

**Knowledge Domain: Motors**  
**Unit: Brush Substitution**  
**Skill: Shim**

**Tools and Parts Required:**

- 1) Motor with Carbon Brushes**
- 2) Flathead Screwdriver**
- 3) Pliers**
- 4) Shim**
- 5) Safety goggles**

**Introduction**

Carbon brushes transfer electric current from the motor housing to the commutator on the motor shaft. The motor housing is stationary. The commutator spins rapidly when the motor is on.

Carbon brushes are continuously worn down where they contact the commutator. Worn carbon brushes can be too short to reach the commutator. Carbon brushes that do not reach the commutator prevent motors from starting. Worn carbon brushes must be replaced.

Sometimes replacement carbon brushes are not available. When replacement carbon brushes are not available, an additional piece of metal may be added to increase the amount of spring tension on the carbon brush. This additional piece of metal is called a shim. Shims give extra length to worn carbon brushes. Shims allow the carbon brush to reach the commutator.

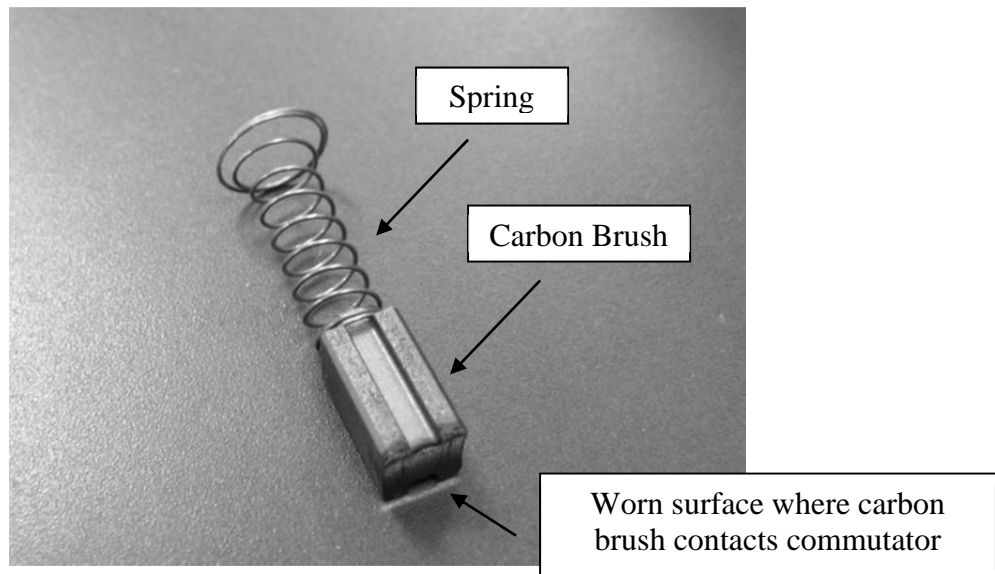
**Example**

Below is a picture of a metal nut. A nut is a piece of conductive material that can be used as a shim.

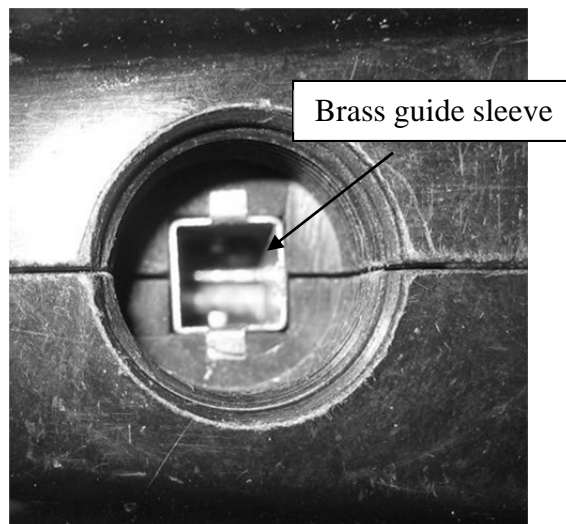


## Identification and Diagnosis

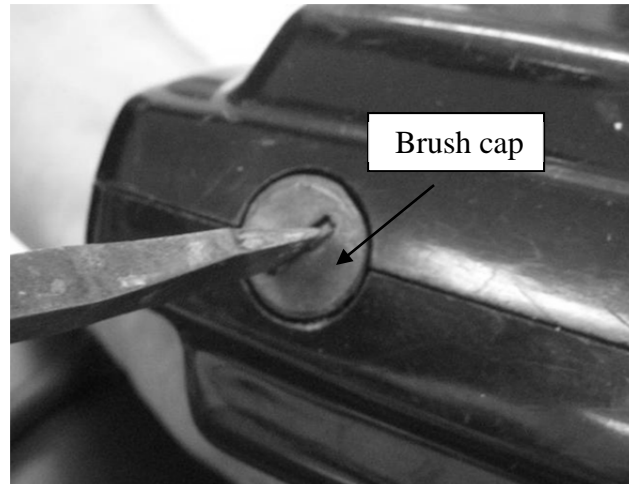
Carbon brushes are rectangular pieces of carbon. Carbon brushes are attached to springs.



Carbon brushes slide into brass guide sleeves on opposite sides of the commutator. The brass guide sleeves align the carbon brushes with the motor.



Carbon brushes are found under brush caps.



Check the carbon brushes if the motor does not start. Carbon brushes that are too short to provide full contact with the commutator must be replaced or shimmed.

Also check the carbon brushes if arcing occurs. Arcing is caused by insufficient spring tension on the carbon brush. Arcing causes the carbon brush to burn onto the commutator. If you smell ozone or hear static when the motor is running, check the carbon brushes for arcing. Carbon brushes must be replaced or shimmed after arcing occurs.

## Procedure

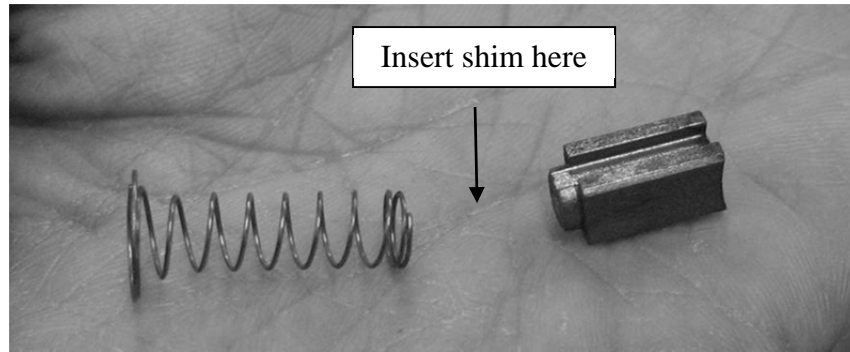
Follow the procedure in *Motors-BrushSubstitution-Filing* to remove the carbon brushes from the motor.

If arcing has occurred, clean the commutator. Follow the procedure in *Motors-Cleaning/Lubrication-ArcingGroovesInCommutator* to clean the commutator. Also clean the inside of the guide sleeve. Dirt in the guide sleeve prevents the carbon brush from moving freely.

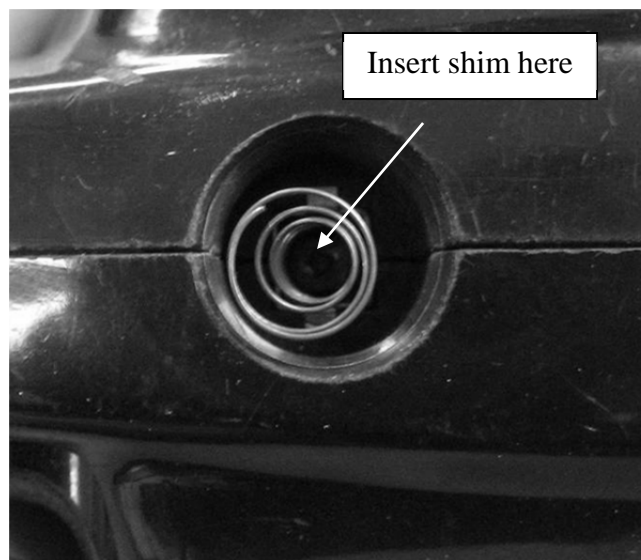
Determine whether or not any of the brushes need to be replaced. ***Use a shim only if a replacement brush is not available.***

Any piece of conductive material may be used as a shim. Metal nuts may be used as shims. Pieces of metal bolts or screws may be used as shims. Cut metal bolts or screws to an appropriate length before using them as shims. Estimate the length of shim that is necessary to restore brush contact with the commutator. The width of the shim should just fit inside the sleeve so the shim does not slide around.

You can place the shim on either end of the spring. Shims may be placed between the brush and the spring.



Shims may also be placed between the spring and the brush cap. The spring will be held in place in both positions by the force of the spring.



Follow the procedure in *Motors-BrushSubstitution-Filing* to replace the carbon brushes and test the motor.

### **Exercise**

Your instructor will provide you with a motor. Insure that your motor is disconnected from the power supply before working on the motor. Locate the carbon brushes. Shim the brushes if necessary. Test the motor.

Your instructor must verify your work before you continue.

### **Preventative Maintenance and Calibration**

Always calibrate every medical device before returning it to use.