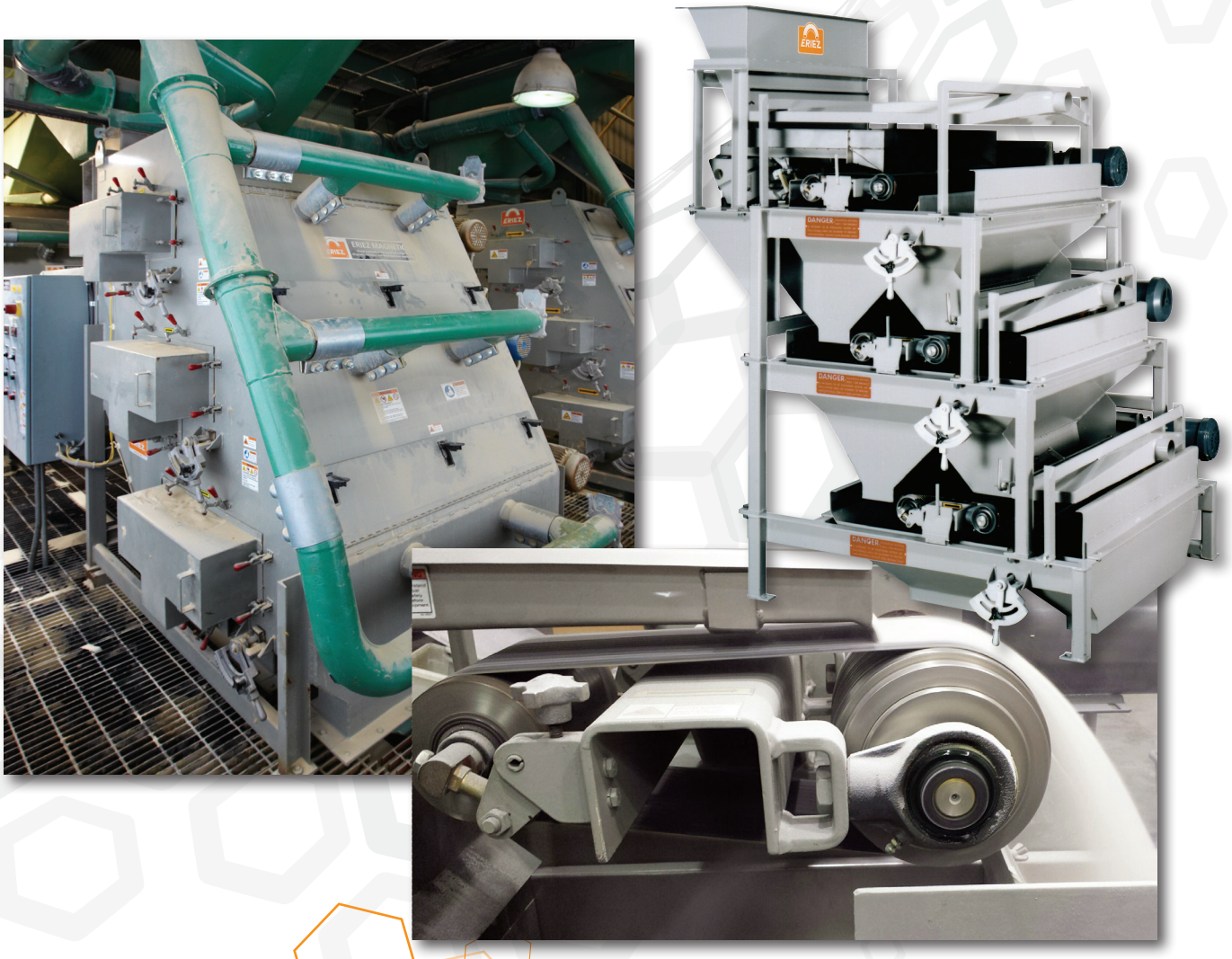
MMPB-730N

Rare Earth Roll Magnetic Separator

DRY HIGH INTENSITY



SETTING INDUSTRY STANDARDS WITH
HIGH-INTENSITY RARE EARTH ROLL PERMANENT MAGNETS

ERIEZ®

HIGH INTENSITY RARE EARTH ROLL

Magnetic Separators

With the ever increasing demand for high-purity feedstocks used in manufacturing, Eriez offers its Rare Earth Roll dry high-intensity magnetic separators. These DHIMS provide maximum efficiency in the separation of weak magnetic particles for product purification applications.

Eriez applied sophisticated finite element analysis in magnetic circuit design to produce an energy-free separator capable of generating the exceptionally high field-strengths needed to remove unwanted fine iron contaminants.

Magnetic cleaning has been applied to the most basic industry foundations such as industrial minerals, metals recycling, glass batch and cullet, abrasives and refractories, chemicals pharmaceuticals, and plastics.

ENGINEERED FOR OPTIMUM PERFORMANCE

- **High-intensity magnetic roll assembled from rare earth permanent magnets**
- **Magnetic roll diameters of 4, 6, and 12 inches**
- **Magnetic roll widths up to 60 inches**
- **Continuous duty applications treating up to 12 TPH feed/separator**
- **All stainless steel construction**
- **Variable speed drive on each magnetic roll.**
- **Mounted spread box/hopper and vibratory feeder**

WIDE RANGE OF APPLICATIONS:

- **Industrial Mineral**
  Silica Sand
  Quartzite
  Feldspar
  Nepheline Syenite
- **Abrasives and Refractories**
  Alumina
  Garnet
  Chromite
  Corundum
- **Heavy Mineral Sands**
  Ilmenite
  Leucoxene
- **Chemicals and Pharmaceuticals**
- **Recycling**

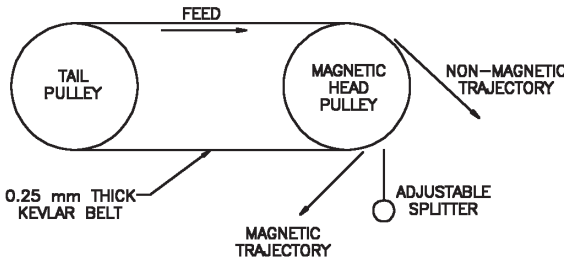
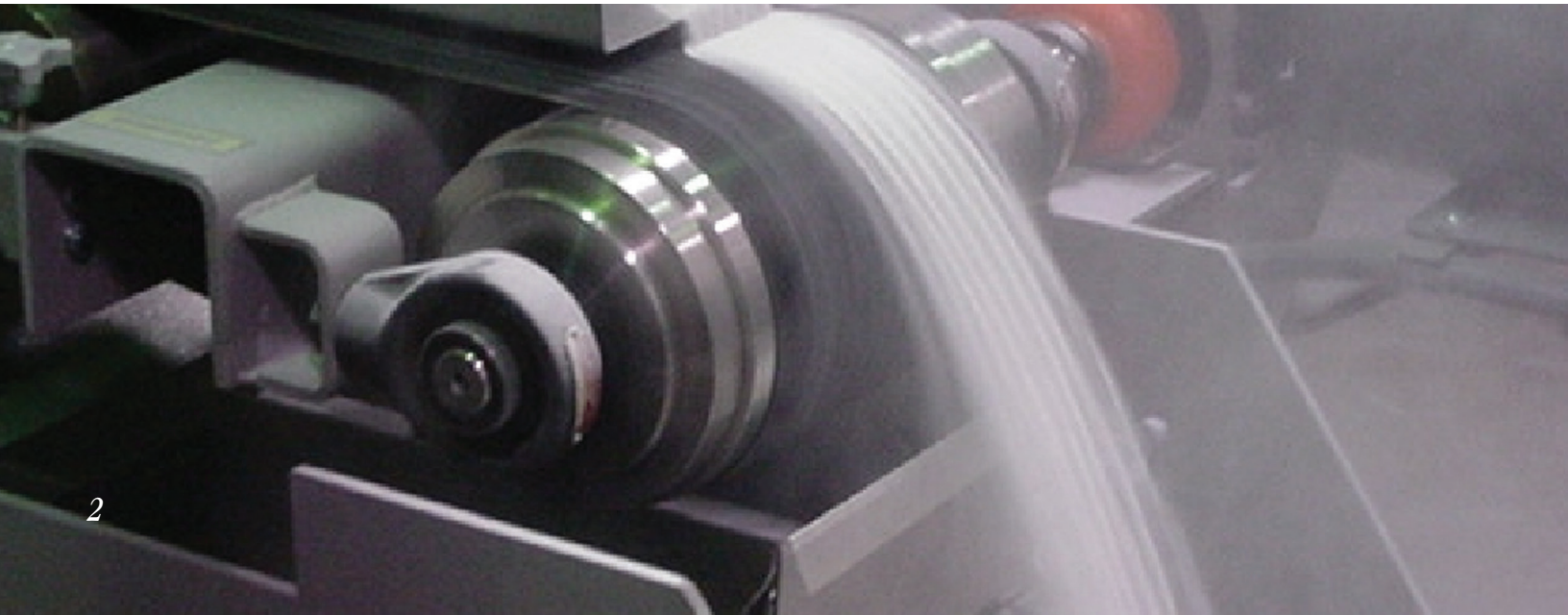


Fig 1: Schematic of the Rare Earth Roll Magnetic Separator



The Rare Earth Roll, generating peak magnetic field strengths approaching 24,000 gauss, is very effective for concentrating or removing weakly magnetic minerals from a dry process stream. The Rare Earth Roll magnetic separator is designed to provide peak separation efficiency and is typically used when a high-purity product is required. The roll is constructed of discs of neodymium-boron-iron permanent magnets sandwiched with steel pole pieces. The steel poles are magnetically induced to the saturation point of approximately 24,000 gauss. Magnetic roll diameters are typically 3, 4, and 6 inches, although separators as large as 12 inch diameter are available.

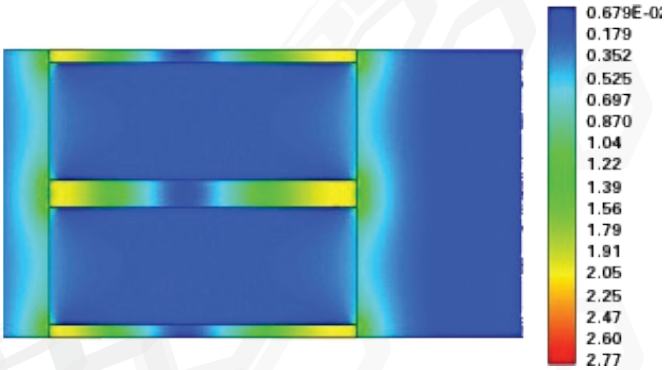
The separator is configured as a head pulley in the separator. A thin belt, usually from 5 to 20 mils thick is used to convey the feed material through the magnetic field.

When feed material enters the magnetic field, the non-magnetic particles are discharged from the roll in their natural trajectory. The paramagnetic, or weakly magnetic, particles are attracted to the roll and are deflected out of the non-magnetic particle stream. A splitter arrangement is used to segregate the two particle streams.

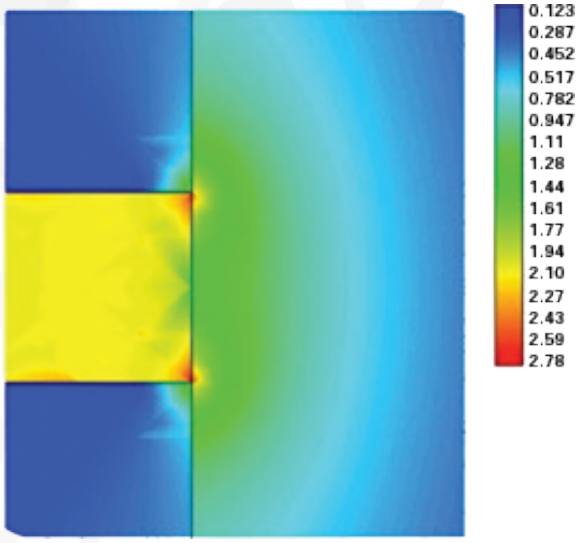
Magnetic Circuit

The magnetic element is comprised of alternating discs of rare earth (neodymium-boron-iron) permanent magnets and steel poles. The magnet discs induce the steel poles and generate a high-intensity high-gradient magnetic field. A contour plot of the magnetic field configuration of this magnetic circuit is illustrated in Figure 2. The highest magnetic field strength occurs at the interface between the magnetic disc and the steel pole piece. A close-up of the magnetic field configuration at this interface is also shown if Figure 2.

Fig 2: Modeling the Magnetic Roll



Contour plot of magnetic field configuration. Close-up on magnetic discs and steel pole. Note that the highest magnetic field strength occurs at the interface of the magnet and steel pole.



Contour plot of the magnetic field configuration of magnetic roll. The magnetic circuit consists of alternating magnetic discs and thin steel pole pieces.

Separation Variables

The magnetic attractive force generated by the magnetic roll is opposed by centrifugal force. The primary variables affecting separation efficiency are the magnetic field strength, feed rate, linear speed of the separator surface, and particle size. An effective separation requires an equilibrium among these variables.

FEED RATE

In assessing the feedrate, a balance must be struck between an economic feedrate, product specifications, and collection of the magnetics. As the feedrate increases, the layered particle bed on the feed belt increases in height and the collection of magnetics decreases.

LINEAR SPEED

The linear speed of the roll is also a primary variable related to the feedrate. As the linear speed is increased, the layered particle bed decreases in height responding with an improved collection of the magnetic particles.

The centrifugal force exerted by the roll surface is the critical factor in providing separation. Beyond the critical speed, the centrifugal force overcomes the magnetic attractive force and the separation efficiency deteriorates.

PARTICLE SIZE

Particle size will also affect separation efficiency independent of all other variables. Coarse particles provide a relatively high burden depth on the separator surface and respond with a relatively high magnetic attractive force. Coarse particles typically provide high unit capacities with high separation efficiencies. Fine particles with a relatively low mass respond detrimentally to electrostatic forces. As a consequence, precise magnetic separations balancing magnetic forces against centrifugal forces deteriorates.

Separation Stages

Another primary variable is the number of separation stages. This is very common when treating industrial minerals such as silica sand, quartzite, feldspar, or nepheline syenite. The Rare Earth Roll magnetic separator is utilized to remove weakly magnetic iron-bearing minerals producing a high quality non-magnetic product. Multiple separation stages may be required to achieve product quality.

A multiple separation is commonly performed as is illustrated in Figure 3. The initial separation produces a magnetic and a non-magnetic product. The non-magnetic product is subsequently treated on the second separation stage producing an additional non-magnetic and magnetic product. This process is repeated on a third separation stage.

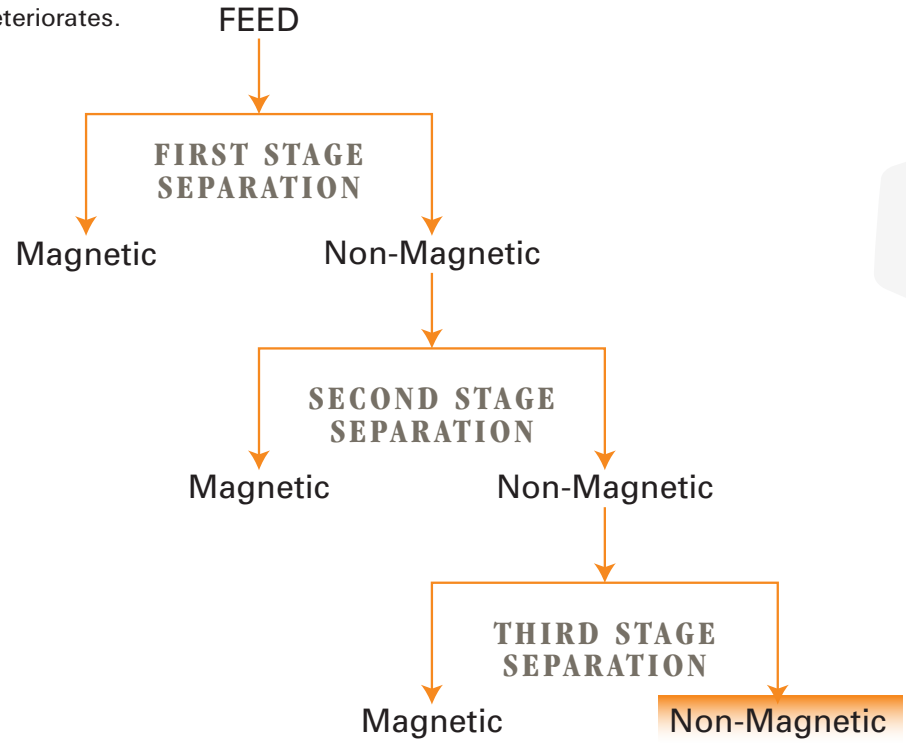


Fig 3: Three Stage Separation

This test work provides a classic example of diminishing efficiency at each separation stage. Both the iron and weight rejection as a magnetic product diminishes with each separation stage. A general separation efficiency curve is illustrated in Figure 4. The highest level of iron rejection to the magnetic product is achieved in the first stage of separation. Subsequent separation stages provide a diminishing return. As expected, the weight rejected to the magnetic fraction follows the same trend.

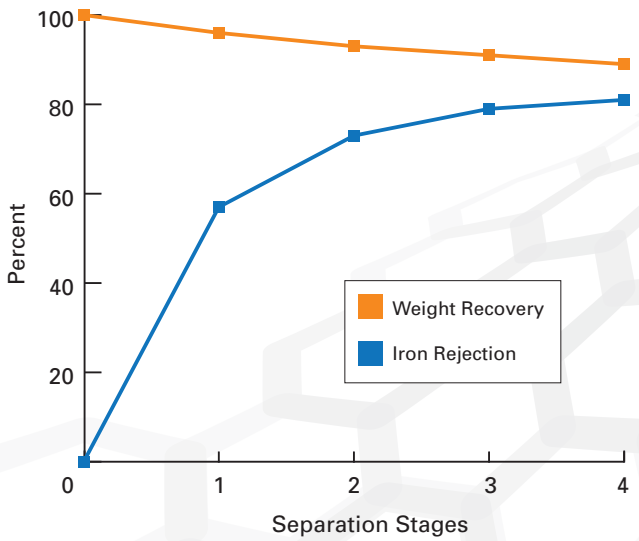


Fig 4: Effect of multiple separation stages on the magnetic cleaning of silica sand

Separator Sizing

Eriez Rare Earth Roll magnetic separators are available in several sizes to meet any specific application. There are several variables affecting the feed rate on the Rare Earth Roll magnetic separator. The bulk density and the size of the material are fundamental in determining the appropriate unit capacity.

Rare Earth Roll Sizes

Roll Diameter	Roll Width
3″	5″ to 60″
4″	5″ to 60″
6″	5″ to 60″
12″	5″ to 60″

Roll widths are available in 5 inch increments

Unit Capacity

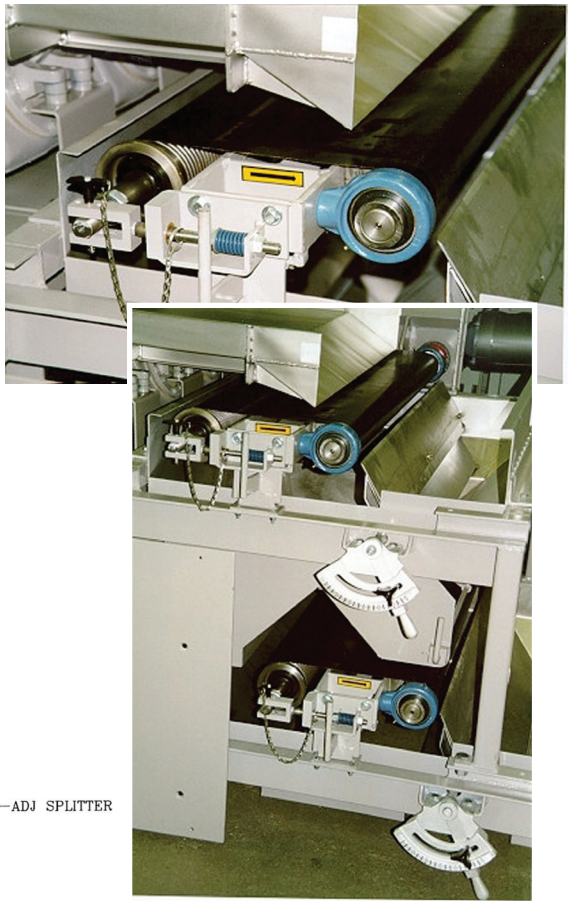
Application	Unit Capacity[1]
Light Material - Plastic Pellets for Compounding, Fine (-20 Mesh) Industrial Minerals such as Silica or Alumina, Pharmaceutical Powders, Resins, or Grains	50 to 100
Industrial Minerals – Glass/Ceramic Feedstocks sized at –20 Mesh + 150 Mesh – Silica Sand, Quartzite, Feldspar, Nepheline Syenite, Alumina, or Tabular Alumina.	100 to 250
Heavy Mineral Sands – Sized at -10 Mesh - Ilmenite, Leucoxene, Rutile, Zircon, Staurolite, or Monazite.	150 to 300
Fine Heavy Material – Hematite and Limonites Sized at -10 Mesh or Metallic Powders.	200 to 400
Coarse Heavy Material – Iron Ore and Slags Sized at -1/2 Inch.	300 to 500

[1] Unit Capacity is pounds/hour for each inch of magnetic roll width.

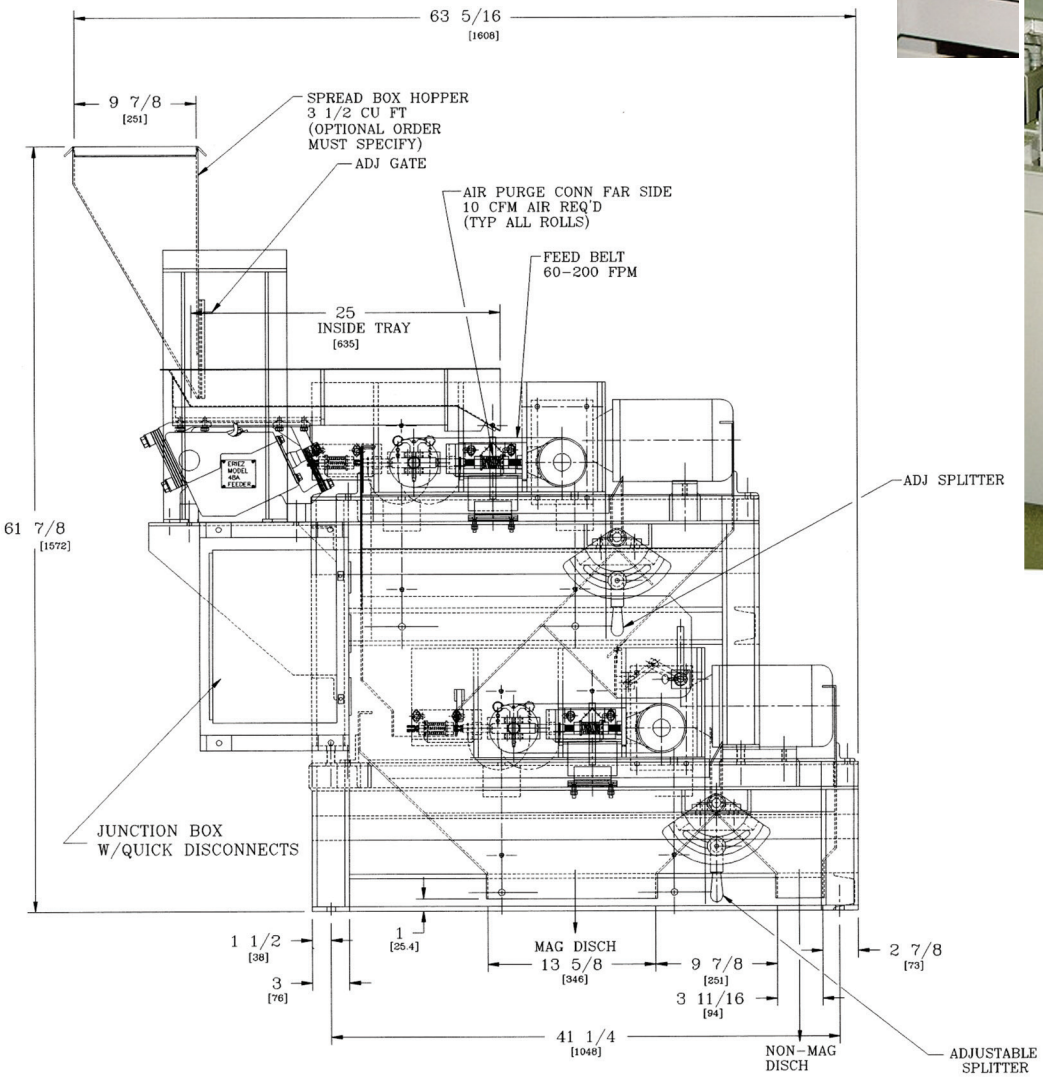
Separator Specifications

HIGH INTENSITY RARE EARTH ROLL MAGNETIC SEPARATOR

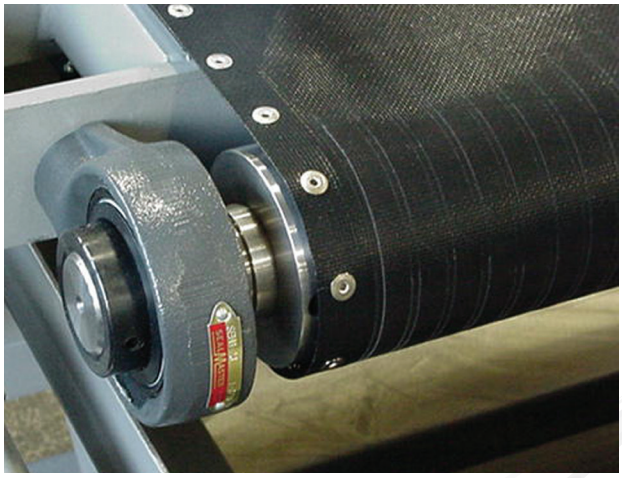
The Eriez Rare Earth Roll magnetic separator incorporates the latest available design and technology. The highest strength and highest quality magnet material is utilized. This separator combines the best engineering and operational features and provides excellent performance with ease of operation, inspection, and maintenance.



top: magnetic head pulley and tail pulley
bottom: two stage separation



Rare Earth Roll Magnetic Separator. The Magnetic Rolls are 4" diameter and 60" wide. This separator is configured to provide a two-stage separation



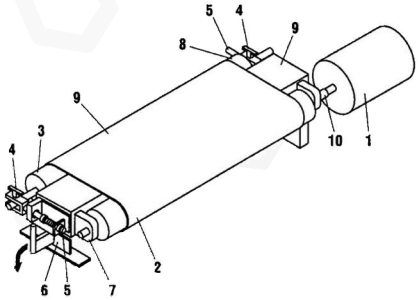
positive belt tracking feature

several three-roll separators treating feldspar

OPTIONAL FEATURES:

- **High strength neodymium-boron-iron permanent magnets.**
- **Several magnetic roll diameters available to match the specific application.**
- **Several magnetic roll widths available to match the production capacity.**
- **Multiple separation stages available on one separator. Up to three magnetic rolls placed in series.**
- **Kevlar feed belt. Positive belt tracking features.**
- **Cantilever rolls for ease of operation and maintenance.**
- **Mounted hopper with slide gate control.**
- **Mounted vibratory feeder with control to provide consistent feed rate to the magnetic roll.**
- **Independent drive on each magnetic roll.**
- **Variable speed drive. Feed belt speeds up to 250 fpm using a variable frequency control.**
- **All stainless steel construction.**
- **Wide range splitter to segregate magnetics and non-magnetics.**
- **Flanged magnetic and non-magnetic product discharge chutes.**
- **Dust tight housing available.**
- **High temperature magnets available.**

three-roll separator with 6" diameter magnetic rolls

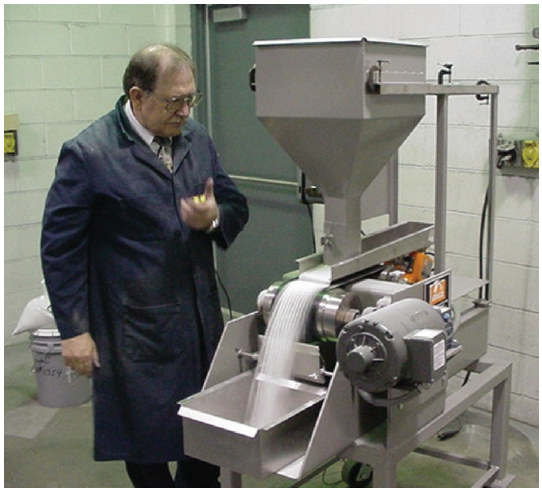


1. Electric Motor - TEFC
2. Feed Belt
3. Tail Pulley Assembly – Dynaloc for positive belt tensioning
4. Tail Pulley Shaft Pin
5. Tracking Adjustment
6. Steady–Cantilever Arm
7. Hanger Type Bearing Housing
8. Rare Earth Roll Assembly
9. Cantilevered Support Frame
10. Direct Drive with Flexible Coupling

Engineering Services and Technical Center
AT ERIEZ

ERIEZ PROVIDES ENGINEERING SERVICES TO COVER A WIDE RANGE OF FUNCTIONS, ASSISTANCE, AND SUPPORT

- Design and equipment modifications incorporating specific features and options. The separator may incorporate various options and features applicable to the process.
- Equipment layout and dimensional drawings. Modifications are common to fit an existing plant or provide specific operating characteristics.
- Equipment selection, sizing, material flows and balances. Eriez has a database for accurate separator sizing and separation performance.
- In-plant audit to determine iron contamination levels, production flow rates, material handling aspects, equipment selection and sizing, and predict performance.



The Technical Center at Eriez has a wide variety of Magnetic Separators. Testing high purity quartz on the 6 inch diameter Rare Earth Roll magnetic separator.

Eriez Technical Center

The Technical Center at Eriez provides material testing services and is the most complete and advanced laboratory facility of its kind anywhere in the industry. Located in Erie, PA, a wide variety of magnetic separators are available to evaluate an extensive range of separation applications. High intensity magnetic separation tests are typically carried out to assess separation performance on a representative sample to characterize the separation parameters. A series of separation tests are conducted investigating the effect of the different separation variables specific to the material. The test work may extend from the basic bench scale feasibility stage through to an extensive pilot plant program dependent on the assessment required. All test work culminates in a report detailing the test work and equipment recommendations.

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