

Traction Motor for Hybrid Electric U.S. Army Truck

Challenge

The U.S. Army wanted a more effective motor for its heavy, expanded-mobility, tactical truck electric drive system. The truck utilizes four 140-hp electric motors. The 520-V motors are powered by a 400-hp diesel engine, making a hybrid drive system that can move 35,000 pound vehicles and run a 335-kW generator to operate field hospitals, command centers or airstrips. The motor needed to meet efficiency requirements across a broad range of loads and speeds while being small and light enough to meet the space and weight constraints for the vehicle. The army considered both die cast copper motor rotors and AC induction motors with aluminum die cast rotors for this difficult application.



HEMTT-A3 vehicle and copper rotor traction motor

Solution

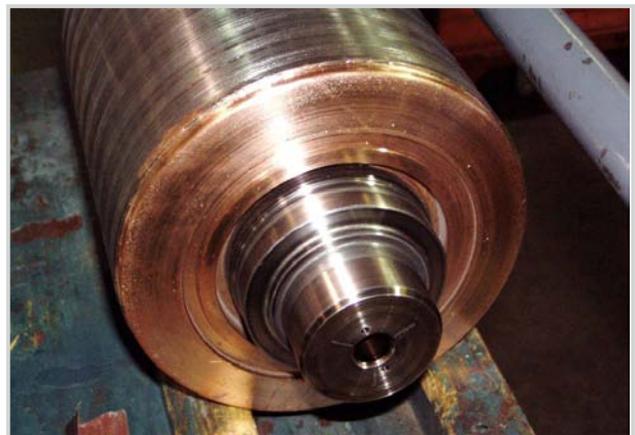
The die cast copper motor rotor proved to be the best solution. While both motors met the Army's efficiency requirements, only the die cast copper rotor motor was significantly smaller and lighter than the aluminum rotor design. In addition, the copper design redistributed losses to allow for more effective cooling. Removing heat from the rotor is a difficult task. By taking advantage of copper's higher conductivity than aluminum, the optimized design moved a substantial amount of motor losses from the rotor to the stator.

Copper rotor motors have historically been manufactured using fabricated motor cages; however, this typical construction could lead to problematic gaps, friction, windage loss and stress concentration points in this high-speed application. The cast copper rotor, with its end rings tight against the stator, provides a more robust mechanical solution to both the fabricated copper motor and the die cast aluminum motor design.

Results

The overall result is a compact, lightweight motor that has much higher heat transfer across the stator wall. The die cast rotor is 23 percent lighter and 30 percent smaller than the aluminum rotor. It has more than a 30 percent increase in overall heat transfer capability than the equivalent aluminum rotor motor.

Building a motor around a die cast copper rotor has proven to be a successful and cost-effective design platform for very high-efficiency industrial induction motors. The copper rotor induction motor is a viable choice for parallel hybrid electric vehicles in terms of overall system performance and durability. This motor successfully supports the challenging requirements of the U.S. Army. The die cast copper rotor offers a smaller, more innovative solution with superior heat management and mechanical robustness compared to die cast aluminum or fabricated copper.



Copper die cast rotor for the traction motor application