

APPLICATION NOTE

A TECHNICAL PAPER FROM BODINE ELECTRIC COMPANY

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Safe Operating Area (SOA) Ratings of AC Inverter Duty Gearmotors Explained



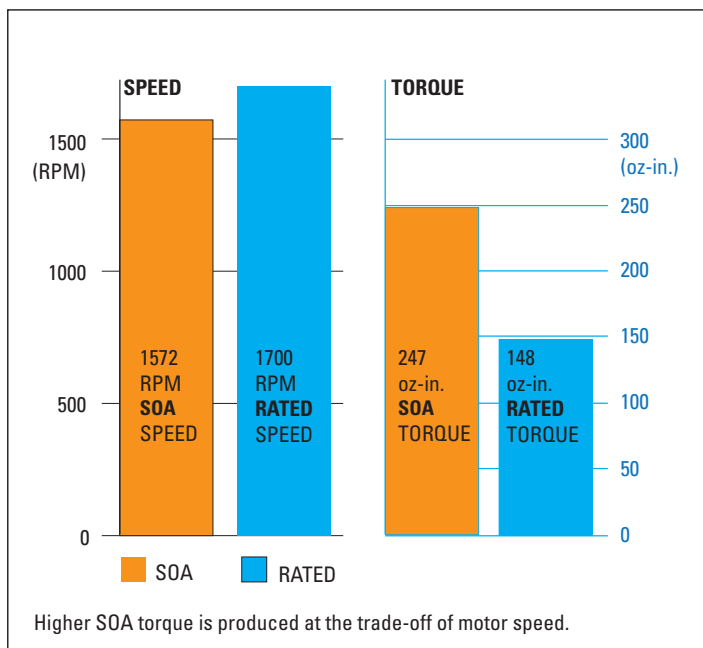
What is Safe Operating Torque?

We define **SOA Torque** as the maximum torque at which the motor still operates within Class F thermal limits, or as the maximum torque of a gearmotor when it is gear-limited. Continuous duty operation must be limited to the area below the SOA or gear-limited torque curves.

Safe Vs. Rated

Rated torque is either the value of torque which corresponds to nameplate output power and speed at 60 Hz, or it is the maximum torque at gear strength limits (rated torque can be either motor limited or gear limited).

The **SOA torque for synchronous motors** is close to the pull-in torque; that is, the motor will pull out of synchronism if the required torque exceeds the SOA torque.

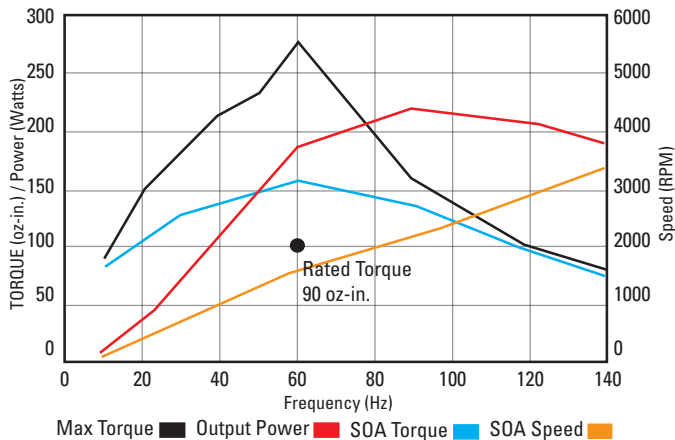


The Relationship Between SOA Torque and Speed

The **SOA speed** of Bodine's Pacesetter™ non-synchronous motors is **below** rated speed. For example, Bodine model 2295, a type 34R6BFPP motor has a rated torque of 148 oz-in. at a rated speed of 1700 rpm (60 Hz), but only a SOA speed of 1572 rpm (60 Hz) at 247 oz-in. SOA torque. Higher SOA torque is produced at the trade-off of motor speed. Starting currents for standard Pacesetter motors were measured with the motor connected to a three-phase power source. Starting currents may be different when the motors or gearmotors are operated with an inverter drive (VFD/ASD). The SOA Graphs for Bodine Electric inverter duty, three-phase, AC induction motors and gearmotors were generated by performance-testing all standard models over the full rated speed/frequency range. The SOA graphs provide the data needed to successfully apply these variable speed AC motors and gearmotors.

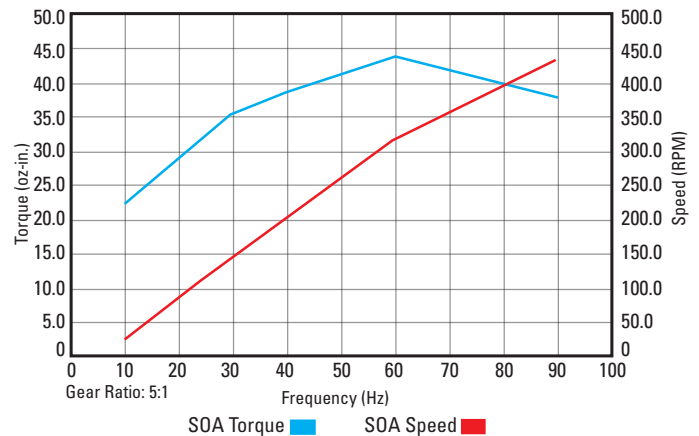
Typical rated and SOA speed/torque curves.

34R4BFPP-FX Winding



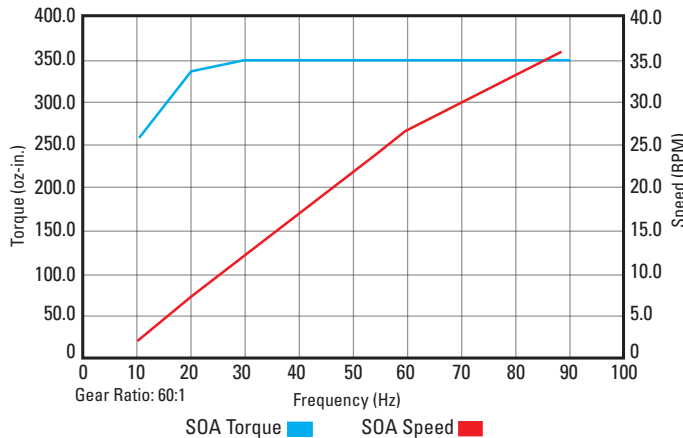
Item No. 2255: 34R4BFPP-FX Safe Operating Area

Gear Ratio 5:1



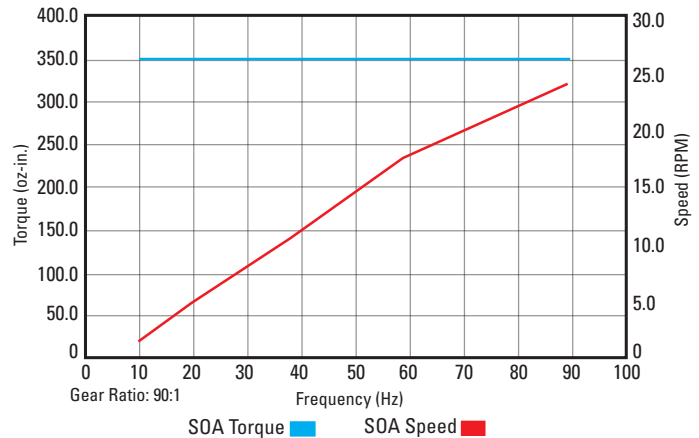
Item No. 2252: 34R4BFPP-FX Safe Operating Area

Gear Ratio 60:1



Item No. 2251: 34R4BFPP-FX Safe Operating Area

Gear Ratio 90:1



Benefits

Inverter duty, three-phase gearmotors offer performance improvements over comparable single-phase units. When operated with an AC speed control (inverter), the motor or gearmotor speed can be easily matched to varying application loads. Pacesetter gearmotors and motors are more efficient than their single-phase counterparts, they are more compact, and provide higher output torques in the same size package. In addition, these variable-speed AC gearmotors and motors don't require brush replacement or brush maintenance, and the gearheads are lubricated for life.



AC Speed Controls

As a true system-solution provider, Bodine Electric Company also offers several new AC speed controls (Variable Frequency Drives or Adjustable Speed Drives), including chassis type (IP-20) and enclosed (NEMA-1, -4 and NEMA-4X). When purchased as a "matched system", Bodine customers benefit from an extended two-year warranty for the motor or gearmotor and control.

For more information on SOA ratings and definitions:

please refer to [UL standard](#) UL1004-8 for inverter duty motors, or review [NEMA standard](#) MG-1, Part 31.

<https://www.ul.com> and
<https://www.nema.org>