Millers Feeding Solutions, Inc.

MANUFACTURERS OF VIBRATORY FEED SYSTEMS
AND PARTS HANDLING EQUIPMENT

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UNDERSTANDING & TROUBLESHOOTING A VIBRATORY FEED SYSTEM

MFS

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Thank you for purchasing your feed system from MFS! We know there are many options in this industry and one of the many things that set MFS apart from the others is our responsiveness if a warranty issue should occur. MFS will cover all labor, travel expense and materials for a service call as a result of to any faulty workmanship, materials or machinery that is not meeting performance specifications that were outlined in the MFS order confirmation.

However, please understand that MFS cannot be responsible for the performance of parts being fed that were not supplied during the manufacturing and runoff at our facility. Our equipment has been set up to specifically run parts that were quoted and supplied to us. There are many variables in successfully feeding these parts, therefor any changes to the equipment or its settings, any changes in part configuration (no mater how slight) or even change in part color, could negatively affect the feeding performance or cause system jams. Changes, that have not been previously approved by MFS, including any part of the system which has been taken off and on, altered, modified, or added to, can void the system warranty.

The service warranty does not cover improper assembly, installation or interface with equipment we did not supply. When equipment is purchased separately your system will be set up and run off as a complete system at MFS, however, MFS cannot be responsible for any malfunctioning equipment that has been assembled or installed incorrectly. Incorrect installation includes such things as, not mounting your vibratory equipment on a properly sized table or the transfer and transition between the equipment we supplied, as well as, the transfer from our equipment to yours.

Should a warranty issue arise, MFS does not want to waste your time and would like to get in, fix the problem and get back. MFS may ask for video and/or pictures of the system running in your facility in order to identify what may have changed since the run off at MFS. MFS also asks that your equipment be fully debugged and functional (even if not making rate or jams occurring excessively) so that we may do the most efficient job possible.

Once we know this is a warranty issue and that your ready for us we will promptly respond with a service technician.

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MILLER'S FEEDING SOLUTIONS, INC.

CONTENTS

MFS

MILLER'S FEEDING SOLUTIONS, INC.

DESCRIPTIVE TERMINOLOGY

VIBRATORY FEEDER BOWL (SOMETIMES IMPROPERLY CALLED HOPPERS)

The vibratory feeder bowl is a basic bowl complete with internal or external tooling, custom designed to meet feed rate, part orientation and other specifications as required by the manufacturer. The feeder bowl is the actual orienting, feeding, and heart of the system. The feeder bowl is custom tooled to a specific part configuration but a hopper is a standard accessory to a feeder bowl system. Feeder bowls are almost always round and constructed of stainless steel for long life.

BASIC BOWL

The band, bottom, and track assembly prior to any tooling for a specific part. Basic bowls are not off-the-shelf standard items but Individually designed and built.

VIBRATORY BASE UNIT (OR DRIVE UNIT):

The source of vibration to a feeder bowl is the base unit. They are mechanically and electrically tuned to the weight and mass of the feeder bowl. MFS offers base units for bowls from 6" to 42" in diameter. The force used to drive bowl feeders is accomplished by electromagnetic coils, which act upon, striker plates. These plates are constrained by leaf springs attached to the cross arms causing a torsional vibration and these vibrations move the parts in a horizontal direction. When the drive unit moves the parts at a maximum efficiency with minimum current effort, the unit is said to be tuned. The rubber feet placed at each corner of the base drive play an important part in tuning and must be of the proper durometer.

ORIENTATION

The correct position of the piece part at the discharge exit as required by assembly or placing operation.

RATE (OR FEED RATE)

The number of parts per minute or per hour which are require to meet production requirement.

BACK PRESSURE RELIEF POINT (OR BUBBLE)

An area of the bowl, just prior to entering the discharge, where, if the discharge becomes filled, the parts will buckle, not form a straight line, and fall off the track. This will relieve parts pressure at any previous area where it could cause problems.

BACK PRESSURE RELIEF DEVICE

A means of providing pressure relief when the parts will not efficiently bubble-off of their own accord or if confinement dictates. The device can be either a photocell sensor or an air type sensor. It can be set up to operate the feeder intermittently as in the case of a photocell, or turn on an air jet to blow parts off track, in which case the bowl would continue to run.

EXTERNAL TOOLING

Any construction outside of the basic bowl vertical band which separates, selects, orients or relieves pressure buildup on oriented parts.

RETURN PAN

An extra pan-like area welded to the outside of the bowl usually as low as possible which catches the excess or rejected parts falling from the track. This pan will guide these parts back into the interior of the bowl for re-circulation.

CONFINEMENT

Tooling to assure 100% control of correctly oriented parts as they exit the bowl or travel down the track.

HOPPER (OR STORAGE HOPPER)

The storage hopper is the storage area provided to backlog extra parts prior to entering the feeder bowl. The hopper eliminates overloading or insufficient loads of parts causing bowl not to function as required.

TOE CLAMPS

The machined blocks at the end of the cross arms of the base drive unit must be tightened to assure maximum transfer of vibration to the bowl. Failure to do so will result in failure or malfunction of the feeder system.

DISCHARGE OF THE FEEDER BOWL

This is the last section of the bowl. In most cases, it is a tangent straight exit which confines the parts after they have been oriented.

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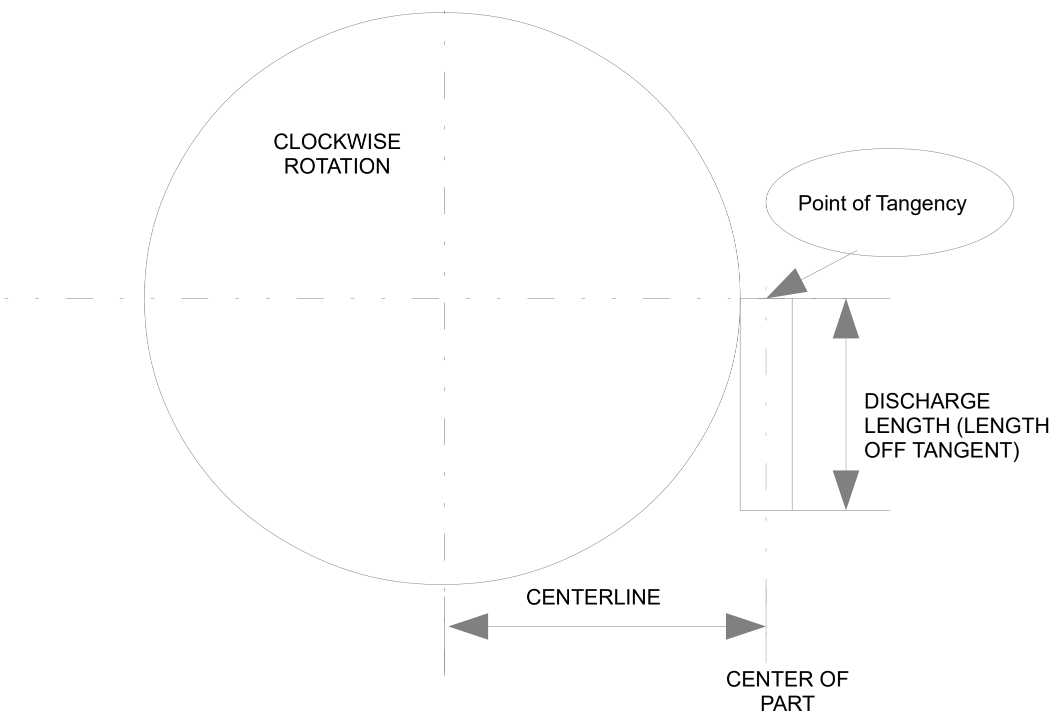
DISCHARGE CHUTE INFORMATION

There are four basic dimensions to nearly every discharge chute. These dimensions are:

1. CENTERLINE
2. TANGENT (Length off)
3. HEIGHT (Running surface to bottom of feet)
4. ANGLE (If necessary)



ALWAYS measure the CENTER LINE dimension by measuring in a straight line through the last few parts coming out of the discharge.

The primary reason for ACCURATE measurement of the discharge chute is for transfer purposes. Ideally, the best transfer is in a perfectly straight line, thus, the importance of recording the CORRECT discharge dimensions.

DOWN ANGLE DISCHARGE CHUTE

Used to assist movement of parts feeding into a gravity track.

RUNNING SURFACE

That portion of the discharge chute with which the part makes contact. This is a variable dimension depending upon the particular piece part.

SELECTOR

An area of the feeder bowl designed and custom fit to profile only the proper position part. Parts coming to this point, not in the proper position, would fall out of the feed line.

CONVERTER

A properly designed converter positions, turns around or turns over a part which is not in the proper position. This means a higher feed rate can be achieved, because a percentage of parts can be converted to the desired position. This also minimizes re-circulation of the parts and thus extends the life of the bowl especially on metal or heavy abrasive parts.

ANGLE SKIRT

A conic section calculated to fit at the required angle and attached to the bottom side of the track and to the bowl wall. It is used for the purpose of preventing parts from stacking and causing jams between the tracks.

COIL CLATTER

A warning sound that indicates the coil gap should be checked and set.

ADJUSTABLE THIN-DOWN SECTION

A short section of interior track that slides in and out. The length depends on the size of the bowl. This can also be external type, usually placed on the bowl just after exit to the outside of the bowl. It is a piece of metal formed to fit 90 degrees to the track, bolted on and adjusted horizontally to limit parts to a single layer on the track.

ROUGHING CAM

An irregularly shaped piece of metal usually placed inside the bowl at different points above the parts to regulate the parts level on the bowl track.

RING MOUNT

External rings of metal, usually 3/8” thick, attached to the vertical band of the bowl to hold it to a matching ring mounted on the cross arms of the base drive unit. Bolts are used for vertical fastening pressure. Ring mounts are typically used on 36” & 42” diameter bowls in order to transfer vibration much better than toe clamps and to avoid breaking the bowl reinforcing band.

CHORD SECTION

A short straight section of two parallel pieces of metal sometimes used to select or orient parts.

SWEEP

A short strip of metal placed on the inside of the bowl bottom to guard the return hole and to allow parts to flow evenly back up the track from the return pan.

AIR JET

A block with small diameter tubing welded in place which is sometimes used to assist in acelerating or orienting parts. It is adjusted by trial and error using up to 60 psi air pressure.

FAN SECTION

An area with an adjustable gap which allows parts to swing and/or hang.

DIRT CHUTE

A hole or opening in the bowl that is used to discharge small particles of foreign material from the bowl. The opening cannot be larger than the smallest dimension of the piece part.

QUICK DUMP CHUTE

A quick opening “window” that is provided to facilitate change from one part to another when multiple styles or sizes of parts are being fed from the same bowl.

COUNTER-BALANCE WEIGHT

A piece of metal of predetermined size and weight that is added to the exterior of the bowl. The location is determined on a counter-balance wheel in order to off set the weight of the external tooling.

INLINE FEEDER

A vibratory drive unit designed to produce straight line motion. It is used in conjunction with a straight track to transport parts from the feeder bowl discharge to a dead nest or some pickup point for a placing head. There are two types of inline drives; a rubber inline mounted on rubber pads, one on each end, and a solid inline ,mounted on a steel base. When used in conjunction with a feeder, they are mounted on risers so that the inline tooling can be matched to the feeder bowl discharge.

OVERHANG

Overhang refers to the amount of straight track tooling that extends beyond either end of the inline drive mounting bar.

ESCAPEMENT

A mechanical device usually placed at the end of the track discharge. It allows only one part at a time to move into another place such as a dead nest to be picked up by a placing device.

GRAVITY TRACKS

Gravity tracks and vertical magazines are other options for getting parts from one location to another. A gravity track can set on an angle great enough that gravity will take the part to its proper location. It may be used in conjunction with either the inline or bowl feeder. A magazine is a channel in which oriented parts are stacked. This device is usually preloaded; the feeder maintains a full stack.

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HIGH LEVEL SHUTOFF

See below to better understand the function of a high level shutoff, as applied to a vibratory feed system:

- Feeder bowls are custom designed to deliver a specific part, (or range of parts), at a target rate and orientation.
- This rate is achieved by averaging output over one minute spans. It is normal to be both over and under this rate during different intervals of the one minute span.
- Feeder bowls deliver the parts into a confined track system for delivery to the assembly device. This track is where level is monitored for high level shutoff. A certain amount of back pressure is required to maintain feed rate in the track system. This means that below a certain level of parts in the track, feed
- rate cannot be maintained. This varies for each system.
- Feeder bowls require a certain amount of Recovery Time to make up the gap of parts in the track system after the bowl is restarted. This time also varies for each system and is important for determining the location of the high level sensor.
- In some cases a feeder bowl is able to bubble if parts may be backed up through the track system and into the confined portion of the bowl tooling without causing a jam. The parts simply bubble back into the bowl and recirculate.
- Otherwise, a high level shutoff is required and this becomes another key for determining high level sensor position.
- A high level shutoff consists of a sensor,(usually a photo eye), located in the track system.
- The sensor must be located outside of the bowl to insure that parts will move clear as they are used. The sensor may be placed at an angle to the flow of parts to insure the best sensing potential of part level.
- The sensor must have adjustable "on-delay" and "off-delay". The two delays combined provide the bowl duty cycle for the high level shutoff. These are adjusted through the REO controller.
- The high level sensor must be located in the track above the level where back pressure is adequate to maintain feed rate.
- It must also be far enough away from the bowl to provide a maximum off cycle without impeding recovery time and still maintain tight enough control to prevent jams in bowls which do not bubble.
- Usually there is an operating range which may be adjusted to suit individual preference and still maintain rate.
- Care must be used to insure all of the critical features of a particular feed system are met when setting the high level shutoff.
- Finally, in feed systems which have a bulk feeder, such as a hopper, The high level shutoff must control this device as well. Bowl level sensors are only valid when the bowl is running. Bulk feeders must be disabled any time the bowl is stopped.
- When purchased as a complete feed system that includes a high level shutoff, these factors have already been considered. The system has been set up and run to insure proper operation and maintained rate.

VIBRATION ISSUES

1. No vibration [usually an electrical problem]
   a) Power supply to control may be OFF.
   b) Fuse in controller may be blown.
   c) Cord to feeder may be damaged or unplugged.
   d) Gap between coil and striker plate may be closed.
   e) Bowl or base may be making contact with other equipment.
   f) Air gap between discharge and track could possibly set to close (may hear banging).

2. Vibration (but slow or irregular parts movement)
   a) Check that all marked shipping hold down devices have been removed from the bowl and/or inline.
   b) Check that all bolts are tight, bolts may have come loose during shipment or over time
   c) Input voltage to controller may be fluctuating.
   d) Bowl may not fully seated in toe clamps .
   e) Toe clamps or ring holding bowl may not tight
   f) Lubricant build up on parts or feeder bowl.
   g) Feeder bowl may be overloaded.
   h) Excess dirt build up on bowl or parts.
   i) Mounting plate or table may not sturdy.- see TABLE REQUIREMENTS
   j) Leveling screws on legs may not set firmly.
   k) Bowl may be mounted on a machine which shakes and sets up an interference vibration.

Note: The above list would apply to not only new equipment, but older units as well. Most problems are caused by improper use, or damage from handling between the factory and customer.

TUNING INSTRUCTIONS AND TABLE REQUIREMENTS

TABLE REQUIREMENTS

Tables for vibratory units should be constructed of metal heavy enough to withstand the vibrations generated by the drive unit. Any table motion will change the tuning and orienting features on the system. TOOL TEST - If a tool is placed on the table top and excessively vibrates while the system is running, then too much of the vibration is going down into the table and not up in the bowl.

THE AIR GAP BETWEEN THE BOWL COIL AND STRIKER PLATE DOES NOT AFFECT TUNING.

However, for best Efficiency, on full-wave (systems running at 120Hz) the gap should be .030-. 035, Large bowls (30in or greater) or typically as half-wave (systems running at 60hz) and should have a gap of .055-.085. The air gap between coil assembly and striker plate assembly is important. If the air gap needs to be reset for any reason, find out at what dimension it should be set. If the air gap is to small, the coil will clatter; if its is too large, all the energy will not be used and the coil will overheat.

WHAT IS TUNING?

Tuning a vibrating system means adjusting the mechanical vibration to be the same or be in tune with the electrical impulses (120Hz or 60Hz). Normal 60 cycle current produces 120 magnetic cycles per second and transmits 120 mechanical cycles per second to the bowl, this is full wave. Half wave produces 60 magnetic cycles per second and transmits 60 mechanical cycles per second to the bowl, inline or hopper.

HOW DO YOU KNOW IF A BOWL IS TUNED HIGH OR LOW?

If a spring clamp bolt is loosened gradually and the feed speeds up, then the bowl is tuned high (Tuned high means the mechanical frequency is higher than the electrical). If the feed slows down or stops, it is tuned low (Tuned low means the mechanical frequency is lower than the electrical).

HOW DO YOU ADJUST THE NATURAL OR MECHANICAL FREQUENCY?

- Lower the tuning by reducing the thickness or number of springs
- Raise the tuning by increasing the thickness or number of springs.

DETAILED TUNING INSTRUCTIONS AND MAINTENANCE

NOTE: **Always recheck tuning after each change.** When adding or removing springs, be certain to check the length of bolts, bolts should have ample thread to withstand the torque necessary for tuning but not so long as to bottom out on the coil striker plate. (ALL bolts to be tightened to maximum torque when tuning is complete.)

Tuning is checked by loosening a bolt on the bowl drive or track inline.

A good balance between coil assembly energy development and spring tension is of utmost importance to a smooth and efficient feed system. At this balance point, it should be noted that parts will feed at maximum efficiency with minimum current effort.

1. **UNDER TUNED** – parts slow down – most often because of a loose bolt

   a) If any bolt on the bowl drive unit or track inline is loosened and an immediate slow down of parts travel is noted then the unit is under tuned. If more speed is needed it can only be obtained by adding one or more springs, with proper spacers, or by substituting a spring with one of greater thickness. MFS recommends beginning to add springs, of the same thickness, with spacers, one at a time, starting with a spring bank that may have less springs than the others. If all spring banks have equal amount of springs then start with the spring bank with a coil under the discharge of the bowl. If more springs are to be added, the second additional spring should be added to the coil opposite the bowl discharge, then continue in a "crisscross" pattern around the bowl.

   When a drive unit or inline is under tuned, the spring tension is not great enough to allow the feeder mass to return to its neutral position before the next magnetic pulse takes over. Therefore, the mass remains in a state which never allows it to return to its neutral position. Also when the unit is under sprung (under tuned), the magnetic energy developed by the coil assembly is not being used and is dissipated in the form of heat. The heat, if prolonged, could shorten the life of the coil or even cause it to be badly burned.

2. **OVER TUNED** – parts speed up – most often caused by a change in the bowl or inline weight, parts of the bowl or inline may have been removed

   a) If a bolt on the bowl drive unit or track inline is loosened slightly and parts speed up, the unit is over tuned. The degree of over tuning must now be established. When this bolt is loosened just slightly more and the parts begin to slow down, the unit is not excessively over tuned, and can most likely function as expected. The tuning of the bowl should check slightly over tuned so that, once the bowl is filled with parts, a constant speed will be maintained as the parts level decreases. If, when the loose bolt is loosened just slightly more, the unit continuously speeds up and does not slow down even when the bolt is completely loosened, it is best to remove a spring on the unit. Removing (1) spring may improve the function or additional springs may need to be removed. Removal of too many springs could under tune the unit. If removing one spring under tunes the unit, replace the removed spring with a thinner spring (if possible) or leave overtuned.

   b) If springs are to be removed MFS recommends beginning to remove springs, and spacers, one at a time, starting with a spring bank that may have more springs than the others. If all spring banks have equal amount of springs then start with the spring bank that does not have a coil and is under the counter-weights on the bowl. If more springs are to be removed, the second spring should be removed from the non-driving coil bank opposite the previously removed spring, then continue in a "crisscross" pattern around the bowl, removing springs from the coil driven spring bank under the bowl discharge last.

   c) Most vibratory base units can have a fairly wide range between the lowest and highest points of the tuning range and should be final tuned with the bowl carrying a normal load of parts and running at the slowest possible speed and yet maintain the specified rate. MFS recommends the use of a closed loop control for extremely heavy parts, the controllers will automatically adjust as the bowl empties.

   d) Special tips:
      - Stands or tables on which feeder equipment is to be mounted must be level, rigid, and of adequate strength to not set up its own resistant vibration, thus lowering the efficiency of the bowl.
      - Vibratory feeder equipment must not touch any track, bracket, and other equipment.
      - Never attach other objects to the bowl, base drive, track or inline.
      - Never remove any parts of the bowl or inline that are not intended to be removed.
      - Operate vibratory feeder equipment at the minimum speed required to obtain good parts and meet specified rate.

      To over spring (over tuned) demands more energy from the coil assembly than is available. while this may not cause harm to the coil, it will result in minimizing spring energy development.