Tips:

How to troubleshoot problems with your screw conveyor

While your screw conveyor has fewer moving parts than a lot of the machines in your plant, the conveyor parts are still subject to wear. Read this tip for help diagnosing and solving problems with your screw conveyor. The information is listed by conveyor component.

A screw conveyor, as shown in Figure 1, is a mechanically simple device that can move dry bulk materials at various speeds over straight distances typically up to about 100 feet. The conveyor usually consists of several screw sections, each mounted on a hollow pipe, which slide over a rotating drive shaft. The drive shaft is supported in a U-shaped trough by bearings at the trough ends; one (or more) hanger bearing is suspended from the trough top to hold the coupling shafts between screw sections. These bearings maintain the correct screw-trough clearance. A cover on the trough top has an inlet opening; a discharge opening in the trough bottom is at the conveyor's opposite end. A motor is mounted at the conveyor's discharge end.

Problems with various components can affect your conveyor's performance. The components include the conveyor trough, inlet and discharge trough end bearings, hanger bearings, screw flight tips, the coupling shaft, the drive shaft, shaft holes, and the motor and heater.

Caution: Safety is critical in installing, using, and maintaining your screw conveyor. Before troubleshooting your screw conveyor, the Conveyor Equipment Manufacturers Association (CEMA)[1] and all screw conveyor manufacturers highly recommend that you review CEMA Brochure 201 on conveyor safety label guidelines.

Conveyor trough

Any of three problems can cause the conveyor trough to fail prematurely:

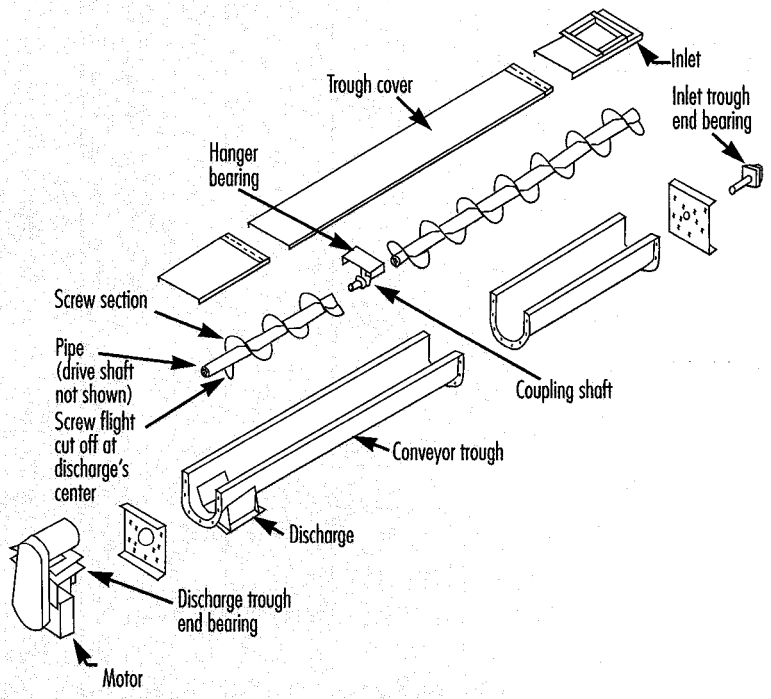
- The trough material (typically steel) is too light for your conveyed material or conditions.
- The screw has excessive deflection.
- The screw flight tips are bent.

If the steel in your trough is too light, an abrasive material such as aggregate rock can wear holes in it. A caustic material can eat through the trough. Rust from a moist powder or humid operating conditions can also produce holes in the trough walls. A high-temperature material can damage the trough.

In these cases, you need to replace the damaged trough with one made of a heavier-gauge steel. Consider your conveyed material and operating conditions when selecting the gauge. If your material is abrasive, caustic, or moist, you can also consider lining the trough with plastic. Consult your screw conveyor manufacturer for help selecting a suitable trough material.

Figure 1

Typical screw conveyor (exploded view)[a]



[a]*Note:* Refer to CEMA Brochure 201 (see reference 1 in this article) for safety label identification and placement guidelines.

And once you install the new trough, make sure your conveyed material fills only 15 to 45 percent of the trough. This will prevent material from riding too high in the trough and wearing more area on the trough walls.

If the screw has deflected beyond the acceptable CEMA limits[1] for screw-trough clearance, it can gradually wear a hole in the trough or even puncture it. You need to find the deflection's cause before repairing or replacing the screw and replacing the trough. Bearing failure, which allows the screw to move out of alignment, can cause the screw to deflect. So can high torque loading on the screw when it rotates at slow speed, as can a drive shaft that's too light for your material or operating conditions. An obstruction, such as a large rock buried in a load of wood chips fed to the conveyor, can also cause screw deflection.

If the deflection is relatively minor, you may be able to straighten the screw rather than replace it. If you must replace the screw, select a screw that will minimize deflection under your operating conditions. Consult your screw conveyor manufacturer for information on calculating the correct pipe size and screw length for the new screw. Whether you repair or replace the screw, check that it's straight before operating the conveyor.

Bent screw flight tips are typically caused by an abrasive material that wears the flight tips to the point that they bend over and roll. The bent tips not only prevent the screw from carrying a full load of material but can contact the trough walls and damage the trough. You can straighten the tips if the damage is relatively minor, or you can replace the screw. In either case, check the screw for straightness before operating your conveyor.

Inlet trough end bearing

The bearing at the inlet trough end can fail from one of these causes:

- Material has gotten into the bearing.
- The bearing has insufficient lubrication.
- The screw has excessive deflection.

If the bearing is damaged because material has worked into it, the bearing's seal has failed. This is more likely to occur when you convey a fine or abrasive material or convey with a high trough loading. To keep material out of the bearing, add a new seal to the bearing or upgrade the existing bearing. You can switch to an air-purged bearing that uses compressed air to blow material away from the seal, but this bearing is costly and requires a compressed-air supply. You can also change from a conventional inboard bearing to an outboard style, so your material no longer contacts the bearing.

If the bearing has been damaged by a lack of lubrication, replace the bearing and lubricate its seal more often. Don't wait until the bearing squeaks. Instead, follow the bearing manufacturer's recommendation for lubrication frequency, and make this schedule part of your plant's preventive maintenance procedures.

If the screw has deflected beyond acceptable limits, the screw won't be parallel to the trough and will oscillate as it rotates. This can wear out the bearing. Besides deflection sources discussed in the previous "Conveyor trough" section, other sources include accidentally dropping the screw before it's installed or bumping into the conveyor with a forklift or other equipment. After replacing the bearing and straightening and realigning the screw or replacing it, make sure the screw is straight before running the conveyor.

To prevent future problems, check the screw alignment in the trough during your plant's scheduled maintenance downtimes. More important, walk by the conveyor and listen to it every day or several times a day; small operating changes from deflection and other problems are usually audible, and the problems are easier to fix before they

have a chance to damage your conveyor components.

Discharge trough end bearing

The bearing at the trough's discharge end can be damaged by the same problems that affect the inlet trough end bearing, and you can solve the problems in the same ways. But the discharge trough end bearing is subject to another problem because of its location at the discharge. The screw flights can carry material across the discharge and into the bearing, which can damage the bearing. To fix the problem, you can cut off the screw flight at the discharge's center (Figure 1). This causes the material to change direction and push itself over the flight edge and through the discharge.

Also make sure you place the discharge trough end bearing in the right spot. Your screw conveyor generates thrust in the opposite direction of the material being conveyed, because for every action there's an equal but opposite reaction. If you place the discharge trough end bearing where the thrust bearing is located, the end bearing will be able to accommodate the thrust loads generated by the screw conveyor. You can consult your screw conveyor manufacturer for help selecting the proper thrust bearing.

Hanger bearings

Each hanger bearing (sometimes called a *hanger-bearing assembly*) includes a T-shaped hanger and round bearing. The hanger's short T ends are attached to the conveyor trough top; the T's center hangs down into the trough. The bearing attaches the T's bottom to the screw at the coupling between two screw sections: The bearing is bolted onto a coupling shaft that holds together two pipe ends for adjacent screw sections (Figure 1).

The hanger bearings can fail as the result of these problems:

- The hangers are incorrectly aligned.
- A high-temperature material overheats the bearing.
- Insufficient lubrication overheats the bearing.
- Thrust from the screw's rotation damages the hanger bearing.
- The hanger bearing construction material is weak or has been improperly selected.

If a hanger bearing failed as the result of improper hanger alignment, replace the bearing and realign the hanger so that the bearing's centerline aligns with the trough's centerline. The bearing's slotted (rather than round) bolt holes allow some play for adjusting the alignment. Proper alignment keeps the screw in a straight line

in the trough and ensures the proper screw-trough clearance.

If the failure was caused by heat from conveying a high-temperature material, replace the bearing with a ceramic or heat-treated hard iron bearing that can withstand the heat.

If a hanger bearing failed because it was poorly lubricated, properly lubricate the bearing at more frequent intervals, as outlined in the previous "Inlet trough end bearing" section. If your operating conditions are extremely harsh, you can replace the bearing with an oil-impregnated, self-lubricating bearing or equip the bearing with fill tubes that extend outside the trough cover so that workers can quickly add lubrication to the bearing without removing the cover. You can also replace the bearing with a heavier-duty version. For instance, in a sugar mill, the fine abrasive sugar can penetrate a conventional bronze bearing's seal because the bronze wears quickly. The bronze wear particles can also contaminate the sugar. In this case, you can replace the bearing with a sugar bearing made from Synthane, a ceramic bearing, an air-purged bearing, or — the least effective — a white nylon bearing that won't leave dark wear particles in the sugar.

If a hanger bearing failed because the screw develops strong thrusting forces during rotation that the bearing isn't strong enough to withstand, replace the bearing and check the coupling shaft bolts for wear and the bolt holes for elongation. If necessary, replace the coupling shaft. Then readjust the hanger bearing attachment to the screw to provide the proper screw-trough clearance.

If a hanger bearing wore prematurely because it was constructed of the wrong material for handling your application's operating conditions, you need to replace the bearing with one made of a more suitable material. A high-temperature conveyed material can require a ceramic or heat-treated hard iron bearing. High trough loading creates more wear on the bearing and other contact parts, and a high screw speed creates more friction, also leading to more wear. In these cases, you can replace the bearing with a wear-resistant hard iron or ceramic unit. At the same time, make sure that the bearing material is compatible with your coupling shaft material. Work with your screw conveyor manufacturer to choose the right hanger bearing material.

Screw flight tips

Two problems can cause the screw flight tips to wear quickly:

- The flight tip material is too light to withstand contact with your conveyed material.
- The screw speed is excessively high.

A light-gauge flight tip material can fail to withstand abrasion from materials like aggregate rock or coal. You can repair flights that aren't too damaged. One repair method is to cut off the damaged tips and weld on new ones made of thicker material. You can also lay a welding bead on the tips' top 3 to 4 inches or bolt on wear sections made of abrasion-resistant, high-temperature, high-strength steel. For handling an extremely abrasive material, you can apply a hardfacing paste to the tips and then heat-treat the tips to harden the paste. But in many cases, it's cheaper to simply replace the screw sections.

Quick tip wear can also be caused by an excessively high screw speed, because higher speed creates more friction and more wear on the flight tips and other contact parts. The obvious solution is to slow down your screw speed. However, because screw speed and trough loading both contribute to the conveying rate, consult your screw conveyor manufacturer for help determining what screw speed and trough loading will work best for your application and prevent rapid flight tip wear.

Coupling shaft

The coupling shaft can break if it doesn't have enough torque capacity to handle your motor's horsepower. To solve this problem, replace the coupling shaft with a larger one. Check the motor amp demand (horsepower) to see what torque capacity you'll require.

Drive shaft

The conveyor's drive shaft can break as the result of these problems:

- The shaft is subject to excessive torque.
- The shaft has insufficient torque capacity.

- An object obstructs the conveyor.

Excessive torque on the drive shaft can be the result of several factors, including your conveyed material's characteristics. For instance, conveying a nonfree-flowing material or switching to a material that's denser than the material your conveyor was originally designed to handle can create excessive torque on the shaft. To reduce torque on the shaft, recalculate your conveyor's horsepower requirements and, if necessary, install a bigger motor.

You can usually solve the problem of insufficient torque capacity by replacing the shaft with a heavier-duty unit.

When an obstruction enters the conveyor, it can stop the screw's rotation, breaking the drive shaft. After removing the obstruction and replacing the shaft, take steps to prevent foreign objects from entering the conveyor, such as by adding a cover to the conveyor if it hasn't been covered before, adding a chute above the inlet, or placing a grid or bars above the inlet (as long as your material flows well and isn't fibrous or stringy). Then check the screw's alignment before operating the conveyor.

Shaft holes

The holes in the drive shaft, where the screw pipe sections are bolted to the shaft, can elongate, loosening the bolts. This can affect the screw-trough clearance and damage the trough and other components.

One common cause of hole elongation is using too few bolts to fasten the screw sections to the shaft. In this case you can install more bolts, such as by switching from a two-bolt to a three-bolt pattern. You can also use a bushing inside each pipe section to make the pipe cross section thicker, or you can add a pad to the screw to likewise thicken the screw cross section. Either method provides more support for the bolts.

Jogging the conveyor, starting and stopping it frequently, and overloading it can also elongate the shaft holes. Try to limit these conditions, but if that isn't possible, increase the drive shaft's bearing capacity by replacing it with a larger-diameter shaft, which will transmit more torque, or a shaft made of a stronger alloy, which will increase the shaft's tensile strength. You can also increase the number of bolts fastening the screw pipe sections to the shaft.

Motor and heater

The conveyor motor can overheat if the amperage demand on it is too high. Certain material characteristics, high trough loading, and high screw speed can increase the amperage demand. High amperage demand can also overheat a heater that supplies hot media to a thermal jacket, if your conveyor is so equipped.

To reduce the amperage demand on the motor or heater, recheck your horsepower calculations and determine whether they're appropriate for your operating conditions and your conveying capacity. Also regulate the material feeding to the conveyor inlet.

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Reference

1. For more information, contact Conveyor Equipment Manufacturers Association, 6724 Lone Oak Boulevard, Naples, FL 34109; 941/514-3441, fax 941/514-3470 (e-mail: cema@cemanet.org).

For further reading

Find more information on screw conveyors in articles listed under "Mechanical conveying" and "Mechanical conveying components" in *Powder and Bulk Engineering*'s comprehensive "Index to articles" (in the December 1998 issue and on *PBE*'s Web site, www.powderbulk.com).