

## Drive Package Cuts Auto Assembly Conveyor Downtime

Written by Gene W. Pokes and Donna Akers, Rexnord  
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The new drive package at Ford's Michigan Truck Plant includes (front to back) Stearns 333-3 armature-actuated electric disc brake and a 2 hp right-angle helical bevel Rexnord gearmotor with High Efficiency EAct inverter duty electric motor. Guards are removed to show the sprocket and chain.

A versatile drive replacement package that handles a variety of applications has reduced downtime, extended service life, and cut replacement costs at a major automotive assembly plant.

The package includes a helical-bevel gearmotor with a hollow shaft and motor brake. It replaces 10 different drive configurations on power roll bed conveyors and related material handling equipment. This project illustrates the ongoing effort to empower the company's United Auto Workers (UAW) skilled trades personnel to partner with Tier 2 suppliers to solve maintenance problems, thereby increasing minimum time between failures (MTBF) on production equipment.

**Skids hold vehicles on conveyors**

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Ford Motor Co.'s Michigan Truck Plant, Wayne, MI, produces the Expedition and the Lincoln Navigator. Skids holding the vehicles in various stages of manufacture are transported on a series of power roll bed conveyors throughout the entire plant, from their start in the body shop, through the paint shop to their completion in the final assembly shop.

Drive systems for these conveyors consist of electric motors, speed reducers, chain and sprocket drives, and electric motor brakes that hold the skid-mounted bodies in place while assembly operations are performed. Similar gearmotor packages are used on Marmac lift tables in the paint shop as well as on pivot tables.

### Problems developed

Previously, the number and variety of these gearmotor packages made spare parts stocking and replacement difficult, expensive, and time consuming. Several different speed reducers, each in right- and left-hand drive configurations with different shaft and sprocket sizes, as well as different brands and sizes of gearmotors used for roll beds, with a variety of horsepower ratios and frame sizes, added to the possibility of confusion when a maintenance worker went to get a replacement.

Another problem encountered with these conveyors was worn keyways, not only on the output shaft where the sprockets are mounted, but also on the input where the motor is mounted. These had been the weakest link. Less than half of the power roll bed conveyors are installed with a variable frequency drive (VFD) that gives them a soft-start capability. Without a VFD, the cycling on and off caused these keyed shafts to take a beating.

The accumulated stresses took a toll on the shafts and keyways of the gearboxes, but because many were behind braces or otherwise difficult and time consuming to inspect, frequent failures occurred.

The increased service factor of the new style gearmotor has solved this early-failure problem on the input shaft. On the output shaft, the problem has been solved by using keyless locking devices that hold the sprockets to the shaft with a fit in excess of a normal press fit.

The extra service factor capacity of the new drive package is more than enough to handle even the most severe applications. The worst cases were on the roll beds with a 1000 lb truck on

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urethane rollers and no VFD. Steel rollers would allow a load to slide and dampen the effect on the gearmotors, but with the urethane rollers, the load just stopped hard without sliding.

Another problem with the existing worm gear reducers occurred when a malfunction prevented the conveyor from running under its own power or caused a skid to be positioned incorrectly. In these cases, interaction of the worm gear sets made it impossible to push the loaded skid by hand in either direction. Backdriving, changing the reducer shaft position by rotating the output shaft, is simply not a capability of worm gear reducers. Often, it took four or five people to lift the skids up and pull them back into position.

In a few cases, when shafts failed, people simply removed the drive chain and pushed the vehicle bodies along the conveyor by hand temporarily, rather than shut down the line. The problem was especially acute in robotic areas, where light curtains prevented a maintenance worker from being in the area unless the equipment was shut down.



The adapter base speeds installation and alignment of the new gearmotor package in place of several others. Slotted holes make aligning sprockets easier. **Developing a universal package**

After some research, it was determined that a single basic package would fit a broad range of applications by standardizing on a single hp size, ratio, and gearbox size, with only a few

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modifications in mounting. The package is built around a 2 hp right-angle helical bevel gearmotor from Rexnord, Milwaukee, WI, which incorporates a 2 hp High Efficiency EPAct inverter duty electric motor equipped with a Stearns 333-3 armature-actuated electric disc brake. The output shaft of the reducer drives a sprocket and chain that provides further reduction to the proper speed for each conveyor and pivot or lift table.

Among potential solutions, almost all manufacturers that mount integral motors directly onto their gear reducers use a key and pinion on the motor shaft. This new gearmotor uses a press fit to secure the pinion gear on the motor shaft which eliminates the possibility of motor shaft keyway failure. On the output shaft, the sprocket uses a Ringfeder shaft locking device, which eliminates output shaft key failures.

In order to support the "low or no" maintenance concept for this new drive package, the Stearns dc brake that was selected requires virtually no maintenance for 3 million cycles, an estimated 12-year life in this application. The brake is direct acting, with only two moving parts.

In operation, when electric power is applied, the armature is pulled by the electromagnetic force in the magnetic body, which overcomes spring action. This allows the brake's friction disc to rotate freely. When power is interrupted, the electromagnetic force is removed and the pressure spring mechanically forces the armature plate to clamp the friction disc between itself and the pressure plate.

This develops the force necessary to overcome any inertia that could cause the loaded conveyor to continue to move. In this application, the brake's primary function is to hold the skid-mounted body in position until the operation at that location is complete, then release it so it can move on to the next station.

One problem with the previous motor brake was the failure of rectifiers, which were difficult to replace. Because they were in the end bell of the brake, and a brace was in the way, workers could not get to them. With the Stearns brake, the rectifier can be located either in the cabinet with the VFD or in the motor terminal box.

Now, if a rectifier has to be replaced, it takes only about 5 minutes. The brake originally was designed for high-cycling applications in the food and beverage industry and is one size larger

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than the application normally would require, which ensures service-free operation for 3 years under the plant's demanding production conditions.

### Benefits of new package

Among the benefits of the gearmotor are its greater torque and horsepower capacity, which provides a higher service factor and longer life, and its hollow double-tapered bushing output shaft design. It is easy to convert to either right- or left-hand mounting, and interchanges with previous drives by using adapter plates that are furnished by the gearmotor manufacturer. The Class 12 helical bevel gearing reduces energy costs significantly and, unlike worm gear drives, can be back-driven manually when necessary.

With the previous worm gear drives, there was no easy way to push a skid backwards if it had to be moved. Now with the helical gearing, all the workers have to do is pull the brake release, and the skid can be moved freely in either direction. This saves time and eliminates waiting for four or five people to come and help move it.

Although solid-shaft gearboxes are less expensive initially and therefore are used for original installations, the versatility and ease of replacement makes the hollow-shaft gearboxes less expensive overall as a retrofit item. With this hollow-shaft output feature, maintenance workers have the ability to change shaft sizes, from 1 in. to 1 1/2 in., so they do not have to stock multiple shafts.

For applications that require a specific shaft size, it is not necessary to buy a different gearbox but only an inexpensive bushing kit. The new gearmotor package accommodates seven different double-tapered bushing sizes and shaft diameters. While gearmotors with hollow output shafts are traditionally shaft-mounted, this application is unique because this gearmotor can be foot-mounted.

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Previously, the company had at least 10 different combinations of gearbox brands, motor horsepowers, ratios, and mounting configurations, making it necessary to keep 10 spare gearmotors on hand at all times to be covered in case of failure. The hollow output shaft can be used for either right or left hand, so it cuts the required stock in half.



The new drive package has allowed the plant to reduce its inventory. By standardizing on a single gearmotor design, Ford can maintain a small inventory of different shaft sizes (inset) and two adapter plates that make it easy to replace gearmotors when needed. The versatility of the drive package allows stocking only a small number of replacements that will fit all applications, using different size bushings to accommodate various shaft sizes. Now maintenance personnel can create their own shaft, slide it in, and put a sprocket on it. They can still foot-mount the gearbox rather than shaft-mount it, but now they can use an interchangeable shaft. They also can do away with the different ratios by changing the sprockets and keeping the speed the same within a few feet per minute. The steel rollers used on most conveyors allow enough slip to take up the slight speed differences.

By standardizing on a 1 1/4 in. shaft diameter hollow shaft for all replacements, the maintenance department now can inventory a small quantity of replacement shafts and sprockets and a few replacement gearboxes in the same configuration, all with a 30:1 ratio.

Because the new reducers are a helical bevel gear design, they will transmit torque more efficiently, with a higher output capacity than the previously used worm gear drives. This allowed Ford to standardize on this same 2 hp motor and brake, instead of the 3 hp motor used

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previously, on a 90 deg pivot table. The helical bevel reducers have a substantially higher efficiency than the previous worm gear reducers, which translates into a significant annual energy savings.

In addition, many gearboxes were failing every 3-6 months, incurring both the expense of a replacement unit and the 2-hour downtime cost every time one needed to be replaced. By contrast, some of the 29 new drives installed to date have been in service for as long as a year and a half without a problem. One unit was taken apart twice and inspected but did not show any measurable wear.

### Easy installation

To make installation of the new drive packages easy, adapter plates with slotted mounting holes are provided. Only two different plates cover all 10 previous configurations, and the slotted holes simplify alignment. When the plant was built, it used two different roll bed designs, each with a different type of drive mounting. Now, a maintenance worker needs to know only the type in order to replace it quickly.

Formerly, aligning the sprocket used to take another 20-30 minutes. It was necessary to loosen the set screws and move the sprocket back and forth, and the set screws usually ended up on the bottom where they could not be reached easily. Now, the slotted adapter allows the worker to leave the mounting bolts loose until everything is lined up and then tighten the bolts down. To ensure uniformity, Rexnord sent a team to the Ford plant and trained maintenance workers and millwrights on all three shifts in the most efficient way to replace existing drives with the new design.

As a result of the success at the Michigan Truck Plant, two other Ford plants also are implementing the use of similar gearmotor packages. In addition, it is being shared with Ford plants worldwide as a Ford Best Practice. Although there may be some slight differences in weight or configuration, the body shops at all plants use the same type of roll bed and perform similar operations, such as installing doors. **MT**

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