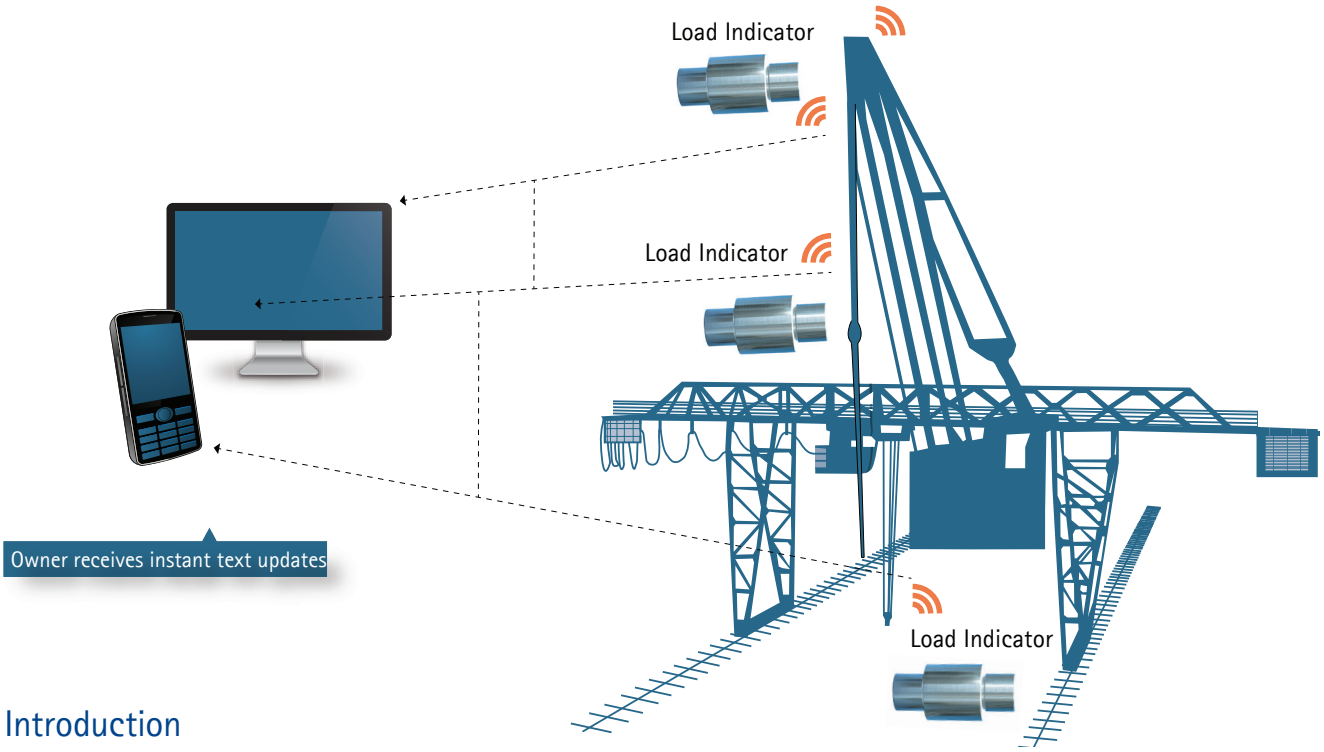
HBM White Paper

Load Pins Help Crane Operators Reduce Maintenance Costs



Introduction

In order to be operated safely, cranes need regular maintenance to replace parts that have come to the end of their service life. This can help prevent catastrophic failures in the future. Unfortunately, this maintenance often includes replacing and scrapping parts that are perfectly safe to keep using. The reason for this is that until recently, it was impossible to really know how much stress and load critical parts had experienced, and if they were really at the end of their operational life.

To help reduce maintenance costs, new cranes have monitoring systems that actually monitor the stresses experienced by key crane components. These monitoring systems can measure and record the stresses, loads and time on the key components, and alert operators when the crane hits certain "milestones." The use of these systems can reduce maintenance costs by up to 75% for crane operators.

On an average crane, that could be a cost savings of up to $75,000 per year. Monitoring systems are also available to retrofit existing cranes. Several companies offer monitoring systems that can be used on older cranes, giving them essentially the same monitoring functionality now found on newer cranes. These systems help operators of older cranes also reduce their maintenance costs and reduce failures.

Strain gaged based sensors such as load pins and strain links are the critical sensing component of these systems. They replace clevis or pivot pins and allow crane operators to measure the forces at these critical points. By measuring and recording these forces over a long period of time, the crane monitoring system is able to predict in greater detail the maintenance needs of the crane.

Load Pin Basics

Load pins are strain-gage based transducers that are used to measure load, compression, or tension in a mechanical assembly. Load pins are typically installed into machines as direct replacements for clevis or pivot pins. Because they directly replace parts of a mechanical assembly, the biggest advantage is that that they do not normally require any change to the mechanical structure being monitored.

Load pins are used in a large variety of applications. In addition to cranes, load pins are used in

- Hoisting gear
- Boom trucks
- Submersible anchor and sea ploughs
- Winches
- Cable laying equipment
- Marine, tankers, offshore platforms
- Rope, chain, and brake anchors
- Bearing blocks, pivots and shackles
- Elevators and floor conveyors

As shown in Figure 1, a load pin deforms slightly when a force is applied to the pin. Strain gages installed inside the load pin, measure this force. To ensure accurate and repeatable results, a load pin must be positioned so that the strain gages are perpendicular to the force being applied to it. The load pin must also be prevented from rotating. There are several different ways to do this.

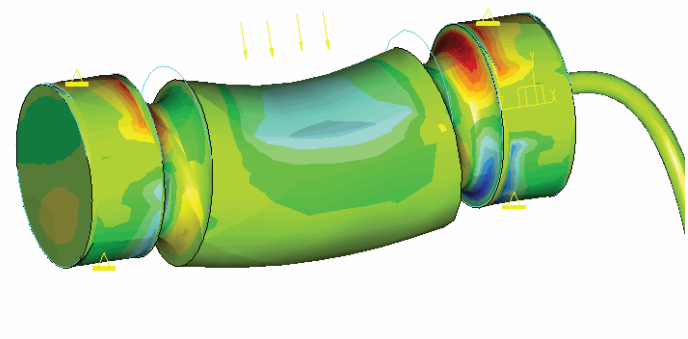


Figure 1. A load pin deforms slightly when a force is applied to the pin. Strain gages installed inside the load pin, measure this force.

Because the strain gages are mounted internally to the load pin, they are inherently protected from the environment. This protection is enhanced when the load pin is fitted with welded end caps or end caps sealed with an O-ring. In either configuration, the result is a highly reliable operation. Load pins are virtually maintenance free, even in the relatively hostile operating environment of a construction crane.

Load pins are available in a wide variety of styles and capacities. Rated capacity can hold up to 100 tons. Typically, overload is 150% of rated capacity and the ultimate breaking load greater than 300% of rated capacity.

Load pins can also be purchased with different types of output signals, including mV/V output, 4-20mA current loop output, 0-5 V DC output, and 0-10 V output. The load pin that HBM recently made for a crane-monitoring system not only had a 0-10 V output, but also a wireless adapter. The wireless adapter allows the user to position the load pins wherever they need to on a crane and not have to worry about routing cables.

Important Specifications

When specifying a load pin for this application, accuracy and repeatability are two very important and beneficial requirements. An HBM load pin averages better than 0.5% (0.005) of accuracy. One of HBM customer's multi-point calibration of a 65,000 pound load pin found that, the HBM sensor performed within 145 pounds of the target weight compared to 354 pounds using a competitor's model.

Safety is a major reason why accuracy and repeatability are important. With correct measurements, the maintenance schedule can be determined. Therefore, maintenance on the crane is performed only when needed. This will result in safer operation as well as reduced maintenance costs.

When selecting a load pin for a crane-monitoring system, also consider some things that are not on the data sheet. One of these intangibles is supplier capability and expertise. Because products like these are practically all custom designs, evaluating how capable the supplier is of providing a load pin that meets specific applications is important. Also, a more capable supplier will be better able to provide the support needed when using the load pin with the system.

Finally, be sure to consider value and delivery time. A capable supplier will be able deliver valuable parts in a timely manner. Timely deliveries could mean the difference between making a sale and not making a sale.

Case Study

Recently, HBM had the opportunity to work with a company that offers a customized monitoring system that they install on existing cranes without monitoring equipment. This system allows the crane owner to control and monitor all technical, maintenance, inventory and financial information related to the crane as well as the various specific tasks the crane is assigned to in a particular project.

The system includes wireless data-acquisition that can be equipped with six to twelve input channels that monitor the following sensors:

- an HBM load pin with a full-bridge strain gage to measure the weight on the crane,
- a length sensor to determine how far the crane boom has been extended or retracted,
- a "slew sensor" that measures the swing of the crane boom in degrees,
- an engine-monitoring package that may contain temperature sensors, force sensors, and other sensors, depending on crane usage.

The sensors connect wirelessly to the data-acquisition system. Additional hardware includes a communication module that interfaces the monitoring system to a programmable logic controller (PLC). The software package is also a custom design tailored to a customer's process and requirements.

The software performs several functions. Perhaps the most popular is that it calculates a parameter called "ton hour value." Ton hour value is a measure of how much value is being gained from a crane based on weight. It includes all of the costs it takes to maintain the crane, including maintenance costs, labor costs, and travel costs.

As already mentioned, the system also performs maintenance scheduling. It tracks both run hours and weight hours. By tracking these numbers exactly, crane operators can go to a longer maintenance cycle and replacement cycle. The reason for this is that many expensive parts are exposed to a small percentage of their full capacity in normal operation. For example, if a load pin is rated 50,000 pounds, but technical data states that the crane has never lifted more than 30% of its capacity, its replacement time is much longer than if it is consistently lifting weights near its capacity.

When a crane does not have a monitoring system, crane owners schedule service every 6 months and simply scrap the parts they replace, even if a part has had little usage and does not require replacement. These parts can cost up to several thousand dollars. Avoiding these unnecessary costs would be attractive to crane operators.

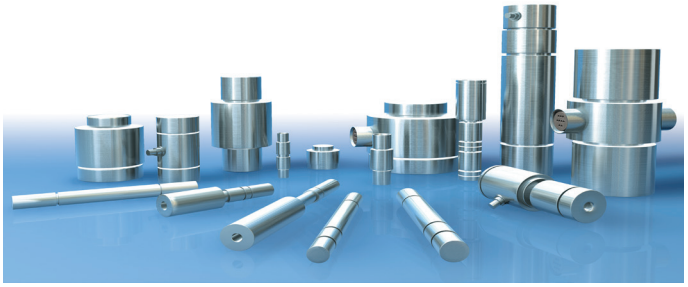
Another function is predictive failure analysis and preventative equipment damage control. By monitoring critical operating parameters, such as engine operation, hoist position, and lifting weight, the system can predict failures. Should any of these parameters approach critical values, the system can shut the system down and prevent any damage. While the crane is offline, the monitoring system can contact a control center and notify the center why the shutdown was required.

Accuracy, Timely Delivery Makes System a Success

Before they approached HBM, the company was using a load pin from another manufacturer. Unfortunately, that part was not really accurate or repeatable enough for this application and the customer was not getting the results they wanted. After talking to HBM, the customer received a more accurate part and in an expedited delivery of two weeks. Since HBM is one of the few manufacturers of the internal strain gage, they were able to design and build for a two week dock date.

In addition, because HBM manufactures load pins here in the U.S., it was more able to consistently meet delivery dates.HBM also helped the company integrate the load pin into their system, including helping them with the wireless gateway. HBM even modified the load pin design so that the wireless gateway could more easily connect to the load pin.

The crane monitoring system has proven to be a successful product, and HBM is proud to be part of it. This system is currently in use on more than 20 cranes, and that number could reach 100 by the end of 2013. Each and every one of them is saving their owners and operators thousands of dollars annually in maintenance costs.



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