Carbon Brushes

A guide for

elevator technicians

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HELWIG CARBON PRODUCTS, INC.

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Carbon brush installation, maintenance and troubleshooting for elevator technicians

There is no "magic" brush grade and there is no substitute for good maintenance.

"Magic Grade"
Over the years, manufacturers, contractors and brush suppliers have searched for the "magic" dustless brush grade or that impossible, frictionless material. There is no magic brush grade, but you can maximize brush life and equipment performance by taking the appropriate steps:

- Check that there is proper spring pressure.
- Check for proper current density.
- Check on proper maintenance of the commutator.
- Check to be sure brushes are changed properly.

NOTE: Brushes of different designs or materials should **not** be mixed on the same unit. Brush life of 1-2 weeks or less is **not** a grade problem. Be sure to check that the brushes are not hanging up in the holder, neutral is set properly, the commutator is round within .002" and there are no high bars or mica, and spring pressure is 3.5-4.0 PSI.

Installation

Proper installation is a key to long life for carbon brushes and the commutator. Follow these steps when installing new carbon brushes.

1. Disconnect the power to the machine by using approved lockout procedures.
2. Remove all old brushes from the holders. Make note of any unusual conditions of the brushes including roughness or burning of the contact face, polished sides on the carbon, excess heat on the wires or frayed shunt wires. These are indications of the need for maintenance on the machine.
3. Inspect the commutator for unusual conditions, such as high bars and mica, and those described under "Trouble shooting" in this guide. Make note for required maintenance.
4. Check the inside holder cavity for dust, dirt, oil, deposits, corrosion or burned areas. Clean as needed.
5. In a similar manner, check the terminal connection area and clean as needed.
6. Measure spring forces to ensure there is consistent contact force at the recommended levels of 3.5-4.0 psi.
7. If the new brushes are made from a different grade, then the old film must be removed from the brush tracks. Dry, untreated canvas applied with a pressure block or rubber abrasive is usually adequate for this task.
8. Install new brushes in all holders with attention to the orientation on angled designs. Ensure that the brushes can move freely in the radial direction. Apply the spring pressure on the top of the carbon.
9. Connect the terminals. Be sure all terminal connections are tight and secure.
10. Seat the brushes to the contour of the commutator using non-metal bearing sandpaper or garnet paper. Do NOT use emery. Medium coarse grade paper pulled under the brush face in the direction of rotation improves the quality of the brush contact surface and speeds the process. There should be at least 80% of the brush face seated to the contour of the contact surface prior to operating the machine. Once this level has been achieved, then the resulting dust in the machine around the brushes, holders and commutator should be vacuumed or blown out.
11. In order to ensure complete electrical contact of the brushes, it helps to operate the machine at no load for the final wear-in contour of the contact surfaces. This will stabilize the contact resistance and reduce the potential leveling problems.
12. The machine is then ready for use. The film process on the contact surface can be enhanced with the use of a untreated hardwood burnishing block. This can reduce the high friction and brush dust developed during the initial film-forming period.

NOTE: In some cases, time allotment, operating conditions or performance issues may require the replacement of less than a full set of brushes without normal seating. Then it is especially important to adhere to step 11 with extended operation at no-load to avoid excess electrical damage to the brush face and the commutator.

Maintenance

The following steps will help to obtain maximum carbon brush performance and life. An investment in proper maintenance will pay off in a substantial reduction in repairs and overall carbon brush costs.

Operational inspection

The following observations should be made and recorded while the motor or generator is under load:

Sparking

Check to see if the sparking is uniform under all brushes. The degree of sparking should be considered severe if the sparks are trailing out from under the brushes and action is required to prevent serious damage. "Furry" or light sparking may be seen at peak current loads. While light sparking should not be considered critical, it may indicate future problems.

Brush noise

Listen for brush noise (i.e. chatter or squealing) often accompanies sparking and indicates a commutator surface problem. A high bar, low bar, high friction, flat spot or high mica could cause the chatter. Occasionally, commutators go out of round and cause sparking and brush noise. Finally, the commutator film may be contaminated, resulting in a high friction interface between the commutator and the brushes. This usually takes place in a chemical or particulate atmosphere.

Movement of brushes

The movement of the brushes in the holders is confirmation that there is a commutator or film imperfection, or that springs may have weak tension and need to be replaced.

12 steps to improve carbon brush life

1. Remove the brush and see what it's telling you.
2. Inspect the brush box and spring clip condition.
3. Make sure the commutator is round.
4. Inspect for high mica or mica fins.
5. Check for high and low commutator bars.
6. Make sure slots are clean.
7. Chamfer bars.
8. Polish commutator with polishing stone and burnishing stone.
9. Burnish commutator with oak board to remove microscopic edges of copper left from cleaning out slots, mica and chamfering.
10. Install a complete new set of brushes ensuring that they are seated in 80-100%.
11. Start generator without load and use seating stone behind each brush for final seating.
12. As a last step, use the oak board once again to heat the commutator surface, which helps work-harden the surface and helps enhance the development of oxide layer.

Non-operational inspection

To ensure maximum brush life and performance, make sure that the following conditions are in place.

Brush holders

A. The brush holders should be spaced not more than .125" from the commutator surface to ensure that the brushes are properly supported on the commutator.

B. Brush holder spacing around the commutator should be checked to ensure that there are an equal number of bars between each brush.

C. The pockets in the holders should be checked to make sure that brushes move freely. Holders that have been overheated may become distorted and cause the brushes to jam in the holders.

D. Conventional spring finger-type holders should be replaced with constant pressure spring holders to ensure that the pressure applied is more uniform through the usable length of the brushes. Using constant pressure holders will help to eliminate selective action. Selective action takes place when there is a current imbalance across the brushes due to a variance in applied spring force.

Brush holder springs

Weak spring tension is the single most common cause of commutator/brush problems. It is very important that the spring force be checked at every third or fourth brush change to ensure that the recommended pressure is being applied. While they need not all be exactly equal, the spring pressure should calculate between 3.5-4.0 PSI.

Improper spring force may well be the root cause of many problems that are encountered. Weak springs should be adjusted or replaced as soon as possible. The spring pressure is determined by dividing the brush face surface area into the applied force. When beveled brushes are used, it will be necessary to take that into consideration. The greater the angle the less downward spring pressure and it is the spring pressure at the contact face that is important. Refer to Helwig's brochure "Brush Holders and the Performance of Carbon Brushes."

Weak spring tension is the single most common cause of commutator and brush problems. Spring force is measured with a scale and spring pressure is the calculated result.

Brushes

- Check brushes for chips on their faces. Chipped faces may indicate a commutator imperfection. Brushes should be eased onto the commutator surface, not dropped, as that will cause the brushes to fracture or chip.
- Check the brushes for shiny surfaces on the front and back of the brush, which indicates movement in the brush

holders. Some movement may be expected, but if the shiny area is worn into the brush, excessive movement is taking place. The most likely cause is a commutator imperfection.

- Check the shunts for fraying. Windage or movement of brushes in the holders may cause fraying because the shunts rub against the holder or spring clips. If the fraying is caused by windage, use a shunt sleeve or a stiffer shunt material to reduce the problem. Proper dressing of the shunts away from the sides of the holders will also help. If the shunts are frayed due to movement of the brushes, correcting that problem will also eliminate frayed shunts. Frayed shunts will often limit the life of the brushes, regardless of the remaining brush length.
- Check the brushes for a "coked" or discolored appearance, usually found on the trailing edge of the brushes. This indicates severe sparking is occurring.

NOTE: The face of the brush will reflect the condition of the commutator surface. For example, if the commutator surface is threaded or rutted, the brush face will likewise be threaded or rutted. Running a finger across a threaded brush face will indicate the depth of the threading on the commutator.

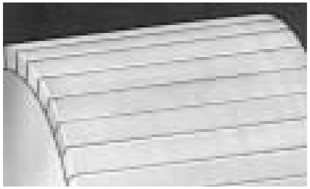
Commutator

The commutator should have a smooth film and consistent color. The film should be from light to dark brown. A streaky film is often a warning that the commutator might thread. If this is the case, fine copper dust will be found on the brushes and brush rigging. Bar marking, where some bars are lighter or darker than others, is usually considered to be normal and related to the number of conductors per slot. However, if some bars have a burnt or grayish appearance, it may indicate an armature winding fault or a high resistance riser connection. If some bars are burnt along the trailing edge, the problem could either be the neutral positioning of the brushes or a brush grade with insufficient commutating ability.

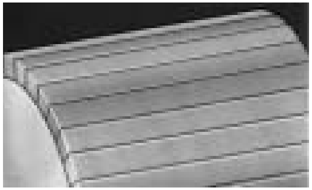
Satisfactory commutator surface conditions

The commutator film condition is a primary indicator of the performance of any motor or generator. A consistent color over the entire commutator in the brown tones from light tan to dark brown indicates a satisfactory film condition.

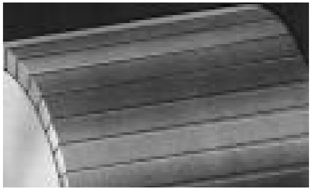
Light film: Indicates good brush performance. Light load, low humidity, brush grades with low filming rates, or film-reducing contamination can cause lighter color.



Medium film: The ideal commutator condition for maximum brush and commutator life.



Heavy film: Results from high load, high humidity or heavy filming rate grades. Colors not in the brown tones indicate contamination resulting in high friction and high resistance.



Environment

Caution must be taken to prevent environmental contaminants from reaching the carbon brush and commutator surfaces. Contaminants range from particulate matter to chemicals, fumes and lubricants. Even cigarette smoke can affect brush film and thus performance. Proper selection of filtration media will help to prevent brush problems and increase brush performance and life. In some cases, such as a plastics environment, special brush grades may be used to compensate for poor performance.

Trouble shooting

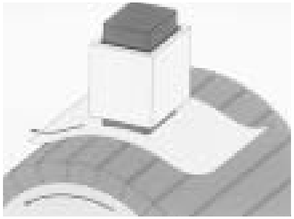
Dusting

Dusting is the most common complaint on elevator applications. Dusting often results from very low average current densities, which is common on elevator generators. Low current densities result in inadequate film development, high friction and dusting of the brushes**. Removing a row of brushes to bring up current density or changing to a composite grade – which is a combination of a strong dense low friction electrographite grade and a low friction graphite material – has been very successful in reducing dusting**.

The amount of dust is in direct proportion to the amount of contact area, the surface speed, the roughness of the commutator, the level of spring pressure, the operating time and the coefficient of friction at the brush face.

Under normal circumstances strong, dense, electrographite grades have been successful in slowing dusting. Low-friction graphite grades offer the best brush life. However, they can cause threading and commutator wear.

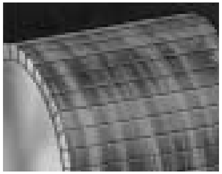
Leveling/Compounding



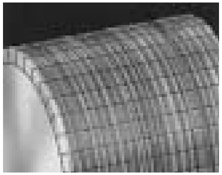
The most common cause of leveling or compounding is inadequate spring pressure. Check the spring pressure. It should be 3.5 to 4.0 PSI to ensure proper brush contact. Do **not** change all brushes in a set at one time as this can cause leveling problems. Other recommendations:

- Check to see that the brushes are seated to at least 80% of the contact face prior to application of current load. This process is made far easier by purchasing the brushes pre-radiused for the commutator diameter.
- Check to see that the positioning of the brushes on the commutator is accurately adjusted within the neutral zone.
- Check for any high resistance electrical connections that could affect leveling. Loose or dirty terminal connections, poor quality connections of the shunt to the carbon, and the electrical connection to the holder are the areas of greatest concern for high resistance and must be checked to be sure they are clean and tight.

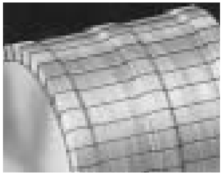
Warning commutator surface conditions
The commutator film condition is a primary indicator of the performance of any motor or generator. Inconsistent film color and deformation of the commutator surface are warning signs for developing trouble conditions with rapid brush and commutator wear.



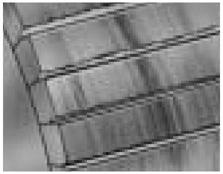
Streaking: Results from metal transfer to the brush face. Light loads and/or light spring pressure are most common causes. Contamination can also be a contributing factor.



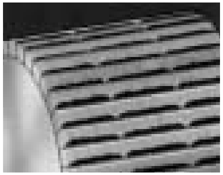
Threading: A further development of the streaking condition as the metal transferred becomes work-hardened and machines into the commutator surface. With increased loads and increased spring pressure, this condition can be avoided.



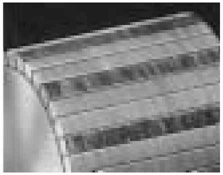
Grooving: May result from an overly abrasive brush grade. The more common cause is poor electrical contact, resulting in arcing and the electrical machining of the commutator surface. Increased spring pressure reduces this electrical wear.



Copper drag: Develops as the commutator surface becomes overheated and softened. Vibration or an abrasive grade causes the copper to be pulled across the slots. Increased spring pressure will reduce commutator temperature.



Bar edge burning: Results from poor commutation. Check that brush grade has adequate voltage drop, that the brushes are properly set on neutral and that the interpole strength is correct.



Slot bar marking: Results from a fault in the armature windings. The pattern relates to the number of conductors per slot.

HELWIG CARBON
PRODUCTS, INC.

8900 West Tower Avenue ▪ Milwaukee, Wisconsin 53224-9008
Toll Free Phone: 800.962.4851 ▪ Toll Free Fax: 800.365.3113
E-mail: info@helwigcarbon.com
Visit us online at www.helwigcarbon.com