JB WINKLE COMPANY

A Proven Past, Serving the Present, Dedicated to the Future

Magnet Preventive Maintenance Manual

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I. Introduction:

The goal of this manual is to familiarize those involved with purchasing, maintaining and operating magnets with the elements essential for customer satisfaction and long magnet life.

Included in this discussion will be overviews of magnet types, applications, components, causes of failure along with proper operation and preventative maintenance.

II. Types of Magnets and Their Application:

In this section we'll discuss the basic categories of magnets and their intended application. Keep in mind that although each magnet has a specific application, overlap in operation may occur.

Round Magnets-

The majority of magnets in use today fall into this category. Their flexible design makes them ideal for a variety of service. Slabs, billets and scrap are just some of the materials that can be handled with round magnets.

Rectangular Magnets-

These magnets probably make up the second largest group of magnets in operation. Rectangular magnets however are somewhat limited in their application. They excel in multiple piece lifting applications (blooms, billets), but their relative size and capacity do not make them efficient slab movers or scrap magnets.

Bipolar Magnets-

Bipolar magnets are designed under different parameters than both round and rectangular magnets. Instead of the core acting as the north pole and the outside shoe acting as the south pole like round and rectangular magnets, the bipolar magnet, with its repositioned core, allows the outside shoes to act as the north and south poles. These magnets are typically used in the same applications that rectangular magnets are used, but their design makes them capable of lift to the ends of the magnet and therefore clearance problems in positioning or material can be overcome.

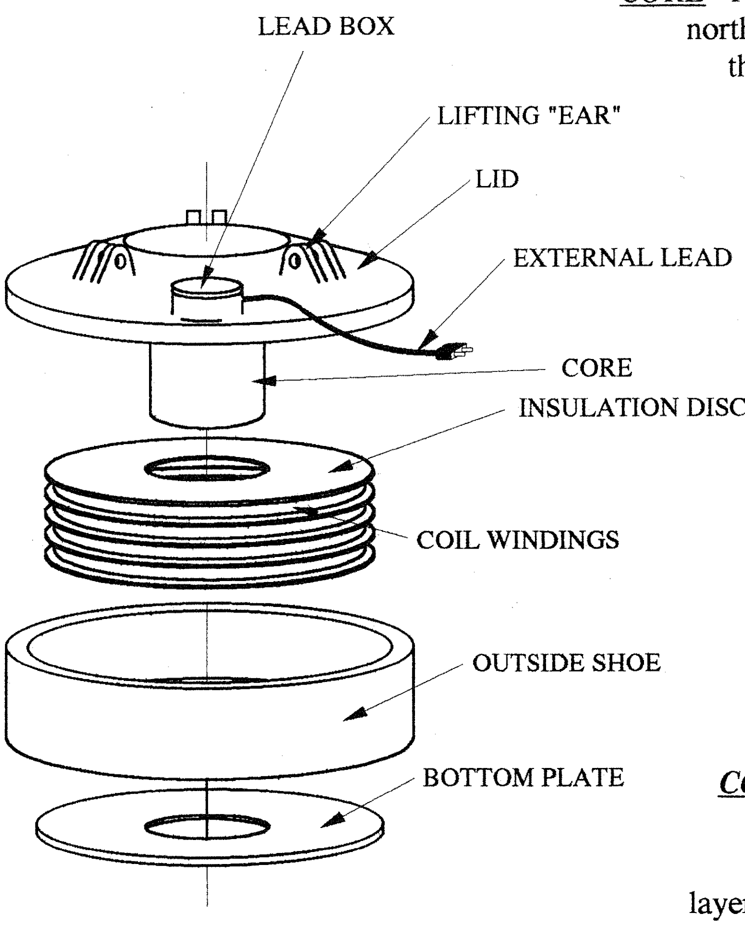
Coil Handlers-

Generally coil handlers are large quadrapolar magnets, sized to the outside diameter of the coil. Typically handling of coils is most efficient in the eye vertical position.

These are the principle types of magnets for standard applications. Variations to each of these types may occur. Specialized bumper rings, for heavy duty lateral impacting i.e. scrap, for elevated material temperatures, heat plates and the J.B. Winkle Liquid Cooled Magnets entail just some of the options available for most magnets.

III. Components of a Magnet

In all electromagnets the following four components are necessary to produce lift; the core, lid, outside shoe, and the coil windings. These parts work together to form the magnetic circuit; however, without the other components that make up an electromagnet, these parts cannot function efficiently.



CORE- The primary function of the core is to act as the north pole when the magnet is energized. Because the coil windings are positioned around the core, it has the secondary function of a heat sink to help dissipate heat generated by the electrified coil.

LID- Acts as a "bridge" to link the north and the south poles. In addition, it is expected to provide structural integrity and to isolate the coil windings from mechanical shock and moisture. It also acts as a heat sink.

OUTSIDE SHOE- Acts as the magnet's south pole, provides structural integrity, isolates the coil winding from mechanical shock and moisture. Also, as in the case of the core and lid, the outside shoe provides a heat sink for the coil windings.

COIL WINDINGS- Consist of layers of multiple turns of conductor, separated from each other using electrically insulating discs between the layers and non- conductive high temperature paper between the individual turns. When energized, these turns produce a magnetomotive force, which in turn generates lines of flux (lift) within the magnetic circuit. Think of this as the magnet's "motor".

BOTTOM PLATE- This non- magnetic plate is normally manganese or stainless steel. It's primary function is to protect the coil from mechanical shock and moisture. The bottom plate also provides structural rigidity for the outside shoe.

LEAD BOX- Junction where the external lead mates with the coil winding. It's construction provides a moisture resistant interface.

LIFTING "EAR"- Provides a point to attach chains or a yoke as a means to lift the magnet.

In addition to these components, the volume between the coil windings and outside shoe and lead box are filled with a non- conductive potting compound. This compound serves to reduce mechanical shock or moisture the coil may be exposed to and help in the transfer of heat from the coil to the magnet case.

IV. Considerations for magnet use:

- *What are we lifting?*

This seems like a basic question, but as a consumer you need to consider exactly what is expected of your magnet. Capacity, temperature of material and frequency of use can greatly affect the price of your magnet. If the magnet will be used for a "double duty" (i.e. slab and scrap handling), wherever possible specifications for both applications should be met to achieve the greatest efficiency for both jobs.

- *What is duty cycle?*

Duty cycle refers to the average "ON/OFF" cycle a magnet will be subjected. 75% duty cycle implies the magnet will be in the "ON" position 75% of the working day. However, this does not imply a three hour "ON", one hour "OFF" cycle, rather duty cycle refers to intermittent duty of five minutes or less "ON" at any one time.

When deciding on a magnet, considerations in duty cycle need to be taken. Duty cycle is directly related to the service life of your magnet. Typically most magnets operate in the 50 to 75% duty cycle range.

- *Use the magnet for it's intended purpose*

To achieve the optimum service life of any magnet it is important that the magnet be used in the manner for which it was designed. As an example, when handling hot material (400°F or above), a standard magnet with no heat protection will have a greatly reduced service life as the coil breakdown due to heat will be accelerated.

V. What Causes Magnet Failure?

There are many factors that can cause breakdown, one is of course age. This cannot be corrected, however the effects of age can be slowed by proper care and use of the magnet.

A. Mechanical Shock:

Many times mechanical shock to the coil windings will produce a turn short, that is, the current flow will "jump" between insulation layers which reduces the total magnet resistance and lift. The reduced resistance, if gone unchecked long enough, will cause the coil to heat up much more rapidly thus accelerating turn to turn insulation breakdown and decrease the overall magnet performance (lift).

B. Coil Moisture:

Moisture in the coil can cause internal problems for magnets. Dead shorts (Case to coil grounding), and turn short are the two most common problems. Although dead shorts do not cause major damage to the insulation, they do cause a significant decrease in magnet performance (lift).

C. Heat:

When a magnet is exposed to hot material (400°F or above) and is not equipped for this duty, the excessive applied heat, along with the heat generated by the coil windings accelerate not only breakdown of all insulating materials in the magnet but may also accelerate breakdown of the magnet's conductor.

D. Over- voltage operation:

Magnets operated at voltages higher than those specified can cause premature breakdown of all magnet internal insulation. Magnets are designed to run at a specific peak voltage. When this voltage is exceeded, internal coil winding temperatures can rise and exceed recommended peak temperature for both insulating materials and conductor.

VI. Practices to extend Magnet Life:

Magnets are specifically designed for moving material with magnetic force. They should not be used for purposes other than this. Below is a list of just some of the practices and misuses to which magnets are subjected. These uses severely reduce a magnet's effective life.

- **Do not use magnets as drop balls or wrecking balls to break up cast scrap.**

- **Do not use magnets to straighten stacks of material** (i.e. "bumping" slab stacks in cooling beds).

- **Do not use magnets as drag weights for railcars.**

- **Do not use magnets to straighten bent billets, slabs or blooms.**

- **When not in use do not set the magnet directly on the ground**, set it on wooden support blocks. (magnets draw moisture when set directly on the ground after operation).

- **Allow the magnet to rest on load to be lifted while energizing.** In the case of scrap handling this allows the maximum magnetic field to build. Also, by resting the magnet directly on the load, impacting to the bottom plate and surface of the magnet help reduce mechanical shock applied to the coil.

- **When disconnecting magnets after operation wait at least five minutes after power to the magnet has been cut before unplugging.** Magnets store a residual electrical charge. If this charge is not allowed to dissipate before unplugging the magnet, a destructive electrical field collapse can occur (The voltage spikes occurring with this collapse can be as much as 15,000 volts or more, depending on magnet size). These spikes can cause dangerous electrical arcing from the magnet and insulation breakdown. (In one case, we received a magnet with its 1 1/8" thick bottom plate blown off from such an inductive kick.)

- **Rotate Magnets in and out of service in accordance with their duty cycle and use.** As with any electrical device, magnets heat up with usage. By following the magnet suppliers recommended operating (hot) amp rating, service life can be extended. When using magnets for high duty cycle or hot material applications, rotate magnets in and out of service as often as possible to preserve coils by letting hot magnets cool.

VII. Preventative Maintenance for Magnets:

As with any piece of equipment, preventative maintenance for magnets can not only preserve your investment but allow your magnet to operate at its peak efficiency throughout its service life. In this section we will recommend a preventative maintenance plan, specify tools and instruments needed to gather operating data for magnets and provide a checklist of major points of interest during inspection.

VIII. Suggested steps to be taken when receiving a magnet from supplier.

- Whether the magnet is new or rebuilt, designate the magnet with an identification number in an easily seen position on the top of the case.

- Start a file or folder for each magnet put into service:

When staring a file, make sure to put the date the magnet went into service and the identification number in the file. This will help to designate problem areas in operation (i.e. wrong magnet in service for application). Note all possible problems; cracks, worn ears, lifting devices, exposed lead wires etc. Also, take the magnet's electrical operating data. (We weld a steel tag with all pertinent electrical data to the case top.)

- Inventory instruments needed for basic magnet testing and repair:

This includes a hand held multi- meter (to check resistance), MegOhm (to check for grounding), wrenches etc.

- Train personnel in magnet maintenance:

Train key personnel in testing and basic repair techniques to keep magnets operating at peak efficiency. (Resistance readings, MegOhm testing, tightening lead box bolts etc.

- Begin a regular Preventative Maintenance Schedule to check magnets thoroughly:

By establishing a cycle or rotation of once- a- month thorough inspection of magnets, possible major breakdowns can be averted.

- At the beginning of each shift, a quick observation check can save time and money:

By teaching the magnet operator or maintenance personnel to take a quick inspection at the beginning of each shift possible problems such as cracked case welds, exposed lead wires or worn lifting devices can be seen, noted and repaired before they become serious problems that may take your magnet out of service and cause costly repairs.

IX. Monthly Inspection Report

The data on the following sheet is a basic monthly inspection guideline. These checks will help save time and money by discovering minor problems that could become costly repairs or safety hazards.

Monthly Inspection Report

DATE:________________ FILLED OUT BY:________________

MAGNET I.D. #:__________________

Make sure magnet is safely disconnected and properly supported when inspecting bottom surface.

MAGNET CASE:

1. Check for cracks, broken welds, missing, broken or worn sections, discolored metal (from heat or fluid).

Comments:____

____

____

LIFTING EARS:

2. Check for cracked material, welds and wear on both the pin hole diameter and inside face of ears.

Comments:____

____

____

LIFTING DEVICE:

3. Check for worn links, broken or missing sections and weld, missing or worn chain pins.

Comments:____

____

____

LEAD BOX:

4. Check for broken lead holddowns, missing cover bolts, broken welds or cracks, filling compound leakage and arcing burns under leads.

Comments:____

____

____

LEAD CABLE:

5. Check for exposed wire (cuts), pinched or twisted leads, plug damage.

Comments:____

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____

MAGNET COIL:

6. With a MegOhm Meter, 500V or 1000V, connect between each lead and magnet case, record readings. This checks insulation resistance. Use a hand held multi- meter to check conductor resistance, record readings. (NOTE: Readings **MUST** be taken under the same conditions. (i.e.) Beginning of each day, end of each day.

Comments:____

____

____

BOTTOM PLATE:

7. Check for wear, cracked or bent plate, crack welds, discolored metal (make sure magnet is safely supported when checking bottom).

Comments:____

____

____

POLE FACES:

8. Check for uneven wear, broken sections or missing sections and bolts, inches of metal to bottom plate.

Comments:____

____

____

<u>Ohm's Law</u>:

I= E/R

where

I= Current (in Amps)

E= Voltage

R= Resistance (in Ohms)

Using the above equation, the basic electrical operating parameters of any magnet can be seen, this formula is a useful tool in determining how close your magnet is to its operating (hot) amp value.

Example:

31" x 31" Rectangular RJ Series Magnet Electrical Data:
- Cold Amps: 12.1
- Operating Amps (hot): 8.5
- Cold Resistance: 19.0 Ohms
- Magnet Voltage: 230VDC

Using a multi- meter a 31" x 31" magnet's resistance is taken after operation, the reading is 32 Ohms, using the known data, amp draw can be calculated.

I= E/R
I= ???
E= 230VDC
R= 32 Ohms

I= 230/32

{I= 7.2 Amps}

The current value derived from the equation is below the recommended operating (hot) amp rating and this magnet should be taken out of service and allowed to cool so that severe coil damage can be avoided.