Motor Speed – The Basics

How does a typical motor know how fast to run?

Typical induction motors are slaves of the electrical cycle rate of the entering power (measured in hertz).

Our power in the US makes one full rotation from positive electrical peak to negative peak 60 times per second or 60hz (50hz in many other countries)

This means that the generators at the power plant would have to run at 3600 RPM if they only had two poles of power 2 poles (60 cycles per second x 60 seconds per minute = 3600 rotations per minute) in reality, power plants generators can run at different speeds depending on the number of magnetic poles within the generator. This phenomenon is replicated in motor design.

The more “poles” you have in a motor the shorter the distance the motor needs to turn per cycle.

In a 2 pole motor it rotates all the way around every cycle, making the no-load speed of 2 pole motor in the US 3600 RPM.

A 4 pole motor only goes half the way around per cycle, this makes the no-load (Syncronous) RPM 1800

6 pole is 1200 no load (no slip)

8 pole is 900 no load (no slip)

So when you see a motor rated at 1075 RPM, it is a 6 pole motor with some allowance for load and slip.

An 825 RPM motor is an 8 pole motor with some allowance for slip.

A multi-tap / multi-speed single phase motor may have three or more “speed taps” on the motor. These taps just add additional winding resistance between run and common to increase the motor slip and slow the motor.

This means a 1075, 6 pole motor will run at 1075 RPM under rated load at high speed. Medium speed will have greater winding resistance than the high speed and therefore greater slip. Low speed will have a greater winding resistance than medium and have an even greater slip.

Variable speed ECM (Electronically commutated motor) are motors that are powered by a variable frequency. In essence the motor control takes the incoming electrical frequency and converts it to a new frequency (cycle rate) that no longer needs to be 60hz. This control over the actual frequency is what makes ECM motors so much more variable in ten speeds they can run.

So in summary. There are three way you can change a motor speed.

- Change the # of poles (more = slower)
- Increase slip to make it slower, decrease slip to bring it closer to synchronous speed
- Alter the frequency (cycle rate)

– Bryan