

BETTIS™

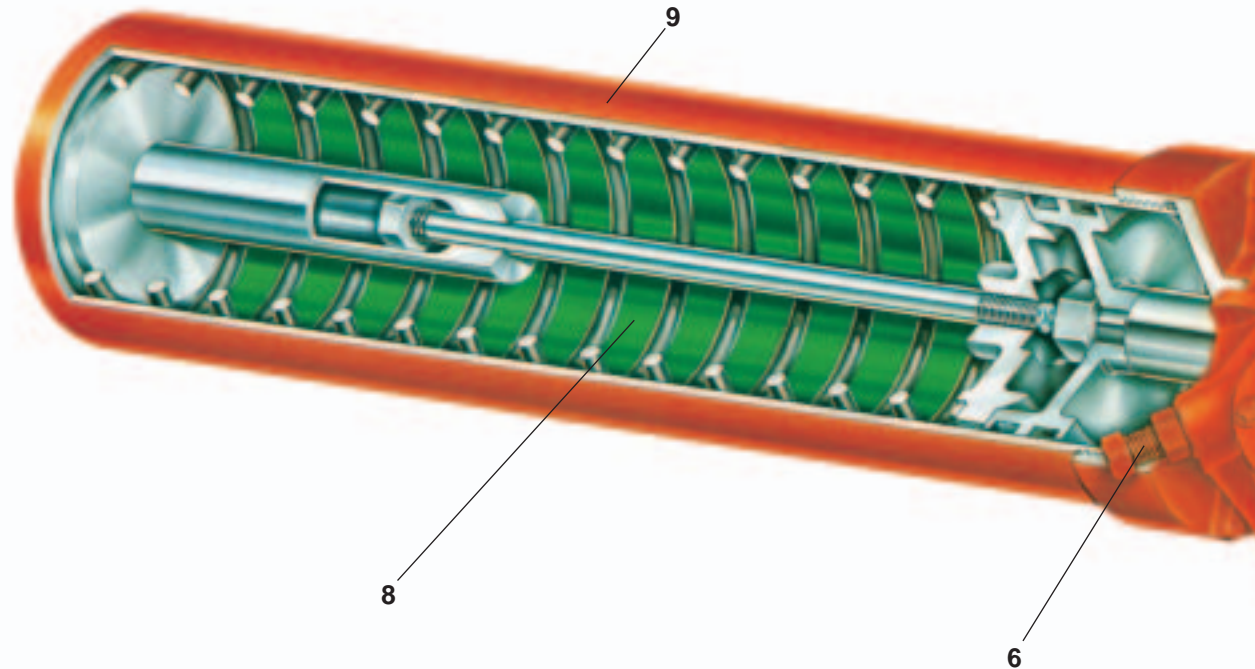
HD-Series Pneumatic & Hydraulic Actuators for Heavy Duty Service




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Process Management

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DESIGN AND CONSTRUCTION



Introduction

Bettis HD-Series pneumatic and hydraulic actuators are ideally suited for operating ball, butterfly, plug valves, dampers and other 90 degree turn devices. The HD-Series actuators provide a practical and reliable method for opening and closing valves by remote control without the need for expensive and unnecessary gearing, hydraulic pumps or other motor driven devices.

Torque Ranges

The **HD-Series** double-acting actuators are available with guaranteed minimum output torques to 50,331 lb-in (5,687 Nm). Fail safe spring-return models produce guaranteed minimum spring ending torques to 18,044 lb-in (2,039 Nm).

Operating Pressures

The HD-Series operates at pressures up to 250 PSIG (17 BAR) or hydraulic pressures up to 3000 PSIG (207 BAR). Consult factory for hydraulic applications

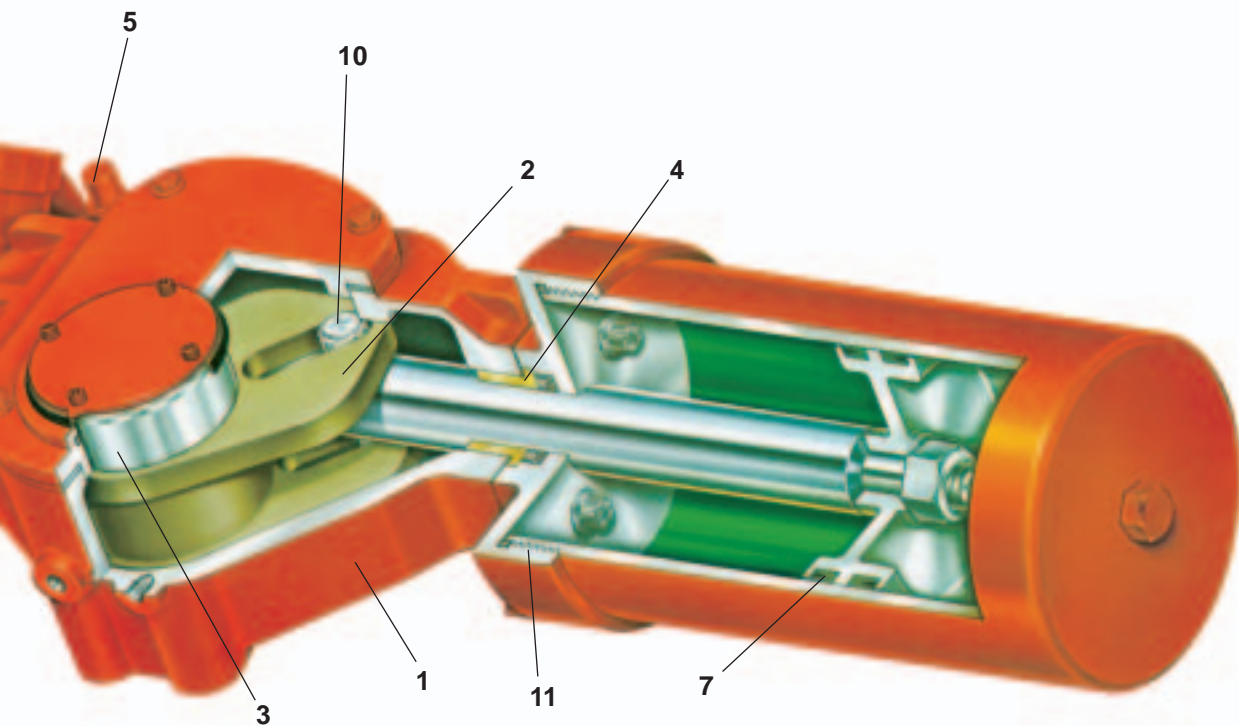
Temperature Ranges

All **HD-Series** heavy duty actuators are designed for operating temperatures of -20°F to +200°F (-29°C to +93°C). Optional low temperature trim allows continuous operation from -50°F to +180°F (-46°C to +82°C). High temperature trim provides operational capabilities from 0°F to +350°F (-18°C to +177°C).

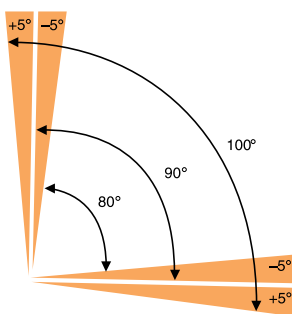
HD Mechanical Components

1 Enclosed Cast Housing. Heavy duty, cast ductile iron housing resists warping or twisting under heavy loads and during wide temperature swings. The cast housing is more stable than plate fabricated housings, minimizing the possibility of stem and component misalignment. Also included are rugged, cast accessory mounting pads and safety designed lifting eyes (not tack welded or bolted-on) for a safe, consistent and maintenance friendly automation package.

- 2 Scotch-Yoke Mechanism.** A balanced scotch-yoke mechanism provides optimum torque output and maintenance simplicity by transforming the linear travel of the piston into a 90 degree rotating movement.
- 3 Journal Bearings.** Large journal bearings in the housing and cover assure proper alignment of the yoke and eliminate side thrust on the valve stem. Yoke journal bearing surfaces and piston rods are coated with a baked on dry film lubricant and corrosion inhibitor for extended service life.
- 4 Dual Rod Bushings.** Bronze piston rod bushings support and guide the piston rod, preventing contact between the piston and cylinder, thus minimizing wear.
- 5 Vented Fill Plug.** A double sealed pressure relief valve exhausts excess body pressure while preventing the ingress of water or atmospheric contaminants from entering the housing.



6 Bi-directional Travel Stops. Travel stops are an integral part of the actuator allowing 80° to 100° total travel adjustment. Extended travel stops are optional.



7 Piston Seals. Dual pressure-energized, wear-compensating lip seals help to evenly disperse lubricants for exceptional life while minimizing seal and cylinder wear. Optional seals for high or low temperature service and other unique applications are available.

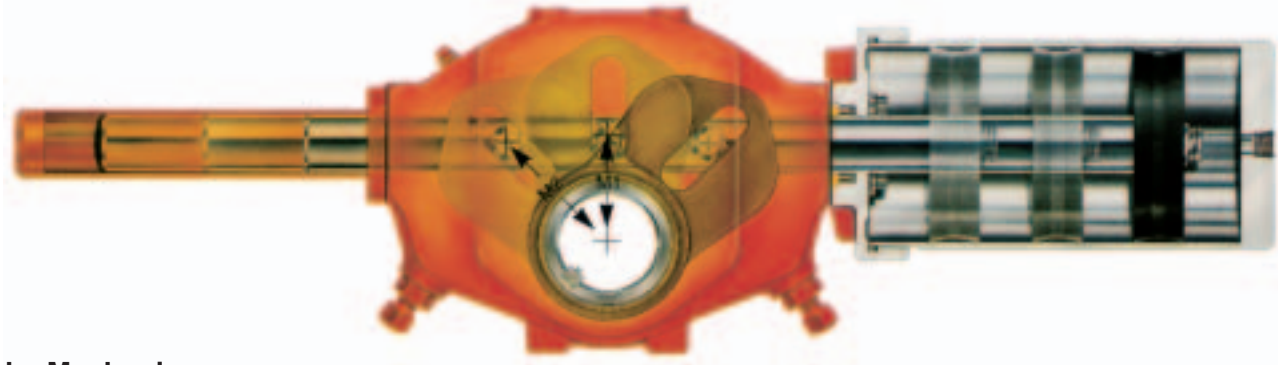
8 Xylan™ Cylinder Coating. HD actuators use rugged Xylan cylinder coating. Xylan combines PTFE and organic polymers to provide for excellent corrosion protection. Because the base material is PTFE, it also provides low coefficients of friction. Xylan is bonded so effectively to the chemically prepared cylinder surface, that unlike nickel, chrome and most metallic coatings, cracking and flaking are virtually eliminated. Xylan has been field proven to be a superior cylinder finish and, using third party labs in conjunction with ASTM B117 Salt Spray Testing methods, achieved excellent results even after 500 hours of salt spray exposure.

9 Spring Cartridge. Spring-return models can be assembled to rotate clockwise or counterclockwise on the loss of operating pressure. Spring return models are furnished with “-service safe” welded spring cartridges or cylinders. The spring assembly can be safely changed or replaced in the field without the use of special tools.

10 Yoke Pin Roller Bearings. The yoke pin has hardened steel roller bearings, which roll within the yoke slot. This feature efficiently and smoothly transfers the piston-generated force to the yoke. Unlike bearing blocks which drag along a yoke slot, roller bearings distribute wear evenly around the bearing circumference, reducing degradation leading to excessive backlash.

11 Threaded Cylinders. HD-Series actuators feature threaded, code welded cylinders. All threads and bore are coated with Xylan™ to protect them from mechanical damage. External tie bars are not used, as they can be damaged both by improper assembly (over-stressing) and corrosion, particularly at the threads. Should corrosion or overtightening occur, failure of critical pressure-containing components could expose personnel to significant hazard.

OPERATING PRINCIPLE



Scotch-Yoke Mechanism

A balanced scotch-yoke mechanism produces torque that closely matches the requirements of most quarter-turn valves. Unlike other methods, such as a crank arm that produces its lowest torque at the start and the end of each stroke, the balanced scotch-yoke produces its highest torque at the start and the end of each stroke, providing maximum torque precisely where it is

required to efficiently operate most quarter-turn valves.

As the piston moves, the length of the moment arm is changing constantly. Because the effective moment arm is longest at the start and the end of the stroke (M2), the start torque (torque output at the start and the end of a stroke) approaches twice the magnitude of the minimum torque (M1)

(torque output at the shortest moment arm length).

This amplification and efficiency of torque output allows the use of a smaller piston, shorter moment arm and lower operating pressures than many other mechanisms. Bettis guarantees all published torque outputs as minimum values. With Bettis, you know what you are getting for your investment.

Manual Overrides

Bettis actuators are available with a variety of manual overrides designed to deliver full rated torque output without assistance from an external power source.

Actuator Series	Available Overrides*	
	Mechanical	Hydraulic
HD Spring-Return	M3 or M3HW	M11
HD Double-Acting	Wrench, M3 or M3HW	M11

- M3 Jackscrew (mechanically locks actuator in position)
- M3HW Jackscrew with handwheel
- M11 Manual Hydraulic Piston Pump with directional control valve

*Consult factory for other types of overrides and override systems.

Mechanical Overrides

On smaller **HD-Series** double-acting actuators, a shaft can be extended through the top of the housing and is easily operated with a simple hand wrench. All HD-Series models can be furnished with jackscrew(s) as an integral part of the unit for hand-wheel or wrench operation.

Hydraulic Overrides

Bettis provides user friendly and dependable self contained hydraulic overrides that do not require a hydraulic power source. Power is provided by operation of a local manual hydraulic hand pump. Hydraulic

manual override systems for both double-acting and spring-return actuators are available with bi-directional speed control during manual and power operation.

Trim Options

For special applications and/or extreme environments, Bettis engineers have developed a wide variety of optional trims with special design criteria. Trim options include: high and low temperature applications, stain-

less steel hardware and special corrosion resistant exterior coatings for offshore applications, high cycle or high speeds, controlled hardness metals and no copper or yellow metals for hydrogen sulfide atmospheres.

The N-Series is specifically designed for nuclear power plant installations and meets the rigid design criteria of the nuclear power industry.

Consult Bettis for more information on specific trim requirements.

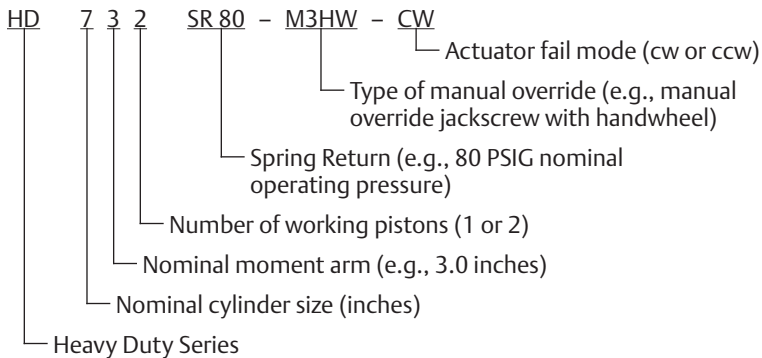
TYPICAL SPECIFICATIONS

The following information may be used as a guide to compose specifications for HD-Series actuators. Bettis supplies actuators that meet or exceed all the specifications stated below.

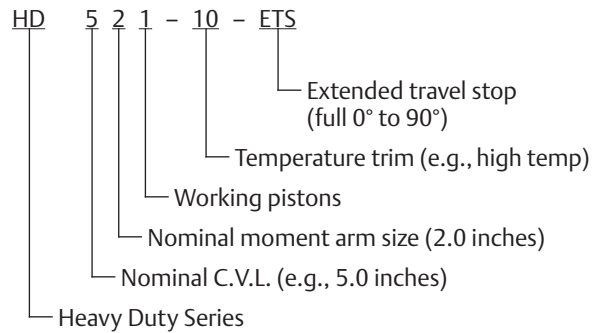
1. All double-acting actuators shall be of the balanced scotch-yoke design and be capable of producing a torque output at both the start and end positions (0 and 90 degrees) of at least 1 1/2 times the minimum torque output. Spring-return actuators shall be of the balanced scotch-yoke design (i.e., air ending and spring ending as well as air start and spring start shall have comparable torque output values).
2. The actuator shall be effectively sealed to prevent entry of water, atmospheric corrosive gases and airborne abrasive dust or water.
3. Power cylinders and spring cartridges shall be mounted rigidly to the actuator housing using metal-to-metal interfaces and weather tight seals. The power cylinder shall be retained by environmentally protected internal tie bars, machined threads on the outside diameter of the cylinder, or rigidly attached by external bolting to the main housing. External tie bars or brace rods on the pneumatic power cylinder are prohibited.
4. The actuator shall utilize permanently lubricated, high performance yoke trunnion and piston rod bearings.
5. All bearings shall be sized and material selected to provide maximum service life while performing as sacrificial protectors of critical sealing and structural components.
6. All bearing surfaces, including cylinder, piston rods, tie rods and yoke shall be treated to provide a durable, self-lubricating, corrosion and wear resistant surface.
7. The actuator shall be permanently lubricated, devoid of lubrication fittings and factory approved for "zero" preventative maintenance practices.
8. Factory installed instrument tubing shall be type 316 stainless steel with corrosion resistant steel fittings.
9. The actuator travel stops shall provide accurate adjustment, be friction locked to prevent changes due to vibration and impact loads, and be positively sealed.
10. Bi-directional travel stops shall be an integral part of the actuator allowing 80° to 100° total travel adjustment. These travel stops shall be capable of stalling the actuators maximum torque output.
11. Actuator torque outputs shall be guaranteed minimum values auditable to type test of each model. Torque testing and certification in accordance with approved test procedures and Q.A. processes must be available on request.
12. The housing, spring cartridge and non-pressurized cylinder elements shall be environmentally protected by a normally closed vent system facilitating a positive pressure purge during operation per BSK 2661, if applicable.
13. The position indicator shall be indexable and highly visible from vertical or horizontal positions for optional valve mounting orientation.
14. When a manual override is specified, it shall be capable of operating the actuator without assistance from the power gas system, produce full rated torque of the actuator and incorporate torque limiting devices to minimize possibilities of valve damage.
15. The actuator shall be manufacturer's standard design capable of operating in a wide range of applications, including corrosive atmospheres, without addition of special trim equipment.

ORDERING / MODEL DESIGNATION

Spring-Return Example



Double-Acting Example



OPTIONAL ACCESSORIES

Bettisystems™

Bettis has pre-engineered and documented a series of commonly required control systems. These approved systems utilize standard components, reduce lead times, and simplify purchasing, installation and startup. We can design a custom Bettisystem™ for you, please contact the factory with your specifications.

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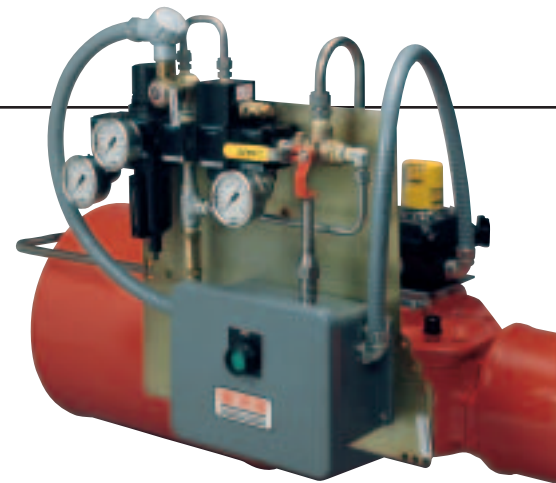
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Important: Due to Emerson's continuing commitment to engineered product advancement, data presented herein is subject to change.

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