# Using Couplings to Reduce Downtime

Joseph L. Hazelton, Contributing Editor

A number of torque limiting couplings can be used in high-speed applications, with many models having maximum speeds of more than 3,600 rpm—much more. (Photo courtesy of R+W America)

**Downtime, downtime, downtime.** When it's planned, it's bearable. When it's not, it's not.

To maintain machinery, planned downtime is necessary. To fix broken equipment, unplanned downtime is excruciating, especially when your factory is running closer and closer to full capacity.

Now, the effort to reduce downtime, planned and unplanned, is ongoing in industry. However, in that effort, some companies are paying more and more attention today to the couplings on their drivelines. This tendency has been noticed by some manufacturers of couplings.

And what's being done with couplings to reduce downtime?

In heavy industry—that is, in heavy-duty, high-speed applications—two trends are 1) to remove a type of coupling and replace it with another type and 2) to reduce a coupling's weight in order to reduce possible imbalance.

Of course, changes should be made when conditions are right, such as after considering various factors and deciding a change is suitable and beneficial.

In the first trend, the change, installing a new type of coupling, depends on the type being replaced.

When a shear pin is being removed, what's often being installed is a torque limiting coupling. That's the tendency pointed out by Andy Lechner, chief marketing officer for R+W America, a coupling manufacturer in Carol Stream, IL. R+W America makes a number of different couplings and serves the mining and tunneling industry and the steel industry, among others.

When the type of coupling removed is a gear coupling, the type often replacing it is a disc coupling. That's what has been noticed by Manuel de Lama Santos. He's product manager–couplings for Flender Corp., a couplings maker in Elgin, IL. Flender manufactures various couplings and serves heavy industries like cement and mining as well as oil and gas.

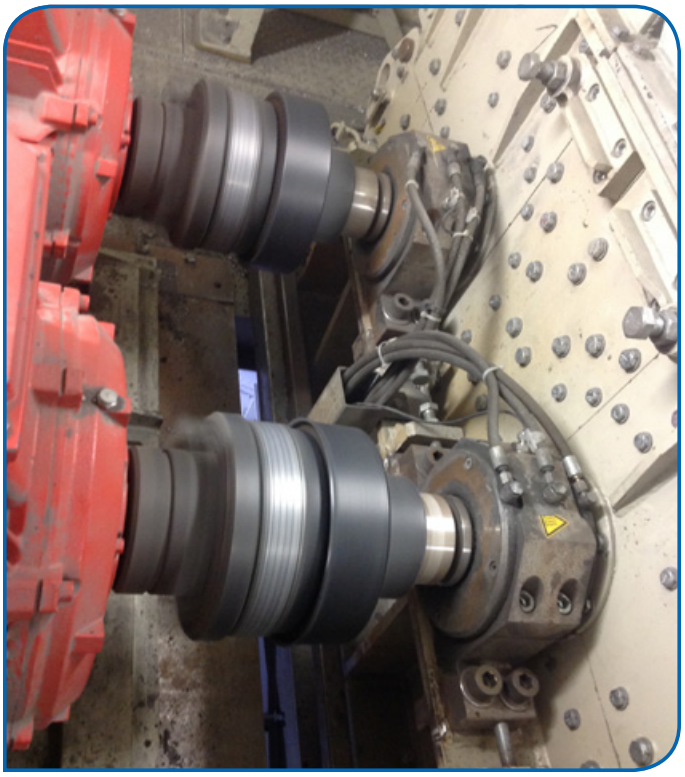
## From a Pin to a Coupling

In heavy industry, Lechner says the trend is affecting rolling-mill operations, like steel mills. As he explains, some mills are operating closer to full capacity than they used to. In many cases, though, their drivelines are equipped with shear pins.

Now, shear pins do their jobs fine. They hold a driveline together and prevent catastrophic damage to the line when there's a torque overload. "Those have been a low-cost way of protecting from torque overloads on mill stand drives for many decades," Lechner says.

Once broken, though, a shear pin can become a pain. It can take up some downtime, even more when the line uses a set of shear pins. The downtime is spent removing the pin's broken pieces and installing a new pin. According to Lechner, this process may take hours, like up to four. If the factory's running at near full capacity, hours of downtime may be unacceptable. "The busier an operation is, the more valuable that time is," Lechner says.

To reduce downtime, the pin could be replaced with a torque limiting coupling. An advantage of the coupling is it can be reset. For example, a coupling's design may allow it to be reset mechanically. With the ability to be reset, when an overload occurs and a coupling disengages a driveline, the coupling could be reset by prying back its plungers. Then, the line can be re-engaged and the machine restarted. Lechner



After a torque overload, a driveline's downtime may be shortened if the line uses a torque limiting coupling instead of a shear pin or a set of shear pins. (Photo courtesy of R+W America)

describes the difference between a coupling and a pin in this way: "It's like a circuit breaker rather than a fuse."

A torque limiting coupling costs more than a shear pin, though, so you should run all the cost numbers for both devices. Examples of the numbers are product cost and downtime cost. Also, a coupling takes up more space than a pin. A pin is compact and can vary in size, number, and material while providing a driveline with protection from torque overload.

Because a torque limiting coupling is bigger, a company will need to figure out whether its driveline has enough space for the coupling. If it doesn't have enough space, the benefit of switching to a coupling would need to be weighed against the time and effort to move the line's engine/motor and gearbox to create the space. If the benefit is sufficient, then the company would need to do some work before installation of the coupling.

"But, for the right applications, it's typically a single disengagement that yields ROI for maintenance managers," Lechner says.

With a disc coupling, a driveline can require less downtime because a disc coupling doesn't have lubricating oil/grease and seals that need to be maintained, a gear coupling does. (Photo courtesy of Rexnord Corp.)

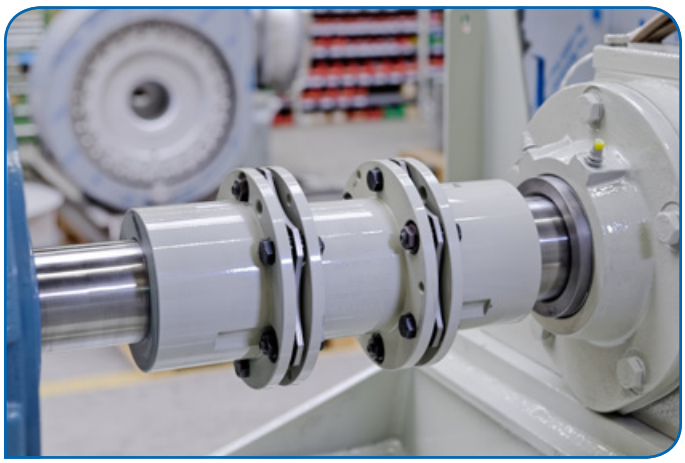
## Switching to a Disc Coupling

If a driveline uses a gear coupling, then the switch to reduce downtime is often a switch to a disc coupling these days.

According to Flender's de Lama Santos, this switch is happening in several types of heavy-industry companies, like steel mills, mining operations, and cement makers.

And, to clarify, de Lama Santos explains that when he says cement makers, he's talking about companies that operate rock crushers to make fine stone for cement; he's not talking about companies that mix and pour concrete at curbside.

Also, he describes how a switch to disc couplings can reduce downtime. Specifically, a gear coupling uses lubricating oil/grease for its gear teeth and has seals. Both lubricant and seals need to be changed from time to time to maintain the coupling in good order. Otherwise, the coupling will degrade, and the factory will face unplanned downtime.



In the right application, a gear coupling can be replaced with a disc coupling so a factory can reduce a driveline's maintenance time. The reduction would be most important if the factory were operating at or close to capacity. (Photo courtesy of Flender Corp.)

A disc coupling doesn't use gears. Instead, it transmits mechanical power through several thin, flexible discs. The discs are steel, though. So, a disc coupling is still power dense, Santos says. And since there are no gears, a disc coupling doesn't use lubricant or have seals. The driveline's planned maintenance time can be shortened.

Moreover, according to de Lama Santos, a disc coupling is meant to be maintenance-free. He adds that disc packs are meant to be durable: "They will last for a lifetime, if used properly."

## Complications of a Switch

However, a switch from one type of coupling to another type can get real complicated real fast.

One complicating factor can be whether the driveline is powered by an engine or a motor. This factor is explained by John Malik.

Malik is general manager for TB Wood's and Ameridrives couplings in San Marcos, TX. TB Wood's and Ameridrives are two brands of couplings made by Altra Industrial Motion Corp., Braintree, MA. Altra makes couplings for a number of heavy industries, including metal processing, mining, and oil and gas.

According to Malik, a switch involving a line with an engine can require more upfront, engineering work to understand whether the line would need to be changed or how it would need to be changed in order to make the switch.

As an example, he mentions a switch from a type of coupling that's high maintenance to a type that's low maintenance. "The weight, the inertia, the stiffness," he says, "all might be different and that's going to affect the machinery dynamics, so you've got to be careful."

## Tradeoffs: Finding the Right Mix

Of course, a switch between types of couplings will likely involve tradeoffs, losing an advantage here, gaining one there, losing a disadvantage here, "gaining" one there. What advantages you want and disadvantages you can accept, depend on what you figure is the best way to reduce downtime.

Now, a coupling that offers all the advantages you want,

it may exist today, but it's not likely. So, when you look into switching to another type of coupling, have your wish list at hand, but be ready to start prioritizing its items.

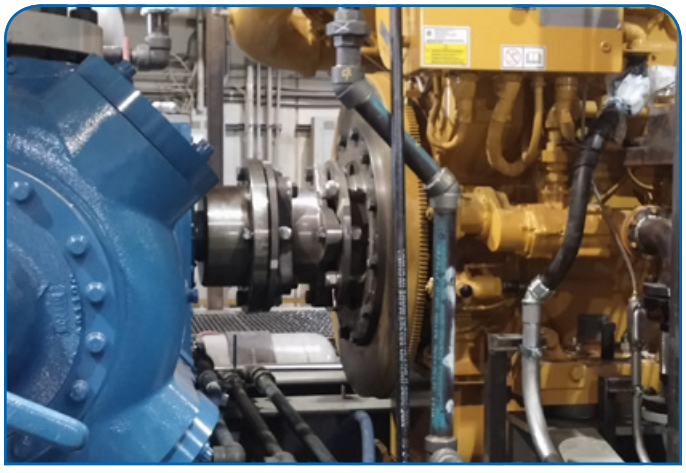
Also, be ready to be told some parameters don't go together. For example, Malik mentions that factories may request a coupling that's low maintenance or maintenance-free and that allows for higher misalignment. As he points out, those parameters are at odds with each other. The allowance for misalignment may be requested so the factory can keep down the time and cost of installation. But, if you have more misalignment: "You get more reaction force," Malik says.

He then adds an example to show the possible consequences of conflicting parameters. His example isn't heavy industry, but it does illustrate his point. The example is a turbine-powered generator mounted on a big truck for use as a mobile, auxiliary power unit.

Rather than use a high-performance coupling, the customer asked that the system use a universal joint to permit three degrees of misalignment. The u-joint may create a problem for the turbine, though.

Malik explains that generally, turbines are very precisely designed and have bearings designed to support a very light weight, very well-balanced coupling. The u-joint with three degrees of misalignment wouldn't be as well balanced as it should be. And a u-joint is generally much heavier than a high-performance coupling.

Given more weight and less balance: "You run the risk of tearing the bearings out of the equipment," Malik says. Depending on the machine system, a possible result could be a short life ending in catastrophic failure.



Depending on the application, a coupling's weight may be a fraction of a driveline's overall weight or may be the bulk of that weight. This coupling connects an engine and a compressor. (Photo courtesy of Altra Industrial Motion Corp.)

Generally, switching from one type of coupling to another type becomes more complicated as the whole machine system becomes more complicated. (Photo courtesy of Altra Industrial Motion Corp.)

## A Complicated Switch due to a Sophisticated System

A switch can become more complicated when the whole machine system is more sophisticated or when the new type of coupling is being retrofitted onto an existing system.

Malik offers a higher-end example: a turbine-powered system running a turbo-compressor at 5,000-plus rpm. Before switching the system's coupling, you'd need to figure the new coupling's effect on the system. "Now, you've got to rerun the machinery dynamic studies, whether it's torsional vibration analysis, lateral vibration," Malik says.

In such cases, a system's owner may need to hire a consultant who can take into account all of the system components in order to ensure that after the switch, the system still works as expected and now includes the benefits of the new type of coupling.

According to Malik, such consultants are limited in number because of the expense and expertise needed to buy and run the software that models complex machinery systems. Once hired, the consultant would look at the system components and contact the various component manufacturers as needed, working with them while tweaking the system's computer model in order to permit a switch in coupling. "It's a big team effort," Malik says.

The other trend, reducing a coupling's weight to increase its balance, that trend has been noticed by Lechner and by Bill Holtz. Holtz is a senior engineering manager for couplings with Rexnord Corp. Located in Milwaukee, WI, Rexnord manufactures various couplings and serves a number of industries, including heavy industries like energy and mining.

Now, this trend has the same goal as the first: reducing downtime.

## Higher Speeds, More Imbalance

Machinery keeps getting bigger and bigger and keeps running faster and faster. Now, for a couplings maker, customers wanting bigger machines isn't a problem, but their wanting faster ones is.

"As they start pushing more power at higher speeds, what ends up happening is more opportunities for imbalance," Holtz says.

According to Lechner, heavy industry—industry in general—is running at higher speeds because doing so is more efficient. Holtz provides an example, two centrifugal pumps. One pump operates at 1,800 rpm, the other at 3,600 rpm. If both pumps are moving fluid at the same rate, the pump operating at 3,600 rpm would be about half the size of the pump operating at 1,800 rpm.

But increased speed means increased forces on the

In heavy-duty, high-speed applications, a coupling's weight should be kept to a minimum because more weight can mean more unbalance forces, which are amplified at higher speeds, creating unwanted stress, wear, and downtime. (Photo courtesy of Rexnord Corp.)

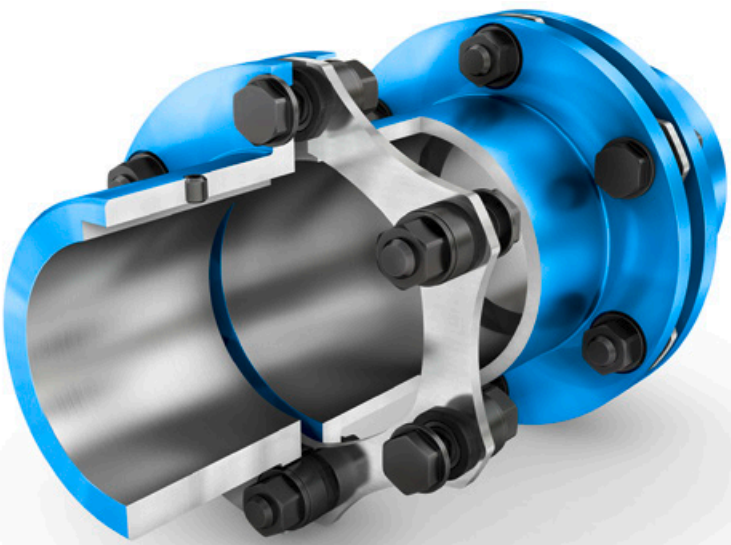
components of a machine system. For the coupling, greater speed means an increase in unbalance forces, an exponential increase. "When I double the speed," Holtz says, "my unbalance force doesn't double; it's squared."

Now, even just some imbalance in a driveline can start a train of bad effects. "It causes vibration, which then causes materials to shift, materials to fatigue," Holtz says. "And then, you're into downtime."

As industry wants to run ever faster, coupling manufacturers have a few ways to reduce imbalance in their couplings. Holtz explains that unbalance forces are affected by speed, weight, and eccentricity.

## Reducing Weight to Reduce Imbalance

Now, to reduce weight in order to reduce imbalance, that effort starts with improving the materials used to make couplings. "We're always working to make stronger materials so that we can have thinner cross sections so we can have less weight and then, therefore, better balance," Holtz says.



A stronger material can lead to a coupling with reduced imbalance. With a stronger material, a coupling's bore capacity becomes greater. The coupling can be made thinner, using less material, resulting in less weight, which reduces possible imbalance. (Photo courtesy of Flender Corp.)

Also, the effort is supported by the latest software for finite element analysis and modeling and by more sophisticated dynamometers and test stands. Speaking generally about couplings, Lechner says, "The sophistication and the ability to improve on these designs has increased with the help of FEA and advanced modeling." He adds that today's dynamometers and test stands have more sensors and more responsive electronics, so they can provide performance data that's larger in amount and more real-time.

Consequently, a coupling manufacturer can remove more material, can test the coupling, and still be confident the lighter weight doesn't affect the coupling's performance. That way, a coupling can be right-sized, not oversized.

## Other Benefits

Also, in the right driveline, a lighter weight coupling can contribute to a machine performing better and costing less. It can help improve performance because its lighter weight can reduce a machine's moment of inertia. Less inertia means less power needed to bring the machine up to speed. The coupling can help lower cost by reducing power consumption, possibly to the point where the machine can use a smaller power source, whether engine or motor.

These contributions may be greatest when a coupling makes up a large part of a driveline's total weight. So, the smaller the coupling's weight in proportion to the line's total, the smaller the coupling's contribution may be to better performance and less cost. Even when a small portion, though, a coupling's lighter weight may still be enough to tip the scale for the whole driveline.

However, you have to be careful. Although more precisely engineered and better balanced, a lighter weight coupling can have a smaller safety factor, a smaller margin of error, so it may not be able to withstand some shocks.

Also, if too much weight, too much material, has been removed, a coupling could actually contribute to the thing you don't want. It could lead to downtime, including that worst kind: unplanned. **PTE**

### For More Information:

Altra Industrial Motion Corp.
Phone: (781) 917-0600
*www.altracouplings.com*

Flender Corp.
Phone: (847) 931-1990
*www.flender.com*

R+W America
Phone: (630) 521-9911
*www.rw-america.com*

Rexnord Corp.
Phone: (414) 643-3000
*www.rexnord.com*

For Related Articles Search
couplings
at www.powertransmission.com