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# White Paper

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**TITLE:** How to Conduct a Magnet Pull Test  
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## **How to Conduct a Magnet Pull Test**

Many manufacturers today invest thousands—if not millions—of dollars annually into magnetic separation equipment, proactively reducing the risk that any foreign object or contaminant will be mixed in with a product sold to their network of customers, including other OEMs, distributors or direct to consumer.

Attention to product purity on the production line has never been greater, creating the need for manufacturers to detect and eliminate foreign objects before the end product reaches end-use customers. Eliminating contaminant metal also prevents damage to expensive processing machinery, reducing downtime and repair costs.

The use of permanent magnetic separators helps draw out fine tramp metal along critical points of the production line. These separators come in different styles and in various magnetic strengths, depending upon the application. Periodically, they all need to be tested for optimum strength. This report, written by Eriez®, offers guidelines on conducting a proper and valid magnet pull test.

## Factors affecting magnet performance

Under normal operating conditions, magnets should retain their strength indefinitely. However, several factors affect performance and should be recognized by plant operators before testing for magnet pull strength:

- Exposing magnets to high temperatures outside their design range may cause magnets to fail completely or show signs of weakening. (Typical ranges for standard Eriez Rare Earth (RE) magnet circuits are up to 150 degrees Fahrenheit, 150 to 250, 250 to 400 and maximum 850 degrees Fahrenheit.)
- Welding equipment used on, or in close proximity to, permanent magnet circuits can be damaging to magnet performance. The direct current can short the magnetic field and essentially kill the magnet. Also, the heat associated with welding will damage the magnet circuit.
- Subjecting the raw magnet material to liquids as a result from a breach in the magnet enclosure. RE magnets are typically made from Neodymium Boron Iron and the iron will oxidize, causing the circuit to fail if it gets wet.
- Physical abuse when handling the magnet will create a shortened lifespan. The actual magnet material inside the separator is brittle. When subjected to repeated abuse or heavy physical handling, it will break down over time and fail. This may occur even when little physical damage is evident on the outside.

Which magnets get tested?

For the most part, smaller permanent magnets should be subjected to semi-annual testing using a pull test kit. (Pull test kits are available from most industrial magnet manufacturers.) These permanent magnets include:



Magnetic Plates—Function: Protect against medium and small-size contaminants. They are installed in chutes, spouts, ducts and in suspension over non-magnetic conveyors and screens.



Magnetic Grates—Function: Remove small and fine tramp iron from dry and free-flowing products. They are designed for steep-sloped hoppers, even with odd and irregular shapes, floor openings, vertical closed chutes and ducts.



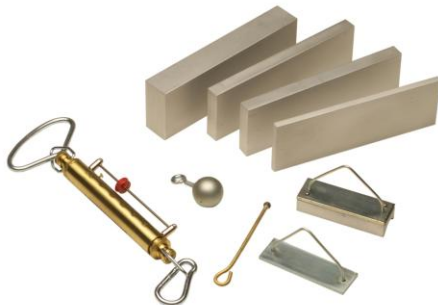
Grates in Housing—Function: Remove ferrous contamination from free-flowing products as it cascades through multiple grate rows within a custom manufactured housing.



Magnetic Traps—Function: To purify products in liquid and slurry lines by removing small particles of scale, oxides and iron contaminants.

### How to conduct a proper pull test

Most magnet manufactures have adopted standard test equipment that measures the holding force of a magnet. Eriez offers a Pull Test Kit that includes a variety of pull test pieces to measure holding force. (You may not need all these pieces, depending upon which magnet is being tested.):



- Scale with snap ring
- Aluminum spacers, including one-inch thick, 1/2-inch thick (2), 1/4-inch thick
- Pull test pieces including 1/4-inch sphere,

1-inch sphere, 1 x 3 x 1/8-inch plate, 1 x 3 x 1/8-inch plate with radius mount.

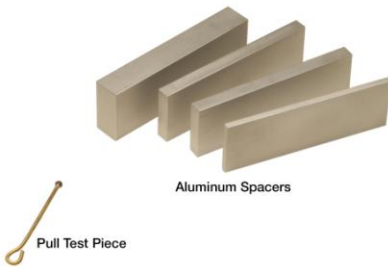
- Instruction manual
- Instructional video

Two test pieces are recommended when measuring holding force for tube magnets. Use the 1 x 3 x 1/8-inch plate with radius mount for Ceramic tube magnets and the 1/4-inch steel sphere for all RE tube magnets.

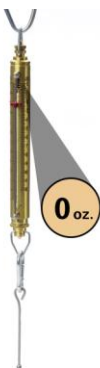
Why is this? Ceramic tube magnets remove tramp metal from free flowing products. Tramp metal consists of large iron such as hex nuts, bolts, nails and other metallics in that size range, so using the 1 x 3 x 1/8-inch test piece is ideal. RE magnets capture iron particles associated with abrasion, scale, or small metallic slivers such as threads stripped from a bolt. Since it is difficult to measure the force associated with removing a metal sliver from a tube magnet, use the 1/4-inch steel sphere.

Here are some rules to follow to make sure you are using standard operating procedure when field testing magnetic strength to obtain accurate results.

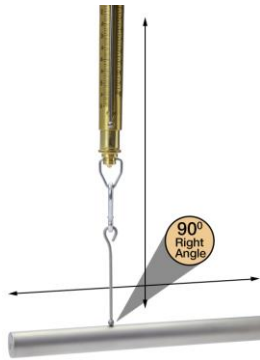
The pull test procedure begins with cleaning the magnet surface. Even a small gap between the pull test piece and magnet will adversely affect test results. Then use the following steps:



-Select the appropriate pull test piece and spacer for the separator, based on guidelines found in your pull test kit, and attach to the scale. For example, it's best to use the 1/4-inch steel sphere attached to a stainless steel bar for testing a grate or tube magnet and the 1 x 3 1/8-inch plate for plate magnets.



-Zero the scale with the appropriate pull test piece by rotating the adjustment knob on top until the scale line measures zero.



-Allow the piece to attract to the magnet and position the scale perpendicular to the magnet surface.



-Pull the scale directly away from the magnet surface slowly, smoothly and evenly. Be careful, as the piece may snap unexpectedly from the magnet surface. Wear protective eyewear during the test. Note the measurement by reading the metal band as it slides down the barrel of the scale.

-Repeat the test to verify results.

After three to four pulls, the results should be within a reasonable range, i.e., a ¼-inch steel sphere might measure 88 to 92 ounces in pull strength during the test sequence on an RE tube magnet. However, if the test is repeated in six months and pull strength drops to 75-80 ounces, definite magnetic erosion can be detected.

It is not necessary to pull test every tube of every grate assembly. Spot check the grate assembly and record an average of approximately three pull tests.

Do not pull test near the ends or edges of any magnetic separator. The magnet strength will measure less at the edges because of magnet design constraints. Measures around the center of a tube or plate should represent the magnet's true working strength.



Eriez has developed a short video to demonstrate proper pull test procedures. This instructional video can be found at: <http://youtu.be/5slbfB0-7zQ>.

### Different test pieces can skew results

You can order pull test kits from different magnet manufacturers to compare and contrast results. Using different pull test kits is acceptable as long as the test pieces are exactly the same. Different pull test pieces yield different measurements, which causes confusion and misleading results.

Even though pull test kits look similar, the test pieces can vary by design, weight, diameter and composition. It is vital to use the exact same test piece for any magnet being tested for holding force. Accurate and comparable results can only be achieved with identical test pieces.

For example, an RE tube magnet gets optimum pull test results when using a ¼-inch steel ball suspended by a three-inch rod of non-magnetic 316L stainless steel. The tube magnet is designed to collect small metallic slivers such as threads stripped from a bolt or other fine particulates, making the smaller ¼-inch steel ball an ideal test piece.

By contrast, a competing manufacturer's pull test kit might include an oversized ¼-inch sphere attached to a magnetic stainless steel ring and a magnetic scale hook. Since the ring and hook are magnetic and positioned within the tube's magnetic field, it requires greater pull force than the lone single sphere suspended from the scale. These variations—sometimes difficult to detect—can inflate pull test values by 10-12 percent.



Other pull test kits might include only a ½-inch diameter test piece for use on RE tube and grate magnets. This test piece, according to standard operating procedure, is too large for accurately measuring the pull force on the more sensitive RE magnets.

These variations of test pieces are significant because they allow some magnet manufacturers to falsely claim their RE tube and grate magnets yield a higher pull test value than their competitors'. Pull testing is widely used to compare relative strength of a given magnet in any industrial setting, including food manufacturing. A side-by-side pull test comparison can only be conducted when both test pieces are identical.

Using a pull test kit to compare magnet strength requires an “apples to apples” comparison. Eriez has developed a short video to explain why using identical test pieces is an essential component to accurate readings. See the video at: <http://tiny.cc/PullTestComparison>.

Pull test results can help determine if (or when) a magnet needs replacing. Magnets with visible cracks or wear holes should be removed from operation immediately, regardless of test results. Magnets showing 15-20 percent erosion in holding force over a six-month to one-year period should also be replaced, particularly if the magnet is part of a Critical Control Point.

Not sure when to replace your magnets? Most magnet suppliers will offer advice on test results and replacement recommendations. Some magnet manufacturers, including Eriez, will lend assistance with pull test inspections and help with evaluations.

*Need to check your magnet strength? Contact Eriez to arrange for one of our magnet specialists to visit your facility and pull test your permanent magnets free of charge. To learn more about this service or other details regarding magnetic pull tests, go to this link:*

*<http://en-us.eriez.com/Products/DownloadsAndTools/PullTest1/>*

*Have a specific question about the Eriez Pull Test Kit or the “apples to apples” comparison?*

*Contact Bill Dudenhoefer, Manager--Separation, for Eriez. He can be reached at 814-835-6385 or [bdudenhoefer@eriez.com](mailto:bdudenhoefer@eriez.com).*

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*Eriez is recognized as world authority in advanced technology for magnetic, vibratory and inspection applications. The company’s magnetic separation, metal detection, x-ray, materials feeding, screening, conveying and controlling equipment have application in the process, plastics, metalworking, packaging, recycling, mining, aggregate and textile industries. Eriez manufactures and markets these products through 12 international facilities located on six continents. For more information, call toll-free (888) 300-ERIEZ (3743) within the U.S. and Canada. For online users, visit [www.eriez.com](http://www.eriez.com) or send email to [eriez@eriez.com](mailto:eriez@eriez.com). Eriez World Headquarters is located at 2200 Asbury Road, Erie, PA 16506.*

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