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ARAB ENGINEERING BUREAU

## 8 ELECTRIC AND PNEUMATIC ACTUATORS

### 8.1 GENERAL

#### 8.1.1 Scope

- 1 This Part specifies the requirements for the design, manufacturer, construction, installation, testing and commissioning of electric and pneumatic actuators for valves and penstocks.
- 2 Related Parts and Sections are as follows:

This Section

Part 1, General

Section 8, Drainage Works

Part 4, Pipe installation

Part 5, Valves Penstocks and Appurtenances

Part 8, Protective Coatings and Painting

Section 10, Instrumentation, Control and Automation

#### 8.1.2 References

- 1 The following standards are referred to in this Part:

BS 5501 (IEC 60079).Electrical apparatus for potentially explosive atmospheres – (EN 60079-1Explosive atmospheres - Equipment protection by flameproof enclosures "d"; EN 60079-5 Explosive atmospheres - Equipment protection by powder filling "q"; EN 60079-6 Explosive atmospheres - Equipment protection by liquid immersion "o"; EN 60079-14 Explosive atmospheres - Electrical installations design, selection and erection; EN 60079-18 Explosive atmospheres - Equipment protection by encapsulation "m"; IEC 60079-7 Explosive atmospheres - Equipment protection by increased safety "e"; IEC 60079-25 Explosive atmospheres - Intrinsically safe electrical systems; IEC 60079- Explosive atmospheres - )

BS 5793 (IEC 60534).Industrial-process control valves - ; (IEC 600534- Industrial-process control valves - ; IEC 60534-4 Industrial-process control valves - Inspection and routine testing; EN 60534-8-1 Industrial-process control valves - Noise considerations. Laboratory measurement of noise generated by aerodynamic flow through control valves)

EN 60534 .....Industrial-process control valves -

PNEUROP .....(European Committee of manufacturers of compressors, vacuum pumps and pneumatic tools) Recommendations

#### 8.1.3 System Description

- 1 Actuators shall be capable of extended and continuous operation under conditions specified in Section 1 and at the specified valve operating pressure. Submersible actuators, if required, shall operate at the specified temperature.

#### 8.1.4 Submittals

- 1 In addition to the requirements of Part 1 of this Section the Contractor shall provide data and information as described in the following paragraphs.
- 2 Design Data. This shall include calculations justifying the sizing of valves and actuators for the hydraulic and system requirements.
- 3 Shop Drawings. Complete shop drawings for each type of actuator shall be provided, including:

- (a) specifications for materials of construction of actuators and all appurtenance
  - (b) wiring diagrams
  - (c) ratings for actuator torque, power input, cylinder or diaphragm pressures, motor ratings and enclosures, operating speeds, and other information requested by the Engineer
  - (d) actuator dimensions.
- 4 Operation and maintenance manuals and instructions. These shall be provided for each type of actuator, including:
- (a) list of lubricants
  - (b) lubrication instructions
  - (c) complete assembly and wiring diagrams
  - (d) results of all tests specified above and carried out on site

#### **8.1.5 Spare Parts and Tools**

- 1 One set of manufacturer's recommended spare parts for two years shall be provided for each actuator.
- 2 One set of cover screws, gaskets, 'O' rings and ram seals shall be provided for each actuator.
- 3 Two years' requirement of consumable supplies shall be provided for operation and maintenance of all actuators.

## **8.2 PRODUCTS -ELECTRIC ACTUATORS**

### **8.2.1 General**

- 1 Electric type actuators shall include the motor, heaters, operators unit gearing, limit switches, torque switches, declutch lever, auxiliary handwheel, reversing starter, switches, mechanical position indicator, and accessories as required.
- 2 The valve and gate actuator motor and all electrical enclosures shall be waterproof, IP 67, as a minimum unless explosion proof, to BS 5501, EEXD II BT4, or submersible, IP 68 is specified.
- 3 When specified, a hammer blow mechanism, that travels sufficiently enough to allow the motor to reach full speed before imparting a hammer blow, to start the valve or gate in motion in either the closing or opening direction, shall be incorporated.
- 4 The power gearing shall consist of helical gears of heat-treated steel, and worm gearing of hardened alloy steel. All power gearing shall be grease lubricated with high speed parts on anti-friction bearings.
- 5 It shall be possible to remove the motor operator from the valve and gate without taking the valve or gate out of service.
- 6 The valve actuating speed shall be at 300 mm per minute unless specified otherwise.
- 7 Pneumatic type actuators shall include the cylinder or diaphragm actuator, solenoid valves, pneumatic positioners, pressure gauges, manual testing station, and other accessories, as designated to provide a complete, functional actuator.

### **8.2.2 Motors**

- 1 Motors shall be totally enclosed non-ventilated construction with Class F insulation with temperature rise limited to Class B, and shall comply with Part 1 of this Section and Section 21.

- 2 Available operating torque shall be at least two times the valve manufacturer's maximum torque requirements. The motor shall be designed specifically for use on valve operation, having high torque capacity coupled with low inertia.
- 3 The motor shall be of sufficient size to open or close a valve against the maximum specified differential pressure when the voltage drop at the motor is 10 % of the nominal voltage.
- 4 Electrical power to the motor shall be 3 phase, 50 Hz, 415V for 0.4 kW or larger and 1 phase, 240V, 50Hz, for smaller than 0.4 kW.
- 5 The motor shall be pre-lubricated and all bearings shall be of the anti-friction type.
- 6 Motor rating shall be continuous duty unless otherwise designated.
- 7 Heaters and thermostats shall be provided for high humidity conditions.
- 8 Electrical and mechanical disconnection of the motor shall be possible without draining the actuator grease or lubricant

#### **8.2.3 Controls**

- 1 Each actuator shall be equipped with a reversing starter, control relays, 2-position limit switches and torque limiting switches.
- 2 Additional position, limit switches, hand-off-auto switch, open-auto close hand switch, open, close, stop push-button switches, position indicating potentiometer, position indicating lights, electric braking or a position controller, or both, shall be provided for the specified analogue signal input, unless otherwise specified.
- 3 Position limit switches shall be double pole, double throw and provided for both open and close positions of travel. They shall be connected directly to the valve through continuous gearing and follow its position at all times. Switches shall be rated 10 amps at 240 V a.c. The actuating point shall be adjustable over at least 50 % of the travel.
- 4 Torque limiting switches shall be provided and be responsive to the mechanical torque developed in seating, backseating, or by obstruction. The torque switch shall operate a calibrated dial integrally mounted and directly related to the torque output of the operator. Torque control accuracy shall be within  $\pm 5\%$ . The use of torque wrenches for calibration will not be required.
- 5 Reversing starters shall include a reversing contactor, mechanical and electrical interlocks, and thermal overload relays as required. The contactor shall break all lines to the motor. All controls shall operate on 110 V.a.c.
- 6 Push-button switches (open-stop-close) shall be located for ease of accessibility. The controls shall be arranged for remote operation by isolated momentary or continuous contact switches rated not less than 2 A at 240 V a.c. Terminals shall be wired such that open and close operation only is possible by appropriate external connections.
- 7 The hand-off-auto switch shall select between local (HAND) and remote (AUTO) control for open, close, stop operation. In the OFF position both local and remote controls shall have no effect.
- 8 For all modulating duty operations a 4-20 mA convertor shall be provided, powered internally from a 24 V supply, to transmit the valve position remotely.
- 9 Position indicator lights shall be at least 2 W, green lens for open, red lens for close; shall be interchangeable and located near the push-button switches. Both shall light when the valve is between open and closed limits.

- 10 Additional position limit switches shall be fully adjustable, of the same rating, and driven in the same manner as the other limit switches provided.
- 11 The position controller shall utilise an independent position feedback potentiometer and shall accept a 4-20 mA d.c. signal for modulating the valve position, unless otherwise specified. The final positioning accuracy shall not be less than 1 % of position specified by the signal. A damping circuit shall prevent overshoot in excess of 2 % for a full-scale step input. The controller may be separately housed but must be of the same class as the actuator housing. Power shall be derived from the actuator power supply.

#### **8.2.4    Actuator Mounting**

- 1 Special mounting requirements, such as shaft and neck extensions, shall be provided as shown on the Contract Drawings, and as required for safe operation.
- 2 If valves are installed inside the chamber, actuator should be mounted above the ground with extension stem and power isolator to be provided

#### **8.2.5    Factory Inspection and Testing**

- 1 The Contractor shall secure from the actuator manufacturer certification that each actuator has been performance tested at the factory and individual test certificates shall be supplied for each actuator. The test equipment shall simulate a typical valve load and the following information shall be recorded, and included with the test certificate.
  - (a) current at maximum torque setting
  - (b) torque at maximum torque setting
  - (c) test voltage and frequency
  - (d) flash test voltage
  - (e) actuator output speed or operating time
- 2 In addition, the test certificate shall display details of specifications such as gear ratios for both manual and automatic drive, closing direction, wiring diagram code number, remote position transmitter resistance and interposing relay voltage, etc.

### **8.3    PRODUCTS -PNEUMATIC ACTUATORS**

#### **8.3.1    General**

- 1 The available instrument and operating air pressures and quality are as specified in the particular Project Specification. Pressure reducing valves shall be provided where required for each actuator.
- 2 Direct mounted pneumatic positioners shall be provided for each valve, mounted on the valve, unless specified otherwise. Positioners shall provide 0.1 to 1 bar (gauge) output. Electronic output of 4 to 20 mA shall be provided
- 3 Wrench or handwheel operated manual override shall be provided for each actuator, unless otherwise specified. The force to operate these shall not exceed 25 Kgf.
- 4 Throttling manual override shall be provided for actuators where specified.
- 5 Where potentiometers are specified for positioning cylinder actuators they shall be 1000  $\Omega$ , mounted, enclosed and provided with double pole double throw position indicating switches.
- 6 Test points shall be provided at each actuator to allow an external supply of compressed air to be connected to checked the operation of the actuator and the position indicator.
- 7 Where required fail-safe actuators (fail open or fail closed, as required) shall be provided

- 8 Pressure gauges for pneumatic signal and operating air supply links shall be provided.
- 9 A filter shall be provided for each pneumatic actuator, unless specified otherwise.
- 10 Special mounting requirements, such as shaft and neck extensions shall be provided as shown on the Drawings.
- 11 Connection of pneumatic air to the actuators shall be by means of stainless steel tubes.

### **8.3.2 Cylinder Actuators**

- 1 Cylinder actuators shall be as follows:
  - (a) type: double acting cylinder, unless otherwise specified or shown. In compliance with BS 5793, EN 60534 and PNEUROP recommendations as applicable
  - (b) actuator cover : cast iron or steel, complete with gaskets and seals, internally coated with epoxy
  - (c) piston : cast iron or steel, epoxy coated
  - (d) piston rod : chrome plated carbon steel
  - (e) solenoid control valves shall be provided with mountings and piping
  - (f) actuators shall be suitable for operation at 5-7 bar, unless designated otherwise. Test pressure shall be 10 bar

### **8.3.3 Diaphragm Actuators**

- 1 Diaphragm type actuators shall not be provided for valves larger than 150 mm nominal diameter unless approved by the Engineer. They shall confirm to the standards in Part 8.3.2 1(a).
- 2 Diaphragm actuator construction shall be as follows:
  - (a) diaphragm case and mounting hardware: cast iron, steel, or stainless steel; aluminium is not acceptable
  - (b) diaphragm : flexible neoprene or Buna N
  - (c) spring : enclosed and corrosion resistant.

### **8.3.4 Solenoid Valves for Pneumatic Actuators**

- 1 Solenoid valve actuators shall be as follows, and to the standards in Part 8.3.2. 1(a) above
  - (a) electrical characteristics : 240 **or 110 V a.c.**, 50 Hz, single phase
  - (b) enclosure : IP 68, unless otherwise designated
  - (c) rated for continuous operation
  - (d) fitted with spring return unless otherwise specified
  - (e) the inlet shall be normally open or normally closed as required by the control system.
  - (f) The Solenoid valve shall be 5/2 way with spring returns
  - (g) Solenoid coil should be suitable for indoor/outdoor mounting as required.

## **8.4 INSTALLATION AND COMMISSIONING**

- 1 Electric and pneumatic actuators shall be installed and commissioned in accordance with manufacturer's instructions.
- 2 The tests listed under Part 8.2.5 shall be repeated at site. In addition the actuator performance shall be tested as part of the control system.

**END OF PART**