Monitoring Equipment

SPECIFYING THE RIGHT EQUIPMENT, INSTALLING AND MAINTAINING IT

This article is based on a presentation by Johnny Wheat, senior vice president for 4B Components Ltd., East Peoria, IL (309-698-5611). He spoke in June 2005 at a North Central Regional Conference sponsored by the Grain Elevator and Processing Society (GEAPS) in Ames, IA.

FIRST IN A SERIES

The ideal hazard monitoring equipment for a grain operation lasts indefinitely, works every time, and never gives you false alarms.

It's possible to come close to that ideal by specifying the correct equipment for your application and having it installed correctly.

The biggest hazard you face with monitoring equipment is grain dust. Monitors generally are placed where a great deal of airborne dust is generated. The first rule with any sort of electronic equipment in this type of environment is that it needs to have a third-party approval rating of Class II, Division I, which means it is safe for use in unusually dusty environments.

Common items that require monitoring equipment on legs and conveyors include bearings, belt speeds, and belt alignments. Failures in any of these areas can generate enough heat or sparks to cause a dust explosion. Even a small explosion that injures no one can cost you hundreds of thousands of dollars to repair.

Bearing Monitors

Left unchecked, every bearing eventually fails. Even with a top-notch preventive maintenance program, catching every bearing failure is impossible without a full-time permanent monitoring system.

Bearing operation can be monitored in two ways, for abnormal vibration or for abnormally high temperature.

Currently, there are no practical vibration monitors available for the use of grain elevator managers. Vibration data can be a useful predictive maintenance tool, but it usually requires trained professionals to analyze the data. When used, vibration monitoring should be a supplement to temperature monitoring.

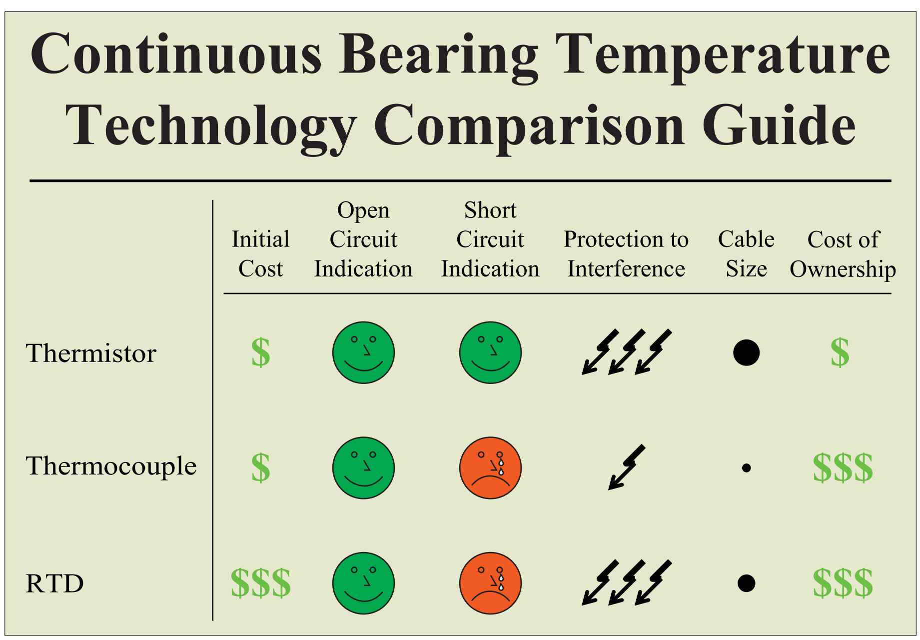
The simplest type of temperature monitor for bearings is a **trip-point monitor**. Trip-point monitors are inexpensive and easy to install. Since electrical resistance increases with temperature, the key component is a thermistor that measures resistance. These monitors usually are set to "trip" at 176 degrees, except for special applications.

The best bearing monitors are **continuous temperature monitors**, which offer the capability of setting multiple trip points for both alarms and automatic shutdown of equipment. Some can provide digital temperature readouts for visual display. Key components include thermistors, thermocouples, and RTD sensors.

Following are preferred specifications for bearing temperature sensors:

- Thermistor-type sensor.
- Open circuit indication.
- Closed circuit indication.
- Capability to make ambient temperature comparisons.
- Grease-through lubrication.
- Temperature sensing range from minus 30 to plus 212 degrees F.
- Conduit entry.
- Minimum cable lead length of 9 ft.
- Visual indication of temperature.
- User-adjustable alarm and shutdown trip points.
- Alarm log.
- Temperature history recording.
- Compatibility with PLCs and computers.

In the next issue, we'll discuss belt speed and misalignment monitors.



Monitoring Equipment

BELT SPEED AND BELT ALIGNMENT MONITORS

SECOND IN A SERIES

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The two biggest areas of concern related to belt slippage that should be monitored for safety are leg belts slipping at the head pulley and enclosed or open conveyor belts slipping at the drive pulley.

Of particular concern are new in-stallations. Among the issues here:

• Leg belts tend to stretch an average of 1% in length during their first 30 days in service.

• When switching from steel to plastic buckets, the lighter plastic buckets exert less force on the belt, so more force is required to maintain belt tightness.

• The very small pulleys on some enclosed belt conveyor systems have little contact area to drive the belt and, therefore, are prone to belt slip.

Sensor technologies available for monitoring belt slippage include inductive sensors and magnetic sensors. Centrifugal switches once were common in the grain industry but now are considered obsolete.

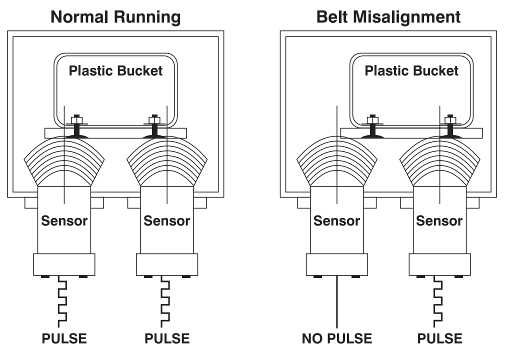
Belt slippage sensors usually work by detecting a pulse from a rotating shaft on the leg or conveyor. Ideally, this sensor is wired to the system's motor starter, for automatic shutdown when the shaft speed drops by no more than 20%. Other useful specifications:

• Detection of speed ranging from 10 to 100 rpm.

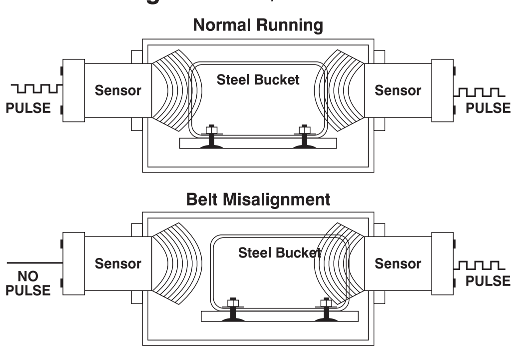
• Totally sealed construction to keep out dust and moisture.

• Trip points for an alarm at 10%

Placement of Magnetic Sensors for Misaligned Belts/Plastic Buckets



Placement of Magnetic Sensors for Misaligned Belts/Steel Buckets



underspeed, automatic shutdown at 20% underspeed.

• Overspeed detection capability.

• Startup delay, until shaft rpms reach operating speeds, to prevent false alarms.

• Acceleration detection capability during startups.

• Simple installation instructions.

• LEDs for visual indication of operation and status.

• Capability of testing the sensor.

Belt Misalignment

Belt misalignment sensors belong in three places in a grain operation:

• To detect leg belts rubbing against the bucket elevator casing.

• To detect enclosed conveyor belts rubbing against conveyor casings.

• To detect open conveyor belts rubbing against the conveyor frame-work.

A variety of technologies are avail-able for belt misalignment detection including rub blocks, limit switches, force switches, and magnetic sensors.

Rub blocks consist of a piece of brass outfitted with a heat sensor. Their advantages include ease of installation, ease of understanding their output, and low cost. Among their drawbacks are that the soft metal tends to wear out quickly, heat is required to trigger the sensor, no visual indicator is available, and the unit is difficult to test.

Roller limit switches offer the ad-vantages of large contact area, ease of understanding their output, and easy testing capabilities. On the down-side, they operate mechanically—lead-ing to wear issues, they are relatively expensive, they require a large foot-print, and they can plug easily. Roller limit switches are best suited for use on open belt conveyors.

Force sensors measure the force that the misaligned belt exerts against the sensor face. These sensors have the advantages of no moving parts, instantaneous detection capabilities, and no heat buildup is required to trigger the sensor. They also are small and compact in design, can be tested with the push of a button, and are equipped with LED indicators. They require only a small footprint, which allows for multiple sensor installation. They are suitable for use on either open or enclosed belt conveyors.

Magnetic alignment sensors are

for use on legs only. They work by measuring the proximity of buckets or bolts as they pass by the sensor and are the only "failsafe" devices available for use on bucket elevators. These sensors have no moving parts, are non-contacting, and do not require a heat buildup to trigger the sensor. They come equipped with test buttons and LED indicators.

Disadvantages include a relatively complex setup and adjustment procedure, pulse counter and controller are required. The leg needs to be in relatively good working condition for this sort of sensor.

Additional Sensors

Other types of monitoring sensors have found applications in grain operations:

• **Pulley alignment sensors** use inductive proximity sensing. These have an application because pulleys can move without any belt misalignment.

• **Plug switches** detect plugged chutes and spouts. Diaphragm-type switches are most commonly used in grain elevators, but they require frequent replacement. Other types of plug switches available include RF capacitance, proximity, and rotary-type units. Capacitance sensors have the advantage of no moving parts but are relatively expensive.

In the next and final installment in the series, we'll discuss installation and maintenance of these operational safety sensors.

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TIPS ON SENSOR INSTALLATION AND MAINTENANCE

LAST IN A SERIES

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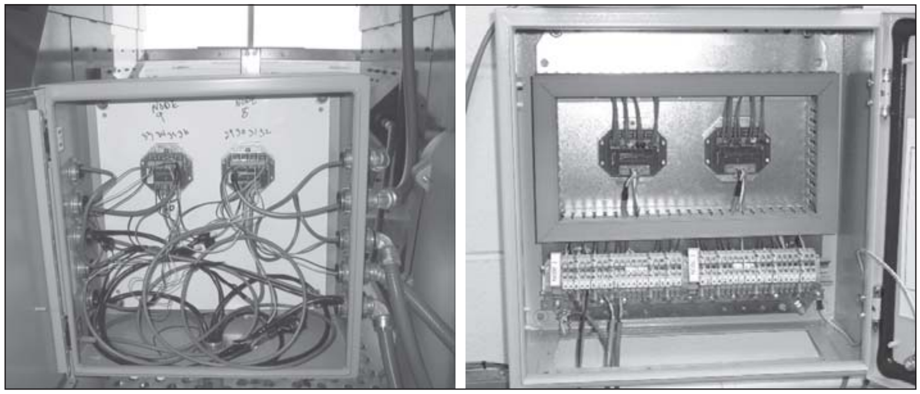

Neat and tidy wiring such as that shown at right promotes safety and provides efficient maintenance of electronic equipment such as monitoring sensors. Photos courtesy of 4B Components Ltd.

Safety and efficiency are achieved through a combination of correct installation of electronic monitoring sensors and their continuing maintenance.

Installation Tips

• Monitoring equipment really needs professional installation. For proper operation from the start, installers need to be thoroughly familiar with these systems. Your average "large screw driver electrician" probably lacks the expertise. Check out electrical installers' credentials and their experience with installing similar systems.

• Equipment must be installed according to all relevant codes including OSHA, National Fire Protection Association (NFPA), state and local regulations, and the National Electrical Code (NEC).

• Follow all manufacturer specifications and your own facility rules during installation.

• Make sure your electrical contractor provides you with a wiring schematic for all equipment.

• Mount a diagram of the equipment layout and wiring schematics inside electrical panels.

• Make sure your electrical contractor provides you with an instruction manual for all equipment.

• All equipment needs to be labeled.

• All wires should be numbered.

• After installation, perform a commissioning test prior to startup. Make sure your systems work as specified.

• Record all measured parameters during the test.

• Provide training in system operation to the plant manager, plant operators, and maintenance personnel.

• Preferred installation methods include the use of steel conduits for wiring, low-point conduit drains, large-size junction boxes, flexible metal sealtite, fittings designed for hazardous areas, and neat and tidy wiring.

• Keep low-voltage sensor wiring separate from high-voltage cables.

• Install all control units where they can be easily seen by operators.

Equipment Maintenance

• Monitoring equipment should be tested periodically. This should be done when no material is running through legs and conveyors. Testing should include all alarm and automatic shutdown features. Consult your plant's written preventive maintenance program for testing procedures and frequency.

• A visual check of contact sensors should be performed periodically and after any alarm or automatic shutdown.

• Make sure you have spare sensors and related equipment on site. In the event of a shutdown, that will help get your plant up and running in a minimal amount of time.

Preferred installation methods include the use of steel conduits for wiring, low-point conduit drains, large-size junction boxes, flexible metal sealtite, fittings designed for hazardous areas, and neat and tidy wiring.

• When sensors must be removed, physically mark their location, including depth and position, before removing them. This will help when installing a replacement or reinstalling existing sensors.

• Record the normal operating parameters for monitoring equipment including speeds, temperatures, alarm triggers, and shutdown points, and keep these records on hand to assist with inspection and maintenance.

• Log and record all checks and all alarms and/or automatic shutdowns.

• Always train new operators on the workings of the monitoring system.

Maintenance tools. Some common tools are extremely useful for monitoring equipment maintenance:

• A hand-held tachometer to check shaft speeds.

• A hand-held infrared temperature sensor for checking bearing temperatures.

• A hand-held stroboscope for studying belt and bucket motion.

Ed Zdrojewski, editor

(Photo caption)
Neat and tidy wiring such as that shown at right promotes safety and efficient maintenance of electronic equipment such as monitoring sensors. Photos courtesy of 4B Components Ltd.

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