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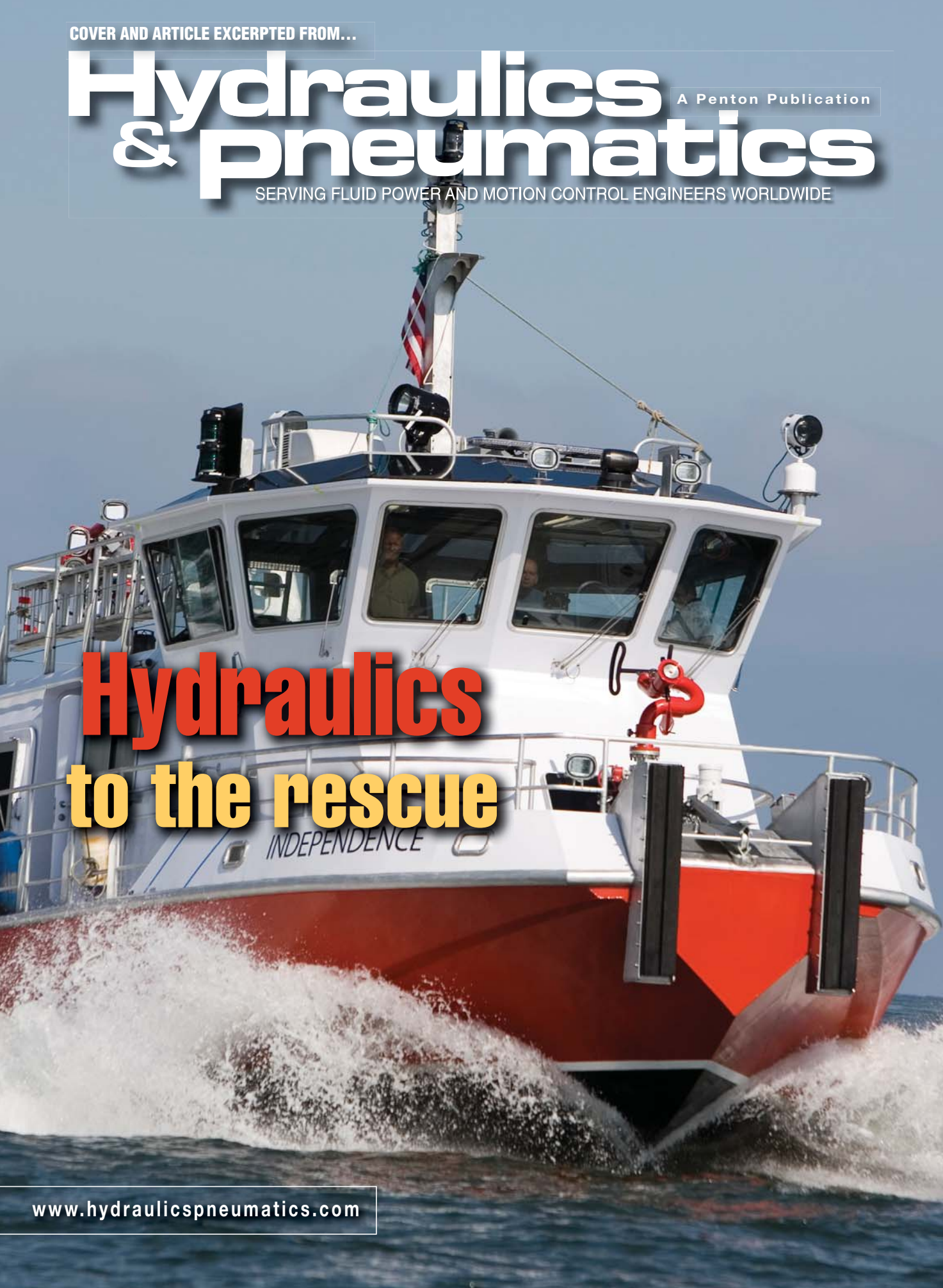


Hydraulics to the rescue

www.hydraulicspneumatics.com

Edited by **Alan L. Hitchcox**

Boat ducks for low bridges

Considering that more than six million people live in the Philadelphia region, government officials realized they needed a fast-response emergency river vessel with both fire fighting and rescue capabilities for any type of emergency it may encounter. Philadelphia officials turned to Derecktor Shipyards, New York, to manufacture the Independence, a 2000-Class Fireboat, which was christened in December 2007.

The Independence, a fire and rescue boat, has a navigation mast mounted to the top of its pilot house that pivots downward when the vessel must pass under a low clearance. The mast is pivoted 180° by a helical rotary actuator.

Established in 1947, Derecktor Shipyards builds a variety of commercial vessels and custom mega yachts for customers around the world.

The waterways around the Philadelphia region pose a significant and serious set of obstacles that needed to be considered when designing and building the Independence. With regional responsibilities from as far north as Trenton, N. J. and as far south as the Delaware Bay, the Independence would find itself in water depths as shallow as 30 in. Furthermore, some of the waterways are very narrow, so the Independence was designed to make 360° turns.

The Independence is powered by four 825 hp engines, allowing it to achieve speeds of 36 knots. Its fire fighting arsenal includes a water pump capable of 5500 gpm and 200 foam tank capacity. It also has a 16-ft rescue boat, and its galley can be converted into a trauma unit complete with advanced life support equipment.

However, the greatest challenge for the fireboat was its height. Many bridge structures in the area only allow vessels with an air draft of 18 feet to pass underneath. Air draft is the distance from the water surface to the upper-most point of a vessel. Therefore, keeping the air draft of the Independence less than 18 feet was imperative to its safe travel and access to all areas within its range.

Making moves

To enable the Independence to achieve an air draft of only 18 feet, a navigation tower on top of the pilot house needed to be pivoted 110°. This is accomplished using a helical rotary actuator from Helac Corp., Enumclaw, Washington.

According to Joe Beckham, project manager at Derecktor Shipyards, “With the navigation mast situated on top of the pilot house, determining how to rotate it through its 110° of travel was difficult.” Hydraulic cylinders and electromechanical positioning devices had been considered, but a Helac L20-15-E-FT-180 rotary actuator was specified to position the mast.

Rotary actuator benefits

Beckham summarized the rationale in four major points. First, the rotary actuator makes better use of space than the other alternatives considered. Hydraulic cylinders and electromechanical positioning devices would have required a well or cavity below the mast. This well would have protruded down into the pilot house. Considering the limited space available, the compact design of the rotary actuator made it the optimal choice.

Second, the rotary actuator

requires less maintenance as a positioning device than hydraulic cylinders. Sealing occurs against smooth cylindrical surfaces, effectively eliminating all leakage and holding selected positions without drift. There are no external moving parts, which eliminates the service and maintenance issue often associated with hydraulic cylinders and mechanical linkages in a marine application.

The L20-15 rotary actuator converts hydraulic energy into high-torque rotational power. Pressurized fluid entering the inlet port forces an internal piston to move axially. Internal and external helical splines convert linear motion of the piston into high-torque rotational output.

Third, the rotary actuator delivers high torque and 110° of smooth rotation from the limited hydraulic supply with power to spare. Achieving 110° of rotation is possible with alternative solutions. However, the L20-15 delivers up to 15,000 lb-in. of torque and produces consistent, smooth motion from a 3000-psi hydraulic source.

Beckham explained that the actuator "rotated the mast from horizontal to vertical so quickly and smoothly that we actually dialed back the pressure to slow it down."

Fourth, Derecktor shipyards saved substantial installation time and cost because the L20-15 serves the double function of rotary actuator and bearing support all in one compact package. This self-contained design reduced the number of parts required of the mast assembly.

It happens from hydraulics

Hydraulic power for the Independence is supplied by a hydraulic power unit (HPU) in the fireboat's engine room. The rotary actuator is plumbed directly from the HPU. Maximum system pressure is 3000 psi with 8 gpm of flow. Operating pressure for lifting the mast typically ranges from 1500 to 2000 psi.

Pressurized fluid flows from the HPU to the inlet port of the actuator (visible on the left end in the image above). Fluid pressure forces an internal piston to move axially. Internal and external helical splines convert linear motion of the piston into high-torque rotational output.

For more information on Helac's rotary actuators, visit www.helac.com.

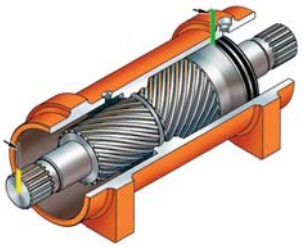
Operating Technology

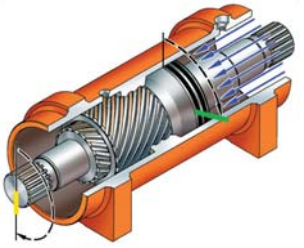
Helac actuators are designed to replace multiple components and function as a rotating device, mounting bracket and bearing, all-in-one.

Helac's innovative, sliding-spline operation technology converts linear piston motion into powerful shaft rotation. Each actuator is composed of a housing and two moving parts — the central shaft and piston. Helical spline teeth on the shaft engage matching teeth on the piston's inside diameter. A second set of helical splines on the piston's outside diameter mesh with the gear in the housing.

STARTING POSITION

The piston is completely bottomed out. Bars indicate starting positions of piston and shaft. Arrows indicate directions they will rotate. The housing with integral gear remains stationary.





ENDING POSITION

When hydraulic pressure is applied to the piston, it moves axially, while the helical gearing causes the piston and shaft to rotate simultaneously. Applying pressure to the opposite port will return the piston and shaft to their original starting positions.

HELAC®

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