Enabling the fast charging of electric vehicles with cold-formed connectors

Dawson Shanahan
Precision Engineering & Cold Forming

The automotive industry is changing at a blistering pace. The production and sale of electric vehicles, for instance, have grown significantly over the last five to ten years. Provider of electric vehicle charging infrastructure, Virta, says that there were a little more than one million EVs (Electric Vehicles) on the roads globally in 2015; by 2021, that figure had jumped to approximately 16 million.[1]

Driving change

Three main factors are driving these changes:

- First, regulators worldwide are defining more stringent targets for greenhouse-gas emissions. The European Union (EU) has, for instance, unveiled its Fit for 55 programme, which seeks to align climate, energy, land use, transport, and taxation policies to reduce net greenhouse-gas emissions by at least 55% by 2030. In the USA, meanwhile, the Biden administration wants sales of EVs to account to for 50% of total vehicle sales by 2030;
- Second, consumers are becoming increasingly open to more sustainable alternatives to traditional car travel;
- Finally, according to consultant McKinsey & Co, companies working to electrify, connect and automate driving technology have attracted more than $400 billion in investments over the last decade, with about $100 billion of that coming since the beginning of 2020. This investment is accelerating the pace of change.[2]

This change shows no signs of slowing down. McKinsey and Co expects sales of electric vehicles to grow by more than 25% a year through to 2030, when about 120 million passenger electric vehicles will be sold.[3]

Range anxiety

For these predictions to come true, the automotive industry must convert consumers that remain hesitant to go electric.

One significant factor preventing many drivers from purchasing an electric vehicle is range anxiety; the fear of being unable to drive long distances owing to poor charging infrastructure.

Charging electric vehicles can be a slow process. While most drivers are accustomed to filling their petrol or diesel tanks in less than five minutes, electric vehicles, depending on the size and specifications of their batteries, typically take at least 30 minutes to get 80% charged at the fastest charging stations currently available.

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Fast charging

As millions of electric vehicles hit the roads in the next decade, therefore, the need for fast-charging stations will grow rapidly.

Currently, fast charging is offered in two varieties. The first, on-the-go charging, is typically the more expensive option, but also delivers the fastest charging speeds. The more moderately priced alternative is destination charging, where drivers can recharge (or just top-up) their batteries while they spend a few hours, for instance, shopping.

To make on-the-go charging viable, it is likely that direct-current (DC) chargers, which can deliver up to 350 kilowatts or more an hour, allowing for the rapid supply of energy to EV batteries, will be required. In contrast, standard alternating-current (AC) chargers found at homes, workplaces and public settings deliver only 7 to 22 kilowatts per hour. DC chargers require a significant investment. Today, the hardware alone costs between £43,000 and £86,000, although costs are likely to fall significantly – by around 40% – over the next five to seven years.

Precision engineering

For such on-the-go fast chargers to become commonplace, they must be affordable, reliable, and efficient. Each component from which they are made will have to be precisely engineered. Battery technology will have to evolve. All electric vehicle batteries have built-in charging speed limits, set by the car's on-board charge ports, to prevent them from overheating. A 350 kilowatt fast-charging station might, in theory, be able to charge a 95 kilowatt/hour battery in about 16 minutes, but the battery itself might only accept about 150 kilowatts of power at most, placing its actual charging speed limit closer to 40 minutes. Further, the means for connecting fast charging stations to electric vehicles will have to be refined.

Power connectors, for instance, are widely used in electric vehicles in charging units and the motors used to drive each wheel. Manufacturers are striving for ways to improve the efficiency of power connectors to minimise power losses, while at the same time reducing their weight and cost.

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Intriguing option

One intriguing option for the manufacture of power connectors its cold forming, which ensures quality and cuts waste. Dawson Shanahan is renowned for the precision of its cold-forming processes, which it has used for several years to produce power connectors that optimise the performance of charging units for electric vehicles. Typically, it manufactures high-power connectors from highly electrically conductive, oxygen-free materials to ensure there are no power losses.

High rates, high quality

Surprisingly, precision cold forming is often overlooked in favour of more conventional machining methods by manufacturers looking to produce robust components with complex geometries. This is perhaps due the legacy of cold forming, which dates to the nineteenth century, when it was used to mass-produce simple parts, such as fasteners. It is, however, a fast and economical way of producing precision parts. Indeed, over 300 such parts can be manufactured every minute using cold forming and scrap rates can be reduced by up to 80% compared with machining processes.

Given the current economic climate, the speed and resource-efficiency of cold forming is highly attractive. Further, lead times for cold formed parts are short, and the parts themselves demonstrate excellent mechanical performance and a mirror-like surface finish.

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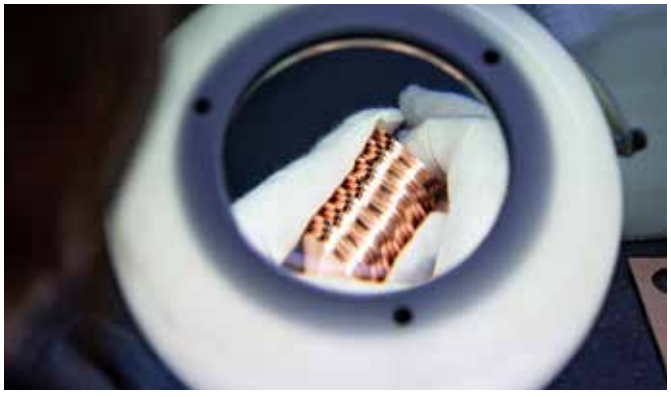
Benefits of precision cold forming

The benefits of precision cold forming are numerous:

- **It is fast.** Carried-out at ambient temperature, a precision cold forming manufacturing run can be set-up and undertaken more quickly than machining processes. As such, parts can be made to order rapidly — slashing lead times;
- **It yields high-quality parts.** By plasticising metals along their grain boundaries, rather than cutting across them, parts are produced with extremely low levels of stress deformation and high levels of mechanical integrity, resulting in improved performance and reliability;
- **It is precise.** The process creates parts with highly defined geometries, even those with complicated contours. Dimensional tolerances of plus or minus two microns can be achieved and their surface finish can be incredibly fine, meaning that they will not require any further machining or polishing. Accurate internal profiles and complex external profiles can be created, enabling precision parts to be manufactured that can have a significant impact on the performance of the equipment in which they are used;
- **It produces strong parts.** Parts undergo work hardening, which dislocates the structure of the metal in a way that prevents further dislocations, during the cold forming process, improving their machinability and durability. The increase in strength generated through work hardening is comparable to that achieved through a heat treatment, so it can be more cost-effective to cold-work a cheaper and weaker metal than to hot-work a more expensive metal, particularly where a precision finish is required;
- **It is versatile.** There is almost no limit to the shape, size or complexity of the metal components that can be produced using cold forming. Simple cold-headed parts or highly complex cold-formed and finished machined components can be produced for a wide range of applications.



Serving the automotive industry

Dawson Shanahan has experienced phenomenal growth in recent years with increasing demand for connectors for electric vehicles. This growth has come from both new and long-standing customers, including original equipment manufacturers and Tier-1 automotive manufacturers.

In response to this demand, Dawson Shanahan has refurbished several of its rotary transfer machines for computer numerical control (CNC). It is also continually refining its precision cold forming capabilities.

To find out how Dawson Shanahan could help you with your automotive electrification project, contact us today.

Source:

1 https://www.virta.global/en/global-electric-vehicle-market
2 https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/why-the-automotive-future-is-electric
3 https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/ev-fast-charging-how-to-build-and-sustain-competitive-differentiation

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