

STECKER MACHINE *Case Study*

Foundry/CNC Machine Shop Partnership:

Driving Success for an
Electric Vehicle Gearbox
Case and Cover



SMC

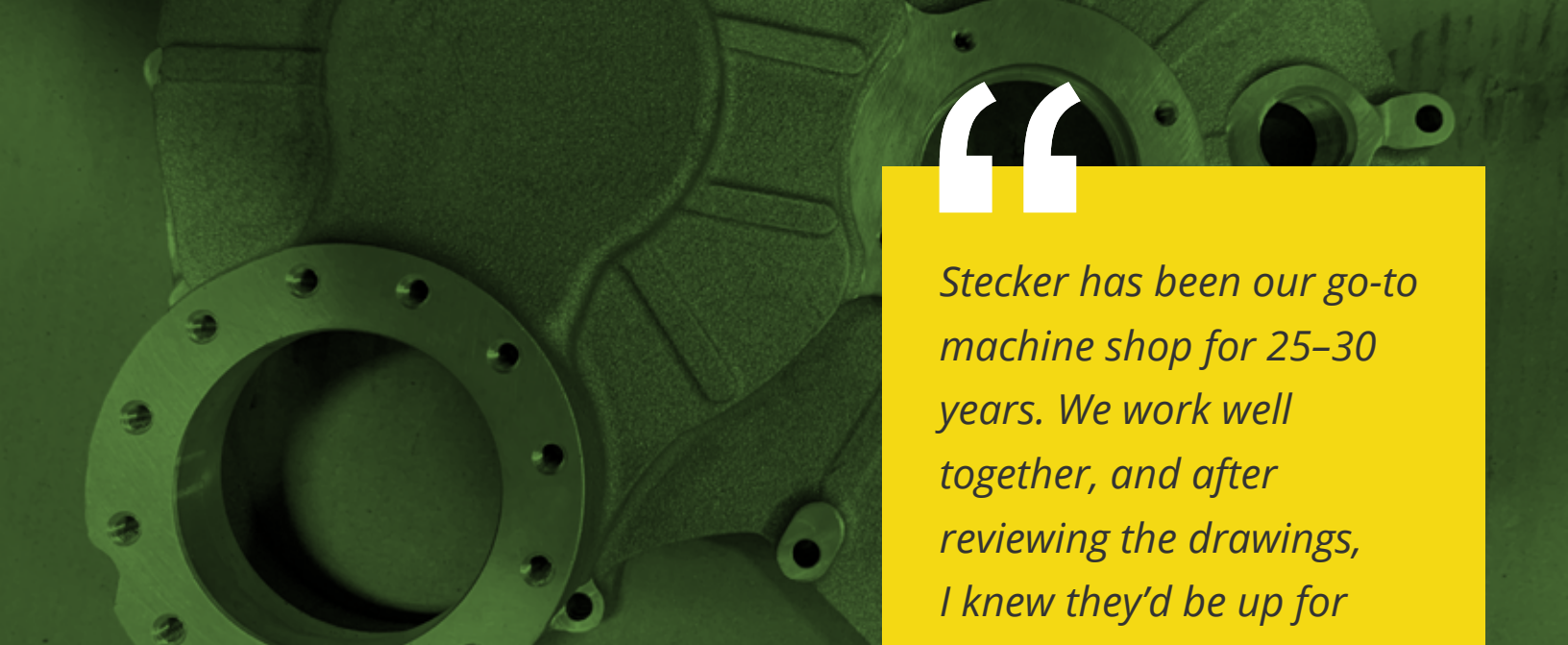
When you have a reputation for taking on complex and challenging projects, it seems to get tested often. That's fine with Stecker Machine, whose decades-long relationship with **Wisconsin Aluminum Foundry** (WAF) resulted in a 3-component machining project within a new and growing market.

The task was to quickly and cost-effectively take a startup product — an electric vehicle's gearbox cases and cover (complex pieces with tight tolerances) — to high-volume production while increasing quality.

After being approached by Tier 1 supplier WAF, Stecker began planning how to machine the sand cast aluminum A356 T6. Although new to machining for an electric vehicle manufacturer, Stecker was comfortable that the demands for these components were well within their capabilities.

"As challenging as we knew this would be, this is kind of a dream project. We get to work with the foundry and the manufacturer from the very beginning to make the project a success," said Ken Jones, Sales Account Manager at Stecker Machine.





Stecker has been our go-to machine shop for 25-30 years. We work well together, and after reviewing the drawings, I knew they'd be up for the challenge.

— Steve Vaness,
Engineering Manager,
Wisconsin Aluminum Foundry

SITUATION

Arcimoto, a forward-thinking manufacturer of sustainable transportation systems, was ready to ramp up production of their Fun Utility Vehicle (FUV). The gearbox cases and cover of this electric vehicle, initially tooled at Arcimoto, while functionally sound, were not designed for high-volume production.

After connecting with Arcimoto, winning the business, and creating the drawings, WAF quickly reached out to Stecker. The complexities and requirements shown in the drawings showed a high level of machining was going to be needed to make these components manufacturable.

Although not yet familiar with electric vehicles, Stecker knew their experience from years of similar, successful products made these gearbox cases and covers a perfect fit.

CHALLENGES



The prints define that all parts, when assembled, run quietly. A lot of blood, sweat, and tears were spilled while developing the prints for this quiet vehicle. It was up to WAF and Stecker to execute them so the vehicle runs as quietly as when we made it.

— Jake deGlee,
Mechanical Engineer IV, Arcimoto

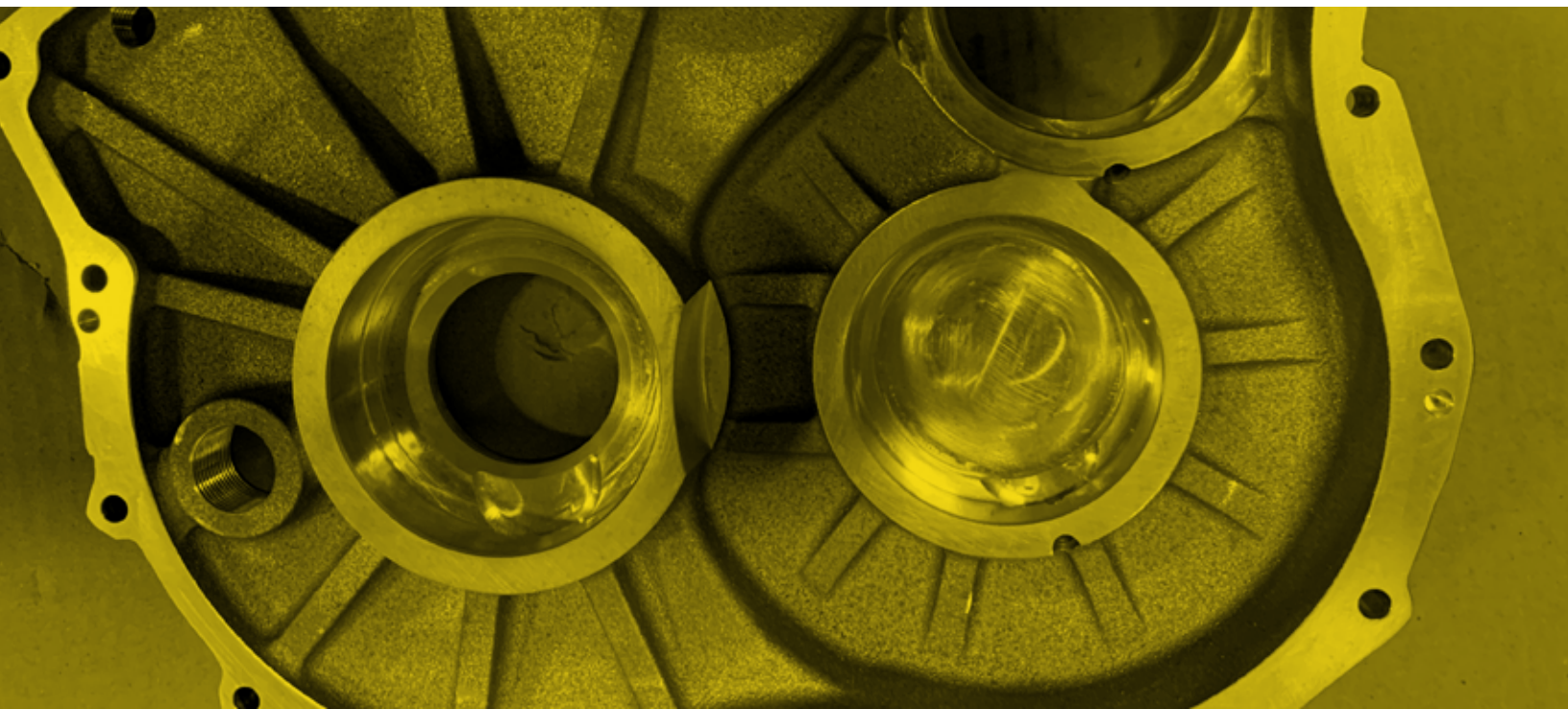
The application of these gearbox cases and covers — within an electric vehicle — is the reason for some of this project's daunting capabilities. It all revolves around making the vehicle quiet while running, in comparison to a combustion engine. The vehicle's driver is close to the drive train. If the components aren't located perfectly to create a straight gear mesh, and if the axial displacement allowed between components is not within tolerance, it results in noise.

A formal capabilities study, conducted with Stecker's help, resulted in adjustments needing to be made to the original drawings. As strict requirements came into play, and more formal PPAP capability requirements were known, tolerances were adjusted in order to make these properly casted and realistically manufactured parts while ensuring that quality was maintained.

A pressure tight requirement of the gearbox was especially challenging, specifically where impregnation was going to take place to seal them. Originally, the parts were to be impregnated at WAF prior to machining to seal them up yet now, after machining by Stecker, the parts are returned to the foundry for that step.

The gearbox needs to transfer significant torque from the electric motor and apply it to torque at the wheel. Plus, it needs to support reverse torque in order to brake the electric vehicle. All acceleration and normal use deceleration depend on this gearbox.

Meeting capability is more demanding than meeting tolerance. Tolerance may be +/- .001 inches, but the manufacturer may need to produce parts within half of that range in order to achieve a passing capability score. In other words, it's the difference between just hitting a dart board 30 times versus hitting 30 consecutive bullseyes.



SOLUTIONS

Aricmoto was flexible as datum schemes needed to be changed early on. Requirements of the original gearbox case were difficult to achieve, driving changes that immensely improved the original gearbox case and cover in several ways:

- New and better cast features, which translate down to the machine shop, making it a better product to machine
- New tabs for better work holding, making CNC machining more repeatable and able to meet required tolerances
- Datum schemes now represent actual tooling points and pick-up points, resulting in a better overall process

Within a tight timeframe — 4 months — the teams worked together to produce the first 50 sets of the 3-component project. A fully ramped-up production run of 500 has since been initiated.



What we did was improve on the original (gearbox case/cover) design, creating a more consistent and capable product. As we've ramped up production, we've experienced zero defects.

— Jake deGlee

TRUE COLLABORATION

"In addition to scaling up production while increasing quality, the partnership with WAF and Stecker has freed up valuable resources in-house at Arcimoto to explore additional projects and efficiencies while also saving money in the back end."

— Jake deGlee

"I always have three or four projects in design review with Stecker before those projects are ever launched. That's the tight, ongoing partnership that we have."

— Steve Vaness

"Our relationship with WAF inspired us to accept this project at a time when we had to be selective about new projects. Obviously, I'm happy that we've been able to make these gearbox cases and covers a reality for Arcimoto while also widening our portfolio by machining components for electric vehicles."

— Ken Jones



Stecker has the capabilities and creativity to tackle challenging projects (small to large).

Visit SteckerMachine.com for more or call Ken Jones at 920-726-5103.