SECTION 1

MAGNET INSPECTION & MAINTENANCE

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GENERAL MAGNET INFORMATION COMMON PROBLEMS

Magnets used on severe applications suffer from terrific mechanical abuse. The result can be cracked casting; outer pole, center pole or even the case; broken or loose bolts, worn chain or ears; completely worn center or outer pole; dented bottom plate; and broken center pole weld.

Under these conditions the coil will eventually fail and appear as a grounded, shorted, or open coil; or a combination thereof. A grounded coil usually happens because the magnet seal has broken, permitting water to enter and causing the trouble. Coils can also become grounded because mechanical shock breaks or cracks the insulation. Broken insulation can also permit adjacent coil layers to arc across, causing a shorted coil. Continued pounding on the bottom plate can loosen the layer insulation and permit individual coil layers to shift, usually resulting in an open coil.

Moisture is the greatest single factor in coil failure. Water will reduce the ground reading at elevated temperature; and, if it is not removed in time and dried out, a complete short to ground will result, requiring a rewind.

A defective magnet coil will cause malfunction of the controller and usually results in poor load drop characteristics. Other problems external of the magnet will also have the same effect; these are grounded magnet terminals, leads or cable reel. When this occurs on a system having a ground also on the generator side of the controller, the reverse current resistors on the controller will overheat and eventually burn out.

SERVICE FACTOR

Magnets are wound for 50% or 75% cycle operation which means they are suitable only for intermittent duty such as thirty seconds (30 s) on and thirty seconds (30 s) off for a 50% duty cycle magnet and ninety seconds (90 s) on and thirty seconds (30 s) off for a 75 % duty cycle magnet. A poor crane operator can easily cause a magnet to become overheated by energizing it more than its rated cycle. A hot magnet loses some lifting capacity and so it is doubly important to keep it cool. Overheating a magnet may not result in a burnout, but each time this occurs the coil life will be shortened by an amount dependent on the time and temperature.

OPERATING INSTRUCTIONS FOR HOT WORK MAGNETS

Limitations

Magnetic steels become nonmagnetic from temperatures above 500°C ~ 600°C depending on the type of steel. Material below these temperatures can be handled economically with magnets provided the following is considered.

Skin Effect Cooling

In the cooling process, material cools from the outside in. If the outside skin is below the magnetic temperature, and is only a thin area, and the inside is still above the magnetic temperature, the
magnet may not be able to develop enough pull to lift the piece. Additional time to cool must be allowed until a thick enough skin of magnetic steel develops to allow the magnet to lift the part.

Magnet Heating

When a magnet is lifting hot material, it is being heated in three ways. First, due to its own coil heating because of current passing through the windings. Second, because of direct contact with the hot parts with the pole shoes by conduction. Third, by radiation given off by the hot material and absorbed by the magnet area in direct line with the hot part.

The second and third ways of heating the magnet add great amounts of heat quickly to the magnet especially when the temperature is above 400°C.

Reduce Heating of Magnets

There are several ways to minimize heating of the magnets. Keep the magnet in contact with the hot material only as long as necessary to move the material. Only leave the magnet energized while lifting.
When the magnet is not being used, do not leave it above the hot material. Do not set the magnet on a solid floor or ground. Do not try to cool in water. Do keep the magnet in the air. If placed to rest, use a frame or blocks to allow air to circulate under the magnet. Provide fans to increase cooling. A moving magnet stays much cooler than a stationary magnet.

Monitoring Magnet Temperature

The coil and leads are the items that must be kept cool, otherwise the magnet will fail in a short time. Average coil temperature can be monitored by monitoring magnet current. However, voltage must be fairly constant to get accurate results. A variance of ±11.5 V will give ± 5% accuracy plus the accuracy of the current reading. If the accuracy of the current reading is 2% then the total accuracy is _± 7%. If you wanted to ensure that the temperature rise never exceeds 180°C rise then the hot magnet resistance should never exceed 1.67 times the cold magnet resistance.

Other methods of monitoring coil temperature are by imbedded thermocouples or thermal switches in the coil, terminal box or outside of the case. Temperature coordination of the thermal device to the average coil temperature must be made.

Specific operating times for particular magnets are difficult to predict due to the many variables involved. If operations are repeatable, typical times can be determined by monitoring magnet resistance over a period of time. The smaller the magnet, the shorter time period. Magnets of any size and/or shape can be monitored over an eight hour (8 h) period with resistance taken every one to two hours. Resistance and ambient temperatures must be taken when the magnet is cold, that is at ambient temperature throughout the magnet. Resistance readings can be taken by measuring voltage at the magnet lead (this eliminates voltage drop through the cable reel and long leads) and current with accurate meters. The resistance can be calculated by dividing voltage by current. Also, direct magnet resistance with an accurate meter is suitable. The following table can be used to determine when magnet temperature is up to coil rated temperature:

Temperature Class	Resistance Ratio max R(hot) / R(@25°C)	Average Coil Temperature Rise 25°C Ambient
B	1.41	105°C
F	1.50	130°C
H	1.60	155°C
C	1.70	180°C

Because of some thermal overshoot, the magnet coil temperature is continuing increase in temperature for a short time after the magnet is removed from service. It is good idea for the magnet to be removed from service and allowed to cool before the rated temperature rise is reached. The overshoot can be minimized by following the suggestion in the "Reduce Heating of Magnets" section.

General

Overheating of magnet coils is a quick way to reduce the life of the magnet. A rule of thumb, often related by insulation manufacturers, is that for every 10°C over the temperature class rating, the insulation life will be reduced by half. It doesn't take too high of a temperature rise over rating to reduce magnet life to months or even weeks. At the cost to rewind magnets, the above methods to increase the life of magnets should pay for themselves in short order. Operator training, along with instrumentation or information, is necessary for efficient handling of hot material.

MAGNET INSPECTION

To determine the condition of the magnet, the resistance of the coil and insulation resistance to ground must be measured. To be meaningful these readings should be compared with figures obtained from the factory for your particular magnet at the ambient temperature in which it is operating.

It can take two days for the magnet to reach ambient temperature after the magnet has been taken out of service. Preliminary readings can be taken immediately, however, and this will indicate if the magnet is grounded, shorted or open. When readings are taken of a hot magnet, consideration must be given to the values for the heated condition.

The coil resistance should be within 5% of the original value when the magnet is at room temperature (25°C). The resistance to ground on a new magnet at room temperature should be 10 MΩ or more. When the magnet is hot the coil resistance can increase to 70% of its value and the ground resistance can drop to 0.1 MΩ.

The procedure for making the readings is as follows:

1. Obtain a resistance bridge or meter with a 10 mΩ resistance accuracy, and a 500 V min. ground megger.
2. Unplug the cable reel leads from the magnet and inspect the magnet leads.
3. If the magnet leads are in good condition, then connect the meter to the ends of the leads for measurement purposes.
4. If the measurement indicates a faulty condition, then remove the leads from the terminals and measure directly at the terminals.
5. If the measurement at the terminals indicates a faulty condition, then the problem is interior of the box and could be the internal leads, the coil itself, or magnet terminals.
6. Refer to the terminal replacement instructions and remove the coil leads from the terminals at the interior of the terminal box.
7. Inspect the leads for burned condition and splice a new section if this appears to be the problem. Measure the coil and if it checks faulty, the magnet should be returned to the factory for further service.
8. Inspect the terminals and measure the resistance to ground on each one. If one checks or appears bad, replace both of them.

In addition to checking the coil, inspect the magnet for worn chain or chain pins; worn center pole shoe; loose center pole bolts; worn, broken, or cracked case; and loose outer pole bolts. The chain and center pole can be replaced in the field, but if problems with the magnet case are evident, the magnet should be returned to the factory for further inspection and service.

PERIODIC MAGNET INSPECTION

AND

MAINTENANCE

Check the general physical condition of the magnet making observations on the following:

1. Chain suspension for wear.
2. Center pole shoe for wear and tight bolts.
3. Casting outer pole shoe for wear and/or cracks.
4. Leads frayed or cut leads to be replaced.
5. Lead shield for tightness.

LEADS AND TERMINAL REPLACEMENT:

The procedure for replacing terminals varies depending upon the type of magnet being serviced. The following procedure specifically describes the OHIO WX or SR series of magnets. (Refer to 499A001A1 assembly Page 1.4.1), other OHIO magnets are similar:

Proceed as follows:

A. Lead assembly replacement:

1. Remove lead shield and lead clamp.
2. Remove rubber terminal boot and disconnect lead connector from terminal with a 3/4"- 19 mm open end wrench.
3. Be careful not to turn the terminal within the Assembly.
4. If damage occurs or is evident to the threads of the terminal stud, replace terminal assembly.
5. Install lead assembly tightening nut to the threaded stud. If replacement leads are not available; a temporary repair can be made by using substitute wire, either #4 25 mm² or #2 or 35 mm² rubber covered and reusing the existing terminal fittings. Be careful not to over tighten or cause terminal assembly to turn.
6. Insulate external terminal with rubber boot
7. Tighten the lead clamp using the rubber bushing for strain relief.
8. Tighten lead shield using the 5/1618 NC hex head bolts.

B. Terminal Replacement:

1. Remove lead shield, lead clamp and leads as outlined above.
2. Remove both 3.5"- 90 mm pipe plugs.

3. "Dig out" the compound from the box being careful not to cut the coil leads or damage the terminals.

4. Observe if compound is charred (black carbon type residue) at the leads or near terminal.

5.If the leads are burned, but still within reach, splice with short length of wire using a KS-26 servit connector.

6. Remove all compound within reach and disconnect leads from terminal assembly.

7. Make a check of the coil resistance connecting directly to the leads. If the values indicate a faulty coil, replace pipe plugs, lead shield and clamps and return to the factory for further inspection. If coil checks good, continue with terminal replacement.

8. Remove terminals using a 3/4"-19 mm open end wrench to remove internal terminal nuts.

9. Remove all the loose pieces replacing with new parts. Be sure the silicon rubber sealing washer is on the external portion of the assembly. Tighten the brass nuts with ample force to prevent rotation of the terminal assembly. Tightness will be limited by the compression of the rubber sealing washer.

10. Assemble the KF26 servit to the internal threaded stud and connect coil leads making sure there is physical separation between the wires.

11. Fill the terminal box with compound using A-950018-09 or A95001802 Kits (available in one and five US gallon (19 L) Kits). Follow instructions for mixing carefully.

12. Replace 3.5"-90 mm pipe plugs using pipe dope on the threads and tighten firmly.

13. Replace leads and lead shield per above.

14. Connecting to the cable reel leads makes the job complete.

CHAIN REPLACEMENT:

Should the chain require replacement because of some accidental damage or due to normal wear replace as follows:

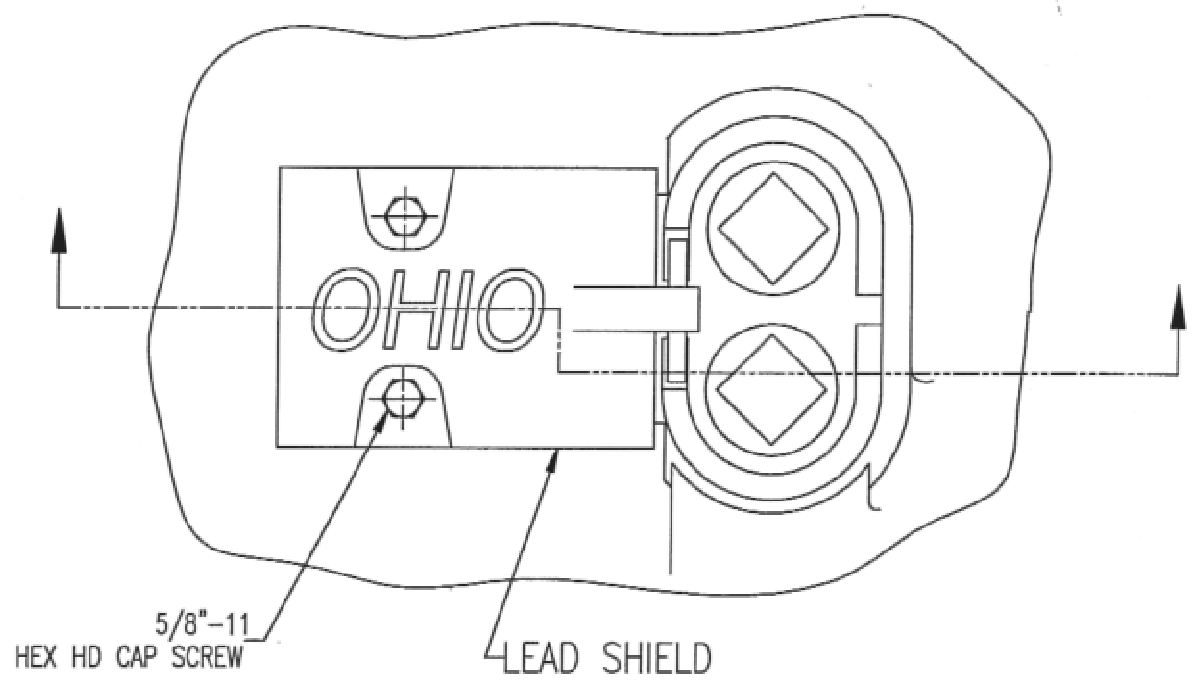
1. Burn off three retaining plates, one from each ear, or remove pin retainer as applicable.

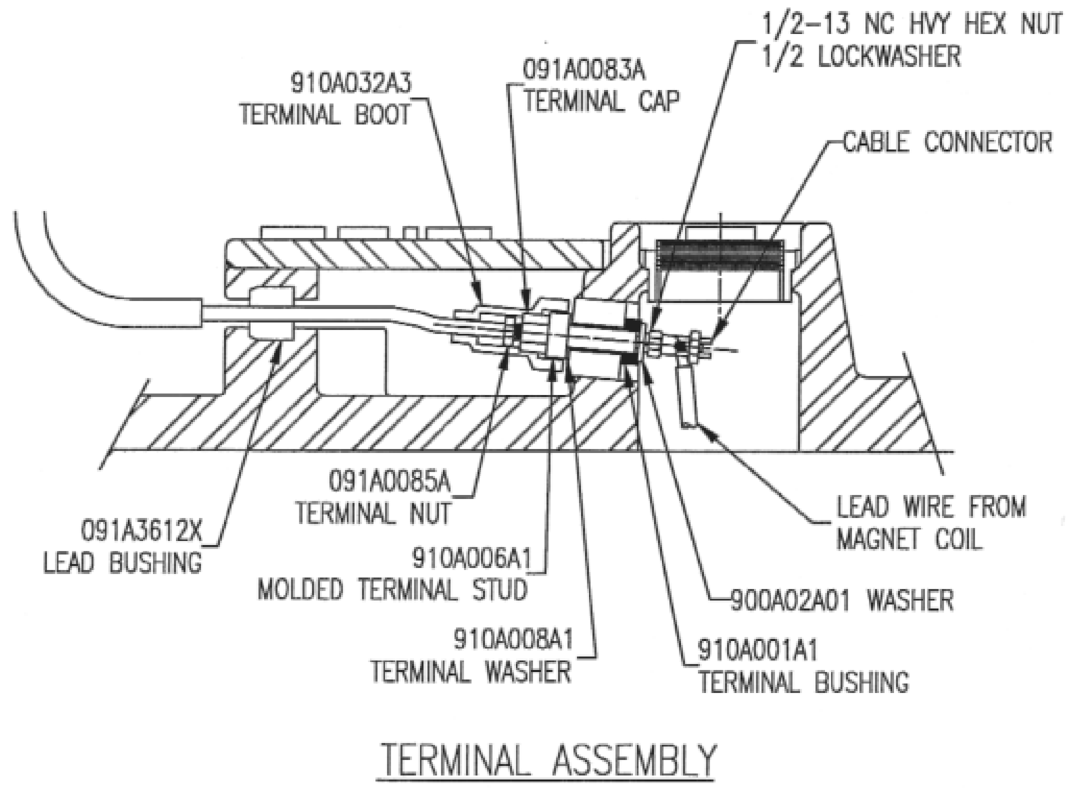
2. Remove chain pins and chain using the crane hook.

3. Install new chain and chain pins. (Use new pins every time chain is replaced).

4. Weld the chain pin retainer plates to the side of the magnet chain ear, or install pin retainers.

The chain should be checked annually for wear. When any portion of the chain is worn 25% or more, it should be scheduled for replacement.





TERMINAL ASSEMBLY

FOR 910A007A4 OR 910A007A1

AVERAGE MAGNET RESISTANCE
(Cold Resistance 25°C Tolerance ± 5%)

SIZE	RESISTANCE (Ω)
20 POW-R-LITE (Ø500)	64.4
25 POW-R-LITE (Ø635)	23.0
30 POW-R-LITE (Ø750)	15.5
34 POW-R-LITE (Ø900)	12.1
40 POW-R-LITE (Ø1000)	7.7
34 AWX (Ø900 mm)	12.8
34 CWX	10.6
34 SRC	10.6
40 AWX (Ø1000 mm)	8.0
40 CWX	8.0
40 SRDC	6.5
45 AWX (Ø1100 mm)	5.9
45 DAWX	5.5
45 CWX	5.0
45 DAWX	5.3
47 AWL (Ø1200 mm)	4.8
47 SRC	5.5
47 SRDA	5.2
47 SRDC	5.1
47 SREDC	4.7
48 LS (Ø1200 mm)	5.5
55 AWX (Ø1400 mm)	4.4
55 CWX	3.5
55 DAWX	4.0
55 DCWX	3.5
57 AWL (Ø1500 mm)	4.1
57 SRC	3.4
57 SRDA	3.5
57 SRDC	3.2
57 SREDC	3.2
58 LS (Ø1500 mm)	3.8
61 AWL (Ø1600 mm)	2.8
65 SRC (Ø1700 mm)	2.7
65 SRDA	2.7
65 SRDC	2.6
65 SREDC	3.0
66 AWL (Ø1700 mm)	3.0
66 AWX	3.0
66 DAWX	2.8
66 CDX	2.2
66 DCWX	2.2
67 LS (Ø1700 mm)	2.7
67 LS-X	2.7
69 SRDC (Ø1800 mm)	1.9
69 SREDC	1.7
71 AWX (Ø1800 mm)	2.4
71 DAWX	2.0
72 AWL (Ø1800 mm)	2.1
76 DAWL (Ø1900 mm)	1.9
77 DAWX (Ø2000 mm)	1.7
77 DCWX	2.3
82 SRC (Ø2100 mm)	2.3
82 SRDA	2.0
82 SRDC	1.9
82 SREDA	3.8
82 SREDC	1.9
82 SRSDC	1.6
83 DAWL (Ø2100 mm)	1.6
83 AWX	1.5
83 DAWX	1.3
83 CWX	1.8
83 DCWX	1.3
93 DAWX (Ø2400 mm)	1.5
93 DAWL	1.5

GROUND READINGS SHOULD BE ABOVE 100 kΩ WHEN MAGNET IS HOT.

HOT RESISTANCE MAY BE UP TO 70% HIGHER THAN COLD RESISTANCE.

WELDING INSTRUCTIONS FOR REPAIRING CRACKED MAGNET CASTINGS

Clean castings to determine the exact extent of the crack. Small racks can be welded without disassembling the magnet. Large cracks require magnet disassembly because the heating which accompanies the welding may harm the electrical insulation.

Bevel edges of material adjacent to the crack to approximately 75 % the thickness of the metal and at a 60 to 70° included angle. The beveling can be done by grinding on small cracks and thin sections or by the use of a carbon arc on large cracks and heavy sections.

Use a D C welder and set it on positive polarity. Use a high strength, low hydrogen, 6 mm (0.25 inch) rod, between 190375 A. Lay a stringer bead in the bottom of the vee. In this operation, hold the electrode vertical with the face of the work but inclined about 10° in the direction of travel. Be sure that both sides of the joint fuse with the weld metal. This may require a slight sideways motion of the electrode. Avoid overheating the base metal.

If the metal shows a tendency to drop off the electrode in globules, withdraw the electrode momentarily but not far enough to break the arc. After a short pause again lower the electrode and continue depositing weld metal. Repeat this procedure as
frequently as necessary.

Upon completing the first pass, allow the metal to cool slowly. As the metal cools peen the weld metal with a peening hammer and a dull chisel to remove oxide, then with a wire brush remove loose
oxide or other foreign matter. Lay other passes required to fill the vee.

Allow the metal to cool slowly. When the metal can be handled, grind out the underside of the weld, if practical, and fill the cavity with a stringer bead, one pass only. Grind this area flush.