



producingresults

Don't lose your bearing!

Protect the lifeblood of your tube mill

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It's Monday morning after a long holiday weekend, and the first shift is starting with a bang. The slit coil supplier is late with your delivery, the second-shift maintenance person has called in sick, the mill operator is going to be late to work, and you wish you were still at the beach with the family. The foreman gives everyone the production schedule, and the last of the big order you were working on before the Friday shutdown is ready to run. Who's that on the phone? Oh, it's your No. 1 customer. He gave you a break on the delivery of the last three truckloads, but he isn't cutting you any more slack—he needs his order NOW!

The mill starts up, but before it gets up to speed, you hear a rumble



and a grinding sound from the driveline. It gets nothing but louder, and the No. 1 mill drive amp meter goes off the scale.

You have just been introduced to a real-life lesson in bearing failure. Bearings make the operation of the tube mill possible or, in this case, im-

possible. The bearings in every tube mill, cutoff, and material handling system require constant care. Ignoring them leads to catastrophic failure.

Equipment Design and Bearing Life Expectancy

The original bearing selection for each piece of equipment is based on a designer's grasp of the operating conditions and the minimum desired life expectancy for the application. In an industrial machine such as a welded tube mill, the minimum design life would be more than 3,000 hours, based on

the worst-case loading and speed.

Each machinery supplier has a different design parameter based on the intended use and the supplier's experience. While a 3,000-hour life may sound short, it's based on the worst-case loading and related safety overload factors. Such circumstances include 24/7 operation, maximum material thickness and yield strength, maximum thickness-to-diameter (t/D) ratio, shock load of 2, maximum roll throat, maximum speed, and a safety factor. Normally, a 3,000-hour minimum life translates to many years of operation at normal load and speed because the equipment is seldom, if ever, operated anywhere near its maximum capacity.

Bearings and the related mechanical support systems are designed for the intended application and anticipated overload conditions. Premature bearing failures result when bearing mounting conditions or operating practices create unintended loading.



Spalling, or breakdown, of a bearing's tapered rollers can be caused by excessive loading or improper lubrication.



Pitting or erosion of the mating bearing cup can result from excessive loading or improper lubrication.

Most existing designs for welded tube and pipe mills are time-proven but might still exhibit bearing failures caused by improper assembly, lubrication, and routine maintenance.

Design parameters and actual operating conditions notwithstanding, all bearings ultimately will fail. Your job is to prevent premature failure.

More often than not, the main reason for a bearing failure is not that someone forgot to do something, but that someone *changed* something.

For example:

- Your buyer found a less expensive coil supplier. He didn't know that the new supplier has poorer coil thickness control. The thicker material puts additional stress on the bearings.
- Your slitter went down last week and you farmed out the slitting chore. It was slit 0.030 inch wider than the tolerance. The wider material puts higher loads on the bearings.
- That new coolant concentrate you switched to last month is stripping the paint off the mill housings. It's also washing the grease out of your bearings.
- One of your salespeople took an order for a higher-strength material than you normally run. This material put greater stresses on nearly every set of bearings in the mill.

Change is a necessary part of any operation. Your employees—the most flexible part of the production process—can and do learn new tricks every day. The bearings in your production equipment, however, can't adapt. Bearings have fixed operating parameters and can be downright stubborn about taking on new challenges.

Want to avoid the pain? Then confront the challenge of change with enthusiastic good humor and a better backup plan. Amassing knowledge is the key to developing your backup plan.

Developing a Three-tier Backup Plan

If you are new to the industry, then I recommend you look into TUBE U®, a basic training course offered by the Tube & Pipe Association, International® (TPA). This course was designed to provide a broad knowledge base for welded tube production. The course, available at www.thefabricator.com, focuses on common factors encountered in producing 3-in.-diameter and smaller welded tube.

Understanding the operational capabilities of your equipment is the next step in knowing if you can take on a new challenge. Contact the manufacturers of your existing equipment and ask if the machines can handle the new process parameters. Their experience and knowledge of what other customers have tackled successfully can be a lifesaver. Ask for the names of other companies that are doing what you want to try. Firsthand knowledge can't be beat.

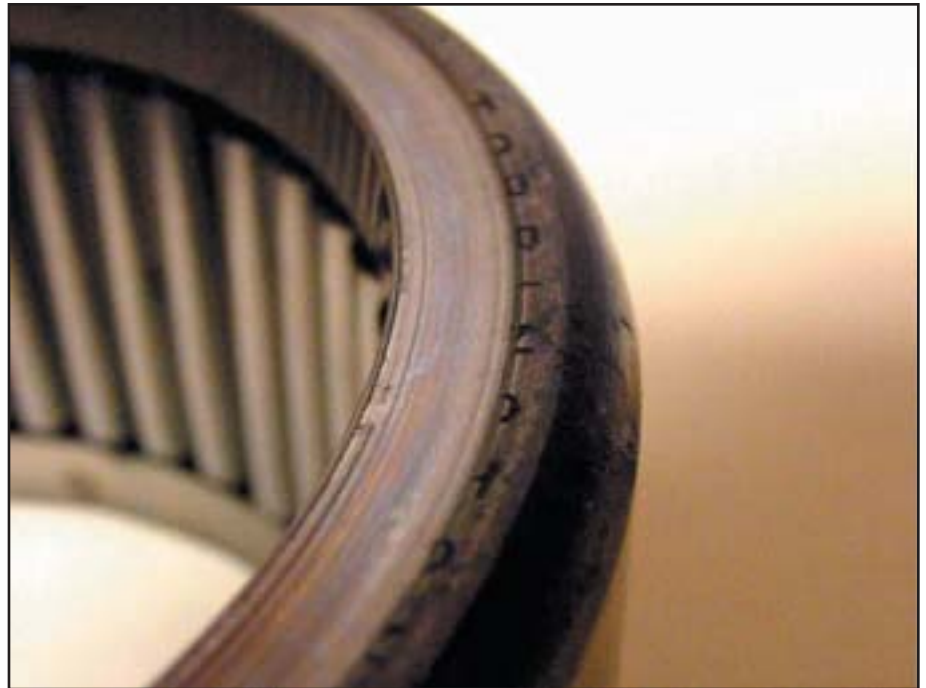
The manufacturer might refer you to a competitor. Don't let that stop

you. The exchange of basic information is a two-way street that usually has a payoff for both parties. One way to make these connections with other people in the industry is to attend tradeshow and technical conferences. Meet and get to know your counterparts and the vendors who supply equipment to the industry. In short, network!

The third approach to the problem occurs after something breaks. Here your recourse is first to contact the manufacturer of the equipment and second to contact bearing suppliers.

The mill manufacturer most likely will lend assistance. If this fails, you still have many other choices. A result of uncovering the problem is that you will be better prepared for the next challenge and will, in the end, learn more than just the replacement part number for the bearing.

Some simple rules can help determine the cause of a failure or the possible consequence of a change in operation for a typical welded tube mill. In these statements the term *load*



Side thrust wear on an outboard needle bearing can result from improper assembly.

means the radial capacity or thrust-carrying capacity of a bearing.

- Doubling speed reduces bearing life by half. Reducing speed by one-half doubles bearing life.
- Doubling load reduces bearing life to one-tenth. Reducing load one-half increases bearing life by a factor of 10.
- Increasing the yield strength of the raw material increases the load. Reducing the yield strength of the raw material reduces the load. For example, changing from a material with a yield strength of 50,000 pounds per square inch (PSI) to a 70,000-PSI material increases the load by a factor of 70/50, or 1.4 times the original load.
- Increasing the root diameter of the work rolls increases the load both in separating force and in torque transmission.

The bending resistance of material generates separating force. The major result is to push the tooling and the roll shafts apart, or to separate them. Torsional force, which is caused by the material's forming resistance as it moves through the roll tooling, provides an additional pulling force opposite to the direction of material flow.

- Increasing strip width for a given setup and roll tool arrangement increases the load because it requires additional reduction. (The term *reduction* refers to the change in girth that results from cold working the tube.)

- Roll shoulder alignment directly affects thrust loading and may reduce bearing life by up to one-half for the fixed or drive-side bearings. Misaligned roll shaft shoulders force the bearing to support all of the separating force on only one-half of the double-tapered roll bearing, thereby eliminating half of the bearing's carrying capacity and life.

Ask for the names of other companies that are doing what you want to try. Firsthand knowledge can't be beat. The manufacturer might refer you to a competitor. Don't let that stop you.

- Increasing or decreasing material thickness directly changes the work load. For example, the bearing work load to form tube from 0.090-in. material is three times that required to produce the same-diameter tube from 0.030-in. material, all other factors being equal.

- The result of multiple changes has a compounding effect. For example, if a new order requires material of 70,000- versus 50,000-PSI yield strength, 15 percent less thickness, but with 25 percent faster weld speed, bearing life could be expected to suffer as follows (assuming a beginning life of 3,000 hours): $3,000 \times (50/70) \times 1.15 \times 0.875 = 2,156$ hours, or a loss of potential life of 28 percent.

Answers to your questions are available. Some additional resources are:

- The Timken Company, Cantor, Ohio (www.timken.com)
- SKF Services Division, Kulpsville, Pa. (www.skf.com)
- The Torrington Company, Torrington, Conn. (www.torrington.com)

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www.weldedtubepros.com. He also is the chairman of TPA's Tube Producers Council. Welded Tube Pros is a consulting firm that provides engineering products and services to the welded tube manufacturing, roll forming, and stamping industries.

If you have a specific question or would like to see an article on a particular problem, please contact the author or TPJ.

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