The Limitorque Fluid Power family of heavy-duty actuators presents the Limitorque Hydraulic Scotch Yoke Actuators Series LHS and LHH.

Today’s industry requirements are more rigorous than ever before. Nowhere is this more evident than in the oil and gas industry, where new requirements are incorporated into project specifications almost every day and emphases on personnel safety and equipment uptime is the norm.

To more aggressively meet these demands, Flowserve Limitorque is offering the LHS and LHH Hydraulic Scotch Yoke Heavy-Duty Actuator—specifically designed to meet or exceed the latest and most rigorous of these requirements. This makes Limitorque Scotch Yoke Hydraulic Actuators the most technically advanced and market-compliant actuators available anywhere in the world.

The LHS and LHH ranges of Limitorque hydraulic actuators are robust, modular Scotch yoke design, available in both springreturn and double-acting configurations. They are suitable for actuating ball, butterfly and plug valves or any other quarter-turn application.

LHS and LHH hydraulic actuators deliver up to 300 kNm (221 000 ft-lb) of precisely controlled torque. The LHS and LHH are available in a selection of standard as well as in different and special material executions, upon request.

The same design philosophy, introduced on heavy-duty LPS actuators, has been adopted for the LHS and LHH ranges, delivering enhanced performance and high reliability.

The actuator features a 25-year design life, depending on service conditions, proper installation, operation and maintenance. In order to achieve this industry-leading design life, in-field maintenance is prescribed to be performed every six years of operation. For high-cycle applications, such as control valve operation, more frequent maintenance of replaceable wear surfaces, as outlined in EN 15714, may be required.

To complete the actuation package, LHS and LHH actuators are available with accessories, such as lockout modules, manual overrides and control panels, like hydraulic power units, accumulator racks, self-contained units and other electro-hydraulic solutions.

Limitorque also provides engineering design services for mounting hardware, ensuring that your actuation solution is ready to handle the toughest challenges.

* For higher torque ranges, consult factory.
LHS and LHH: Limitorque Hydraulic Heavy-Duty Scotch Yoke Actuators

With a design life of 25 years* and a maintenance interval up to six years*, the LHS and LHS are hydraulic heavy-duty actuators, with an output torque up to 300 kNm (221 000 ft-lb). Enhanced performance is achieved by using a superior Scotch yoke support design that significantly reduces transverse loads. LHS actuators feature modular construction to minimize repair time and initial cost while maximizing process availability.

Features

• Spring Return Single Acting (Fail Close CW and Fail Open CCW) and Double Acting (Fail Last / Fail As Is) executions
• True modular design for flexible and easy field conversion from Fail Close CW to Fail Open CCW configuration or vice versa
• Symmetrical and canted scotch yoke types to perfectly fit valve torque requirement
• Fabricated carbon steel scotch yoke housing, hydraulic cylinder and spring can, providing the most rugged actuator available; different materials of construction for polar or offshore applications upon request
• ENP Lined Cylinders with Chrome Plated Piston Rod; Stainless Steel Cylinders, Tie Rods and Spool Pieces available upon request
• Available for use in safety integrated systems up to and including SIL Level 3 in accordance with IEC 61508
• Suitable for use in on/off, modulating and control valve application in general service, protective service and safety applications such as ESD or HIPPS
• Full range of accessories and control systems: switchboxes, positioners; ESD and PST functionalities; hydraulic power units, accumulator racks, self-contained units, integrated electro-hydraulic solutions; fire protection; manual and hydraulic overrides

Specifications

• Available in standard single-acting spring return and double-acting configurations, in torque ranges up to 250 kNm (184 000 ft-lb); contact factory for larger sizes
• 207 barg (3000 PSIG) maximum allowable working pressure (MAWP); 345 barg (5000 PSIG) version upon request
• -29°C to 100°C (-20°F to 212°F) standard operating temperature range; Low temperature -60°C (-76°F) and High temperature 160°C (320°F) ranges available upon request (polar, cold, arid and tropical temperature requirements in accordance with IEC 60721)
• End mounted adjustable travel stops ± 5°, available also in an enclosed protected version upon request

Key Certifications and Standards Compliance

• Certified according to ATEX 94/9/EC Ex II 2GD c IIC T6
• NEMA 4 and NEMA 4X configurations, per NEMA 250
• IP66/IP66M and IP67/IP67M configurations
• Standard output valve interface in compliance with ISO 5211
• Actuator spring design in compliance with EN 13906
• Corrosion protection in compliance with ISO 12944-2 and EN 15714-4; optionally available up to and including C5-M
• Available in compliance with NACE specification MR0175 for sour gas applications
• Available in compliance with PED 97/23/EC, ASME BPVC Sec. VIII Div. 1, EN 13445-3 Part 2 for Unfired Pressure Vessels
• Manufactured and tested in compliance with ISO 9001 and EN 15714-4

*Depending on service conditions, proper installation, operation and maintenance.
Anatomy of Limitorque LHS/LHH Actuator

The LHS/LHH ranges of Limitorque hydraulic actuators are a robust, modular Scotch yoke design, available in both spring return and double acting configurations. The design philosophy introduced on the heavy-duty LPS actuator has been adopted for the LHS/LHH ranges, delivering enhanced performance and high reliability. The LHS/LHH are available in a selection of standard as well as in different and special material executions, upon request.

LHS/LHH Spring Return Actuator

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>MATERIAL</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Housing</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>2</td>
<td>Scotch Yoke Bushing</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>3</td>
<td>Scotch Yoke</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>4</td>
<td>Bushing</td>
<td>PTFE + Steel</td>
</tr>
<tr>
<td>5</td>
<td>Cylinder</td>
<td>Carbon Steel (with treatment)</td>
</tr>
<tr>
<td>6</td>
<td>Piston Rod</td>
<td>Alloy Steel (chrome plated)</td>
</tr>
<tr>
<td>7</td>
<td>Piston</td>
<td>Carbon Steel (with treatment)</td>
</tr>
<tr>
<td>8</td>
<td>Stop Bolt</td>
<td>Carbon Steel (with treatment)</td>
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* Special or different materials available upon request

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
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<tr>
<td>9</td>
<td>Hex Nut</td>
<td>Carbon Steel</td>
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<tr>
<td>10</td>
<td>End Flange</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>11</td>
<td>Guide Ring</td>
<td>PTFE + Graphite</td>
</tr>
<tr>
<td>12</td>
<td>O-Ring</td>
<td>NBR</td>
</tr>
<tr>
<td>13</td>
<td>Split Collar</td>
<td>Alloy Steel</td>
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LHS/LHH Standard Materials of Construction*
LHS/LHH Double Acting Actuator

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>MATERIAL</th>
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</thead>
<tbody>
<tr>
<td>14</td>
<td>Tie Rod</td>
<td>Alloy Steel (with treatment)</td>
</tr>
<tr>
<td>15</td>
<td>Head Flange</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>16</td>
<td>Yoke Pin</td>
<td>Alloy Steel</td>
</tr>
<tr>
<td>17</td>
<td>Fork</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>18</td>
<td>Slider Block</td>
<td>Bronze</td>
</tr>
<tr>
<td>19</td>
<td>Guiding Block</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>20</td>
<td>Guide Bar</td>
<td>Alloy Steel (chrome plated)</td>
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</table>

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>MATERIAL</th>
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<tbody>
<tr>
<td>21</td>
<td>Cover</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>22</td>
<td>Spring Rod</td>
<td>Alloy Steel</td>
</tr>
<tr>
<td>23</td>
<td>Spring</td>
<td>Spring Steel</td>
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<tr>
<td>24</td>
<td>Spring Guide</td>
<td>Carbon Steel</td>
</tr>
<tr>
<td>25</td>
<td>Spring Can</td>
<td>Carbon Steel</td>
</tr>
</tbody>
</table>
Due to the Scotch yoke mechanism, LHS/LHH actuators have a particular U-shaped output torque curve, whether powered by a fixed supply pressure or the spring. For a proper actuator model selection, the safety factors between actuator output torque and valve torque requirement shall be calculated at least in six points along the valve stroke. In addition, a final check is necessary to guarantee that actuator Maximum Output Torque does not exceed valve Maximum Allowable Stem Torque (MAST).

The minimum set of parameters and features necessary for an optimal actuator selection:

- Valve torques, including MAST
- Type of actuator:
  - Single Acting/Spring Return: Fail Safe Close (CW) or Fail Safe Open (CCW)
  - Double Acting configuration for Fail Last or Fail As Is
- Minimum, Normal and Maximum Hydraulic Supply Pressure to the actuator
- Safety Factors requested by the project or by a specific application
- Working Temperature range
- Open/Close stroking times
- Additional options (manual override, control panel, limit switch box, positioner, …)

Detailed output torque graphs covering the full valve stroke are available for both spring return and double acting actuators.

### Definitions

<table>
<thead>
<tr>
<th>BTO</th>
<th>Break to open torque</th>
<th>BTC</th>
<th>Break to close torque</th>
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<tbody>
<tr>
<td>RTO</td>
<td>Running to open torque</td>
<td>RTC</td>
<td>Running to close torque</td>
</tr>
<tr>
<td>ETO</td>
<td>End to open torque</td>
<td>ETC</td>
<td>End to close torque</td>
</tr>
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</table>

| MAST | Maximum allowable stem torque | SF | Safety factor |

*Viton is a registered trademark of E. I. du Pont de Nemours.*
LHS/LHH Torque and Pressure Table

<table>
<thead>
<tr>
<th>Model</th>
<th>MOT Maximum Operating Torque Nm (ft-lb)</th>
<th>MOP Maximum Operating Pressure barg (PSIG)</th>
<th>MAWP Maximum Allowable Working Pressure barg (PSIG)</th>
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<tbody>
<tr>
<td>LHS/LHH-15</td>
<td>6000 (4425)</td>
<td></td>
<td>LHS: 207 barg (3000 psig)</td>
</tr>
<tr>
<td>LHS/LHH-20</td>
<td>12 000 (8851)</td>
<td></td>
<td>LHH: 345 barg (5000 psig)</td>
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<td>LHS/LHH-25</td>
<td>20 000 (15 489)</td>
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<td></td>
</tr>
<tr>
<td>LHS/LHH-30</td>
<td>40 500 (29 871)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LHS/LHH-35</td>
<td>75 000 (55 317)</td>
<td></td>
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</tr>
<tr>
<td>LHS/LHH-40</td>
<td>150 000 (110 634)</td>
<td></td>
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<tr>
<td>LHS/LHH-50</td>
<td>300 000 (221 268)</td>
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<tr>
<td>LHS/LHH-60</td>
<td>Consult Factory</td>
<td>Consult Factory</td>
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</tbody>
</table>

* MAWP 410 barg (6000 psig) available upon request

Control System Options
Limitorque offers a selection of standard and custom controls packages for most applications, including:
- Hydraulic Control Panels
- Hydraulic Power Units (HPU)
- Hydraulic Accumulators Racks
- Self-Contained Units (SCU)
- Electro-Hydraulic Integrated Solutions, upon request

Limiterque Additional Product Range Offering

Electric Actuators and Controls
- MX — Non-intrusive, electronic multi-turn actuators
- QX — Non-intrusive, electronic quarter-turn actuators
- Master Station, Controller for redundant networked actuators
- Network Controls, Modbus, Profibus DP/PA, Foundation Fieldbus, DeviceNet, HART
- L120 — Electro-mechanical, Multi-turn electric actuators with integral & network controls
- SMB — Electro-mechanical, Multi-turn electric actuators for nuclear and severe duty service

Fluid Power Actuators
- Scotch Yoke Pneumatic actuators — LPS
- Compact Scotch Yoke Pneumatic actuators — LPC
- Scotch Yoke Hydraulic actuators — LHS/LHH
- Compact Scotch Yoke Hydraulic actuators — LHC*
- Linear Pneumatic actuators — LPL
- Linear Hydraulic actuators — LHL
- Direct Gas actuators — LDG*
- Gas Over Oil actuators — LGO*
- Electro-Hydraulic actuators — LEH*
- Standard and Customized Controls
- Application Engineering Support

Flowsolve Solutions
In addition to providing actuators and controls, Flowsolve and Limitorque lead the industry with all the solutions that our customers need to maintain efficiency and productivity.
- Aftermarket Parts and Services
- Business Assessments
- Actuator Inspection, Maintenance and Repair
- Engineering and Technical Services
  - Engineering Support and Technical Assessments
  - Equipment Performance Analysis and Upgrades
- Education and Training
  - On-site and Online Trainings
- Asset Data Management and Optimization Solutions

Gearboxes
- V — Bevel gearboxes for manual or motorized operation
- WG — Worm gearboxes for manual or motorized operation
- SR — Spur gearboxes for manual or motorized operation

One Flowsolve Solution
Flowsolve brands for most common control accessories:
- Digital Positioners
  - Logix™
  - PMV™
- Analog Positioners
  - PMV
  - Accord™
- Diagnostic Software
  - ValveSight™
- Valve Controllers
  - Automax™
  - Worcester Controls™
- Limit Switch Boxes
  - Worcester Controls
  - PMV
  - Automax
  - Accord

* Contact Flowsolve for product availability and additional information.
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