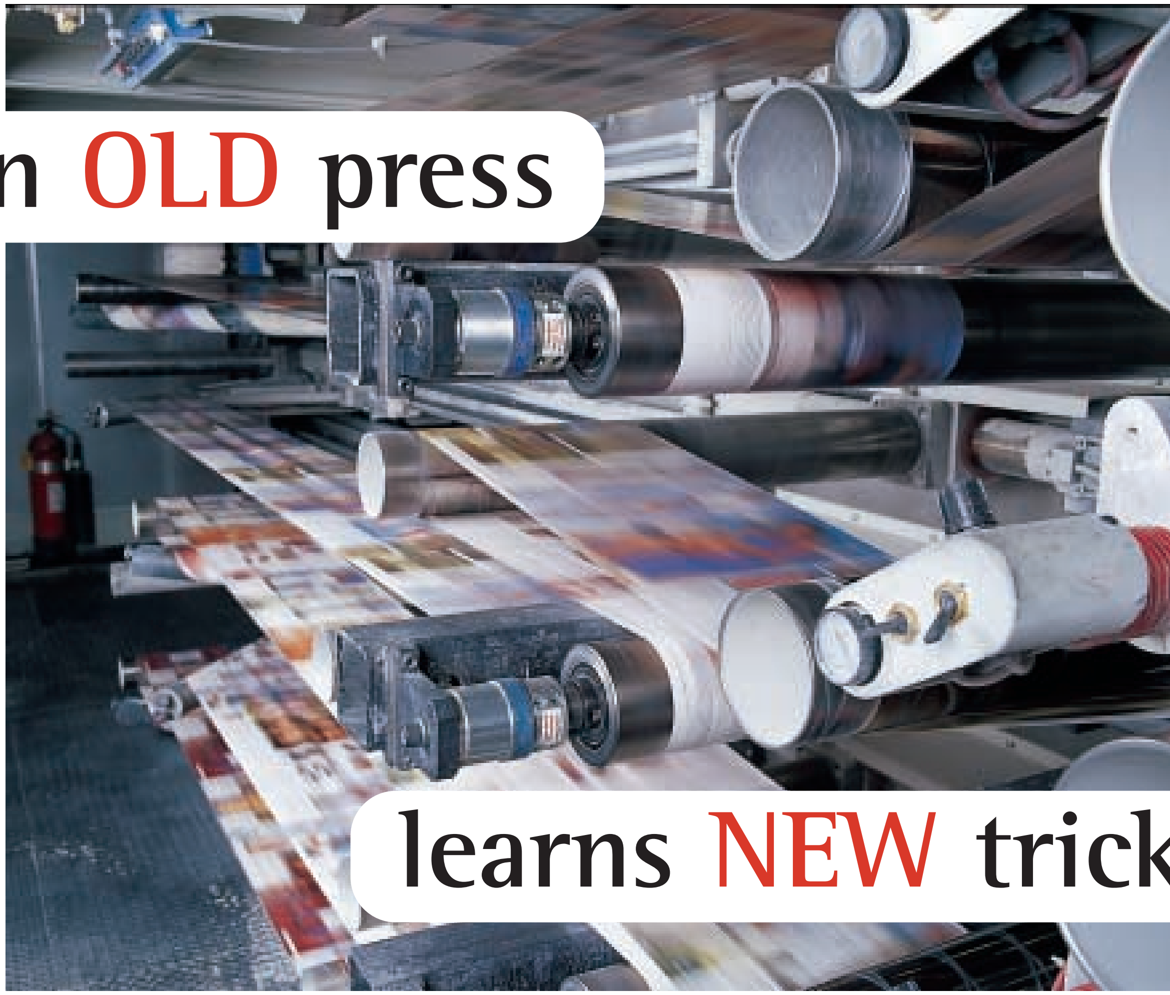
As seen in
Converting

An OLD press learns NEW tricks



Commercial printing giant R.R. Donnelley saved millions of dollars by upgrading its Motter press with electronic load cells, rather than buying a brand-new press. Further press updates are in the works.

Is old equipment slowing you down? Instead of spending $20 million for a new press, R.R. Donnelley gave theirs a $3 million electronic load-cell update.

Converters can learn a valuable lesson from R.R. Donnelley. One reason for the commercial-printing giant's growth and success is a fierce commitment to serve customers and develop integrated solutions that meet specific needs. Donnelley defines this concept as customer "response-ability."

Consistent with that concept, the company's Warsaw Div., which specializes in the printing of catalogs, magazines and newspaper inserts, recently embarked on a major press-modernization program. One such effort was the updating of its Motter printing press, a 1970 rotogravure dual-web press with 10 printing units.

As originally installed, the Motter press handles up to 50-in. dia. rolls (6,000 lbs/roll) and is capable of moving 2,200 ft of paper/min., while making 46,000 impressions/hr. The three-story press is approximately 130 ft long and 40 ft wide at the four-level folder. Prior to its modernization, it had a fixed cutoff at the folder, meaning that it could only print one size of book (from backbone to open edge) on the press. From a 34-in.-wide signature sheet (divided by four), this equalled a book that had about an 8-5/8 in. spine. With only one fixed cylinder size, the press was forced to sit idle when customers required other products.

With changing customer requirements, Donnelley managers knew they needed variable cutoff. However, a new rotogravure press, with a variable cutoff feature, would have cost about $20 million. Instead, Warsaw Div. managers decided to modernize and retrofit the existing press, providing maximum flexibility for under $3 million.

David Bruick, Warsaw engineering supervisor, oversaw the three-month metamorphosis of the old press. The first issue addressed was the folder and superstructure. An existing folder was relocated from another press. Purchasing a new folder for the other press was a better fit and would increase productivity for that press as well. Donnelley then purchased a totally new superstructure for feeding slit ribbons into the lower folder.

The next step required the upgrade from individual mechanical drives to an electrical drive system. In the past, transmission gearboxes were placed at each cylinder as well as at each driveshaft location (at the reel stand, for the infeed to the 10 printing units, to the folder superstructure and then to the lower folder). The entire line was also set for one cylinder size. Changing that size required extensive makeready at all locations.

Managers decided to retrofit the press so that it could accommodate nine different printing circumferences (from 34-1/2 to 43 in.), which would give operators the ability to immediately change the ratio of the drive between each printing unit and the reel, and then between the printing unit and the folder superstructure. This had been impossible with the previous system.

The company installed a complete electrical-drive system with closed-loop control. The system incorporates eight new drives with AC motors at each location, all using Cleveland-Kidder transducers from Cleveland Motion Controls (Cleveland, Ohio) to monitor and regulate web tension. Three of the motors and drive systems are directly controlled by CMC transducers, while the others follow drive-to-drive communications.

Eliminating the mechanical system immediately freed up additional floor space because the large and bulky transmission gearboxes were replaced by electrical drives and motors. In total, the modernization replaced 12 gearboxes, along with driveshafts and couplings. It also saved the need for a change gear. In the past, one gearbox size could not be used for every cylinder size.

The modernization also saved operator time and reduced maintenance headaches. Changing gears from one cylinder size to another required extensive press makeready and realignment. Multiple gearboxes required ongoing maintenance for boxes as well as drive shafts, universal drive shafts, and lubricants.

According to Bruick, "With a closed-loop electrical drive system, you have immediate efficiency. Very little alignment is required. You simply dial in the new cylinder size and push a button. The drive system automatically knows which speed to run. That's all there is to it."

With the older mechanical drive system, tension transducers provided indication only. Driven roller speeds were then trimmed manually by adjusting a PIV (positive infinitely variable) mechanical drive. Adjustments trimmed the driven roller RPM. The press operators then checked web tension by actually running upstairs and physically pressing on the web and web ribbons. "You could count on a certain amount of spoilage," recalls Bruick.

Flexibility, accuracy and less spoilage are major benefits of the new system. When cylinder sizes need to be changed for a new product press run, operators simply dial in the tensions, automatically setting the transducers. Very little spoilage occurs.

"When operators accelerate or decelerate the press, or a folder jam occurs, load cells keep the web and web ribbons running smoothly so they do not lose tension or get too tight and tear out—eliminating the need for an operator to have to web-up those areas again," says Bruick.

A closed-loop system means the tension transducers tie right into the drive system. According to Bruick, "Load cells give us the feedback to accurately control and close the tension loops. For instance, we now have set-point tensions, so that the web pulls that setting automatically. The new system also allows us to pre-set different tensions for different types of paper—coated or uncoated—or different weights of paper, eliminating even more spoilage. This is especially important when pacers for a new roll are being strung through the press. In the past, operators would have to constantly tweak the tension to make sure it was consistent with the roll before, because paper characteristics sometimes change from roll-to-roll and even from end-to-end. With CMC transducers, we automatically and immediately bring the new roll in at the predetermined setting."

Complete control

The complete system includes a PC-based touchscreen control unit, a programmable logic controller (PLC) for general

Who is R.R. Donnelley?

R.R. Donnelley & Sons is a multibillion-dollar printing company with over 26,000 employees in 39 countries on five continents. One of the foremost printing and information management companies in the world, Donnelley produces virtually every kind of commercial publication—from books and financial documents to phone directories, inserts and catalogs. Donnelley's Warsaw Division employs 1,600 people. Its customer list is a virtual Who's Who *of consumer* press control, and drives and motors for drive-to-drive communications that do not go through the PLC. For the two full webs (with two levels of angle bars), 2T SC CMC transducers are used, with maximum force ratings of 1,000 lbs. For the six web ribbons on each level, 1T SC CMC transducers with maximum force ratings of 150 lbs. are used.

Operators control the entire system using the control panel inside a centrally located control station. They simply touch the screen to turn printing units and drives on and off. They input cylinder circumferences. They also change tensions for the main web and for the ribbons at the draw rollers simply by typing in the exact tension setting they want.

Bruick explains, "The controls monitor two of the six transducers as control transducers for each web. One is the lead load cell for controlling tension with respect to setpoint. For example, if an operator wants 50 lbs of tension, the operator uses that as the setpoint for the lead load cell. All of the transducers and other ribbons then follow suit close to that setting, eliminating the need for individual drives for each ribbon. In turn, the input from the other 1T SC-type transducers goes directly to the main drive for control. The main drive on the press (using two 150-hp motors) and all of the other drives, use that as a reference feedback.

"With tension transducing," Bruick says, "we simply trim the speed once to maintain an accurate tension setting. Both sets of transducers then maintain the pre-determined setpoint on both of the webs and all of the subsequent ribbons."

The new closed-loop system also provides Donnelley with built-in diagnostic control. In one instance, one of the rollers somehow lost its bearings. Press operators were able to detect the roller defect before it presented problems. One of the transducers in the closed-loop provided very erratic indications, trying to make up for the bearings that went bad and were lost. This, in turn, enabled press operators to detect the problem, to quickly find the roller and then fix it before it resulted in significant downtime.

In another instance, another transducer detected a vibration problem within the superstructure early enough to prevent major problems later. The manufacturer simply made new brackets for the superstructure and the problem was quickly rectified.

In operation for over three years, the retrofitted press provides R.R. Donnelley's Warsaw Div. with the same capabilities that the company has come to expect from newer presses. Consequently, managers there are considering the retrofit of four more of its older presses, so that the division can offer customers even more capability and flexibility.

According to Bruick, "It's no surprise that we are looking at Cleveland Motion Controls for additional transducer solutions. We have a level of confidence with the company because CMC does not just sell load cells. They are in the business of closed-loop tension-control solutions, and that is exactly where R.R. Donnelley is heading."

More information:

Cleveland Motion Controls, 216/524-8800, fax: 216/642-5155, www.cmccontrols.com

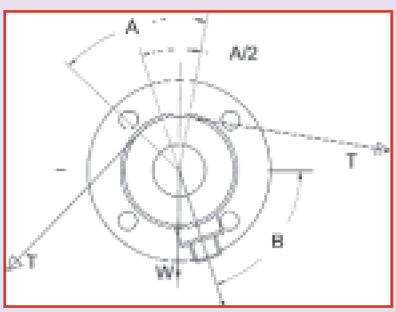
How to select the right transducers

For RR Donnelley & Sons, two CMC SC Transducers are used on each tension roller, one on each side. The web is wrapped around the tension roller. The transducers measure the force that is exerted on the roller by the tension in the moving web. The maximum working force (MWF) exerted on the transducers is then calculated from the following equation:

$$MWF = \frac{2T \times K \times \sin(A/2) \pm W \sin(B)}{2}$$

MWF= Maximum Working Force (lbs)
T= Maximum Total Tension (lbs)
K= Transient Tension Overload Factor (normally 1.4 to 2.0)
A= Wrap Angle
B= Angle of Tension Force
W= Weight of Roller (lbs.)

According to Don Strenio, sensors and controls product manager for Cleveland Motion Controls, the user needs to proceed as follows in order to determine the parameters used in the equation:



First, make a sketch that shows where the web enters and exits as it wraps around the roller. (Refer to the above diagram). The point where the web touches the roller as it enters and exits the wrap is referred to as the tangent. Draw a radius from the center of the circle and perpendicular to each tangent at entry and exit. These lines define angle A, which is the Wrap Angle.

To determine angle B, draw a line that bisects angle A. The angle that this line makes with the horizontal is angle B—the Angle of Tension Force. If angle B is below the horizontal, use positive (+) in the calculation, if angle B is above the horizontal, use negative (-) in the calculation.

Determine the Maximum Tension T, and the minimum tension that is required for your process. If this is not known, consult your transducer supplier. The supplier should have charts that indicate typical tensions for various materials.

Weigh the roller or calculate the roller weight to determine W. K is a safety factor that is used to account for tension transient overloads (a value of 1.4 to 2.0 is typical, depending on the application.).

Insert those values into the equation to determine the maximum working force (MWF) that is exerted on each transducer. Select a transducer rating that exceeds the MWF.

The calculation should be performed using the minimum tension. The resulting value indicates what the force output will be at the lowest tension. If it is a very small percentage of the transducer rating (typically less than 1/20 or 1/30 the rating), you may need to increase the wrap angle, re-orient the web wrap, or reduce the roller weight to achieve a usable measurement at low tension.

Strenio adds, "To select and size the right transducer for the application requires careful attention to detail. You need to totally understand the application and then calculate a basic equation for each transducer. The equation is only the first step. In fact, you should never order a transducer without consulting the supplier first. The success of the application often depends on the extent to which the user and supplier work together in addressing the application. Once the supplier receives your information, you need to rely on the supplier's application experience to perform the calculations, evaluate the requirement, and if necessary, recommend machine design changes or alternate methods."

During the process, it was found that the main draw rollers (which are extremely important for maintaining steady tension on the entire web) were too heavy to take full advantage of the load cell's capabilities. The output signal would not be great enough to achieve optimal performance. Based on Strenio's recommendation, Donnelley replaced the existing roller with a composite roller, which weighed much less. By making this change, Donnelley realized a significant improvement in load-cell resolution, which resulted in a significant improvement in the overall performance of the closed-loop system.

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