MMPM-730B

# Installation, Operation and Maintenance Instructions


# RARE EARTH MAGNETIC ROLL SEPARATORS

**ERIEZ MAGNETICS** HEADQUARTERS: 2200 ASBURY ROAD, ERIE, PA 16506–1440 U.S.A.
*WORLD AUTHORITY IN ADVANCED TECHNOLOGY FOR MAGNETIC, VIBRATORY and INSPECTION APPLICATIONS*

# Introduction

This manual details the proper steps for installing, operating and maintaining the Eriez Rare Earth Magnetic Roll Separators.

Careful attention to these requirements will assure the most efficient and dependable performance of this equipment.

If there are any questions or comments about the manual, please call Eriez Manufacturing at 814-835-6000 for RE Roll Separator assistance.

**CAUTION**

**Safety labels must be affixed to this product. Should the safety label(s) be damaged, dislodged or removed, contact Eriez for replacement.**

# Table of Contents

**ERIEZ RARE EARTH MAGNETIC ROLL SEPARATORS**

**CANTILEVERED SLIDE TENSIONER MODEL**

# General Description

The Cantilever Rare Earth Roll magnetic separator is an improvement on Eriez' proven standard RE roll. All of the basic features of the standard roll remain, with the exception of the belt support and tracking system. The new cantilevered belt support is designed to reduce belt replacement time from one hour to less than one minute. The belt tensioning and tracking system uses Eriez proven spring loaded pillow block design. Extensive testing has established the ability of the new system to handle a wide range of belting types and materials.

The Rare Earth Roll has met with much success in mineral, metal, recycling, plastics, and chemical process applications. This separator type has several advantages over other types—advantages that include compact design, simplicity of operation, and a greater magnetic field gradient. Eriez' improvements, described in this IOM, increase user convenience, reduce down time, and reduce the cost of consumables (belts) over previous generations of Rare Earth Rolls.

This document is intended to help you get the best performance from your Eriez Rare Earth Roll. The next section describes the basic equipment in detail, and the sections following provide guidelines for installation, operation and maintenance. The appendices include a parts list and descriptive literature on OEM components.

Please read and understand the cautions in the adjacent column before installing or operating your RE roll. Please make sure that all personnel who will come into contact with this equipment are aware of these cautions.

Please feel free to contact Eriez for additional assistance in the installation, operation, or maintenance of this equipment, as well as for application advice.

**⚠ CAUTION ROTATING MACHINERY**

**As with all equipment involving rotating parts and moving belts, the Rare Earth Roll involves the potential for property damage or serious personal injury if not treated with caution during all installation and maintenance procedures. Equipment should be switched off and locked out during all procedures that involve contact with the machine. Avoid pinch points between belt and pulleys. Never operate with drive guards removed.**

**⚠ CAUTION STRONG MAGNET**

**The Rare Earth Roll incorporates exceptionally powerful magnetic circuits. Steel and iron tools and other objects may be attracted suddenly and strongly to the magnetic roll, creating the risk of serious pinch-type injuries. Keep all mild steel and iron tools and equipment well away from the magnetic roll at all times. Avoid situations in which hands, fingers, or other body parts could become trapped between a steel or iron object and the magnetic roll.**

**Personnel using heart pacemakers should not service or operate this equipment. Such personnel should remain at least 3' (1 meter) from the magnetic roll at all times.**

# Description of Equipment

### PRINCIPLES OF OPERATION

The primary physical principle that makes the Rare Earth Roll effective is the ability of a highly magnetic pulley (or “roll”) to attract and hold magnetically susceptible particles on the surface of a thin, non-magnetic belt passing over the pulley, thereby altering the discharge trajectory of these particles. Non-magnetically susceptible particles in the same mixture are not attracted by the roll, and therefore discharge in a “normal” trajectory, under the influence of the belt motion, centrifugal force, and gravity only. The difference in the discharge trajectories of the two classes of particles enables a separation to be made.

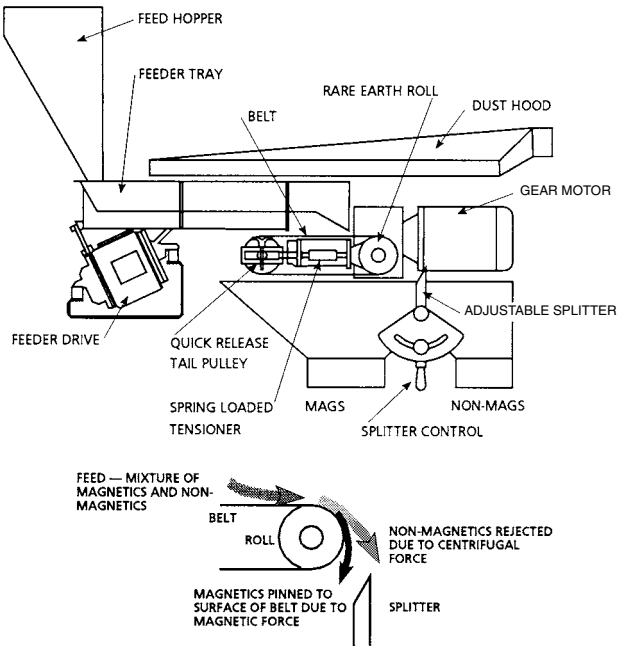



**FIGURE 1**
Schematic of Rare Earth roll

### MAGNETIC CIRCUIT

Figure 2 illustrates the typical magnetic field generated by an Eriez RE roll. The roll consists of a stack of alternating Erium® RE magnet rings and steel pole pieces. As can be seen from the figure, the lines of magnetic flux are concentrated in the steel pole pieces, which may be saturated near the surface of the roll. The field intensity is highest at the surface points where the pole pieces and magnet discs are in contact. At these points, the field intensity may be more than two Tesla, compared to a field intensity of about .5 Tesla at surface points located close to the center of the magnet discs. Because of the concentration of flux in the pole piece, surface field intensity over the entire pole piece will be nearly two Tesla. Material collected on the belt will tend to form lines defining the pole piece edges.

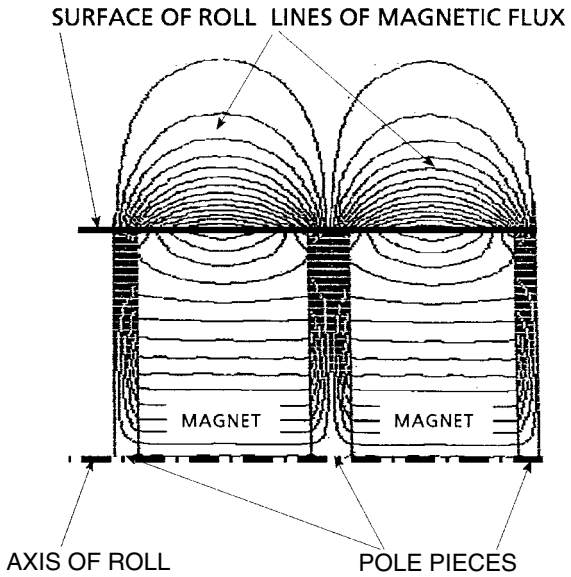



**FIGURE 2**
Magnetic field of RE roll

**⚠ WARNING**

**Under no circumstances should the construction of the RE roll itself be disturbed or modified. Disassembly of the roll would not only be dangerous to personnel because of the strong magnetic forces involved (see warning in the Introduction section), but would destroy the carefully engineered magnetic circuit, and could only be repaired by returning the roll to Eriez.**

### BELT

Thin fabric belts, generally of Kevlar™ coated with Teflon™, are used on the RE roll. Standard belts are approximately .010" (.25 mm) thick to allow the process material to come as close as possible to the surface of the magnetic roll.

# Description of Equipment *(cont.)*

For very fine materials, belt thicknesses down to .005" (.12 mm) are available, and for coarser or more abrasive applications, belts up to .040" (1.0 mm) in thickness (or more) may be recommended.

Thicker belts will generally result in a reduction in field strength, which may affect separation performance, and which may have to be balanced against longer belt life in operation.

Eriez' experience with a variety of belts in a large number of applications is at your disposal in selecting the proper belt for your system.

**FEED AND OPERATING SPEED**

In general, the roll separation performance is based on an assumed layer of particles, one particle thick, as the feed approaches the roll. This must be achieved by careful and uniform feed to the RE roll machine itself, and by careful control of the belt speed, allowing the feed material to spread in the desired mono-layer. Since the belt speed also affects the centrifugal forces acting on both the magnetic and nonmagnetic particles passing over the roll, selection of the correct speed and feed rate depends greatly on the material characteristics, including relative densities of the magnetic and non-magnet constituents. Eriez technical experts can help greatly with this selection.

Belt speeds are variable on most RE rolls built by Eriez, with a normal operating range from 80 to 200 fpm (24 to 61 mpm). Speeds in excess of 400 fpm (125 mpm) are available if required.

**STAGING**

Several magnetic rolls can be configured to provide optimum recovery and cleaning of the product. Two or three magnetic rolls are typically placed in a modular series arrangement. When purifying a non-magnetic material or when concentrating a magnetic product, the rolls are typically arranged in a non-magnetic repass configuration. The non-magnetic material from the first stage roll is delivered to the second stage roll for further separation.

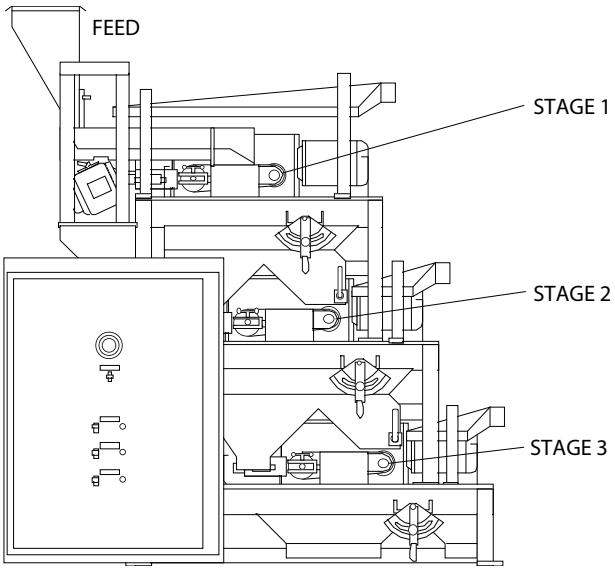



**FIGURE 3**
Staged RE rolls

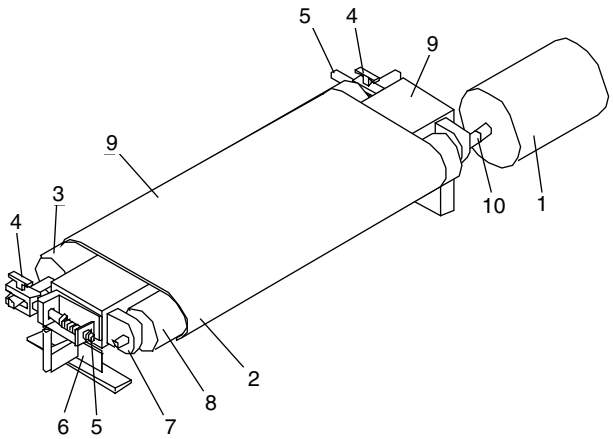
The rolls can also be arranged in a magnetic repass configuration to provide a cleaning stage for a magnetic fraction.

**CONSTRUCTION**

An outline drawing of your RE Roll is provided with this manual, and/or attached to the equipment itself. This should be reviewed carefully for special features not covered in the following discussion.

**OVERALL ASSEMBLY**

The Cantilevered RE Roll consists of a 3", 4", or 6" (76 mm, 102 mm, or 152 mm) diameter rare earth magnetic roll and a tail pulley mounted on a combination mild steel and stainless steel frame. The frame is rigidly attached to a supporting structure at one end, while the other end is vertically supported on a releasable steady-rest. The magnetic roll incorporates a through shaft, which is supported on self-aligning roller bearings. The tail pulley is supported on bearings mounted in the end flanges, with the shaft being stationary. Take-up is through a spring loaded mechanism that preloads and maintains tension on the tail pulley. The tail pulley can be moved quickly and easily by pulling a T-handled pin to allow easy belt replacement.




1. Electric roll drive motor
2. Feed belt
3. Tail pulley assembly - typically dynaloc grooved for positive tracking
4. Tail pulley shaft locking pin
5. Tracking adjustment
6. Cantilever arm steady rest
7. Hanger-type bearing assembly
8. Rare earth roll assembly
9. Cantilever-type support frame

**FIGURE 4**
Cantilever RE roll construction features

**FRAME**
The frame is an all-welded combination stainless steel hot rolled steel structure. The drive end is rigidly attached to the support frame, and the opposite end is supported during operation by a steady rest. The steady rest is a hinged arm that supports vertical load, and can be swung out of the way when necessary to clear the belt. The frame center section is open to minimize material build-up under the belt. All sizes of rolls have similar frames. However, the frame for the 60" unit incorporates additional stiffening.

The support frame is constructed of welded hot rolled steel channel and angle, and is configured for each application to accommodate the particular combination of roll modules, hoppers, and/or feeders required.

**ROLL**
The magnetic roll consists of stacked 3", 4", or 6" (76 mm, 102 mm, or 152 mm) diameter discs, alternating neodymium-iron-boron ceramic magnets and mild steel pole pieces.

The effective width of the roll ranges from 5" to 60" (127 mm to 1524 mm), depending on the capacity of the equipment. The steel pole pieces have the same outside diameter as the magnets, but are much thinner. The roll center shaft rides in self-aligning roller bearings, rigidly attached through pillow blocks to the roll support cantilever structure. The roll is driven directly by a TEFC AC motor, coupled to the shaft through a flexible coupling.

**BELT**
The standard belt is .010" (.25 mm) thick Kevlar with an overlap splice. Other commonly used thickness options are .005" (.125 mm) and .017" (.4 mm). For high speed applications, the belt is furnished with a special wrap-around V-splice.

**TENSIONER**
The tensioner and take-up adjustment consists of a spring loaded assembly located on either side of the tail pulley. A clevis, guided by an oilite bearing, allows free movement of the support shaft. The spring can be adjusted by hex nuts to change tension on the conveyor belt. In addition, as the belt pulls toward the magnetic pulley, the spring allows movement but maintains tension.

A close fitting T-handle pin holds the tail shaft to the adjusting assembly. The tail pulley provides belt tracking control via the action of the stainless steel buttons on the belt and grooved collars at the ends of the pulley.

**DRIVE**
The magnetic roll is driven by a single reduction worm gearmotor. The motor is mounted to the support frame and connected directly to the roll shaft by a Rex Omega self-aligning coupling. The motor is “inverter duty” or premium efficient to handle a variable frequency control. The standard variable speed control is furnished in a NEMA 12 dust tight housing, and can be mounted either locally or remotely.

# Description of Equipment *(cont.)*

**FEEDER**

The feed is delivered to the belt by an electro-magnetically driven vibratory feeder, sized to provide accurate, consistent and uniform delivery of feed. Multiple Eriez model 45A, 36C or 46C vibratory feeder drives are used, driving a single stainless steel feeder tray. The vibratory feeder operates on 60 Hz AC and a maximum amplitude of .060" (1.5 mm). A single Eriez model G control, housed with the roll control, is used to control the feed rate from 0 to 100 percent of design capacity.

**CHUTE WORK AND HOUSING**

All chute work and the roll housing are constructed of 300 series stainless steel. Separate discharge chute work and hoppers are used to segregate the non-magnetic and magnetic fractions. The discharge chutes are designed for maximum dust containment and easy maintenance. Each roll incorporates a fully adjustable stainless steel product splitter with a graduated position scale.

A dust tight housing that fully envelopes the feeder(s), magnetic roll(s) and the product streams is available as a option. The housing has adequately sized dust exhaust couplings. An air purge system that produces a positive pressure in the belt area is also available as a option.

# Installation

The unit has been fully assembled, adjusted, and tested at the factory prior to shipment. Use care when transporting and uncrating to avoid damage to the equipment. Also, take note of the cautions presented in the introduction to this manual. These precautions should be made known to all operating and maintenance personnel involved with this equipment.

**ALIGNMENT AND LEVEL REQUIREMENTS**

The unit is self supporting, but should be bolted into position, using the bolt holes provided, to assure continued proper alignment with feed and discharge chutes and hoppers. The unit should be installed level from side to side to within ±1/16" (1.6 mm) for 20" units, ±1/8" (3.2 mm) for 40" units, and ±3/16" (4.8 mm) for 60" units.

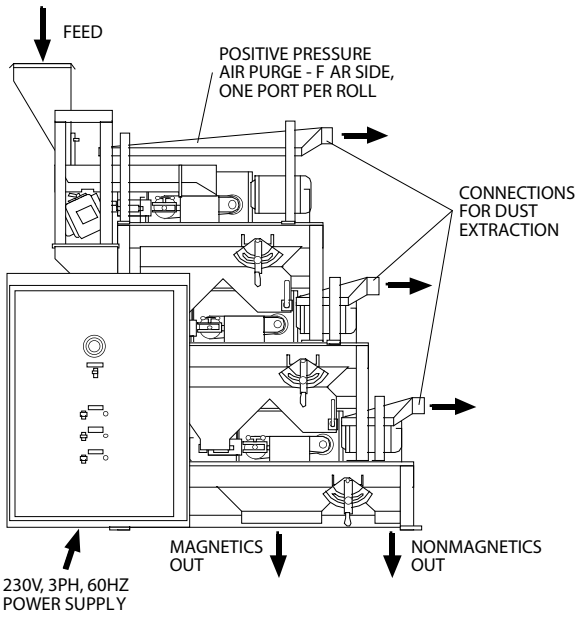



**FIGURE 5**
Installation connections

A level installation is important to assure uniform bed density in the product flow over the roll(s) and to assure reliable belt tracking.

**CLEARANCES**

The unit should be installed so that inlet chute work does not contact the vibratory feeders. There should be approximately 1" (25 mm) of clearance between the stationary chute work and the vibrating feeder pan at the feed end and bottom of the pan, and approximately 1/8" (3 mm) of clearance at the sides.

No clearance is required at the discharge points. However, access should be provided for the purpose of clearing plugging that may occur.

**ELECTRICAL CONNECTIONS**

The standard RE Roll separator is supplied for a 230 VAC 60 Hz single phase power supply. The feeder drive(s) are controlled by a single potentiometer, and the roll speed(s) are set by individual variable frequency controllers. All switches and controls are housed in a single NEMA 12 box. Unless specified otherwise, all internal connections on the machine have been made at the factory; you need only connect line power at the control box.

**⚠ CAUTION ELECTRICAL HAZARD**
**Voltages present in the control housing can cause serious injury or death. The control panel disconnect switch should not be defeated. All electrical work should be carried out only by a qualified electrician.**

Check the line voltage and current requirements stamped on the name plate of your RE roll control panel. Verify that these agree with your available supply or run appropriate lines to the machine location. Referring to the Control Schematic and Outline drawing supplied with the machine, make the necessary line connections at the control panel.

### BELT ROTATION DIRECTION
After making electrical connections, start the roll(s) at low speed and verify correct roll and belt rotation direction. Correct electrical polarity if necessary.

### AIR CONNECTIONS
An air purge inlet port is provided on the non-drive side of the machine, opposite each roll. This should be connected to a source of clean, dry, non-oily air, capable of providing approximately 10 cfm (281 pm) of low pressure air per roll. This air is used to purge dust from the area under the belt and prevent build-up on the roll.

A dust exhaust hood with adequately sized couplings is also provided for each roll. Connect this to an appropriate exhaust system.

### BELT TRACKING AND TENSION
Observe the unit operating at low speed long enough to be certain that the belt tracking has not been disturbed by shipping and installation. If the belt needs to be re-tracked, refer to the section on Maintenance - Belt Tracking.

Adjust the speed to the desired operating speed and observe the belt motion carefully to be certain that it continues to track properly.

# Operation

### PRIOR TO OPERATION
Prior to operating the RE Roll at any time, the following conditions should be checked.

### BELT ALIGNMENT
If a belt is significantly misaligned, follow the directions in the Maintenance section below to restore alignment before operating the separator.

### BELT WEAR
If any belt is worn excessively, replace it, following the procedure described in the Maintenance section. The ends on the tail pulley generate slight extra loads on the belt edges. Pay particular attention to the edges of the belts where fraying may occur, keeping in mind that a slight amount of fraying is normal but significant tears should be cause for replacement.

### DUST BUILD-UP
Remove any significant dust build up on the roll(s). If dust build up is a continuing problem, consider increasing the air purge volume.

### STARTUP AND SHUTDOWN
To prevent loss of material and/or build up of material within the machine, the roll(s) should always be started prior to starting the vibratory feeder. Start the feeder only when proper roll operation—speed, belt tracking, etc.—has been verified.

For the reasons given above, the feeder should always be stopped prior to stopping the roll(s). Allow the roll(s) to run long enough to clear all material out of the machine to prevent migration of material to the roll surface(s) during the machine downtime. Do not shut down purge air or exhaust fans until after shutting down the roll(s).

### OPERATING ADJUSTMENTS
Many combinations of operating settings are possible on the RE Roll. The precise combination of adjustments appropriate to your material can only be determined by experimentation. Please contact Eriez' technical experts for assistance in setting operating settings for your specific application. Eriez can also carry out laboratory tests on your feed materials to help in optimizing these settings.

# Operation *(cont.)*

Three primary operating parameters can be adjusted to affect the separation performance of the unit. These are:

- Belt (or roll) speed
- Splitter position
- Feeder speed

The discussion below covers, in general terms, the above three operating adjustments and their effects on separator performance.

**BELT (ROLL) SPEED**
This is the primary operating parameter affecting magnetic separation. It controls the balance between centrifugal and magnetic force as the material passes over the roll. Increasing belt speed will increase the centrifugal force, generating an expanded trajectory arc for the non-magnetics, at the expense of losing some magnetics into the non-magnetic stream as the centrifugal force overcomes the magnetic attraction at the surface of the roll.

A favorable effect associated with increased belt speed is an increase in belt capacity for a particle layer of a given thickness.

An adverse effect associated with increased belt speed is potentially greater vibration of the belt and consequent mechanical agitation of the particle layer. This effect results in a slightly increased distance between the “average” magnetic particle and the roll surface as the belt passes over the roll, and thus may decrease the effectiveness of the magnetic field.

**SPLITTER POSITION**
A splitter position close to the roll will result in a relatively high grade magnetic product with relatively low recovery. If the desirable product is the non-magnetic fraction, a close splitter position will result in a relatively high recovery, but with some remaining magnetics in the product.

The converse is true for a splitter position relatively distant from the roll. If the desired product is magnetic, the recovery will be relatively high but the grade will be relatively low (ie: non-magnetic contamination will remain).

If the desired product is non-magnetic, a distant splitter position will result in relatively low recovery of a high grade product.

In multi-stage roll separators, the early stage splitter(s) may be set primarily to scalp large quantities of the undesirable fraction, raising the effective grade of the feed to the later stage(s), which can then be adjusted primarily for recovery.

As in most separation processes, the optimum splitter position must be determined by experimentation using the actual feed to be processed, and taking into account the capacity, recovery, and grade requirements of your specific process.

**FEEDER SPEED**
In conjunction with the belt (roll) speed, this controls the thickness of the material layer on the first roll (the only roll on a single roll unit). It should be adjusted for a uniform flow across the width, with a depth that is compatible with the belt (roll) speed as discussed above. Note that the material may leave the feeder in a layer thicker than one particle, depending on the relative speed of the belt. The objective is to have a one-particle thick layer of material on the belt as the feed passes over the roll.

# Maintenance

The following sections discuss maintenance of the roll separator itself. See the appendices and attachments for maintenance procedures and requirements for the feeders, controls, and other ancillary equipment supplied with the roll.

**⚠ CAUTION**
**Rotating parts, moving belts and pinch points may cause severe personal injury. PROPERLY LOCK OUT THE SEPARATOR BEFORE PERFORMING ANY MAINTENANCE THAT REQUIRES CONTACT WITH THE MACHINE. To avoid eye injury, wear goggles when cleaning off dust accumulations.**

**ROUTINE MAINTENANCE**
The procedures described here should be carried out at least daily (or as noted in the discussion); more often if your process demands it. The machine should be checked hourly during the first few days of operation, and at least once per shift thereafter.

**REMOVE DUST ACCUMULATION**
On a daily basis, the machine should be inspected for dust buildup on the rolls or other internal components. Dust accumulated on the rolls can adversely affect magnetic performance, damage the belts by increasing wear rate, and cause mistracking of the belts.

If dust buildup is observed, it should be removed by vacuum or air blast, scraping or brushing as necessary.

**REMOVE TRAMP IRON**
Inspect for and remove ferrous materials, such as nuts, bolts, or welding slag, that may not have discharged from the belt. These materials may simply roll in place when trapped on the magnetic roll, eventually wearing through the belt.

**CHECK BELT TRACKING**
Verify that each belt remains essentially centered on the pulleys. Note that the tracking method incorporated into the roll separator requires that a slight off-center condition exist in order to generate a restoring force and maintain stable tracking. However, if a belt edge has risen more than about 3/8" (10 mm) onto one of the collars on the tail pulley, re-track the belt using the procedure described under Belt Tracking below.

**CHECK BEARING LUBRICATION**
Each roll stage incorporates four pillow block bearings, two on the magnetic roll and two on the tail pulley.

**ROLL BEARINGS**
The magnetic roll bearings are Sealmaster™ Type SEHB. They should be checked periodically for overheating or other signs of inadequate lubrication. They should be relubricated periodically according to the following table.

| Temperature | Cleanliness | Greasing Interval |
|---|---|---|
| Up to 150°F (Up to 66°C) | Dirty (normal RE roll operation) | 1 week to 1 month |
| Over 150°F (Over 66°C) | Dirty | Daily to 2 weeks |
| Any temp | Very dirty | Daily to 1 week |

**Table 1**

**RE-LUBRICATING**
When re-lubricating, the grease should be a good quality conforming to NLGI Grade 2. It should be free of dust, rust, metal particles, or abrasives. Approximately 3/4 oz (22 cc) of grease is required to fill the grease chamber. For best results, the grease should be added while the roll is in operation. **CAUTION: Only the grease gun should contact the machine during this procedure.** The grease should be pumped in slowly until a slight discharge is noted around the bearing seal. Note that during operation immediately following re-lubrication there may be a temperature rise of 10-30°F (6-17°C). This is normal, and will disappear as operation continues.

**TAIL PULLEY BEARINGS**
The tail pulley bearings are Sealmaster Type ER and are lubricated for life unless optional greasable design is ordered.

**BELT REPLACEMENT**
All of the belt options available on the RE roll are fragile compared to commonly used conveyor belting. This is a result of the requirement for a thin, flexible material that can bring the process material extremely close to the surface of the relatively small diameter roll while running smoothly at relatively high speeds. These belts CANNOT be handled like a common conveyor belt. Use the following procedure to change the standard black Kevlar belt and most other belts used on the RE roll:

1. Remove any surrounding dust covers.
2. Referring to Figure 6, pull the steady rest down and out of the way. Note that a strong initial pull, directly outward, is necessary to disengage the steady rest.
3. Pull the T-handle upward, out of its socket, and allow it to hang by its attached cable.
4. The near end of the tail pulley will have moved slightly toward the magnetic roll when the T-handle was removed.

   Grasp the end of the tail pulley and continue to swing it toward the head pulley as far as it will go (one to two inches [25 to 50 mm]).
5. The belt may now be removed easily by simply pulling it toward you. IMPORTANT: If the belt is to be reused, be careful not to crease it during removal.
6. While the belt is removed, take advantage of the opportunity to clean the roll and tail pulley of any ferrous material or dust buildup.

# Maintenance *(cont.)*

7. Before installing the new belt, note the direction of the overlap splice, if any. The overlap should be installed “trailing”. This will reduce the possibility of catching the edge on the splitter or on ferrous material.
8. Slide the new belt into place on the tail pulley and roll. Use care not to damage or crease the belt during this procedure. Creases are generally not self-repairing, and will adversely affect the smooth operation of the roll.
9. Center the belt on the tail pulley. Make sure the stainless steel buttons are riding in the grooves on the collars.
10. Push the tail pulley away from the roll as far as it will go and reinstall the T-handle to its proper socket. The belt tension may seem loose by most standards. This is correct. Reposition the steady rest.
11. Follow the directions below to tension and track the new belt.

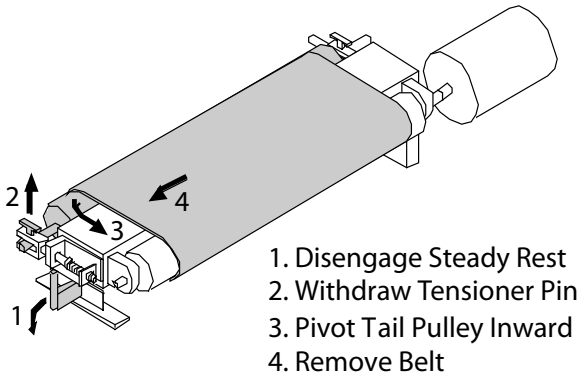



**FIGURE 6**
Belt removal

**BELT TENSIONING AND TRACKING**

All of the belts used on the cantilever RE roll separator are tensioned and tracked similarly. The machine has been designed so that this procedure should take less than 5 minutes, including tracking time. Only one person should be required, as only one end of the tail pulley is adjusted at a time.

**GENERAL GUIDELINES**

It should be remembered that all of these belt types are very thin, short and wide. The stresses put on the belt during tensioning can quickly damage it. Try to achieve a tension that is uniform across the width of the belt and that would be characteristic of a fairly ‘loose’, low pitched drum head. A symptom of over tightening is a crease that forms in the center of the belt and spirals outward. If this persists for more than a few seconds, the belt is irreparably damaged.

All belts have a break-in period to remove lumps and flat spots, and to come to operating temperature. The overlap splice may cause a slight bounce of feed material initially. This should improve with time. If it does not, check the belt for possible creases that may have occurred during installation.

There are possible contact points under the feeder and other parts of the separator. The belt makes 50,000 to 100,000 or more cycles per day. Even a slight contact will wear a hole through the belt if it is allowed. Examine these points of near contact after tracking and tensioning the belt. If points of contact are found, adjust the equipment to eliminate it.

**TENSIONING/TRACKING PROCEDURE**

Tensioning and tracking must take place simultaneously. Use the following procedure to tension and track the belt:

1. Run the belt at slow speed.
2. Carefully watch the edges of the belt where they contact the grooved collars at the ends of the tail pulley. The edges should remain in the grooves.
3. If the belt does not remain centered, referring to Figure 7, tighten or loosen nuts (A) and (B), or their counterparts on the other end of the tail pulley to shift the belt toward the center of the pulley.

   Turn the nut to increase tension on the side of the belt away from which you want the belt to move.
4. Continue to make small adjustments (1/4 turn) as necessary to improve the tracking of the belt. Do not continuously tighten one side of the belt. After tightening one side, loosen the other if more tracking is needed.

5. If the belt moves quickly or requires excessive adjustment, this can be done very easily. After stopping the roll, readjust the position of the T-handle pin. Then restart the belt and 'fine tune' the tracking as described above.
6. If the tension is too low or too high in the belt as finally tracked, tighten or loosen the tensioning nuts on both ends of the tail pulley by the same amount, and continue this process until the correct tension is achieved.

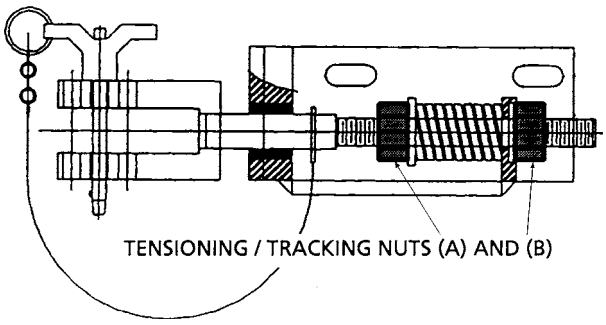



**FIGURE 7**
Belt tensioner

7. The belt should be closely monitored (periodically) for the first hour. Because of the extreme width to length ratio, it can take a long time for changes in tracking tension to take effect.

**BEARINGS**
The Sealmaster™ hanger bearings furnished on the head pulley of the separator have inside diameters ground for a sliding fit over the shaft. They are easily and securely locked to the shaft by means of self-locking, cup point, socket head setscrews. Two setscrews are furnished on each bearing sleeve, and both setscrews must be used for satisfactory performance.

To install a new bearing on a shaft:

1. Make certain that the shaft is free of burrs and foreign material.
2. Back the bearing setscrews out so that the tips are clear of the bore.
3. Slide the bearing onto the shaft to the approximate final position. Never hammer the ends of the inner race, since they are relatively soft. If necessary to apply force, use a brass bar or pipe against the inner race to drift the bearing into place. Do not tighten the setscrews at this time.
4. Mount the bearing hanger securely to the supporting frame, adjusting the bearing position on the shaft as required.
5. Rotate shaft to make sure it turns freely.
6. Tighten the setscrews securely onto the shaft. Recommended torque: 126 in-lb (14.2 Nm).

The bearings on the tail shaft are supplied as part of the tail pulley assembly, and are not user serviceable.

**MOTOR/GEAR REDUCER**
Refer to manufacturer's instructions attached to the separator.

# Spare Parts

A separate spare parts list is available per order.

**CANTILEVERED**
**LABORATORY MODEL**

# General Description

The Cantilever Rare Earth Roll magnetic separator is an improvement on Eriez' proven standard RE roll. All of the basic features of the standard roll remain with the exception of the belt support and tracking system. The new cantilevered belt support is designed to reduce belt replacement time from one hour to less than one minute. The belt tensioning and tracking system uses Eriez proven spring loaded pillow block design. Extensive testing has established the ability of the new system to handle a wide range of belting types and materials.

The Rare Earth Roll has met with much success in mineral, metal, recycling, plastics, and chemical process applications. This separator type has several advantages over other types—advantages that include compact design, simplicity of operation, and a greater magnetic field gradient. Eriez' improvements, described in this IOM, increase user convenience, reduce down time, and reduce the cost of consumables (belts) over previous generations of Rare Earth Rolls.

This document is intended to help you get the best performance from your Eriez Rare Earth Roll. The next section describes the basic equipment in detail, and the sections following provide guidelines for installation, operation and maintenance. The appendices include a parts list and descriptive literature on OEM components.

Please read and understand the cautions in the adjacent column before installing or operating your RE roll. Please make sure that all personnel who will come into contact with this equipment are aware of these cautions.

Please feel free to contact Eriez for additional assistance in the installation, operation, or maintenance of this equipment, as well as for application advice.

**⚠ CAUTION ROTATING MACHINERY**

**As with all equipment involving rotating parts and moving belts, the Rare Earth Roll involves the potential for property damage or serious personal injury if not treated with caution during all installation and maintenance procedures. Equipment should be switched off and locked out during all procedures that involve contact with the machine. Avoid pinch points between belt and pulleys. Never operate with drive guards removed.**

**⚠ CAUTION STRONG MAGNET**

**The Rare Earth Roll incorporates exceptionally powerful magnetic circuits. Steel and iron tools and other objects may be attracted suddenly and strongly to the magnetic roll, creating the risk of serious pinch-type injuries. Keep all mild steel and iron tools and equipment well away from the magnetic roll at all times. Avoid situations in which hands, fingers, or other body parts could become trapped between a steel or iron object and the magnetic roll.**

**Personnel using heart pacemakers should not service or operate this equipment. Such personnel should remain at least 3 feet (1 meter) from the magnetic roll at all times.**

# Description of Equipment

**PRINCIPLES OF OPERATION**

The primary physical principle that makes the Rare Earth Roll effective is the ability of a highly magnetic pulley (or “roll”) to attract and hold magnetically susceptible particles on the surface of a thin, non-magnetic belt passing over the pulley; thereby, altering the discharge trajectory of these particles. Non-magnetically susceptible particles in the same mixture are not attracted by the roll and therefore, discharge in a “normal” trajectory under the influence of the belt motion, centrifugal force and gravity only. The difference in the discharge trajectories of the two classes of particles enables a separation to be made.

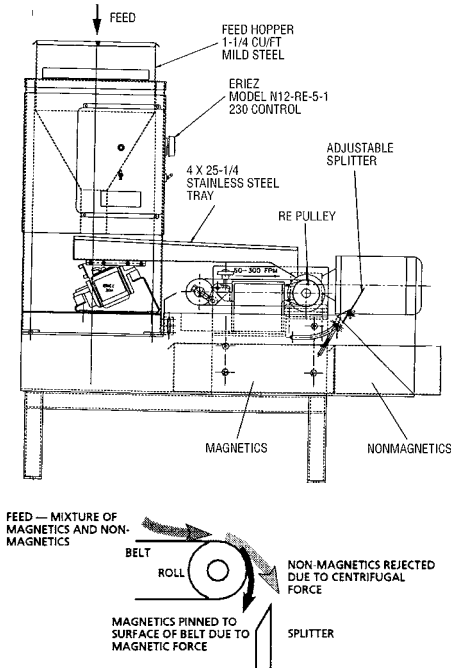



**FIGURE 1**
Schematic of Rare Earth roll

**MAGNETIC CIRCUIT**

Figure 2 illustrates the typical magnetic field generated by an Eriez RE roll. The roll consists of a stack of alternating Erium® RE magnet rings and steel pole pieces. As can be seen from the figure, the lines of magnetic flux are concentrated in the steel pole pieces, which may be saturated near the surface of the roll. The field intensity is highest at the surface points where the pole pieces and magnet discs are in contact. At these points, the field intensity may be more than two Tesla, compared to a field intensity of about .5 Tesla at surface points located close to the center of the magnet discs. Because of the concentration of flux in the pole piece, surface field intensity over the entire pole piece will be nearly two Tesla. Material collected on the belt will tend to form lines defining the pole piece edges.

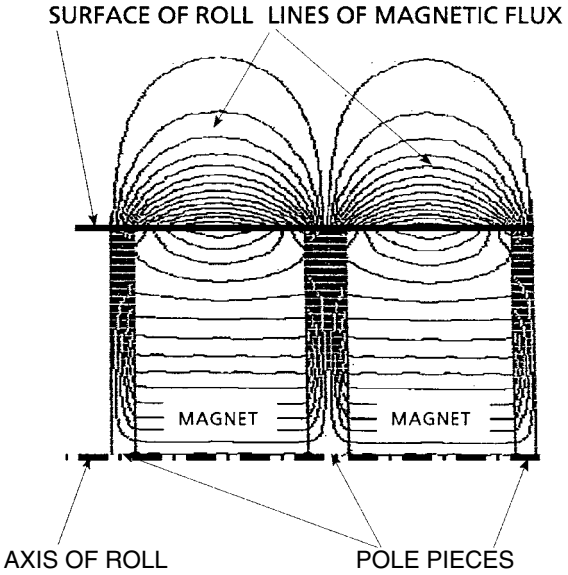



**FIGURE 2**
Magnetic field of RE roll

**⚠ WARNING**

**Under no circumstances should the construction of the RE roll itself be disturbed or modified. Disassembly of the roll would not only be dangerous to personnel because of the strong magnetic forces involved (see warning in the Introduction section), but would destroy the carefully engineered magnetic circuit, and could only be repaired by returning the roll to Eriez.**

**BELT**

Thin fabric belts, generally of Kevlar™ coated with Teflon™, are used on the RE roll. Standard belts are approximately .010" (.25 mm) thick to allow the process material to come as close as possible to the surface of the magnetic roll.

# Description of Equipment *(cont.)*

For very fine materials, belt thicknesses down to .005" (.12 mm) are available, and for coarser or more abrasive applications, belts up to .040" (1.0 mm) in thickness (or more) may be recommended.

Thicker belts will generally result in a reduction in field strength, which may affect separation performance, and which may have to be balanced against longer belt life in operation.

Eriez' experience with a variety of belts in a large number of applications is at your disposal in selecting the proper belt for your system.

**FEED AND OPERATING SPEED**

In general, the roll separation performance is based on an assumed layer of particles, one particle thick, as the feed approaches the roll. This must be achieved by careful and uniform feed to the RE roll machine itself, and by careful control of the belt speed, allowing the feed material to spread in the desired mono-layer. Since the belt speed also affects the centrifugal forces acting on both the magnetic and nonmagnetic particles passing over the roll, selection of the correct speed and feed rate depends greatly on the material characteristics, including relative densities of the magnetic and non-magnet constituents. Eriez technical experts can help greatly with this selection.

Belt speeds are variable on most RE rolls built by Eriez with a normal operating range from 80 to 200 fpm (24 to 61 mpm).

**CONSTRUCTION**

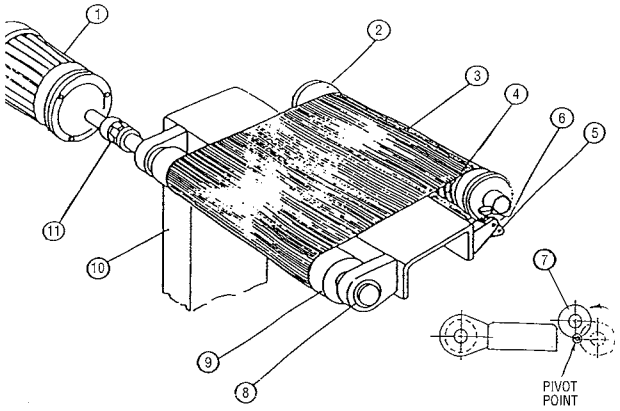
An outline drawing of your RE Roll is provided with this manual, and/or attached to the equipment itself. This should be reviewed carefully for special features not covered in the following discussion.

**OVERALL ASSEMBLY**

The Cantilevered RE Roll consists of a 3" (76 mm), 4" (102 mm), or 6" (152 mm) diameter rare earth magnetic roll and a 3" (76 mm), 4" (102 mm), or 6" (152 mm) diameter tail pulley mounted on a combination mild steel and stainless steel frame. The frame is rigidly attached to a supporting structure at one end.

The magnetic roll incorporates a through shaft, which is supported on self-aligning roller bearings. The tail pulley is supported on bearings mounted in the end flanges, with the shaft being stationary.

Take-up is achieved by the mass of the tail pulley floating on the pivoting cams. Once tracked no further take-up adjustment is required. The tail pulley can be pivoted up and out of the way to allow easy belt replacement.




1. Electric roll drive motor - TEFC
2. Tapered collars - belt tracking (optional)
3. Feed belt
4. Tail pulley assembly - herringbone grooved
5. Take-up- cams - pivoted
6. Tracking adjustment hand screw
7. Tail pulley rest - for belt change (position)
8. Hanger-type bearing housing
9. Rare earth roll assembly
10. Cantilever - type support frame
11. "Spider" type flexible coupling

**FIGURE 3**
Cantilever RE roll construction features

**FRAME**

The frame is an all-welded combination stainless steel hot rolled steel structure. The frame center section is open to minimize material build-up under the belt. All sizes of rolls have similar frames.

The support frame is constructed of welded hot rolled steel channel and angle, and is configured for each application to accommodate the particular combination of roll modules, hoppers, and/or feeders required.

### ROLL
The magnetic roll consists of stacked 3" (76 mm), 4" (102 mm), or 6" (152 mm) diameter discs, alternating neodymium-iron-boron magnets and mild steel pole pieces. The effective width of the roll ranges from 5" to 60" (127 mm to 1524 mm), depending on the capacity of the equipment. The steel pole pieces have the same outside diameter as the magnets, but are much thinner.

The roll center shaft rides in self-aligning roller bearings, rigidly attached through pillow blocks to the roll support cantilever structure. The roll is driven directly by a TEFC AC motor, coupled to the shaft through a flexible coupling.

### BELT
The standard belt is .010" (.25 mm) thick Kevlar with an overlap splice. Other commonly used thickness options are .005" (.125 mm) and .017" (.4 mm) For high speed applications the belt is furnished with a special wrap-around V-splice.

### TENSIONER
Conveyor belt tensioning consists of a pivoting tail pulley. The weight of the tail pulley in combination with an adjustment screw allows ease of belt tracking.

### DRIVE
The magnetic roll is driven by a single reduction worm gearmotor. The motor is mounted to the support frame and connected directly to the roll shaft by a Rex Omega self-aligning coupling. The motor is “inverter duty” to handle a variable frequency control.

The standard variable speed control is furnished in a NEMA 12 dust tight housing, and can be mounted either locally or remotely.

### FEEDER
The feed is delivered to the belt by an electro-magnetically driven vibratory feeder, sized to provide accurate, consistent and uniform delivery of feed. Eriez model 20A vibratory feeder drives are used, driving a single stainless steel feeder tray. The vibratory feeder operates on 60 Hz AC and a maximum amplitude of .045" (1.1 mm).

A single Eriez model G control, housed with the roll control, is used to control the feed rate from 0 to 100 percent of design capacity.

# Installation

### CHUTE WORK AND HOUSING
All chute work and the roll housing are constructed of 300 series stainless steel. Separate discharge pans are used to segregate the non-magnetic and magnetic fractions. The discharge pans can be easily removed and replaced. Each roll incorporates a fully adjustable stainless steel product splitter with a graduated position scale.

The unit has been fully assembled, adjusted, and tested at the factory prior to shipment. Use care when transporting and uncrating to avoid damage to the equipment. Also, take note of the cautions presented in the introduction to this manual. These precautions should be made known to all operating and maintenance personnel involved with this equipment.

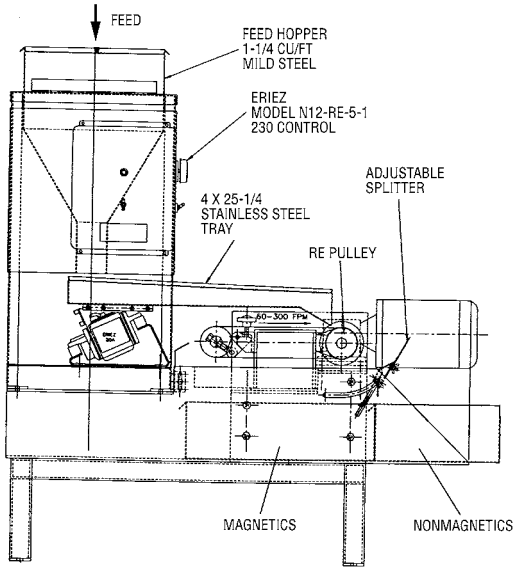



**FIGURE 4**
Installation connections

### ALIGNMENT AND LEVEL REQUIREMENTS
The unit is self supporting, but should be bolted into position, using the bolt holes provided, to assure continued proper alignment with feed and discharge chutes and hoppers.

The unit should be installed level from side to side to within ±1/16" (1.6 mm) for 20" units, ±1/8". (3.2 mm) for 40" units, and ±3/16". (4.8 mm) for 60" units. A level installation is important to assure uniform bed density in the product flow over the roll(s) and to assure reliable belt tracking.

# Installation *(cont.)*

**CLEARANCES**
The unit should be installed so that inlet chute work does not contact the vibratory feeders. There should be approximately 1" (25 mm) of clearance between the stationary chute work and the vibrating feeder pan at the feed end and bottom of the pan, and approximately 1/8" (3 mm) of clearance at the sides.

No clearance is required at the discharge points. However, access should be provided for the purpose of clearing plugging that may occur.

**ELECTRICAL CONNECTIONS**
The standard RE Roll separator is supplied for a 230 VAC 60 Hz single phase power supply. The feeder drive(s) are controlled by a single potentiometer, and the roll speed(s) are set by individual variable frequency controllers. All switches and controls are housed in a single NEMA 12 box. Unless specified otherwise, all internal connections on the machine have been made at the factory; you need only connect line power at the control box.

**⚠ CAUTION ELECTRICAL HAZARD**
**Voltages present in the control housing can cause serious injury or death. The control panel disconnect switch should not be defeated. All electrical work should be carried out only by a qualified electrician.**

Check the line voltage and current requirements stamped on the name plate of your RE roll control panel. Verify that these agree with your available supply or run appropriate lines to the machine location. Referring to the Control Schematic and Outline drawing supplied with the machine, make the necessary line connections at the control panel.

**BELT ROTATION DIRECTION**
After making electrical connections, start the roll(s) at low speed and verify correct roll and belt rotation direction. Correct electrical polarity if necessary.

**BELT TRACKING AND TENSION**
Observe the unit operating at low speed long enough to be certain that the belt tracking has not been disturbed by shipping and installation. If the belt needs to be re-tracked, refer to the section on Maintenance - Belt Tracking.

Adjust the speed to the desired operating speed and observe the belt motion carefully to be certain that it continues to track properly.

# Operation

**PRIOR TO OPERATION**
Prior to operating the RE Roll at any time, the following conditions should be checked.

**BELT ALIGNMENT**
If a belt is significantly misaligned, follow the directions in the Maintenance section below to restore alignment before operating the separator.

**BELT WEAR**
If any belt is worn excessively, replace it, following the procedure described in the Maintenance section. The tapered ends on the tail pulley generate slight extra loads on the belt edges. Pay particular attention to the edges of the belts where fraying may occur, keeping in mind that a slight amount of fraying is normal but significant tears should be cause for replacement.

**DUST BUILD-UP**
Remove any significant dust build up on the roll(s).

**STARTUP AND SHUTDOWN**
To prevent loss of material and/or build up of material within the machine, the roll(s) should always be started prior to starting the vibratory feeder. Start the feeder only when proper roll operation speed, belt tracking, etc. has been verified.

For the reasons given above, the feeder should always be stopped prior to stopping the roll(s). Allow the roll(s) to run for long enough to clear all material out of the machine to prevent migration of material to the roll surface(s) during the machine downtime.

**OPERATING ADJUSTMENTS**
Many combinations of operating settings are possible on the RE Roll. The precise combination of adjustments appropriate to your material can only be determined by experimentation. Please contact Eriez' technical experts for assistance in setting operating settings for your specific application.

Eriez can also carry out laboratory tests on your feed materials to help in optimizing these settings.

Three primary operating parameters can be adjusted to affect the separation performance of the unit. These are:

- Belt (or roll) speed
- Splitter position
- Feeder speed

The discussion below covers, in general terms, the above three operating adjustments and their effects on separator performance.

**BELT (ROLL) SPEED**

This is the primary operating parameter affecting magnetic separation. It controls the balance between centrifugal and magnetic force as the material passes over the roll. Increasing belt speed will increase the centrifugal force, generating an expanded trajectory arc for the non-magnetics, at the expense of losing some magnetics into the non-magnetic stream as the centrifugal force overcomes the magnetic attraction at the surface of the roll.

A favorable effect associated with increased belt speed is an increase in belt capacity for a particle layer of a given thickness.

An adverse effect associated with increased belt speed is potential greater vibration of the belt and consequent mechanical agitation of the particle layer. This effect results in a slightly increased distance between the “average” magnetic particle and the roll surface as the belt passes over the roll, and thus may decrease the effectiveness of the magnetic field.

**SPLITTER POSITION**

A splitter position close to the roll will result in a relatively high grade magnetic product with relatively low recovery. If the desirable product is the non-magnetic fraction, a close splitter position will result in a relatively high recovery, but with some remaining magnetics in the product.

The converse is true for a splitter position relatively distant from the roll. If the desired product is magnetic, the recovery will be relatively high but the grade will be relatively low (ie: non-magnetic contamination will remain). If the desired product is non-magnetic, a distant splitter position will result in relatively low recovery of a high grade product.

In multi-stage roll separators, the early stage splitter(s) may be set primarily to scalp large quantities of the undesirable fraction, raising the effective grade of the feed to the later stage(s),which can then be adjusted primarily for recovery.

As in most separation processes, the optimum splitter position must be determined by experimentation using the actual feed to be processed, and taking into account the capacity, recovery, and grade requirements of your specific process.

**FEEDER SPEED**

In conjunction with the belt (roll) speed, this controls the thickness of the material layer on the first roll (the only roll on a single roll unit). It should be adjusted for a uniform flow across the width, with a depth that is compatible with the belt (roll) speed as discussed above. Note that the material may leave the feeder in a layer thicker than one particle, depending on the relative speed of the belt. The objective is to have a one-particle thick layer of material on the belt as the feed passes over the roll.

# Maintenance

The following sections discuss maintenance of the roll separator itself. See the appendices and attachments for maintenance procedures and requirements for the feeders, controls, and other ancillary equipment supplied with the roll.

**⚠ CAUTION**

**Rotating parts, moving belts and pinch points may cause severe personal injury. PROPERLY LOCK OUT THE SEPARATOR BEFORE PERFORMING ANY MAINTENANCE THAT REQUIRES CONTACT WITH THE MACHINE. To avoid eye injury, wear goggles when cleaning off dust accumulations.**

### ROUTINE MAINTENANCE

The procedures described here should be carried out at least daily (or as noted in the discussion); more often if your process demands it. The machine should be checked hourly during the first few days of operation, and at least once per shift thereafter.

### REMOVE DUST ACCUMULATION

On a daily basis the machine should be inspected for dust buildup on the rolls or other internal components. Dust accumulated on the rolls can adversely affect magnetic performance, damage the belts by increasing wear rate, and cause mistracking of the belts.

If dust buildup is observed, it should be removed by vacuum or air blast, scraping or brushing as necessary.

### REMOVE TRAMP IRON

Inspect for and remove ferrous materials, such as nuts, bolts, or welding slag, that may not have discharged from the belt. These materials may simply roll in place when trapped on the magnetic roll, eventually wearing through the belt.

### CHECK BELT TRACKING

Verify that each belt remains essentially centered on the pulleys. Note that the tapered collar tracking method incorporated into the roll separator requires that a slight off-center condition exist in order to generate a restoring force and maintain stable tracking.

However, if a belt edge has risen more than about 3/8" (10 mm) onto one of the tapered collars on the tail pulley, re-track the belt using the procedure described under Belt Tracking.

### CHECK BEARING LUBRICATION

Each roll stage incorporates four pillow block bearings, two on the magnetic roll and two on the tail pulley.

### ROLL BEARINGS

The magnetic roll bearings are Sealmaster™ Type SEHB. They should be checked periodically for overheating or other signs of inadequate lubrication. They should be relubricated periodically according to the following table.

| Temperature | Cleanliness | Greasing Interval |
|---|---|---|
| Up to 150°F (Up to 66°C) | Dirty (normal RE roll operation) | 1 week to 1 month |
| Over 150°F (Over 66°C) | Dirty | Daily to 2 weeks |
| Any temp | Very dirty | Daily to 1 week |

**TABLE 1**

### RE-LUBRICATING

When re-lubricating, the grease should be a good quality conforming to NLGI Grade 2. It should be free of dust, rust, metal particles, or abrasives. Approximately 3/4 oz (22 cc) of grease is required to fill the grease chamber. For best results, the grease should be added while the roll is in operation. **CAUTION: Only the grease gun should contact the machine during this procedure.** The grease should be pumped in slowly until a slight discharge is noted around the bearing seal. Note that during operation immediately following re-lubrication there may be a temperature rise of 10-30°F (6-17°C). This is normal, and will disappear as operation continues.

### TAIL PULLEY BEARINGS

The tail pulley bearings are Sealmaster Type ER and are lubricated for life.

### BELT REPLACEMENT

All of the belt options available on the RE roll are fragile compared to commonly used conveyor belting. This is a result of the requirement for a thin, flexible material that can bring the process material extremely close to the surface of the relatively small diameter roll, while running smoothly at relatively high speeds.

These belts CANNOT be handled like a common conveyor belt. Use the following procedure to change the standard black Kevlar belt and most other belts used on the RE roll:

1. Remove any surrounding dust covers.
2. Lift the tail pulley up then swing and rest against the cantilever arm. This may have to be done one side at a time.
3. The belt may now be removed easily by simply pulling it toward you. IMPORTANT: if the belt is to be reused, be careful not to crease it during removal.
4. While the belt is removed, take advantage of the opportunity to clean the roll and tail pulley of any ferrous material or dust buildup.
5. Before installing the new belt, note the direction of the overlap splice, if any. The overlap should be installed “trailing”. This will reduce the possibility of catching the edge on the splitter or on ferrous material.
6. Slide the new belt into place on the tail pulley and roll. Use care not to damage or crease the belt during this procedure. Creases are generally not self-repairing, and will adversely affect the smooth operation of the roll.
7. Center the belt on the tail pulley. It is normal for the edges of the belt to overlap the tapered collars slightly.
8. To track the belt, adjust the knurled screw attached to the cams.

   For example:

   a. If the belt tracks away from the adjustment end then slightly loosen the adjusting screw.

   b. If belt tracks to adjusting end then tighten the knurled screw as required.

**BELT TENSIONING AND TRACKING**

All of the belts used on the cantilever RE roll separator are tensioned and tracked similarly. The machine has been designed so that this procedure should take less than 5 minutes, including tracking time. Only one person should be required, as only one end of the tail pulley is adjusted at a time.

**GENERAL GUIDELINES**

It should be remembered that all of these belt types are very thin, short and wide. The stresses put on the belt during tensioning can quickly damage it. Try to achieve a tension that is uniform across the width of the belt and that would be characteristic of a fairly ‘loose’, low pitched drum head. A symptom of over tightening is a crease that forms in the center of the belt and spirals outward. If this persists for more than a few seconds, the belt is irreparably damaged.

All belts have a break-in period to remove lumps and flat spots, and to come to operating temperature. The overlap splice may cause a slight bounce of feed material initially. This should improve with time. If it does not, check the belt for possible creases that may have occurred during installation.

There are possible contact points under the feeder and other parts of the separator. The belt makes 50,000 to 100,000 or more cycles per day. Even a slight contact will wear a hole through the belt if it is allowed. Examine these points of near contact after tracking and tensioning the belt. If points of contact are found, adjust the equipment to eliminate it.

**TENSIONING/TRACKING PROCEDURE**

Tensioning and tracking must take place simultaneously. Use the following procedure to tension and track the belt:

1. Run the belt at slow speed.
2. Carefully watch the edges of the belt where they contact the tapered collars at the ends of the tail pulley. The edges should run up on the tapered collars about 3/8" (10 mm) on both sides of the belt.
3. If the belt does not remain centered, referring to Figure 5, tighten or loosen knurled screw to shift the belt toward the center of the pulley. Turn the screw to increase tension on the side of the belt away from which you want the belt to move.
4. Continue to make small adjustments (1/4 turn) as necessary to improve the tracking of the belt.
5. The belt should be closely monitored (periodically) for the first hour. Because of the extreme width to length ratio, it can take a long time for changes in tracking tension to take effect.

# Maintenance *(cont.)*

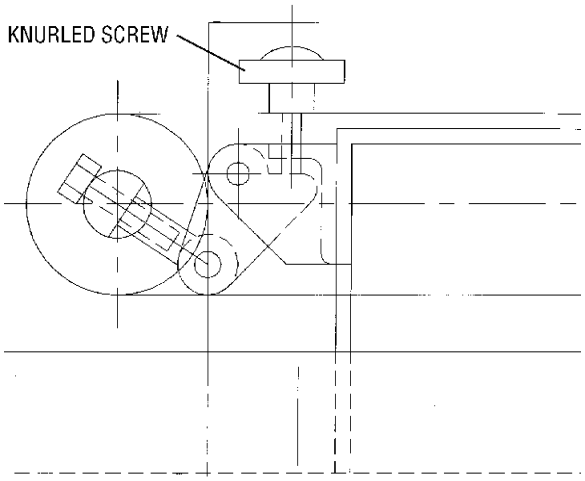



**FIGURE 5**
Belt tensioner

**BEARINGS**
The Sealmaster™ hanger bearings furnished on the head pulley of the separator have inside diameters ground for a sliding fit over the shaft. They are easily and securely locked to the shaft by means of self-locking,cup point, socket head setscrews. Two setscrews are furnished on each bearing sleeve, and both setscrews must be used for satisfactory performance.

To install a new bearing on a shaft:

1. Make certain that the shaft is free of burrs and foreign material.
2. Back the bearing setscrews out so that the tips are clear of the bore.
3. Slide the bearing onto the shaft to the approximate final position. Never hammer the ends of the inner race, since they are relatively soft. If necessary to apply force, use a brass bar or pipe against the inner race to drift the bearing into place. Do not tighten the setscrews at this time.
4. Mount the bearing hanger securely to the supporting frame, adjusting the bearing position on the shaft as required.
5. Rotate shaft to make sure it turns freely.
6. Tighten the setscrews securely onto the shaft. Recommended torque: 126 in-lb (14.2 Nm).

The bearings on the tail shaft are supplied as part of the tail pulley assembly, and are not user serviceable.

**MOTOR/GEAR REDUCER**
Refer to manufacturer's instructions attached to the separator.

# Spare Parts

A separate spare parts list is available per order.

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**World Authority in Advanced Technology for Magnetic, Vibratory and Inspection Applications**
Headquarters: 2200 Asbury Road, Erie, PA 16506-1440 U.S.A.
Telephone: 814/835-6000 • 800/345-4946 • Fax: 814/838-4960 • International Fax: 814/833-3348
Web Site: http://www.eriez.com e-mail: eriez@eriez.com
Manufacturing Facilities: AUSTRALIA • BRAZIL • CANADA • CHINA • INDIA • JAPAN • MEXICO • SOUTH AFRICA • UNITED KINGDOM • UNITED STATES

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