OPTIMAL HOPPER TRANSITIONS: DESIGN GUIDELINES FOR MAXIMUM HOPPER-TO-FEEDER PERFORMANCE

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Across a wide range of industries, vibratory feeders play a critical role in metering and conveying bulk materials efficiently. Yet even the most advanced feeder system cannot perform to specification if it receives material from a poorly designed hopper.

ERIEZ

One of the most common and costly issues in vibratory feeding systems arises not from the feeder itself, but from the hopper transition—the section where material moves from the bulk hopper into the feeder tray. Improper transitions can significantly reduce feeder capacity, damage equipment and compromise flow consistency.

This technical paper outlines design parameters for optimal hopper-to-feeder performance to ensure consistent throughput, reduced wear and reliable long-term operation.

THE IMPORTANCE OF TRANSITION DESIGN

When designing the hopper transition that supplies material to the vibratory feeder, we must consider several factors to ensure the feeder can perform optimally.

Key design variables such as opening size, gate configuration, wall geometry, and clearance between the hopper tranistion and the vibratory feeder tray must all be aligned with the physical characteristics of the material being conveyed.

Throat Opening

The throat opening (T)—or the width of the outlet at the hopper base—is one of the most important factors in achieving proper flow into the feeder tray.

- **For random-sized materials**, T should be at least 2x the largest particle size.
- **For near-sized materials**, T should be at least 3x the largest particle size.

To avoid overloading the feeder, T should not exceed 30% of the tray length. This is because oversized throat openings can create excessive headload, leading to reduced amplitude, decreased capacity, and potential feeder damage.

Gate Height

The gate height (H) governs the volume of material that flows into the tray and directly affects the feed rate and material burden depth. It should increase proportionally to the particle size and the flow depth to deliver the desired feed rate.

- H should be at least 2x the largest particle size.
- H should be 1.2–1.5x the material burden depth.

Ideally, the relationship T = 0.6 x H should be maintained. As H values become smaller than T, this can lead to uneven or stagnant material flow.

The fed material's angle of repose should allow it to settle naturally onto the bottom of the feeder tray surface at least 150 mm (6 inches) before the end of the tray. If not, material will flow off the tray—even when the feeder is turned off.

Adjustable gates must be mounted parallel to the tray's front wall. Angled or misaligned gates can cause material to accumulate unevenly and apply excessive force on the feeder.

Hopper Opening Width

The width of the hopper opening—measured where material exits the hopper and enters the feeder tray—plays a key role in ensuring uniform flow across the tray surface.

An opening that is too narrow can cause material bridging or funneling, which leads to uneven loading and reduced feeder performance.

- **For random-sized materials**, width should be at least 2.5x the largest particle size.
- **For near-sized materials**, width should be at least 4x the largest particle size.

This measurement should be taken between the skirtboards at the point where the hopper discharges onto the feeder tray.

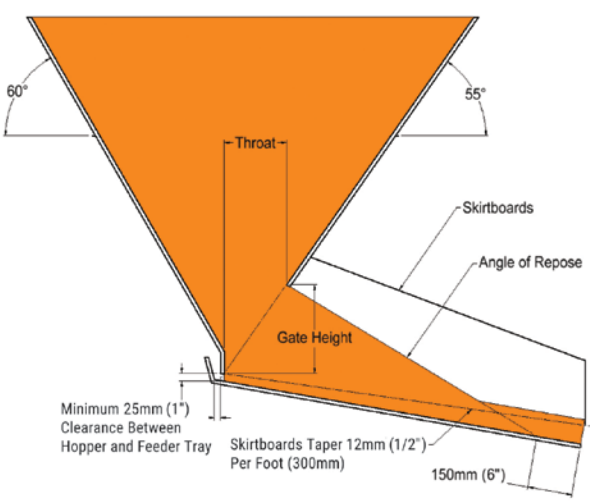
Hopper Wall Configuration

The main section of the hopper should have sloped walls that are steeper than the material's angle of repose to ensure self-emptying and poor flow from the hopper does not impede the capacity that can be achieved by the feeder. However, overly steep walls can create excessive headload on the feeder and lead to uneven flow. In such cases, flow aids like vibrators may be necessary to maintain consistent discharge.

The front wall should sit at an angle between 50° and 65°, while the rear wall should be 5°–10° steeper than the front wall to promote drawdown from the back of the hopper.

Additionally, the projected angle of the front wall should meet the bottom of the rear wall to form a properly converging material flow channel *(see Figure 1)*.

FIGURE 1



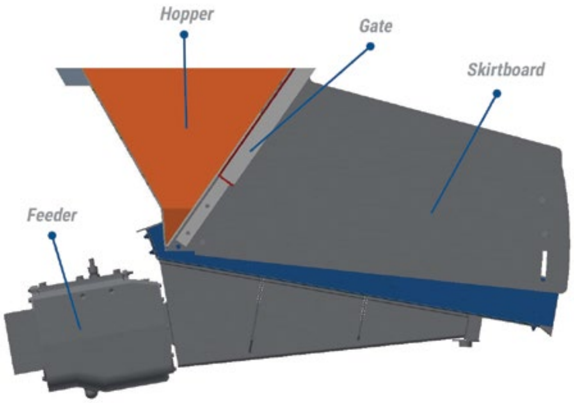
Structural Clearance

Vibratory feeders require freedom of motion to operate at full stroke and amplitude, making it critical to maintain adequate clearance on all sides of the feeder tray.

- **B and B-HC models:** At least 25 mm (1") tray clearance.
- **HVF and Brute Force models:** At least 37 mm (1.5") tray clearance.
- **Compact feeders:** At least 6–12 mm (¼"–½") tray clearance.

These clearances should be verified both when the hopper is full and empty. Any physical interference and/or contact with rigid surfaces during operation will dampen vibration, reduce feed rate, and may even lead to equipment damage.

FIGURE 2



Skirtboards

To achieve the rated capacity of Eriez B-HC feeders or HV mechanical feeders, the material burden depth must exceed the height of the feeder sides. To prevent spillage, install skirtboards on both sides of the gate opening, extending to the end of the trough and tapering upward gradually to avoid material jamming *(see Figure 2)*.

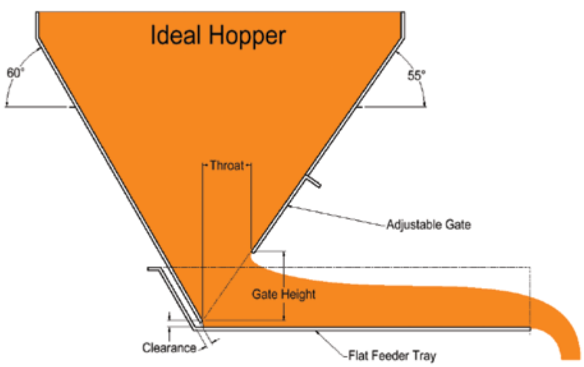
Skirtboards are especially critical for downsloped tray installations, where gravity accelerates material movement and can lead to uncontrolled discharge.

TYPICAL HOPPER TRANSITIONS

While hopper transition designs can vary based on material and application, three common types are widely used in Eriez feeder systems. Each of these transition types offers unique advantages and requires specific design considerations to ensure optimal performance.

Selecting the appropriate transition type is critical to achieving consistent material flow, reducing equipment wear, and extending the service life of both the hopper and the feeder.

FIGURE 3



Flat Tray Transition

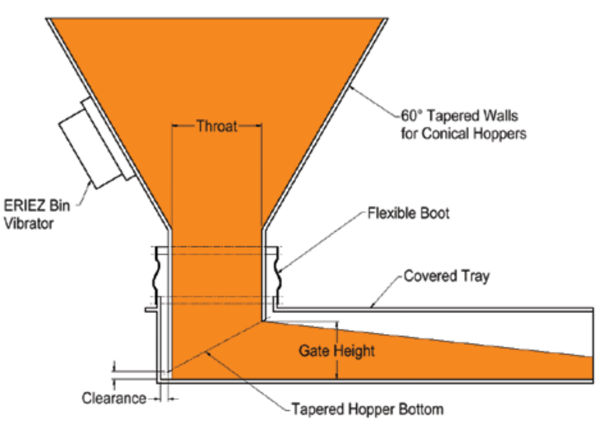
For flat-tray applications, hoppers are ideally designed with a wedge or chisel-shaped transition and an adjustable gate mounted on the front wall *(see Figure 3)*. This configuration reduces material load on the feeder tray and promotes uniform flow.

However, not all materials discharge smoothly from a wedge-shaped hopper, so the transition design should be tailored to the specific material characteristics. Any interference with feeder vibration, either as a result of poor geometry or misalignment, can significantly reduce capacity and even lead to equipment failure.

The hopper bottom should be configured so that material flow stops completely when the gate is fully closed. As an alternative to a slide gate, an adjustable collar can be used to control material flow during operation of the feeder.

NOTE: Fine or fluid-like materials may require an alternative transition design to prevent flushing or uncontrolled flow.

FIGURE 4



Tubular or Covered Tray Transitions

Tubular or covered trays are commonly used when feeding dusty materials or when the material must be contained or isolated during handling. To maintain proper feeder operation, it is crucial to provide adequate clearance around the infeed spout or hopper. This ensures the feeder can vibrate freely under all conditions without interference.

Hopper transitions for covered or tubular trays should be designed to increase flow efficiency while reducing the material load placed on the feeder. Proper geometry helps prevent overloading and supports consistent feeder performance *(see Figure 4)*.

FIGURE 5

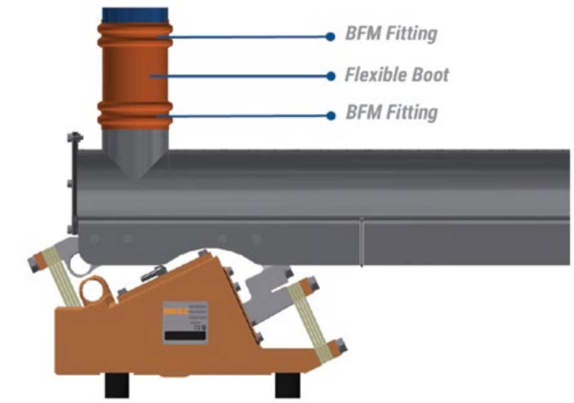
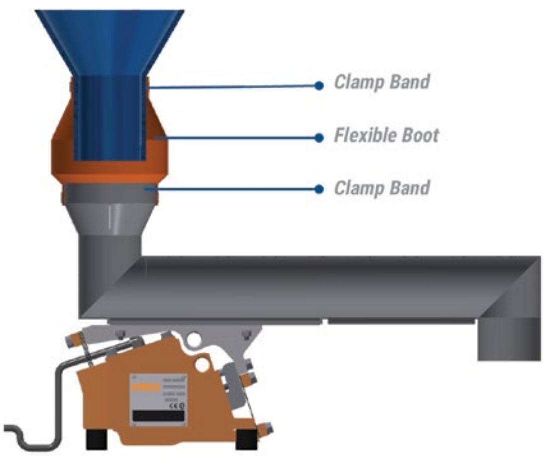


FIGURE 6



Spring ring-type flexible dust boots are generally effective at the discharge end of the feeder. However, at the infeed, these boots should only be used when the feeder is meter fed—such as from a rotary valve or screener—so the boot remains unfilled and flexible. If the boot fills with material, it can restrict the feeder's motion and hinder performance. The hopper extends down into the feeder tray and the boot is merely a dust cover between the feeder and hopper outlet *(see Figure 4)*.

Transitions Without Hopper or Material Column Above Tray

When the feeder is meter fed and there is no material surge or column above the tray, a flexible boot connection from the bottom of the hopper to the tray inlet is acceptable.

In this setup, the boot remains unfilled, allowing the feeder to vibrate freely without restriction. This configuration is typical for BFM-style flex boots and works well when material is delivered in controlled amounts—such as from a rotary valve or screener *(see Figure 5)*.

However, if a hopper or material column is present above the feeder tray, the transition must terminate directly into the tray *(see Figure 6)*. This prevents the boot from filling with material, becoming rigid and restricting the feeder's motion.

SUMMARY

Feeder performance depends not only on the equipment itself, but also on how the material is presented to it. Properly designed hopper transitions enhance flow consistency, protect feeder components, and help achieve the full rated capacity of your Eriez vibratory system.

By implementing the design parameters that are outlined in this technical paper—particularly as it relates to throat sizing, gate height, wall angles and clearances—engineers, and equipment operators can avoid costly feeding issues and ensure reliable, efficient operation.

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