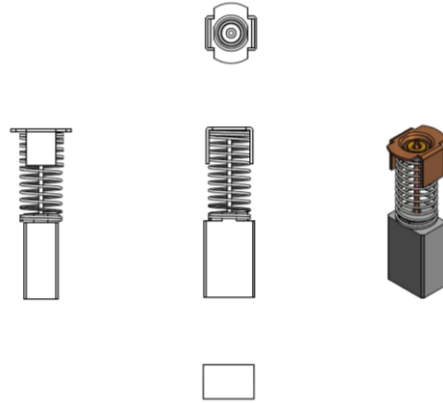


Brush Wear Guide:

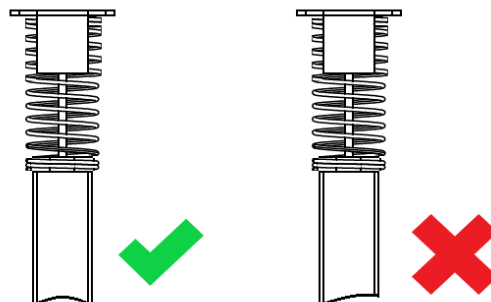
Motor brushes should wear in an even pattern after extended periods of usage.
Some common wear patterns to look for and assess if the brushes are in good condition.



First, when viewed from the long side, the length of brush on both sides should be approximately the same.
The length also should not be shorter than the recommended minimum length due to the shunt wire present inside the brush.



Next, when viewed from the short side, the brush should have a curved cross-section due to continued contact with the commutator. The curve should be centered and not uneven.

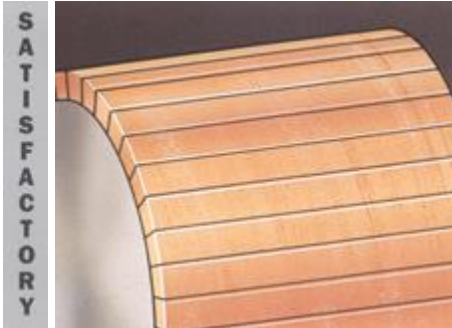


Next, when looking at the brush face itself it should have a fairly clean, smooth, shiny look.
Some streaks are normal as part of operation. Signs of excessive streaks or dark spots are not a good sign.

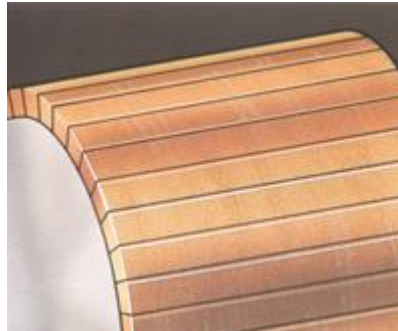


Commutator Appearance Guide:

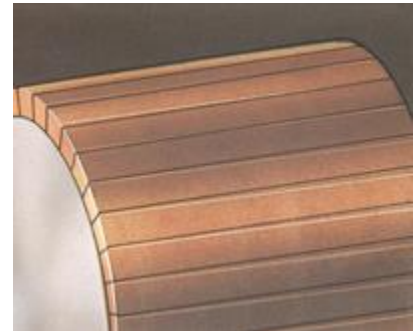
In addition to the physical appearance of the surface of the commutator, the skin or patina (film) is of equal importance for the good running of the carbon brushes. Each carbon brush builds a characteristic patina (film) which is affected by operating and ambient conditions. The patina (film) consists mainly of copper oxides, graphite deposits and absorbed water, and its appearance is of importance for the assessment of the running behavior of the commutation set. The following pictures are used by carbon brush manufacturers and users of brushes as a guide to assist in judging the operation of carbon brushes.



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: Is the ideal commutator condition for maximum brush and commutator life.



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



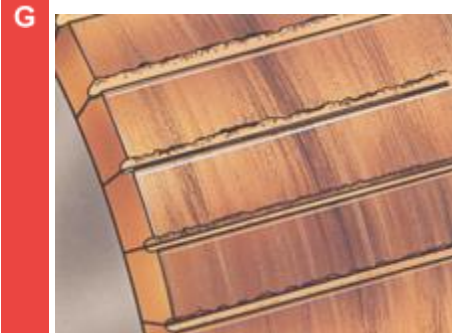
STREAKING: Results from metal transfer to the brush face. Light loads and/or light spring pressure are the most common causes. Contamination can also be a contributing factor.



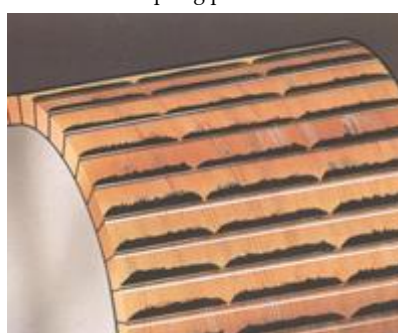
THREADING: Is a further development of the streaking condition as the metal transferred becomes work hardened and machines into the commutator surface. This condition can be avoided by increased loads and increased spring pressure.



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 1.) The brush grade has adequate voltage drop, 2.) The brushes are properly set on neutral, and 3.) 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.