QUEEN CITY FORGING CO.
People who make the process work

Case Study

Queen City Forging Solutions in Copper **Advanced Automotive Electric Motor Components**

The Problem:

The advancement of electric motor manufacturing is one of the touchstones enabling the emergence of electric vehicles into the mainstream automotive market. When a prominent U.S. electric vehicle manufacturer developed a line of upscale EVs that captured the imagination of the automotive world, an important next step was transitioning its advanced electric motor technology into viable manufacturing processes.

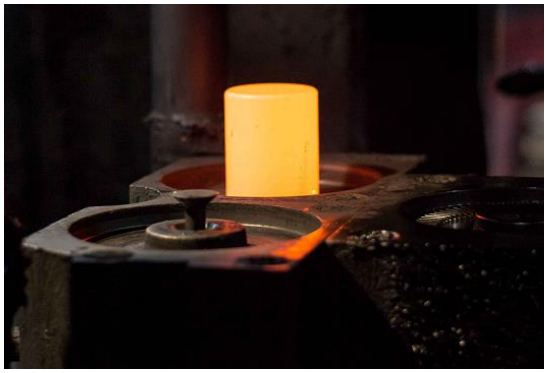
The challenge of manufacturing high-performance EV prototypes, at the scale and cost needed for a growing market, led this automaker to seek suppliers with innovative solutions for production of a number of critical systems and assemblies. Supporting a core technological advantage of the vehicle, quality manufacturing of components for the EVs advanced electric motor assembly was a high priority. One such part was an 8-pound motor end cap, which had to be manufactured in high-purity copper with maximum durability and conductivity.

The auto manufacturer first looked at a copper casting process to manufacture the end cap. This turned out to be unsuccessful because the durability of the cast prototypes proved to be insufficient for the vehicle system service life requirements. The automaker then turned to wrought processes, seeking to improve the part's copper metallurgy and strength. However, the forgings produced by the initial supplier did not yield an acceptable scrap rate in prototype runs.

Upon learning of Queen City Forging's award-winning forging expertise and innovative approach, the EV manufacturer engaged QCF in researching forging

alternatives to meet the challenge of combining the dimensional and metallurgical qualities needed for the copper motor end cap, while providing a scalable, cost-viable manufacturing solution . . .

The QC Forge Solution:



QC Forge started by addressing the metallurgical factors that were key to extending the service life of the advanced electric motor. This involved research and testing of processes for conversion of pure copper, with its soft, diamagnetic properties, into a highly durable part. Queen City Forging investigated a range of forging temperatures and annealing cycles that optimized the microstructural characteristics of the copper and improved the structural properties of the end cap. This process also enhanced the electrical conductivity of the material, an important benefit that the customer would come to appreciate in downstream system performance.

The deformation energy, inherent in the forging process, proved to be the ideal solution. By heating a copper billet to high temperatures and placing it on the forging die in a vertical orientation, QCF used the deformation energy to create copper components with a fine, radial grain structure, that significantly improved structural integrity over previous casting and forging prototypes. Through an iterative prototyping process guided by QC Forge's extensive forging knowledge, the team was also able to improve the dimensional tolerances of the motor end cap forgings and substantially reduce the scrap rate compared to earlier prototype runs.

After impression die forging, the end cap flashing was trimmed by QC Forge. This was followed by secondary manufacturing operations that included management of special thermal processing and CNC machining of inside and outside diameters. The finished net shape part was then delivered just-in-time to the automotive manufacturer for motor assembly.

The Results:

QC Forging's expertise in copper forging and metallurgy allowed development of an impression die process that delivered the perfect combination of production efficiency and end-use performance. Not only was QCF successful in improving the

manufacturing cycle and service life of the critical electric motor end cap, but was also able improve finished part tolerance to +/-.002 in., as forged through a cost-effective production process that was scalable to growing market demand for the electric vehicle.

Queen City's process expertise really paid off for the automotive customer by delivering a manufacturing process that also improved the motor end cap's electrical conductivity, which added additional value to the EV's innovative motor design and system performance.

With the help of QC Forge, a new generation of premium, all-electric vehicles are finding their way onto our highways in greater numbers . . . and moving us closer to a zero-emissions, alternative energy automotive future!

…a solution forged by innovation.

For more information:

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