Chorus Motor Comparison

8 July 2010

For ease of comparison, this data was collected on a 3 phase machine which we rewound with a Chorus 18 phase short pitch meshcon winding. The original motor was a EM2513T TEFC squirrel cage induction machine, with aluminum cage and conventional steel laminations, nominally rated at 15 horsepower at 1720 RPM, 460V 60Hz. The data sheet for the EM2513T is attached, but in confirming we notice a significant anomaly:

	Test Motor	EM2513 Motor Data sheet
Stator housing length	15 3/16 inches	17.37 inches
Motor housing OD	9 1/4 inches	11.69 inches

So the machine tested has a substantially smaller volume than the data sheet would suggest.

The test performed was open loop, using our current best model of motor operation to predict correct voltage and drive frequency for operation at the target torque and speed. To more accurately model overload torque for automotive applications, we ran for 60°C temperature rises, which took between 60 and 80 seconds. True automotive peak performance would presumably be closer to a 10 second intermittent condition, and Chorus would deliver substantially higher torques.

1) Motor volume:
   16.7 liters (1020 cubic inches)
   a. torque per motor volume
      13.2 newton meters per liter (13200 Pa, 0.159 foot pounds per cubic inch, 1.91 PSI) (60 second overload, fundamental drive)

Note that this is the volume of the body of a standard NEMA frame motor, and includes the stator, end bells, etc. It does not include the mounting feet, shaft extension, or terminal box.

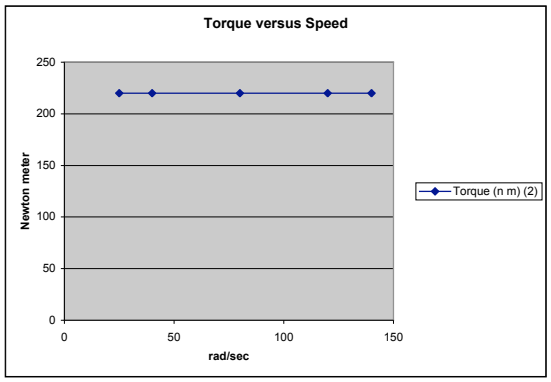
2) Rotor volume
   2.43 liters (148 cubic inches)
   a. torque per rotor volume
      90.5 newton meters per liter (90500 Pa, 1.1 foot pounds per cubic inch, 13.2 PSI) (60 second overload)

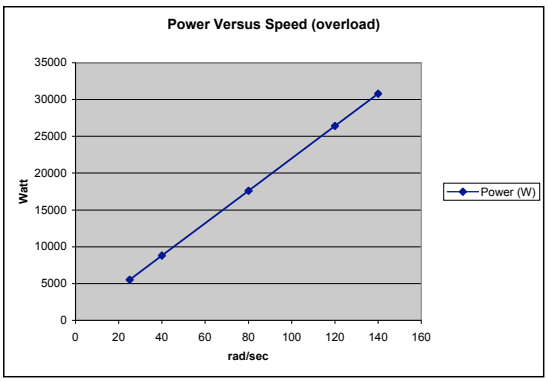
3) Airgap shear pressure
   6.58 PSI 45400 Pa (60 second overload)

Data generated for torque-speed curves:

Speed (rad/sec) (1)	Torque (Nm) (2)	Power (W)	ΔT for 60 second run (3)
25	220	5500	57°C
40	220	8800	45°C
80	220	17600	64°C
120	220	26400	48°C
140	220	30800	(4)

1) All speeds are measured in radians per second. Motor nominal base speed is 1760 RPM (184 radians per second)
2) All torques are in newton meters. During experimental overload runs, torque was ± 5 nm
3) The temperature rise during a 60 second period where the target was to go from 120C to 180C in 60 seconds. Standard in-motor fan cooling in the lab environment.
4) Calculated inverter limit based upon 140 rad/sec capabilities.
5) Standard industrial-spec aluminum rotor cage is used.





4) Motor Mass, excluding junction box and floor flange: approx 140 lb