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Permanent Magnet Motors

Challenge

A leading manufacturer of motion control applications approached Tempel to produce laminations based on the inclusion of embedded, permanent magnet laminations for a high torque, low speed motor. This type of motor presents a challenge during the design phase. For this type of motor design, electrical engineers prefer the smallest possible steel web in the rotor to maximize motor performance, while mechanical engineers favor a bigger and stronger steel web to be able to hold the magnet in place and not distort the rotor. However, thicker webs have a negative effect on motor performance. In addition, production has the challenge to be able to stamp the laminations with thin webs without distortion and maintain tolerances on some very small dimensions. On top of the design challenges, the customer was in a hurry to get the motor into production.

Strategy

In order to meet the strict time requirements and the challenges of the design, Tempel's Tool Engineering team worked with our customer to resolve all of the tolerance and dimensional issues without jeopardizing motor performance. Our engineers designed a web dimension together with retention features to hold the magnets in place inside the rotor. Tempel was able to do this using detailed mechanical property measurements for the steel grade. This design provided manufacturing tolerances that would make it suitable for production and would meet all of our customer's requirements. Tempel also recommended that the rotor laminations be supplied without annealing and indicated that this would not affect motor performance for this design of motor.

Results

The customer used their own internal laser machine to create a prototype motor so they were able to quickly test the laminations that we had helped to design. The test motor met all of the performance specifications with good magnet retention and no distortion of the laminations. Our customer won the contract with their customer using Tempel laminations. Based on successful performance testing of the prototype, our tooling team was able to design and source a soft progressive tool in less than 10 weeks. We delivered on time and met all of our customer's expectations. By engaging with our customers in the early stages of tool design and material selection, we were able to go from initial design concepts to the start of a limited run production within twelve weeks.

Motor Design Consolidation Project

Challenge

A large global manufacturer of electric HVAC motors had a redundancy in operations after purchasing two competitors. They were manufacturing three similar motors, one of which they produced with laminations they stamped internally. Tempel had been working with this customer on many projects and they wanted a more collaborative relationship on this challenging program. They approached us to consolidate the three motors and streamline the design into a single 48 frame sized motor. The customer wanted a cost-effective solution that would use stacked laminations. In addition, the customer was moving their operations to México and wanted a supplier who could deliver product in a timely manner.

Strategy

Tempel's team of technical experts including Tooling Engineers, Motor Designers, and Metallurgists reviewed the motor designs and came up with a solution. We took the best material grades, steel thickness, and tolerances and offered a simple solution. We provided quick-turn prototype samples in two different materials and proposed three complex die-modification alternatives to support serial production. In order to meet the customer's migrating business needs to Mexico, we determined that Tempel de México was going to be an integral component for this plan to work.

Results

We were awarded the business and the team of Tempel Engineers designed a two row, stacked rotor, stacked stator progressive die. By outsourcing production of the consolidate design instead of in-house stamping, our customer avoided capital expenditures required for maintenance, upkeep, and replacement of equipment. Tempel's world class electrical steel materials, advanced engineering solutions, and application competency bolstered our customer's product line and electrical steel simplification efforts.

Annealing and Hybrid Electric Vehicle Motors

Challenge

A global automotive Tier-1 manufacturer approached Tempel to provide laminations for a Hybrid Electric Vehicle (HEV) application. This was Tempel's first experience working with an electric motor design. We followed our customer's specifications and met all of their requirements with our quotation for services. The customer felt that the quote we provided them was higher than their international benchmark for the cost of the motor and wanted us to find an alternative solution to reduce costs. The second challenge was that the motor was marginal in meeting performance specifications using the steel grade specified by the customer.

Strategy

The customer had their own tight deadlines to meet so we did not have an opportunity to alter or redesign the motor. Instead, we went back to our quoting department and challenged them to find pricing that was more in the range of what our customer was expecting without altering the strict tolerance requirements. Our Purchasing and Materials Engineering Teams proposed an alternative steel grade that utilized annealing. This permitted Tempel to consider alternative, lower cost, non-oriented steel grades while still enhancing the steel's performance and properties. Our Materials Engineering Team felt that with this solution, the motor would perform to meet our customer's expectations at a lower cost and consistently meet the critical performance requirements.

Results

At first the customer was skeptical, but the data our Materials Engineers provided was convincing. Our customer decided to go forward with the annealed laminations. During the prototype phase, they discovered that the motors tested at or above the performance specifications for the motor. The final cost of the motor was in line with our customer's global benchmarks. As a result, our customer was able to provide a competitive solution, meeting performance requirements and still comply with a strict production schedule. The HEV motor was successfully launched into the market.