

**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 “valve” 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 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 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.

## 2.2 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 an auto-clutch system or a hand-operated declutching device. The handwheel shall be padlockable to prevent unauthorised manual operation.

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

## 2.3 Local Electrical Control

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

## 2.4 Local Position Indicator

The actuator shall be fitted with a back-lit local indicator showing the valve position in terms of the percentage opening without the requirement of external electrical supplies.

## 2.5 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.

## 2.6 Performance on Loss of Supply

On loss of power supply, the actuator shall remain in the position attained before loss of power supply. The output signals for actuator status and position limit switches shall be refreshed and the actuator position shall be maintained and displayed locally when the valve is manually operated.

## 2.7 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.

## 2.8 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 1200 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. The rated torque and starting torque of the actuator shall be greater than 100% and 200% of the required maximum unseating torque respectively.

The actuator motor shall be of duty S2 or S4 30% to IEC 60034-1. It shall be rated not less than 15 min. or 2 times the valve stroke time, whichever is longer, based on an average load of at least 30% of the rated torque with ability to transmit 100% of the rated torque for at least 10% of the time.

For modulating application, the actuator motor shall be of duty S4 50% for 1200 starts per hour based on an average load of 50% of the rated torque.

### 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 occurs:

- (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 or messages for indicating problems of the valve and actuator shall be incorporated into the actuator local back-lit display to indicate the potential area of problems and facilitate fault attendance in dim light condition when the power supply is lost. A battery of a minimum life of 5 years operation shall be provided.

### 3.6 Valve Motor Running Indication

A pair of normally open volt-free auxiliary contacts 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, i.e. be non-intrusive. The setting shall be adjustable via local control buttons and/or a remote control setting tool with password protection. For the actuator at which non-intrusive setting can only be performed via a remote control setting tool, a minimum of one set of tool per project location shall be provided. For the actuators non-intrusive setting can be performed via a computer, the software shall be supplied.

The actuator shall be provided with reliable storage devices for keeping all settings during power supply failure.

The following table summarises 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

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 and LS-7 shall be able to be set to make or break at any position of valve travel.
- (d) The limit switches shall be wired to the terminals for external cable connections. Limit switch contact shall be rated at 2A, 220V, 50 Hz, inductive a.c. or 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 and termination of one 6 mm<sup>2</sup> 3-core and one 1.5 mm<sup>2</sup> 27-core PVC/SWAPVC cable. When fieldbus connection is specified, provision shall be made of two communication cables for fieldbus.

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

Terminals for the power supply cable shall be shrouded by a plastic cover and separated effectively from control wire terminals.

### 3.10 Position Transmitter

When specified, the actuator shall be fitted with a position transmitter or equivalent device which outputs a signal of 4-20 mA d.c. in proportion to percentage of valve opening. Accuracy shall be within  $\pm 2.5$  %.

Its output shall be capable of driving a load with impedance of 500 Ohms when power supply to the position transmitter is derived from the actuator. It shall operate at 24V d.c. when external power supply is used.

### 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%.

### 3.12 Fieldbus Connection

When fieldbus connection is specified, the fieldbus module shall meet the following requirements:

- (a) The fieldbus module shall be suitable for direct serial communication to an industrial standard programmable logic controller and shall support Modbus or Profibus protocol.

- (b) It shall take power supply from the actuator.
- (c) It shall support a data rate of 9600 baud for a communication distance of up to 1200 metres without repeaters, configured as a ring to ensure system security.
- (d) When fibre optic connection is specified for an installation vulnerable to lightning strikes such as service reservoir, Profibus module shall be provided. The use of other communication protocols complying with the international open standard IEC 61158 / EN 5170 or equivalent shall be subject to approval.

- End of this Specification -