



a technical paper from **Bodine Electric Company**

Motor Windings – Custom and Standard Options

Winding design is one of the major factors that determines gearmotor performance. For example, the windings may be driven by AC or DC current. They may require a capacitor, or a control to run, and may be configured as single, split or three-phase systems. Some motor types provide precise speed and position control, while others are less accurate. They may be built to run at either a constant or variable speed. Understanding these differences is critical to selecting the right gearmotor for your application.

As a manufacturer that exclusively focuses on fractional horsepower (less than 1 HP/746 Watts) products, Bodine Electric Company offers a

range of standard gearmotors and motors with the most common voltage and frequency ratings for both the North American and International markets. Bodine Electric also has the engineering expertise to design and manufacture a great variety of custom winding types and ratings.

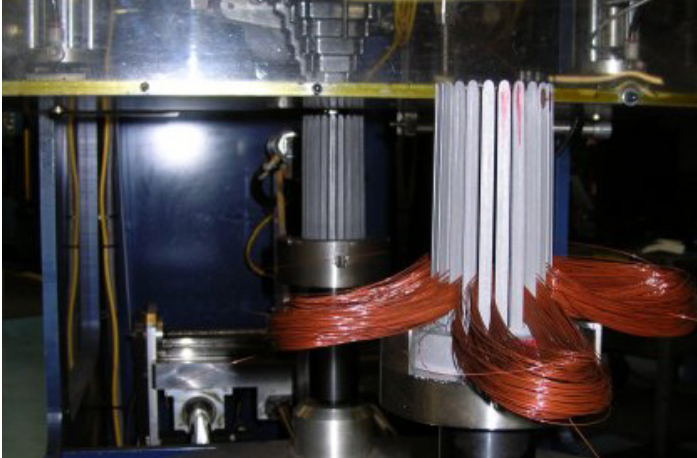
AC Induction

AC windings are available in single-phase, two-phase and poly-phase (three-phase) designs including the following types; split-phase (with centrifugal start switch), capacitor start, permanent split capacitor, 2 capacitor start, 2 capacitor start/one capacitor run, and reluctance synchronous.

AC Induction, Permanent Magnet DC and Brushless DC (EC) Motor Winding Performance Characteristics

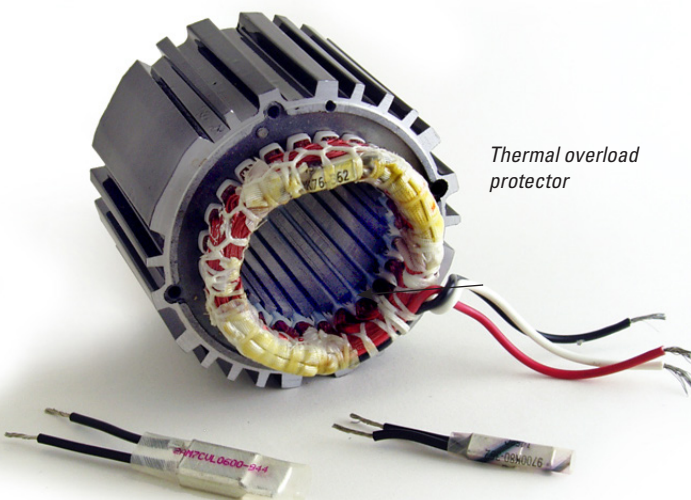
Motor Winding	Speed Tolerance	Typical Rated Speeds at 60 Hz	Start/Stop Frequency	Coast Without Brake (Revolutions)	Coast With Dynamic Braking (Revolutions)	Starting Torque (% of Rated Torque)	Pros	Cons
AC Windings								
Split Phase (SI)	±3%	1700-1750 (4-pole) 3450 (2-pole)	Up to 6 per hour	20-600	0.5-6	175% and up	No capacitors	Switch life 50k to 250k starts
Permanent Split Capacitor (CI)	±3%	1700-1750 (4-pole) 3450 (2-pole)	Up to 10 per min.	20-600	0.5-6	90-100%	Very reliable, Low starting current	Low starting torque
Three Phase ¹ (PP, Non-synchronous)	±3%	1700-1750 (4-pole) 3450 (2-pole)	Up to 10 per min.	20-600	0.5-6	200- 400%	Most reliable and efficient, No cap/switch	Requires three-phase power, or a control
Reluctance Synchronous Split Phase (SY)	near 0%	1800 (4-pole) 3600 (2-pole)	Up to 6 per hour	20-600	0.5-6	110-150%	Same as split-phase, plus exact speed	Switch life 50k to 250k starts
Reluctance Synchronous Capacitor (YC)	near 0%	1800 (4-pole) 3600 (2-pole)	Up to 10 per min.	20-600	0.5-6	80-100%	Exact speed, Very reliable, Low starting current	Low starting torque
Reluctance Synchronous Three Phase (YP) ¹	near 0%	1800 (4-pole) 3600 (2-pole)	Up to 10 per min.	20-600	0.5-6	200-500%	Exact speed, Most reliable and efficient, No cap/switch	Requires three-phase power, or a control
DC Windings								
Permanent Magnet DC	0-1%	2500 (130V DC)	Up to 10 per min.	10-20	0.5-6	175% and up	Linear speed/torque characteristics	Requires a control
Brushless DC (BLDC)	near 0%	2500 (130V DC)	Up to 10 per min.	20-600	0.5-6	175% and up	Exact speed control, Linear speed/torque characteristics	Requires a control

1. Fixed and variable speed (inverter-duty) options available.



**AC & BLDC motor stator in process – Winding cell
(Bodine Peosta, Iowa Plant)**

These windings can be produced in 2-, 4-, 6- & 8-pole configurations and can be rated as continuous duty, intermittent duty, inverter-duty, dual voltage, dual frequency and fixed or variable speed. Our AC windings are available in voltages ranging from 12 to 575 VAC. Bodine Electric Company also provides solutions for OEM applications that require thermal overload protectors with manual or automatic resets, or simple temperature limiting switches.



AC motor stator with on-winding thermal overload protector

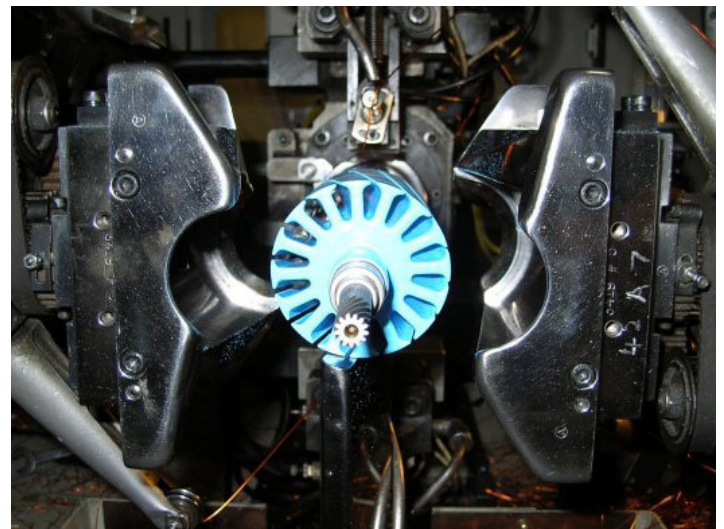
Permanent Magnet DC

PMDC motors are available with rated voltages from 12 to 240 VDC. They can be designed in 2 & 4 pole versions and in lap or wave (4 brush vs. 2 brush) configurations. Multiple magnet grades are available for enhanced performance or added demagnetization protection. End-of-life signaling brushes, and a new proprietary brush wear sensor system are also available from Bodine Electric Company.

Brushless DC (EC)

Our standard brushless DC windings are 3-phase, 4-pole designs (standard voltages are 24 VDC and 130 VDC). Custom designs with voltages ranging from 12 VDC to 260 VDC, and horsepower ratings up to 1 HP/746 Watt are also available.

In addition, we also offer our unique 24 VDC INTEGRAmotor™ product line of brushless DC motors with built-in motor speed control and motor feedback device.



DC motor armature in winder (Bodine Peosta, Iowa plant)