HYDRAULIC ACTUATORS

CONTENT

1. Application

Hydraulic actuators are rotary actuators used for turning, opening, closing, positioning and many more mechanical functions involved in restricted rotation. Mostly they are used for the automation of quarter turn valves, like ball, plug and butterfly valves of large sizes.

Hydraulic actuators convert the energy of compressed air by means of a hydraulic cylinder to an oscillating rotary motion. The required hydraulic oil at operating pressures is normally supplied by a Hydraulic Power Unit (HPU) which can provide oil to one or more actuators.

Hydraulic actuators are generally durable, suited for hazardous environments.

2. Principle of operation

The scotch yoke mechanism transforms the linear movement of the piston into a 90° rotation.
The piston rod is directly coupled to a piston and to a slider with a pin that engages into the yoke mechanism. When a force is applied on the piston the slider moves in the yoke slot, causing the yoke to rotate.
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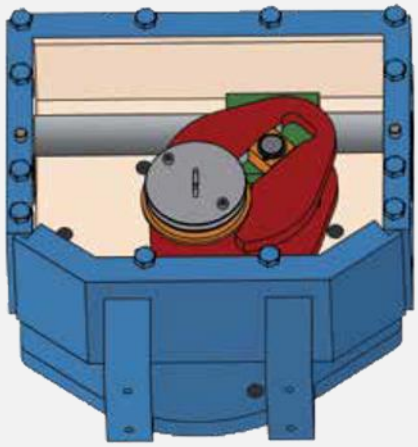
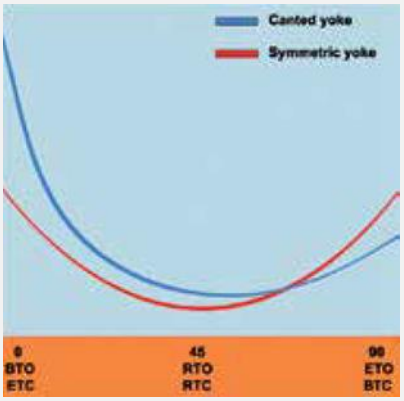
The mechanism is positioned inside a sealed housing which protects it against adverse environmental conditions. The housing has a guide rod suitable to withstand the transversal forces generated during rotation and ensures the proper alignment of the piston rod with the slider.
Low rotational friction is ensured by means of precise fitted bronze yoke shaft bushings which provides a long service life.



Scotch yoke actuators can be supplied with an inclined yoke (canted) or a symmetric yoke.
The symmetric yoke is normally used when the valve torque requirements are highest during the intermediate positions of the rotation (running), while lower at the beginning and end of the rotation. This type of yoke is normally used for plug valves and metal seated ball valves and for control valves with modulating service.

The canted yoke mechanism has advantages when the valve torque requirements are highest at the beginning and end of the rotation. This mechanism covers most ball and butterfly valve torque requirements



2.1 Double acting actuators

In a double acting actuator, oil is supplied to chambers on both sides of the piston. Higher oil pressure on one side drives the piston to the other side.
These types of actuation is used when actuation needs to be performed in both directions.
An advantage of double acting is the optimal output force through a full rotation range. The disadvantage is the need for oil for movement in both directions and a lack of defined position in case of power or pressure failure (**fail last position**).

2.2 Single acting actuators

In a single acting actuator, oil is supplied to one side of the piston and is responsible for the movement of the piston in only one direction. The movement in the opposite direction is performed by a mechanical spring. Single acting actuators conserve the oil pressure, but perform in only one direction, but the spring brings the actuator in a defined position (e.g. safe position of the valve, **fail safe close** or **open**) by the spring. A disadvantage is the inconsistent output force through the full stroke due to the opposing spring force.

3. Main features of the hydraulic actuators

- The body is entirely manufactured from **forged carbon steel** and is totally encapsulated.
- Hydraulic cylinder for a pressure of up to 400 bar
- The piston is of carbon steel with dynamic floating O-ring seals coupled with lubricating piston guide rings.
- Shaft of 17-4PH steel and mechanical position indicator fully sealed (IP68) and square male output according to NAMUR for monitoring devices like limit switches.
- Bronze sliding blocks which ensure minimum friction.
- Bronze thrust bearings which guide the actuator shaft & yoke throughout its stroke and supports all transversal loads.
- Stainless steel (AISI 316) end travel stops adjustable
- Integral manual override facilities
- The design allows 4 x 90° actuator rotation
- External bolting of AISI 316

4. Technical specifications

Temperature range	Standard version: -30°C till +100°C Low temperature version: -60°C High temperature version: +200°C
Design pressure	max. 400 bar
Torque output	1.000.000 Nm for single acting and up to 2.000.000 Nm for double acting
Spring starting torque	up to 600.000 Nm
Spring ending torque	up to 400.000 Nm
Design	according to ASME VIII div. 1 and EN 13445

5. Dimensioning of an actuator

To dimension an actuator which should be installed on a valve, following data is required:

- Type of valve (ball, butterfly, plug, etc.)
- Action (double or spring return)
- For spring return actuators, the fail position (valve open or closed)
- Function (on-off or modulating)
- Required torque (break to open, run to open, end to open, break to close, run to close and end to close)
- Maximum allowable torque of the valve (MAST)
- Overlapping angle of the seats on the ball or plug
- Oil supply pressure (maximum and minimum)
- Required closing and opening time
- Coupling form to the valve (ISO 5211 or any other)
- If the coupling and adaptor to the valve stem should be part of the supply (in this case the drawing of the valve top works must be supplied).

6. Automation

An actuator can be supplied with automation components like a complete HPU (Hydraulic Power Unit) with, oil pump, oil reservoir, solenoid valves, control system, limit switches, positioners, etc.