How to Select a Feeder

To simplify we are using the term “Parts” as a general description covering parts, packages and materials.

Part feeders come in many forms. These include vibratory bowls, inline feeders, centrifugal feeders, belt feeders and step feeders. All part feeders utilize common engineering principals to feed and orient parts which include part weight, center of gravity, part geometry and part velocity. Part feeders differ in the method with which each motivates or conveys parts past tooling. Tooling may be passive, like a simple rail with an elevation wiper, or more recently PLC controlled programmable active with sensor and a pneumatic or servo-electric to sort or orient parts. The later devices are often used to tend upstream machines as well.

**Step One- Analyze the Part**

It always begins with the part. Consider the length, width, thickness, material weight and shape of the part. Parts generally have a natural bias. This is caused by basic geometry and by various features which might be included within the part’s design. These features should also be considered in relation to the centre of gravity and the general shape and size of the part. In combination features will determine the ‘natural’ feeding bias of the part. This is also called the parts “aspect ratio” and it defines how parts are fed, metered and ultimately oriented. In addition any outstanding feature may serve as a guide for orientation, such as; angles, grooves, flanges, bosses, projecting pins and convex or concave surfaces. In simplest terms part with good weight to surface are with few features to slow it feed best. Parts with a center of gravity or features which allow for simple, passive tooling are oriented in simple low cost feeder-orientors. How fragile the part of part surface is should also be a primary consideration. Some feeder designs work very well with robust or rough form parts but are likely to damage parts which require “gentle” handling. So a nut, bolt or screw may be appropriate for a vibratory bowl or step feeder which are excellent at metering part to tooling but are generally best suited for more robust parts while ceramic, powdered metal, high value packaging and machined parts are generally fair better in a linear feeder such as the Dyna-Slide lines of machines. Additionally, the part surface condition needs to be identified. When parts are dry the surface is not a limiting factor but when wet or oily the parts are best handled within a brushlon lined bowl or linear feeder which reduces part to machine surface adhesion.

Testing is generally required to determine how well it will feed and how simply the part is to orient but our skilled part handling engineers can generally provide initial guidance and suggestions with answers to a few simple questions, imagery or a few test parts.

**Step Two- How fast do you need the parts?**

The second issue to consider is feed rate. Both bowl and linear vibratory feeders generally operate at a similar maximum effective operating speed of not greater the 320 ipm. Belt feeders and centrifugal feeders can operate at much higher speeds but only on certain. Feed rate is affected by tooling efficiency. A simple part like a washer with random oriented part fed single layer x single file OD to OD has 2 in 2 tooling efficiency. If the part is being sorted for a feature like an ID chamfer then the efficiency drops to 1 in 2. It is important to understand that every feeder operates on an average feed rate so sufficient run out should be included in the discharge track or conveyor to maintain a supply of conforming parts available for your next operation.

**Step Three- What is your environment?**

The third issue to consider is the environment where the feeder will be operating. Feeders are constructed for every industrial environment. It is critical the designer understands the requirements of the environment where the feeder is operating. The size of the feeder is effected by the size of the part and the part supply required to maintain the desired feed rate.
**Step Four- Part Supply?**

The fourth issue to consider is where the part supply is coming from. The feed rate is a related issue since sufficient supply. Various floor level hoppers, table hoppers, horizontal hoppers, integrated bin dumpers, tote dumpers and “in line” part supplies are available to maintain part supplies to feeders. These supply devices are generally combined with simple part flow controls sensors so that parts are supplied to feeder “on demand”. This is often vital to the efficiency of a feeder since too few or too many parts within the feeder will negatively impacts the feeder performance.

**Step Five- Part Orientation?**

Part orientation is affected by passing the part through a series of engineered obstructions or guides in the feeder track. CDS LIPE uses standard modular tooling as well as custom tooling as needed. Parts lacking adequate aspect ratio, geometry or feature suitable for efficient feeding or passive tooling may be oriented using “active tooling”. Active tooling are sensors combined with an active orientation device such as a pneumatic pick/rotate/place device.

Parts that are not well suited for part feeding can also be fed to upstream automation. This category of feeding is called Flex Feeding. Flex Feeding guidelines are available from CDS LIPE under separate title.

**Feeder Types & Terms**

**Linear Vibratory Feeders**

Linear parts feeders use an ½ Wave electromagnetic drive generally combined with a biased brush material to induce movement. As the drive unit is energized, the parts will gently flow in the direction and frequency of the vibrating brush. When the parts arrive at the tooling several different actions can occur depending on their orientation at that point and the discharge orientation desired. After the parts have passed all the tooling ,they will be consistently oriented for delivery to the discharge conveyor. Those parts “tooled” off do not drop back into a hopper but are general gently slid back onto chute. If possible tooling will re-orient the part ensuring it will pass tool on second pass. These feature combined make the linear feeder very gentle on parts.

<table>
<thead>
<tr>
<th>Linear Vibratory Feed System (Terms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Integral Bulk Parts Pre-Feeder-Hopper.</td>
</tr>
<tr>
<td>2) Supply Chute &amp; Tooled Ramp</td>
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<tr>
<td>3) Tooling Rail(s)</td>
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<td>4) Inline Electromagnetic Linear Vibratory Drives</td>
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<tr>
<td>5) Tooling</td>
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<tr>
<td>- Rail Tooling-</td>
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<tr>
<td>- Tube Tooling</td>
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<tr>
<td>- Active Tooling</td>
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## Dyna-Slide Linear Feeder / Orientor

<table>
<thead>
<tr>
<th>Part No</th>
<th>FEEDERS</th>
<th>Min.</th>
<th>Max.</th>
<th>Min.</th>
<th>Max.</th>
<th>IPM</th>
<th>MM/P</th>
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<tbody>
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<td>Basic Table Mounted Feeder (PSA/Dry) Rail Tooled</td>
<td>0.025</td>
<td>0.500</td>
<td>0.125</td>
<td>0.750</td>
<td>0 to 320</td>
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* Weight Limited = *

Temperature Limited

Horizontal or Linear Feeders are price competitive vibratory bowl feeders but differ significantly. Dyna-Slides generally require less footprint. Linear Vibration is Gentle on parts since brush bias allows for minimum pitch and vibration amplitude to be used. Feeder/ Orientor operates at <65 dba. Part supply typically operate with zero drop. Surfaces are non-marking. Tooling is most often modular and fully adjustable to allow a family of parts of similar geometry to operate with minimal changeover from the same feeder. This allows feeder to be easily reconfigured for "new" parts making justification for short run projects possible. The brushlon surface is easily replaceable so feeders are easily maintained even under harsh operating conditions. The feeders are available in "typical" standard below but can be sized to meet your application needs.

Direction of

![Bias Brush Surface](image)

Linear Vibration Action
Linear Accumulator Vibratory Feeders

When the parts need to be simple parts need to be gently accumulated and then fed to upstream process an accumulator table combined with a simple tooled chute can be used. Generally round parts and packages work well. This very gentle linear feeder works well as an inline buffer.

Rail Feeders

When the parts need to be simple parts need to be gently accumulated, oriented and then fed to upstream process. Rail feeders can also be used as a horizontal magazine. Combined with an escapement device these systems can provide very effective and gentle means of queuing parts to an upstream process.
Centrifugal Rotary Feeders

These use centrifugal rotation not vibration to carry the parts through the qualifying area. The parts are processed by rotating past stationary stainless tooling on a rim relying on centrifugal force to push the parts against the ring. The centre of the bowl has a reservoir that contains some bulk parts and acts as a "return pan" for parts that are not in the proper orientation. Rotary feeders are capable of providing high rates of feed with gentle handling characteristics but require parts that can be back pressure fed.

1) Straight band wall
2) Tooling Ring
3) Disk
   a) Single
   b) Dual
4) Drive motor (common or dedicated)
5) Drive line (may be gear or chain)
6) Frame
7) Tooling
   a) Air with sensors
   b) Fabricated sortation devices similar in construction to a vibratory bowl tooling
Step Feeders

The step unit includes stationary steps and cam driven elevating steps. These steps are designed with a slight backward angle and utilize a supporting ledge that carries only parts that meet the desired orientation. As the cam completes rotations, the first elevating step strips parts from the discharge hopper and groups of parts travel up the remaining steps. Each time the cam places the elevating steps at the raised position, parts roll to the stationary steps where they are staged for the next lift. When the elevating steps are in the down position, staged parts roll from the stationary steps to the next elevating step. This cycle continues until the parts reach the last stationary step. The feed process supplies part to orientation rails, tooled ramp or discharge. Parts sorted out by tooling are returned to step hopper. Very small and parts which require gentle handling can by metered to chute or orientation rail. More gentle then a low level hopper feeder the step feeder still works best on simple part geometries.

Step Feeder

1) Hopper
2) Step Width
3) Discharge snout.
4) Snout to tooling interface.
5) Tooling rail.
6) Tooling.
7) Part rejection chute / Return chute.
8) Discharge track.
Low Level Hopper/Elevator/Feeder- Orientor

These combine an elevating supply hopper with orientation tooling. There are three basic styles of floor hopper elevator. Part supply, feeder-orientor using vibratory ramp or rails and non-vibratory. Parts need to be have simple geometry and be fairly robust to use this type of feeding solution.

**Part Pre-Feeder-(Supply)**

These low level hopper elevators use belts with angled cleats, discharging feeder. Generally include high/low level sensor to ensure part flow “on demand” to feeder or other upstream equipment.

**Non-vibratory Orientor**

Simple parts that roll or slide can be oriented in chute or track. These parts can be oriented directly on the belt with angled cleats, discharging onto a gravity track near the top of the belt, non-oriented or excess parts spill back into the hopper via a return chute.

**Vibratory Orientor**

Many parts can use an inline vibratory orientor mounted near the top of the belt to provide orientation. Oriented parts are discharged into an accumulation device. Non-oriented parts or excess parts spill back into the hopper via a return chute.

**Low Level Hopper/Elevator/Feeder (Terms)**

1) Hopper with load level at 36” or less. (For load level definition see detailed terms).

2) Cleated conveyor at an up angle best suited for parts and available floor space.

3) Conveyor discharge snout.

4) Snout to tooling interface.

5) Tooling rail.

6) Tooling.

7) Part rejection chute / Return chute.

8) Discharge track.

(The hopper conveyor interface may very based upon part configuration)
Belt Feeder- Orientor

Bi-Directional Belt Feeder consists of Twin Belts with angled belt acting as part supply ramp and tooled chute. Belt Feeders require integrated part supply and can perform as feeder-orientor using vibratory rails and non-vibratory tooling. Can be produced to meet most sanitary and all washdown construction specifications.

**Belt Feeder**

1) Pre-Feeder
2) Chute Conveyor
3) Tooled Ramp Conveyor
4) Snout to tooling interface.
5) Tooling rail.
6) Tooling.
7) Part rejection chute / Return chute.
8) Discharge track.
Vibratory Bowls

Vibratory parts feeders use an electromagnetic drive to induce movement. As the drive unit is energized, the parts will separate and work their way toward the outer wall of the bowl, and then up the inclined track in the bowl. When the parts arrive at the tooling, they either pass by it or fall back into the bowl depending upon their orientation at that point. After the parts have passed all the tooling profiles, they will be consistently oriented for delivery to the accumulation device outside of the bowl.

The diameter of the vibratory bowl should be many times the length of the part to be fed. Good feeding characteristics come primarily from part contact with the bowl track. Other factors influencing the bowl size are the spacing between the tracks (pitch), the width of the track, and the size of the return pan.

There are three basic types of bowls with additional specialty bowls used for unusual or difficult applications. All these can be mounted atop the same base drive units to accommodate a wide variety of parts.

Outside Tooled (O.T.) Bowls

Bowls with outside tooling are the most common style of bowl used in applications requiring moderate-to-high feed rates, multiple discharge lanes, or where intricate tooling is required to properly orient the part. The outside track portion houses all of the tooling needed to bring the part to its desired orientation. Parts that are correctly oriented advance to the discharge while incorrectly positioned parts fall from the track into the return pan for recirculation.

The Outside Tooled Bowl discharge height is based on the tooling required for the desired part orientation and feed rate. O.T. Bowls can be designed with multiple discharge lanes tooled to correctly orient the parts. Multiple lanes help OT bowls to achieve high feed rates.

Inside Tooled (I.T.) Bowls

These are based on the same basic straight wall core as used in the O.T. bowls. In this case, the tooling all occurs inside the bowl and is suited towards simpler parts and lower feed rates. The I.T. bowl uses a smaller drive unit due to the lack of external tooling weight, the ability to load a greater amount of parts into the bowl since there is no return pan to clog.

Cascade Bowls

These are primarily used for simple applications having in-bowl storage requirements. The Cascade differs from the straight wall bowl because it has no internal "over and under" tracks. Cascade Bowls are used where parts could wedge between the tracks such as large, rectangular or elongated shapes.

Coatings and Linings

Optional bowl linings such as Brushlon™, Urethane and Teflon™ are available for various needs or part characteristics. They are used for the following (among other reasons):

- Noise reduction,
- Ease of cleaning,
- Enhanced part feeding,
- Abrasive parts handling applications

Occasionally a part will not suit a vibratory feeder either due to rate, space required or other characteristics. Hamilton Feed Systems also offers centrifugal rotary feeders and floor hopper elevator orientors for these instances.
Tooled Vibratory Feeder Bowl (Straight Wall Construction)

Consists of:

1) Vertical band
2) Domed bottom
3) Internal helical track. (The internal track can also be inverted)

Variation – Down Feeder – Has an external helical track with no internal parts reservoir.

4) Tooling
   a) Internal (only recommended for basic functions)
   b) External (used in most applications)
5) Return Pan
6) Bowl Discharge
7) Counter Balance
8) Vertical band
9) Domed bottom

Tooled Vibratory Feeder Bowl (Cascade Construction)

1) Cascading Track
2) Cascading side walls
3) Domed Bottom
4) No Return Pan
5) Internal tooling
6) Counter weights as required

(Recommended only for basic part orientations, i.e., pins, some head hanging parts and some random orientations)
Magazine (Short Bar) Feeder

Magazine Feeder provides a means to store parts ranging in size from 1/4” to 3.0” diameter and 4” to 60” in length. The tube, pipe, rod parts will be stacked by hand into a magazine. The accumulator will then feed the parts to a conveyor belt, which will feed the grinder as needed. The Magazine and 72” conveyor are mounted on a common stand, which is attached to a movable base. The movable base is designed to allow ease of movement from one grinding cell to the next. The magazine base is attached to the movable base by means of a track and lead screw assembly system allowing the precise alignment at set-up and when the wheel wears.

**Magazine Feeder**

1) Magazine

2) Escapement

3) Discharge Conveyor

4) Z Adjust

5) X Adjust

6) Y Adjust

7) Work Rest Sensor

**Misc. Items**

**Hoppers**

Hoppers come in several forms from .25 to 12 cu ft capacity. Table top, Pedestal Type, Vibratory, Belt, Pan, Low Level designs are all available.

**Sound & Safety Enclosures**

The typical linear, belt, step centrifugal and magazine feeder operate at less then 65 dba. Bowl feeders operate typically above 65 dba. Part to part noise are not included in total estimate but must be a factor considered within solution design.