

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

MANUAL

QUARTER-TURN ON/OFF ACTUATORS

PTS 31.40.70.30

DECEMBER 1997



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The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPU/Divisions in oil and gas production facilities, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardisation.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use PTS they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will expect them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the PTS. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

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1. INTRODUCTION

1.1 SCOPE

This new PTS specifies requirements and gives recommendations for subsea, shutdown and general-duty quarter-turn actuators for on/off valves. Specific requirements are included for pneumatic, hydraulic, spring-return, double-acting and electric types.

The actuator will normally be supplied with the valve by the valve Manufacturer. If the actuator is being supplied for valves already installed, a detailed specification of the valve and process data will be supplied by the Principal (or nominated design Contractor) for use in conjunction with the actuator specification.

In addition to the requirements for actuators, this PTS specifies some requirements for actuator/valve assemblies, actuator control systems, ancillaries and interfacing components.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this PTS is confined to companies forming part of PETRONAS or managed by a Group company, and to Contractors and Manufacturers/Suppliers nominated by them.

This PTS is intended for use in oil refineries, chemical plants, gas plants, oil and gas production facilities, and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this PTS, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this PTS which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this PTS as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation or maintenance of a facility. The Principal may undertake all or part of duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties supplied by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Fail-safe actuator	An actuator which returns to the safe mode of the application (open or closed) if the operating medium fails.
Protective Applications	Applications which, in the event of malfunction, may result in harm, including ill health and injury, damage to property, products or the environment, production losses or increased liabilities. These include shutdown duties.

Class 'X' systems	Instrumented Protective Function for ultimate protection i.e. no other mechanical means such as rupture discs or relief valves. These systems were formerly known as HIPPS.
ROV	Remote Operated Vehicle, typically used in subsea applications.
Torque, Break-Open	The torque required to move the valve off its seat to the point where it has just started to open.
Torque, Break-Close	The torque required to move the valve off its seat to the point where it has just started to close.
Torque, Resistance	The torque required to overcome the resistance of the valve/actuator assembly, including forces applied by the process fluid or test load, during travel.
Torque, Static	The torque delivered by the actuator, at any point in its 0° to 90° range when the actuator mechanism is not moving. This torque is also referred to as "stall" torque.
Torque, Shearing	The torque delivered by the actuator which would shear part of the coupling to the valve.
Type	Category of actuators in the same design range.
SSIV	SubSea Isolation Valve.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this PTS are made, the referenced section number is shown in brackets. Other documents referenced in this PTS are listed in (8).

1.5 GUIDANCE FOR USE

This PTS has been structured throughout to provide the requirements for three actuator application categories: General Duty, Protective and Special Applications.

Where requirements are common to all three categories, these are contained in [Section 2](#).

[Sections \(3\), \(4\) and \(5\)](#) contain specific requirements for the three application categories mentioned above, whilst the remaining sections are applicable to all categories.

A pre-requisite of supply is that all actuators other than general duty actuators be Type Approved. For a typical Type Test Approval Procedure see [\(Appendix A\)](#). Deviations between this and the Manufacturer's Type Approval Procedures shall be subject to approval by the Principal.

2. GENERAL REQUIREMENTS FOR ALL APPLICATIONS

2.1 ACTUATOR

2.1.1 Actuator mechanism and operating medium

Scotch-Yoke, Rack-and-Pinion or Helical-Spline mechanisms are acceptable. Any other mechanism will require the approval of the Principal.

Pneumatic, hydraulic and electric mechanisms may be considered.

An oil barrier should be provided if the supplied operating medium is not suitable as actuator operating medium, e.g. sour/wet gas, unfiltered instrument air.

For hydraulically operated actuators, see also PTS 31.36.10.30

2.1.2 Actuator design

2.1.2.1 Springs

No rubbing or buckling of the springs shall occur. Compression of the return springs shall be limited so that scragging or blocking of the spring coils does not occur. If disc/washer springs are used, the Manufacturer shall ensure that the mechanism used to keep the springs aligned will not cause hardening of the materials at the contact points.

If multiple springs are used they shall be mounted so that a single spring failure will not result in a complete actuator failure

Spring cans shall have safety features to prevent inadvertent spring release.

2.1.2.2 Tie bolts/bars

Tie bolts/bars may be used on pneumatic and hydraulic actuators if measures are taken to prevent galvanic or environmental corrosion.

Failure of one tie bolt/bar shall not cause the actuator to endanger personnel. In-situ replacement of the failed bolt/bar should be possible.

2.1.2.3 Pressure-retaining and torque-transmitting parts

Power storage accumulators, hydraulic and pneumatic cylinders and fluid reservoirs shall be designed and fabricated in accordance with the requirements of the system design pressure and PTS 31.22.10.32

Bolting shall be of a quality and strength equivalent to ASTM A 193, grade B7. Nuts shall be of a quality and strength corresponding to ASTM A 194, Grade 2H.

2.1.2.4 Speed controlling mechanism (integral)

Speed controlling mechanisms may be required to restrict the operating speed of a valve (i.e. to prevent excessive pressure surge). Alternatively mechanisms may be required to provide fast operation (i.e. dump valves).

Speed may be controlled by restricting the charging/discharging of the operating medium from the actuator. The closing/opening time shall be in accordance with the design. Such mechanisms shall be arranged so that the risk of their blocking the flow of operating medium from the actuator shall be minimised. Mechanisms which are integral to the cylinder are preferred to external ones.

All speed controlling arrangements require the Principal's consent.

2.1.2.5 Lubricants, packing and access

The actuator internals shall be packed for life with suitable lubricants.

2.1.3 Materials

2.1.3.1 Buna N

Buna N rubber shall not be used for any part exposed to gas.

2.1.3.2 Bearings

Bearings shall not contain aluminium and should be protected from the environment.

2.1.3.3 Pressure-retaining parts

Materials for pressure-retaining parts shall comply with PTS 31.22.10.32

2.1.4 Environmental

Actuators shall conform to the local environmental requirements stated in the purchase order and be suitable for continuous use.

If actuators may be drenched by sea water deluge in an offshore environment it is essential for the degree of ingress protection to be sufficient to prevent corrosion within the actuator, particularly on the spring, bearings, guides and cylinder surfaces.

2.1.4.1 General environment

The following details shall be specified by the Principal:

- Minimum and maximum temperatures;
- Maximum humidity.

2.1.4.2 Electrical protection

The following details shall be specified by the Principal:

- Area classification;
- Gas Group;
- Surface Temperature Requirement.

For details, refer to IEC 79-14 and PTS 80.00.10.10

2.1.4.3 Ingress protection

Actuators and their ancillaries shall conform to IEC 529, ingress protection level IP56 (includes preventing insertion of fingers, hands etc. into the actuator and ancillaries) or as otherwise specified in the purchase requisition.

2.1.4.4 Anti-corrosion measures

The Supplier shall state in the bid that the actuator meets the requirements for anti-corrosion measures stated below.

Protective compounds and durable coatings shall be used to prevent corrosion in the event of water condensing inside the various housings, in addition to protection of external parts.

Paint shall be in accordance with the Supplier's standard paint specification provided that the Supplier can show it is equivalent to the Principal's paint specification.

Carbon steel parts shall be painted in accordance with painting and coating specifications relevant to the site of installation. If alternative equivalent coating techniques are proposed, details of these shall be submitted for approval.

Nickel plating may be used for the inside surface of cylinders to provide resistance to wear and corrosion. This shall be an electroless coating technique to PTS 30.48.41.31 The coating thickness shall be at least 75 μ m. The underlying surface material shall be treated to provide corrosion resistance.

PTFE-type coatings may also be used for the inside surface of air cylinders for general-duty actuators, but not for shutdown actuators, as indicated elsewhere in this PTS. If PTFE-type coatings are used they shall conform to the coating and pre-treatment specification reviewed and approved by the Principal during Type Test acceptance (see [Appendix A](#)). The underlying surface material shall be treated to provide corrosion resistance.

Carbonising/nitrating surface treatment processes may be used on internal parts such as piston rods, tie bars etc. but not on the inside surfaces of cylinders.

2.1.5 Interfaces

2.1.5.1 Available power sources

The Principal shall provide a specification for the power sources detailed below.

- Instrument air supply: minimum and maximum pressure, nominal dew point;
- Hydraulic fluid supply: minimum and maximum pressure, hydraulic fluid type, hydraulic fluid cleanliness;
- Electrical power supply;
- Instrument power supply.

The working range of instrument air pressure (i.e. between minimum and maximum pressures) should be specified as the minimum realistic value acceptable. Note that specification of an excessively wide range can result in onerous design requirements with consequential cost implications. The minimum operating pressure shall be specified by the Principal as a higher value than the low instrument air pressure trip setting.

Air filters and liquid catch pots shall be fitted if specified by the Principal. Lubricators shall be fitted if recommended by the Manufacturer.

The hydraulic fluid type shall be compatible with the remainder of the hydraulic power unit, including its components.

The Supplier shall include details of both the fill volume and the flow rate required to fully cycle the actuator.

2.1.5.2 Lifting eyes

Where necessary, the actuator shall be fitted with suitably located lifting eyes. These shall in accordance with local statutory requirements if applicable and otherwise guaranteed by the Manufacturer. The Supplier shall confirm that these are suitable for mounting and de-mounting the actuator in-situ with the specified valve orientation. If fitted, a minimum of two eyes and a configuration providing redundancy shall be provided. In addition, if specified, additional lifting eyes shall be provided on the spring cans to allow the removal of these with the actuator on the valve in the position specified.

2.1.6 Ancillaries

Ancillaries which are not mounted on the actuator body shall meet the same specification those standards as mounted on the actuator body.

Any actuator item which is pressure-retaining, including accumulators for double-acting actuators, shall be in accordance with PTS 31.22.10.32

2.1.6.1 Limit switches and limit stops

Limit switches and stops shall be supplied in accordance with the project documentation.

The switches shall be such that they are closed when the valve is in the corresponding position. Each switch shall operate within 3° of the valve travel from the respective 0° and 90° limits. Switches shall be adjustable by 10° and repeatable to 0.5°. Mechanical protection shall be fitted to prevent disturbance/malfunction of the limit switches by inadvertent impact of portable tools and equipment. The switches shall be of the proximity type and suitable for use in the hazardous area classification specified. Limit switches shall

be fully described in the Supplier's quotation, shall be subject to approval by the Principal and shall comply with DIN 19234 and VDI/VDE 3845.

For applications where the valve is required to be tested under operational conditions, additional limit switches may be fitted at either the 10° or 80° positions to allow partial closure tests to be conducted. These shall only be fitted at the Principal's request.

Adjustable limit stops shall be sufficiently robust so that adjustment is still possible after prolonged cycling of the actuator. The stops shall be such that they are normally securely locked in position and limit the overall actuator travel to within 0.5° from the set position for the lifetime of the actuator. The limit stops shall be arranged so that the valve travel can be adjusted at either end of the stroke with the actuator fitted to the valve. Allowance should be made in arranging the limit stops for the decelerating forces which result from stopping the valve travel at maximum speed as well as the forces applied by the spring and fluid pressure and operating piston.

2.1.6.2 Solenoid valves

Normal operation of the actuator shall be via normally energised solenoid valves driven by 24 V (dc). Pneumatic solenoid valves may also be used. On loss of signal or any other failure, the switching valve shall drive the actuator to its predetermined safe position. The solenoid valve manufacturer and type shall be specified by the Supplier and approved by the Principal. The electrical solenoid valve shall be provided with a local electrical manual or auto reset facility in accordance with the project requirements.

Direct acting solenoid valves are preferred. Pilot operated solenoid valves are not recommended.

IS (Intrinsically Safe) solenoid valves shall only be used with the Principal's consent.

2.1.6.3 Speed restricting mechanisms (external)

The requirements for speed restricting mechanisms which are not integral with the actuator are identical to those for integral mechanisms ([see 2.1.2.4](#)).

2.1.6.4 Field-mounted instruments

Flying leads should be avoided. Where flying leads must be used, they shall be terminated in a junction box to be provided along with the instruments by the Supplier.

2.1.6.5 Tubing and fittings

Tubing and fittings shall conform to local requirements.

Pneumatic and hydraulic power supply to the actuator shall be sized so that the speed of operation in the fail-safe direction is not limited by the tubing size or the bore of connectors. Tubing and compression type fittings shall be stainless steel unless otherwise specified by Principal.

The air passages in the solenoid valves shall be large enough to achieve the opening or closing time of the valve as specified. If this would lead to unrealistically large passages and consequently high power consumption of the solenoid valve, consideration should be given to the use of quick exhaust valves.

2.1.6.6 Pressure gauges and measurement points

Pressure gauges shall be provided as specified in the purchase order.

Any additional pressure measurement points included for use during performance monitoring or failure diagnosis shall be fitted with hand valves with capped outlets.

2.1.6.7 Local manual facilities and indications

If specified, a local manual control facility shall be provided for in-situ testing of the valve. Provision shall be made to protect this facility from interference or inadvertent operation. This facility shall not override the safety functions of the actuator.

Local valve position indication shall be provided.

2.1.6.8 Mechanical locking devices

Mechanical locking devices may be required for valves used in well cleaning and maintenance activities. These mechanisms shall only be fitted with the Principal's consent.

2.1.7 Service limits

The following service limits shall be specified by the Principal:

- service life (years) prior to replacement;
- number of operations per year.

This information is provided to enable the actuator Manufacturer to define maintenance requirements.

2.2 ACTUATOR/VALVE ASSEMBLY

2.2.1 Actuator torque

2.2.1.1 Actuator torque requirement

The torque requirements for the actuator at any point in the stroke shall be as specified in (3.2), (4.2) and (5.2), respectively. In selecting an actuator to meet the torque requirements, the Supplier should take all factors into consideration to ensure that the delivered actuator meets the required torque output but is not significantly over-specified. This is necessary to ensure that problems are not experienced with over-torquing of the valve stem, spool piece, bolts, etc. The factors which, when combined, may lead to significant over-torquing include:

- selection of an actuator from a standard range without allowing for valve torque;
- uncertainty about the specified valve torque;
- the Manufacturer's minimum torque tolerance factors;
- minimum and maximum supply pressures.

The actuator shall be capable of opening the valve with the maximum differential pressure across the valve equal to the maximum line pressure within the opening time specified, and of closing the valve from the open position with maximum line pressure in the valve within the closing time specified.

2.2.1.2 Maximum output torque

Calculations of the maximum output torque, from the actuator, which could shear the valve stem shall be based on:

- maximum air/hydraulic pressure (as achieved with the pressure relief valve fully open, i.e. 110% of relief valve set pressure);
- maximum spring force.

The maximum actuator torque shall not overstress any component of the actuator or valve.

2.2.2 Stroking time

The Principal shall specify the minimum and maximum times (in seconds) to fully open and close the valve. The Supplier shall quote maximum and minimum stroking times at the process conditions specified for the valve and the air/hydraulic supply pressure range and ambient condition range specified in (2.1.5.1) and (2.1.4.1), respectively.