulated, low inertia, high torque squirrel cage type suitable for operating on 380V, 3-phase, 50Hz supply having variation limits of $\pm 6\%$ in voltage and $\pm 2\%$ in frequency. It shall be of S2 duty to IEC 60034-1 for "ON/OFF" control.

Actuator motors specified for modulation control duty shall be of S4 duty continuously rated at 120% of the average load torque and 240 starts per hour. For other applications the motor shall be rated for 2 times the valve stroke time or 15 minutes, whichever is longer, at the average load of at least 33% of the maximum valve torque. For all applications, the starting torque of the actuator at its output spindle shall be not less than 185% of the unseating torque required at the valve gear box input spindle.

3.3 Control Transformer

The primary winding of the control transformer shall be protected by easily replaceable cartridge type fuses.

3.4 Internal Wiring

The control wiring inside the actuator shall be tropical grade PVC insulated cable. Each wire shall be identified by colour code. Terminal number where numerals are printed at both the terminal and component ends will be accepted as alternative if full circuit and wiring diagram are provided by the manufacturer.

3.5 Monitor Function

A monitor relay or similar device with volt-free changeover contacts shall be provided to monitor the condition of the actuator and wired to the terminal block for external connections. It shall be arranged for "fail-safe" operation and shall trip and generate a fault signal when any of the following conditions occur:

- (a) Loss of one or more of the power supply phase.
- (b) Loss of control circuit supply.
- (c) Motor winding temperature high thermostat trip.
- (d) Wrong phase sequence (where applicable).

Alarm icons for indicating problems of valve, control system, battery and actuator should be incorporated into the actuator local back-lit liquid crystal display. The display should be automatically lit to indicate the potential area of problems when the actuator fails to operate.

Position/status indication contacts shall maintain and respond to any changes in valve position or actuator status without the requirement of external electrical supplies. A battery of a minimum life of 5 years operation shall be provided.

3.6 Valve Motor Running Indication

A normally open volt-free auxiliary contact shall be wired to the external connection terminal blocks for the initiation of remote "Valve motor running" indication.

3.7 Torque and Position Limit Switches

Setting of the torque and position limit switches of the actuator shall not require the opening of the actuator enclosure. The re-adjustment/setting shall be performed via an infra-red type remote control setting tool supplied by the manufacturer. A minimum of one set per project location shall be provided. The travel or stroke monitoring shall be of Hall effect magnetic pulse system or equivalent system in converting the mechanical movement into an electronic signal.

Furthermore, each actuator shall be complete with "EEPROM" for storage of all settings and actuator position data during power supply failure. The storage devices shall have backup power supply from internal battery. During power supply failure and when the actuator is operated manually, the actuator position shall be continuously monitored.

The following table summarizes the limit switches to be provided for the actuator for external connections:

VALVE AUXILIARY LIMIT SWITCH POSITION CHART				
Switch	Open	Intermediate	Closed	Function
LS-1			■	closed interlock/indication
LS-2	■			control interlock 1
LS-3	■			open interlock/indication
LS-4		■		control interlock 2
LS-5	■	↔		control interlock 3
LS-6	■	↔		control interlock 4
LS-7		↔	■	control interlock 5
LS-8		↔	■	control interlock 6

Notes:

- (a) “ ↔ ” represents the switch operation is adjustable to any intermediate position.
- (b) “ ■ ” represents the contact to be made for the limit switch.
- (c) Limit switches LS-5, LS-6, LS-7 and LS-8 shall be able to be set to operate at any position of valve travel and be selected to provide a “make” or “break” contact at the set position.
- (d) The limit switches shall be wired to the terminals for external cable connections. Limit switch contact shall be rated at 5A, 220V, 50 Hz, inductive a.c. and 2A 24V inductive d.c.

3.8 Remote Control

The terminal block shall receive the following remote control signals in the form of volt free contacts:

- (a) Open valve
- (b) Close valve
- (c) Stop valve

The actuator shall be configurable for the following modes of control:

- (a) Open/close push to run control
- (b) Open/close maintained control with mid travel reversal
- (c) Open/stop/close maintained control
- (d) Overriding emergency shut-down to close (or open)

3.9 Termination and Connection

Provision shall be made for bottom entry of one 6 mm² 3-core and one 1.5 mm² 27-core PVCSWAPVC cable.

Terminations shall be so positioned to allow connection or disconnection of external wiring without disturbing internal connections. Terminations shall be clearly and durably marked.

A minimum of 40 terminals suitable for terminations of 1.5 mm² stranded copper control cable cores and three terminals for the 6 mm² 3-core power supply cable shall be provided. Terminals for the power supply cable shall be shrouded by a plastic cover and separated effectively from control wire terminals.

3.10 Position Transmitter

The actuator shall be fitted with an electronic position transmitter or equivalent device which output a current of 4-20 mA in proportion to valve opening. Its output shall be capable of driving a load with impedance of 450 Ohms. Power supply to the position transmitter shall be derived from the actuator. Accuracy shall be within ± 2.5 %.

3.11 Position Controller

Where modulation control is specified, an electronic control unit shall be provided to enable the actuator to position the valve in proportion to an analogue d.c. input signal of 4-20mA. The minimum variation of input signal to initiate a change of valve position (deadband) shall be adjustable from 0% to 9.9%. The accuracy shall be better than 2.5%.

A motion inhibit timer with a setting range of approximately 0 - 100 seconds shall be provided to prevent operation of the actuator too frequently.

- End of this Specification -