(Material) Moving into the Future

STRADDLE CARRIER IS EQUIPPED WITH ELECTROHYDRAULIC BRAKES, INTELLIGENT CONTROLS

Mico Incorporated

Mico's electrohydraulic brake system offered Great Lakes Power a variety of electronic control functions (all photos courtesy of Mico).

In the world of industrial equipment, there are plenty of roles to be filled. There are the end users who need specific types of machinery to run effective operations. There are distributors and dealers who supply and service a variety of products. And, of course, there are manufacturers who engineer and develop equipment. Most companies are perfectly content to put their full energies into successfully serving only one of these purposes. But other businesses may find themselves branching out from one area to another.

Take Great Lakes Power, for example, an Ohio-based company that has been anything but complacent throughout its history. Founded in 1973 by Harry Allen, Jr., Great Lakes Power began primarily as a franchised distributor for Twin Disc, Inc., a manufacturer of transmissions, clutches and powertrain components. Through organic growth and strategic acquisitions over 37 years, the company has evolved into a unique organization that focuses not just on service and distribution, but on engineering and manufacturing as well.

"We are problem solvers," said Harry Allen III, vice president of sales for Great Lakes Power, and one of five family members actively involved in the second-generation family business. "We pride ourselves in developing and sustaining long-lasting relationships with our customers and suppliers, and they trust us to deliver solutions."

A rather notable demonstration of Great Lakes Power's customer commitment took shape back in 1989 about five years after the company began distributing Hyster material handling equipment, when Hyster announced they would discontinue their straddle carrier product line. While the move by Hyster closed off a supply chain, it also served to open the door for Great Lakes Power's remanufacturing business.

"Ever since Hyster's Legacy straddle carriers have been out of production, we have been rebuilding and upgrading these units for our customers," said Allen. "These machines were originally manufactured anywhere from the 1960s to about 1990. So there are some challenges in providing obsolete spare parts and servicing vehicles of that age and condition."

Some of the potential applications for straddle carriers include material handling in steel mills, refineries and lumber mills, as well as transporting goods and components for shipbuilding, steel erection on construction projects, wind turbine assembly, and military activities. With such a wide range of possible uses for the machines, there was a diverse population of customers looking to keep their older units up and running.

In recent years, as it became apparent that the Hyster straddle carriers were reaching or exceeding the point where rebuilds were still economically viable, Great Lakes Power began to explore the possibility of engineering and producing its own new replacement option. "Bringing our own product to market is important to our company's future for two key reasons," said Allen. "First off, we are not geographically limited to a regional, domestic customer base as is the norm for a distribution business. This is particularly crucial because we think a significant percentage of sales for the new straddle carrier will come from outside North America. Second, as a distributor we can only be as successful as our partners allow us to be, but as the manufacturer we can control how we market and sell the product."

Development of a new straddle carrier was naturally assisted by 20 years of experience remanufacturing the Hyster product, during which time Great Lakes Power had incorporated various engineered upgrades of its own to address weak points or chronic problem areas. "We were able to take into account many customer suggestions and wish lists," Allen said. "The concept was to produce a state-of-the-art straddle carrier that would excel in new applications and be compatible for customers still operating Hyster Legacy fleets."

As Great Lakes Power prepared to build the prototype of its first production straddle carrier, the ST35, it determined that it would be advantageous to seek out an existing customer partner located in close proximity to the company's manufacturing facility. They found the perfect collaborator in The Timken Company, a global manufacturer of bearings and alloy steels and longtime user of Hyster straddle carriers. With Timken running the unit just an hour away, Great Lakes Power would be able to closely monitor and support the machine, while also having a demonstration area nearby for prospective customers.

The concept of Great Lakes Power's straddle carrier was to produce a state-of-the-art vehicle that provides advantages over alternative types of material handling equipment.

As is the usual case with straddle carriers, the ST 35 was engineered to provide certain advantages over alternative types of material handling equipment—like forklift trucks—in regard to factors such as travel speed, adaptability to road conditions, and the ability to efficiently move long and heavy loads in intra-plant transport.

Where the new design took on a revolutionary look was in its ambition to drastically improve upon several aspects of the Hyster Legacy, from improved safety and operator ergonomics to higher performance and lower operating costs. "One of the factors that sets a straddle carrier apart to begin with is the ability to pick up and deliver a load with only one operator," said Allen. "We focused on furthering this advantage by enhancing the operator experience."

This effort can be seen quickly in the ST35's center-mounted panoramic view operator cabin, which offers improved visibility of the load and surrounding area. Roof-mounted windows also make it possible to see overhead cranes and suspended loads in the operating area. The operator's seat itself is also more practical, enabling 180-degree rotation so that the operator can always face the direction of travel—although this functional requirement dictated that Great Lakes Power would have to think outside traditional means when it came to the machine's braking system. "A conventional hydraulic brake system would have required two sets of fixed pedals due to the operating fluid connections," said Allen. "So using a brake-by-wire, or electrohydraulic, system was definitely on our radar screen because that would allow the brake pedal to be mounted so it would rotate with the operator."

There was no question that Great Lakes Power was undertaking a huge project introducing significant technological integrations, but braking was one endeavor they felt was best left to a dedicated expert. "We did not want to be 'pioneers' with a safety critical system like the brakes," said Allen. "So we connected with Mico, Incorporated. I've known them to be a high quality supplier of brake systems for off-highway equipment, and by partnering with them we were confident we would provide a reliable and efficient braking system for the ST35."

Not only did the Mico electrohydraulic brake system allow Great Lakes Power to design the operator's cab as desired,

Because the straddle carrier has a lifting capacity in excess of its own empty weight, the brake system must have the ability to modulate the braking pressure.

but it also was inherently consistent with the wide array of sophisticated electronic control functions built into the machine. "This electrohydraulic system provides a lot of flexibility," said Allen. "It simplifies the hydraulic plumbing that would otherwise be required. It eliminates the need to protect the operator from pressurized hydraulic lines in the cab, and we can more easily remove the cab for vehicle transport. Overall it's compatible with our goals of being able to monitor complete machine performance at one location, that being our master controller. There is no need to modify components. All it takes is simple parameter changes in the master controller to tailor a machine's braking requirements to a specific customer's request."

The ST35 can handle loads of up to 35 metric tons. Because the straddle carrier has a lifting capacity in excess of its own empty weight, the brake system must have the ability to modulate the applied braking pressures, especially when the machine is unloaded. Traditionally straddle carriers used air over hydraulic systems, but operators often complained about overly aggressive braking performance when the unit was empty. Additionally, sometimes straddle carrier loads can shift under aggressive braking conditions. According to Allen, the electrohydraulic system on the ST35 provides faster and smoother brake response for better control of the situation.

Electrohydraulic braking also makes it easier to adjust the machine for specific uses. "All straddle carriers are custom built with regard to the inside frame height and width dimensions to accommodate a particular bolster or pallet size," said Allen. "These dimensions can vary greatly from one customer to another. This electrohydraulic system can be easily adapted to the range of frame sizes we expect to build."

As for how the electrohydraulic braking system actually works, it originates at the Mico brake foot pedal, where two crossing outputs from the pedal are monitored by the straddle carrier's master controller, which in turn sends a message via a J1939 CAN BUS network to the I/O modules mounted in the side frames. These modules provide a proportional current output directly to the Mico solenoid service brake valves, each of which is located at a corner of the machine as close as possible to the service brake it controls.

The ST35's 365-horsepower Cummins engine includes an auxiliary PTO location with a dual section gear pump. One section of the pump supplies the accumulator charging valve to provide 2,500 psi of pressure to both sides of the braking system. Once charged, the excess flow from this circuit combines with pump flow from the second gear pump section and then is equally distributed to provide cooling for all four brakes. Brake valve and brake coolant returns are combined and filtered to 10 microns before passing through an oil to brake cooler and returning to the tank. "The brake system has a separate reservoir for two reasons," said Allen. "It prevents any brake friction media from contaminating the hydraulic system, and it enables us to use a specific specialty brake fluid with friction modifiers to optimize wet disc brake operation."

Another key consideration in the design of the ST35 braking system was redundancy. "In wired systems there is no mechanical connection between the brake pedal and the service brakes," said Allen. "We need a level of redundancy to ensure that control is maintained and the system is safe against any one failure. The braking system must continue to function in the event of something like a loss of power to the master controller." To ensure braking function is never lost, Great Lakes Power added a redundant brake controller (RBC) to the ST35. The RBC is very similar to the I/O modules that supply current to the hydraulic brake valves. It provides reference voltage and monitors a third voltage output from the brake pedal. The RBC is always active but is placed in "standby" mode when a digital input is received from the master controller.

In addition to advanced braking technology, the straddle carrier also features a steer-by-wire system with four different steering modes—four wheel coordinated, two wheel front, two wheel rear, and crab steering. The electronically controlled steering restricts the steering angles of the rear wheels at high travel speeds to improve stability.

The machine's electronic controls system also monitors operating conditions and alerts the operator if any maintenance is required. A telematics package transmits information like load weights, GPS-based location and alert messages to a dispatch office, and future enhancements will allow remote monitoring and

parameter changes to the straddle carrier, eliminating the need to send a service technician to the job site.

The Timken Company took delivery of the first ST35 in April 2010, and early reviews have been extremely positive. "This machine is state of the art compared to the vehicles we already have," said Howard Millar, Timken's material movement training coordinator. "The brake system is outstanding. It provides controlled braking in a straight line, and the variation in brake modulation is excellent. We're very confident in the vehicle brakes."

Great Lakes Power intends to develop two additional straddle carrier models in the near future, the ST20 (20 metric ton capacity) and ST50 (50 metric ton capacity). "We feel that our design is scalable to meet the requirements for efficiently handling these load capacities," said Allen.

With its first straddle carrier having already met expectations, it shouldn't be long before Great Lakes Power is producing machines for more and more customers in need of material handling equipment. And at that point it will be clear that the company made the correct strategic move in taking the technical expertise it gained as a supplier, and putting it to use in becoming the innovative manufacturer of the next generation straddle carrier.

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Mico Takes On Efficiency, Size, Weight and Costs of New Vehicle Components

Matthew Jaster, Associate Editor

Mico first approaches a new component design by fully understanding the customer requirements including component features, potential improvements, cost targets and lead times. "We also evaluate the internal processes that will be used to manufacture the new component including machining processes, tooling, fixtures, etc.," says Mark Werner, marketing manager at Mico, Incorporated. "The goal is always to design a component that maximizes the value to both the customer and Mico."

Thanks to new Tier 4 requirements in off-highway vehicles, Mico is getting a great deal of customer requests for custom components. "Some of this involves slight modifications to an existing product while others require a complete new product design that is unique to the customer and the application," Werner says.

Pedal-actuated modulating valve.

Mico also works with its customers to design a solution for each model in a particular product line. "A customer may produce four different models of wheel loaders and we will design a custom component that maximizes the performance and value of each wheel loader that the customer manufactures," Werner says.

While the construction, agriculture, material handling and mining industries are a hot bed so to speak for custom components, many of these markets are also looking for more efficiency by using electrohydraulic components in their designs. "It is important for us to understand if there are any vehicle performance issues or upgrades that we could address in our components that would in turn help the customer increase their vehicle's value in the marketplace," Werner says. "The customer's design engineers have direct access to our product engineers and through this partnership Mico is able to design components that meet the customer's requirements."

If the lead time will not fit the customer's requirements, Mico will work with them to see if there are some design characteristics or other considerations that will shorten the lead time. "The customer usually has a predetermined time line for new vehicle development and due to the nature of our components, we are usually able to meet the lead time of the new vehicle development without issue," Werner adds.

Electrohydraulic brake valve.

For 65 years, the company has engineered and manufactured custom designed components, and its experience and reputation have played a large role in the markets it currently serves. "Potential customers frequently approach Mico because of this reputation," Werner adds. "Mico needs to continue to market this recognition. Our new 'You Build It, We Brake It' ad campaign specifically focuses on custom designed solutions."

For more information on Mico's various custom braking solutions, visit *www.mico.com*.