

## CHASSIS

# How to Lose 136 lbs.

## Corvette Z06 sports Dana aluminum spaceframe

By John D. Stoll

**H**opkinsville, KY, is in the racehorse business. Located in the heart of Kentucky's bluegrass pastures, this city of 31,000 people boasts its share of thoroughbred racehorse breeders. Each day, the pounding of hoof beats lends plenty of rhythm to daily life.

In July, that sound will be rivaled by thumping heartbeats at a local 410,000-sq.-ft. (38,000-sq.-m) Dana Corp. frame plant, as it hits full stride in an effort to churn out annually 7,000 of the most-advanced structures ever to underpin a General Motors Corp. vehicle.

The plant continues to build GM fullsize van frames and stamp out parts for Toyota Motor Corp.'s Princeton, IN, truck plant. But this summer it adds Hopkinsville's newest breed of racehorse: The 285-lb. (129-kg) fully aluminum Corvette Z06 spaceframe.

The new spaceframe represents several significant firsts for Dana: Never before has the supplier had primary design responsibility for a frame; it is Dana's first underbody made entirely of aluminum; and it employs the most liberal use of laser welding – 46 ft. (14 m) worth – on a Dana frame.

Dana hopes to replicate the process for GM or other OEMs looking to differentiate a low-volume (10,000 units or less) vehicle program with a unique underbody, Gilberto Ceratti, president-Structural Solutions Group, tells *Ward's*.

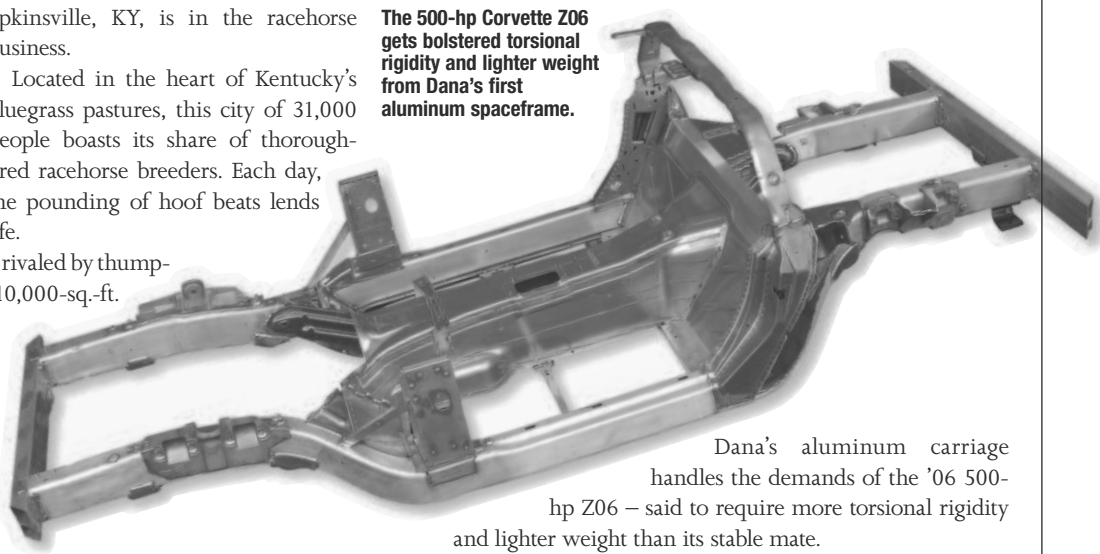
Materials such as aluminum are seen adding sex appeal to high-margin vehicles, such as those playing to the high-horsepower supercar crowd.

"One key advantage for this design is for low- and medium-volume vehicles," Ceratti says. "We can make it reasonable for the customer due to a much lower investment (on their part)."

While auto makers strive to keep underbodies as common as possible to save money for visible differentiation, going with a lighter-weight chassis for low-volume performance models could provide derivatives without breaking the bank.

In the Corvette's case, a less-expensive steel frame built by GM holds together the standard model, introduced in '05, while

**The 500-hp Corvette Z06 gets bolstered torsional rigidity and lighter weight from Dana's first aluminum spaceframe.**



Dana's aluminum carriage handles the demands of the '06 500-hp Z06 – said to require more torsional rigidity and lighter weight than its stable mate.

GM approached Dana four years ago with the task of creating an aluminum frame that would mirror the standard steel frame so the two could share the same assembly line with little process variation.

Ceratti says Dana's proven frame record, combined with can-do determination and a commitment to hitting cost targets, won the business.

"What really drove us here was the innovation and technology," says Mike Laisure, president-Dana Automotive Systems Group, pointing to the Z06 program as a platform for profitable aluminum frame production or chassis components in the future. He concedes, however, the low-volume Z06 program is not profitable for Dana.

"As we move it into the higher volumes, the intent is it will help us improve margins," Laisure told reporters earlier this year. "Obviously we're in this to make money, not just show off our capability."

Hybrid trucks may be the biggest opportunity for Dana to expand its aluminum frame business, company sources say.

Brett Deep, GM's project manager on the program, says Dana is prancing out of the gate, having exceeded GM's targets so convincingly (including coming at least 5 lbs. [2.26 kg] under weight) that he's already moved onto a GM truck program with less than two months until the Z06's Job One.

"There are no issues," he insists.

B.J. Kroppe, director-Dana Structural Solutions product

engineering, says Dana succeeded under the motto, "Same as steel." Same, but different. The Z06 frame boasts at least one major difference: It weighs a crucial 136 lbs. (62 kg), or one-third, less.

Alcoa Inc. brought its expertise from the Ferrari 360 Modena's aluminum spaceframe to Dana's design studio and helped the Toledo-based supplier bang out an aluminum frame that looks nearly identical to the steel one.

Hopkinsville, less than a 90-minute drive to GM's Bowling Green, KY, Corvette plant, is uniquely positioned to initiate the spaceframe revolution at Dana. During a tour, Plant Manager Jerry Bieck says the facility repeatedly has won quality awards and has a laser-weld expert (shared with Dana's Ford F-150 frame plant in Elizabethtown, KY,) on hand to assist with the new technology.

The entire tunnel assembly is laser welded in a high-dollar laser booth that promises maximum efficiency and spot-on accuracy with difficult-to-weld aluminum, according to Dana officials.

In fact, the 21-34 people working on the niche frame line (depending on workload) are themselves laser-weld experts. Bieck says qualified workers – "regardless of whether they're manually welding or not" – had to complete four hours of classroom training specifically for aluminum welding, including mastery of MIG welding; undergo four hours of hands-on training; pass a written test; and complete a manual welding test with 100% accuracy.

"There cannot be any flaws whatsoever" in the laser welds, says Bieck.

The training was extended to each Z06 frame line worker, because Dana wants to have flexibility to plug in players as they are needed, Bieck says. The absence of union representation in the plant undoubtedly plays a role in Dana's ability to flex its workforce.

One thing missing on Hopkinsville's assembly line: spot-weld guns. Dana opted to use 236 self-piercing rivets (SPR), priced at 3 cents apiece, as a bulletproof alternative to spot welds.

GM's Deep insists the SPRs are far more effective joiners, not requiring pre-drilled holes or sealers to fill any gaps. He says SPRs are easier to monitor for quality.

"When you hit a rivet, you know it's there," he says, pointing out it is virtually impossible to misfire a rivet into the aluminum structure given the tooling used. The rivets hold their ground better in a crash,

don't require electricity (air guns do the job) to install and take the same 3-second cycle time needed to produce spot welds.

The aluminum frame requires about 18 minutes to build, with much of the time devoted to precision machining on a 5-axis, high-speed computer-numerically-controlled (CNC) machine located near the end of the line. The unit measures the spaceframe, drills necessary holes, rolls threads and perfects the critical interfaces, including the upper control arm and roof bow cover.

The CNC machining is essential to crafting the Z06 frame to mirror the base Corvette's, so the two can run down the same assembly line with as few variations as possible.

"It basically has the ability to machine within a quarter millimeter plus or minus," Deep says. "We've used it to basically get this frame exactly like the steel one."

Of the 1,777 parts that make up a Corvette, only 11 interface differently with the Z06 than they do with the base model. The magnesium roof, the battery (placed in the rear on the Z06 for weight distribution reasons) and the rear upper control arms are among the critical differences, Deep says.

Hanging the Corvette's fiberglass frame off both aluminum and steel posed a challenge. Dana solved it, dipping the aluminum frame in phosphate and then coating it with a substance that adheres to the fiberglass.

At least one point of differentiation speaks to the utility of aluminum: The rear suspension attachment, placed just aft of the integrated aluminum B-pillar, is a 1-piece casting that is fabricated on the CNC machine. On the traditional steel frame, it is a 5-piece component, welded together and requiring five different sets of tooling.

A similar reduction was achieved with the hinge pillar subassembly.

While this doesn't make the aluminum frame anywhere near as cost effective as the steel unit, it promises improved quality, less upfront tooling and simplicity. Such efficiencies will be necessary if aluminum is going to move beyond niche status.

Deep says GM currently is building a competitive advantage with aluminum, thanks to the Z06 frame project.

"We put a 1-piece aluminum casting on the (steel-frame) convertible as a seatbelt retractor roller assembly instead of four stampings. We did that leveraging what we learned working with aluminum."

Look for more aluminum know-how from GM in the future thanks to the Dana partnership, Deep says. ■

— with Tom Murphy

