

# Cleaning the Commutator and Slip Ring with a Brush

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## Cleaning Brushes Polish Contact Surface While Minimizing Downtime

When there is a need for cleaning the contact surfaces of commutators and slip rings with brushes, emery cloth with aluminum oxide is NOT recommended as conductive abrasive particles will cause arcing and damage to the surface. Many times, stone cleaning, garnet paper, and machining are not a convenient, sufficient, or cost-effective option for machines as the priority is to keep downtime to a minimum. This is when a carbon brush can be designed to clean the contact surface. It will help remove localized high resistance burn spots, contamination, and old grade film before the new grade brush is installed. In many cases, carbon brushes are used as a temporary but highly effective tool to clean the contact surface.

## Understanding Damage and Contamination

A wide variety of applications present numerous challenges for carbon brushes to maintain good contact with the surface. For motors with commutators, note that root causes such as brushes out of neutral, interpole imbalances or a fault in the windings can cause surface damage such as bar edge burning or slot bar marking that should be resolved before cleaning brushes are implemented.

Electric arcing, spikes in voltage or current, mechanical jolt, vibration, weak springs, and contamination are some common issues with equipment. The symptoms of such damage are localized burned spots, photographing, or ghost marks of brush on the surface (Figure 1). These spots can cause higher intensity arcing every time they go under the brush. It is necessary to remove the oxidized areas using cleaning brushes to avoid the redevelopment of photographing at the same locations.



*Figure 1: Photographing or ghosting on a slip ring*

Contamination caused by a wide variety of environmental factors in different applications can affect the contact surface. Copper commutators as contact surfaces are especially subjected to chemical reactions by the physical absorption of materials on rubbing surfaces. The gray-colored copper sulfide films will have a negative effect on the voltage drop and friction (Figure 2).



*Figure 2: Heavy contamination attacking copper*

This affects the desired performance of the brush. The contact surface conditions directly impact the brush operation, both electrically and mechanically. The extreme case would be burning all around, grooving, copper picking, or flashover. The cost of maintenance is high. The root cause is also difficult to detect due to the explosive nature of the event. Therefore, it is best practice to monitor the contact surface very closely during the operation dynamically and, when possible, statically. If the contact surface damage is left unattended, the desired performance or life of the brush and contact surface will be affected. It is just a matter of “when” based on the extent of the damage and application. Just like the used brush, the contact surface tells you the story of the application.

## Knowing When to Use Cleaning Brushes

First, identify the need to use cleaning brushes. They are meant for polishing the contact surface and not to machine it. Cleaning brushes should not be used to fix grooves, or high TIR (total indicated runout) or bring an egg shape contact surface to a perfectly concentric surface. It can be useful in the case of contamination, high resistance spots, photographing, damaged surface, localized burning, or minor damage due to selective action. The second important step is to determine how much cleaning is needed, which can be broadly categorized into mild (or low), medium, and aggressive (or high). It is important to determine the number of cleaning brushes needed in the complete set. To determine this, the contact surface condition must be well-known.

## The Risks and Rewards of Applying Cleaning Brushes

After implementing cleaning brushes, be sure to watch for dust particles. There is the potential for flashovers, especially in a more conductive copper alloy contact surface. If this is the case, vacuum the dust as it can be detrimental, especially for equipment rated 230 volts and above.

Cleaning brushes help buy some time until the root cause can be identified and fixed. Filming and stripping of the film are a continuous process for the carbon grades used for sliding electrical contact for power applications. Extending the life of both contact surfaces can be achieved with much lower cost.

## Determining How Much Cleaning Is Needed

The amount of cleaning needed is dependent on the level of contamination or damage to the contact surface.

First, identify areas or tracks to be cleaned. If localized, spot-mark the spot outside the track for future reference before cleaning. Then slowly increase the number of cleaning brushes based on the need. Use as few cleaning brushes as possible. In many cases, one brush per track could be sufficient. The cleaning brush can be a slight modification of the grade in use. To distinguish cleaning brushes from standard brushes, a different color sleeve or different wire or band can be used.

**a. Mild Cleaning** - Here the grades with low cleaning ability are used. Such grades form a light film under normal operating conditions. In Figure 3, the front section of two sections is made with the mild cleaning grade.



*Figure 3: Composite brush with mild cleaning grade front section*

**b. Medium Cleaning** - Here the grades with medium cleaning ability or low metal content inserts are used. As in Figure 4, such brushes form a light film under normal operating conditions.



*Figure 4: Brush with medium cleaning grade as middle section*

**c. Aggressive Cleaning** - In this case, usually the track or contact surface is in worse condition. These brushes form almost no film under normal operating conditions. Figure 5 shows the brush with an aggressive stone insert for cleaning. Sometimes a shorter length insert can be used to temporarily control the cleaning.



*Figure 5: Brush with stone insert*

**Precautions:** Before, during, and after cleaning, please check the commutator slots or slip ring grooves to determine if they need cleaning or re-chamfering. Also, watch for any potential damage to the contact surface. Using too many aggressive cleaning brushes can damage the contact surface.

Monitoring after the cleaning brush installation is especially important as the amount of cleaning can be controlled with optimum duration of its use while protecting the contact surface. Figure 6 shows the effectiveness of the cleaning brush on removing the contamination from the brush track.

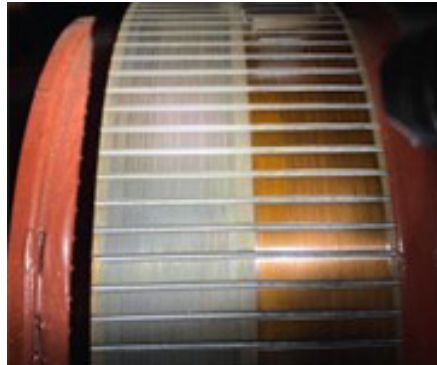


*Figure 6: Effectiveness of cleaning brush applied on adjacent brush track*

## Summary

Proactive actions will help to avoid reactive measures. The intelligent use of cleaning brushes will result in longer life for the contact surface, brushes, and your equipment. It will also help lower the downtime and overall maintenance cost. Note that the brushes can help, but only to a certain extent for cleaning. Brushes cannot replace the machining of the contact surface.

- This needs to be handled case-by-case as each application is different.
- Get application information and running data. Do get a reliable brush expert involved.
- Taking detailed overall and close-up pictures or video is also helpful.
- Working together with the brush expert, identify the level of cleaning needed.
- Use a gradual approach to implement cleaning brushes and avoid an overly aggressive approach as much as possible.
- Cleaning brushes require monitoring. It is temporary in most cases, until the unit can be taken out for proper maintenance.

Note: The sooner you apply cleaning brushes, the faster the surface is cleaned. While this can be effective, the focus should be on fixing the root cause that requires regular cleaning.

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