Tips:

An introduction to screw conveyor discharges and cut-off gates

Do you regard your screw conveyor as a necessary evil? Despite the conveyor's simplicity, it's often the least understood, most disliked piece of equipment in a plant. Choosing the right combination of screw conveyor parts — such as screw, trough, inlet, discharge, and cut-off gate — is one way to turn this attitude problem around. Get started by reading the information here on screw conveyor discharges and cut-off gates.

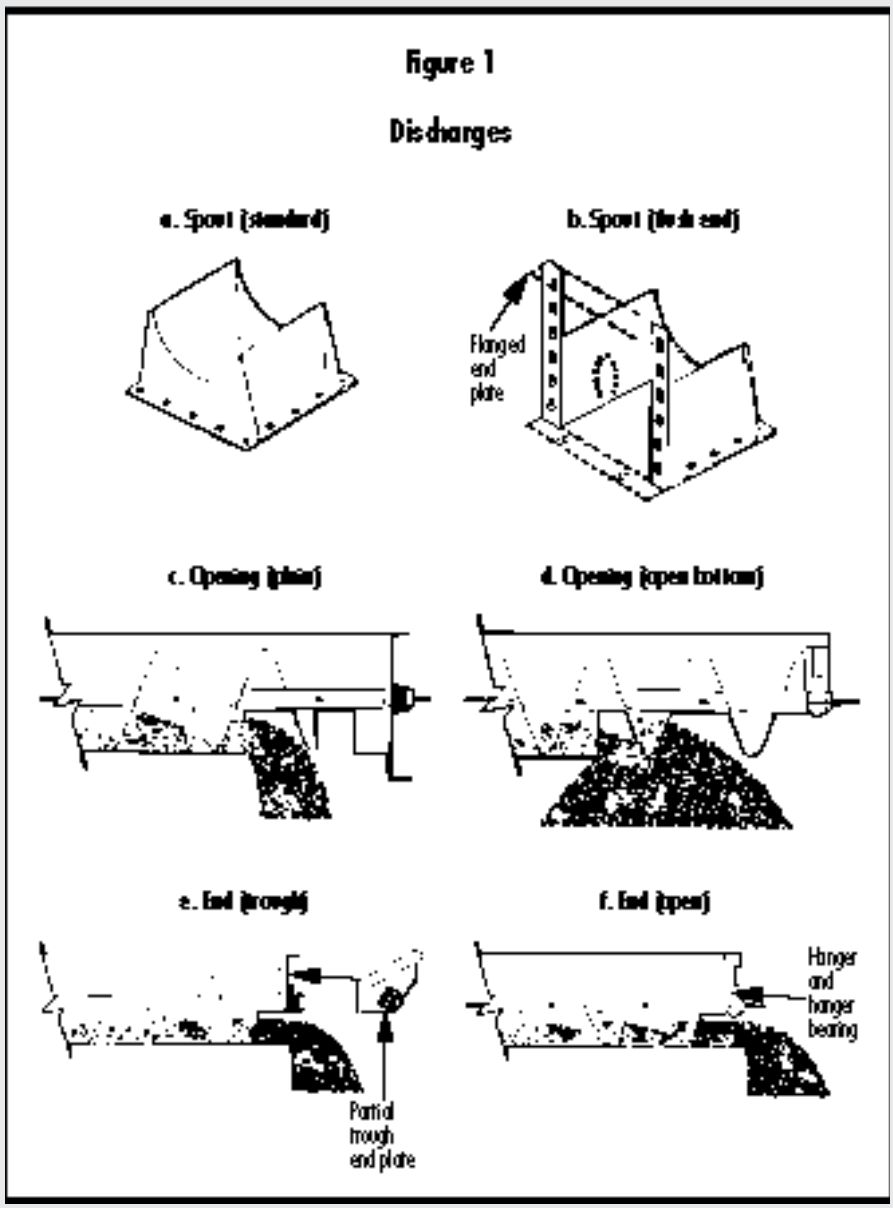
A screw conveyor discharge's main function is to let material leave the trough. Depending on its type, the discharge can also enclose the material for dust or contamination control and provide a convenient way to connect the screw conveyor to downstream equipment or a chute. There are three types of discharges: Spout, opening, and end.

Spout discharge

Ninety-nine percent of all screw conveyor discharges are spout types because they provide multiple benefits: They not only discharge material but enclose it and allow the conveyor to be connected to other equipment. The spout discharge can be a standard or flush end unit, as shown in Figures 1a and b.

Standard. By far the most commonly used, the standard spout discharge (also called a stub discharge) has four sides — two of them with curved ends to conform to the conveyor trough bottom — and a flanged rectangular outlet that bolts to downstream equipment or a chute. The discharge is typically located near (but not at) the conveyor's end.

The discharge can also be located at any point along the trough to provide an intermediate discharge in addition to the final discharge. Several intermediate discharges can be used along one conveyor — for instance, to fill each of several bins. An intermediate standard spout discharge can require a cut-off gate (discussed later) to stop flow through the discharge and allow



the material to be conveyed further downstream.

Flush end. The flush end spout discharge is similar, but one side is a flanged end plate (shown by the dashed lines in Figure 1b) that bolts to the conveyor trough's end. This reduces the conveyor's overall length as well as the distance between the discharge's center line and the tip of the end shaft (which supports the screw).

Reducing this distance can be a factor when the screw conveyor loads a bucket elevator. Each bucket is loaded from its narrow side, and the flush end spout discharge's location allows it to be positioned closer to this narrow side when the conveyor is parallel to the elevator casing's long side.

Opening discharge

The opening discharge is simply an opening in the conveyor trough bottom, making it less expensive than a spout discharge. However, the opening discharge is extremely dangerous because it provides no protection from the rotating screw. Another drawback is that this type of discharge provides no way to connect the conveyor to subsequent equipment or a chute. The discharge can be plain or open bottom, as shown in Figures 1c and d.

Plain. The plain opening discharge is simply a small opening in the trough bottom and can be used for multiple intermediate discharge points into open storage. When material has filled the area under the first plain opening up to the screw level, the material will pass over to the next plain opening and discharge into the next unfilled area of open storage.

Open bottom. The open bottom discharge is one long opening in the trough bottom and is used only for distributing material over an extended storage area. In this case the screw conveyor can be mounted in an A-frame storage building's top, and the open bottom discharge can extend over the entire length of the storage area. As material fills the storage area, it eventually builds up to the screw's bottom, where it forms a natural trough. Incoming material passes through this trough to the unfilled areas.

End discharge

The end discharge produces the shortest possible screw conveyor length. Two types — trough and open — are available, as shown in Figures 1e and f.

Trough. This discharge is a partial trough end plate covering only about the top two-thirds of the trough end. The trough end discharge is suited to applications with very little clearance between the required discharge point and the adjacent equipment or structure.

But the discharge isn't recommended for an application handling a sluggish material in which the screw is more than 30 percent loaded because the end plate can contact the material bed's upper portion and slow the material discharge. However, some loads of extremely free-flowing material can exceed this 30 percent level without slowing discharge.

Open. The open end discharge is formed by removing the entire trough end plate. This discharge is most often used when the trough end is attached to or inserted through a silo wall or chute. However, using the discharge requires installing a hanger and hanger bearing to support the screw in the trough. This type of discharge can make it hard to access and service the hanger and hanger bearing, which are high-wear components.

Cut-off gate

A cut-off gate slows or stops material flow through a discharge (or an inlet) while the screw is still turning. The gate can be a hand slide or rack-and-pinion type, as shown in Figure 2.

Hand slide. The hand slide cut-off gate (Figure 2a) is a set of slide runners supporting a flat slide plate; the plate has a bent flange that can be grasped to manually pull or push the slide plate open or closed. The gate's slide runners have flanges that are bolted to a standard discharge spout (shown by the dashed lines in the figure). By varying how far the hand slide is opened, the operator can control the discharge rate. However, the operator can only achieve precise flow control through trial and error.

The hand slide is the least expensive cut-off gate, is easy to mount, and can be rotated in 90-degree increments to permit operation in any of four directions. However, the unit requires an operator, isn't dust-tight, and may not close tightly enough to prevent material leaks.

Rack and pinion. A rack-and-pinion cut-off gate has a flanged housing; depending on the type, the housing top bolts either on a standard spout discharge or directly on the conveyor trough. The housing bottom can be bolted to downstream equipment or a chute. The gate has a manual or chain-driven wheel operator that can be mounted on either side of the gate, a rack-and-pinion mechanism, and slide runners supporting a slide plate. Turning the wheel operator engages the pinion (or pinions), which in turn meshes with the rack attached to the slide plate. The gate can have a flat or curved slide.

A *rack-and-pinion cut-off gate with a flat slide* (Figure 2b) bolts to a standard spout discharge (shown by the dashed lines in the figure). It's the least expensive of the two rack-and-pinion gates, is easily mounted in the field, is easily modified to prevent dust from escaping into the atmosphere, and can be positioned to open from either side of the housing or in line with the housing. The cut-off gate can also have a hydraulic, pneu-

matic, or electric linear actuator for remote or automatic gate control.

However, when the gate is closed, material accumulates on top of the slide. This makes the gate unsuitable for applications subject to cross-contamination; an example is food or grain handling, in which the accumulated food or grain can spoil and fall into subsequent batches, contaminating them. Some materials (in the Conveyor Equipment Manufacturers Association [CEMA] class codes F, M, O, W, and X)[1] can also build up on the slide runners and cause the gate to bind and operate unreliably. The gate also requires more headroom than one with a curved slide.

A *rack-and-pinion cut-off gate with a curved slide* (Figure 2c) is mounted in place of a section removed from the conveyor trough bottom. It has two slide runners that bolt directly on the conveyor trough and support a slide gate that's curved to match the trough bottom.

This configuration requires minimal headroom because it eliminates the standard spout discharge. The curved slide conforms to the trough bottom, preventing material buildup above the slide and making the gate suitable for food and grain handling and similar applications. Material is also less likely to build up in the slide runners because they're above the material bed and outside the flow.

However, the gate is more expensive than one with a flat slide, and making the gate dust-tight is costly. This gate is also difficult to mount in the field and can't be mounted to open to the side.

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Reference

1. More information is listed in CEMA catalog 350, available from CEMA at 9384-D Forestwood Lane, Manassas, VA 20110; 703/330-7079.

Figure 2

Cut-off gates