endeavor technologies | beyond repair
417 Stone Drive St. Charles, IL 60174
T 630.562.0300
F 630.562.0303
endtec.com

We often receive calls for help troubleshooting synchronous or permanent magnet AC motors, during which the issue of rotor "cogging" is raised. This is intended to be a simple, non-technical, but hopefully helpful answer to the question "What is cogging and when does it represent a problem?".

Cogging occurs in permanent magnet AC motors, and is the sensation that the shaft or rotor wants to "lock-in" to evenly spaced positions throughout its rotation. It may or may not represent a failure in the motor. As a service technician, if checking for cogging is one of the tools in your troubleshooting arsenal, here are some things you should know:

1. Permanent magnet motors tend to cog every time a magnet pole lines up with a slot of the winding. So a motor with a 24 slot winding would naturally cog 24 times throughout one rotation. Manufacturers often incorporate mitigating features into motor designs to reduce or eliminate this effect, resulting in smoother power transmission. This is particularly true in spindle applications.
2. A conductor-to-conductor short circuit in the motor winding will cause cogging points equal to the number of poles in the winding. For example, an 8 pole motor will cog 8 times throughout one rotation if the winding has an internal short. This type of cogging generally feels less precise but produces greater resistance than when magnet poles on the rotor align with slots of the winding.

How can this information be used in field testing?

First, it can be very helpful to know during troubleshooting if a motor is a permanent magnet, or synchronous design. A handy test is to insulate yourself from the motor terminals, short the U and V phases together, and turn the shaft. If substantial cogging develops, a permanent magnet design is confirmed.

Conversely, if it is known that the motor is a synchronous design, and shorting the U and V terminals together produces little or no cogging, it can be a good indicator that the magnets are partially or completely discharged.

Second, keeping in mind the difference in feel noted above, if cogging exists when the motor leads are all clearly disconnected from each other, it is a good indication that the winding has failed with a conductor-to-conductor short circuit.

Third, if subtle but precise cog points have developed in a design in which this is unexpected, it is often an indication of some partial discharge or other problem with the magnet rotor.

Taken together or individually, none of the symptoms discussed here should be used to conclusively determine whether a motor is good or bad. We strongly encourage you to call us for assistance when troubleshooting or field testing windings and motors.