Metal Sculpture

To make the 360 Modena larger yet lighter than its F355 predecessor, Ferrari joined forces with aluminum giant Alcoa early in the development process. GIANCARLO ROSETTI takes a look at a remarkable collaboration.

In an advertisement for an older Ferrari, the words "alloy bodied" generally mean three things: One, that the coachwork is indeed crafted of aluminum; two, that the car is rarer than its steel-bodied counterpart; and three, that the price goes up—*way* up.

Owners of 360 Modenas and Spiders are seldom concerned with this particular issue, however, as their cars carry aluminum bodywork by definition. There have been no steel or Fiberglass-clothed 360s so far, and none are in the works.

The importance of this lighter-than-steel metal to the current generation of Ferraris goes far beyond body panels, however: It's an important element of the car's philosophy and design brief, not to mention its construction. Think about how much of the 360 is crafted of aluminum: exterior body panels, monocoque/chassis, engine, transaxle, wheels—even portions of the instrument panel, door panels and console.

When Ferrari set out to design a replacement for the F355 (a process that commenced not long after that car came to market as a 1995 model), the company's engineers and Pininfarina were instructed that the new car needed to be roomier inside, both in terms of passenger and cargo space. No problem there—just make it bigger.

Not so fast: The car's engineers were also given the mandate of increased performance, which did not allow for an increase in weight. If the car needed to get larger without getting heavier, and also needed to improve its performance without a substantial bump in engine power, only one variable was left to manipulate: weight.

Completed 456 chassis—steel frames to which aluminum skins are bonded—await shipment to Maranello.

Just about the time that Ferrari was considering its options, Alcoa came knocking. "In the mid-'90s, a couple of our guys had gone down to Maranello and asked them [Ferrari] what they were doing," says Rick Winter, president of Alcoa Automotive Engineering. "We want to understand what their car builds were looking like, what they were thinking of in terms of next-generation technologies and so forth. We were talking about what we had done, and trying to demonstrate that if they wanted to do something in aluminum, we could help them—but we needed to be engaged early on in the process if we were to bring maximum value to the equation."

The timing certainly seemed right. "We talked, then went away for a bit," Winter continues, "and they thought about it and said, 'We'd like to talk more.' They asked us to do some preliminary conceptual work, and that was the beginning of what ultimately became the 360 Modena. It started off as 'Let's find out what their interests are and tell them a bit about us' and it blossomed into a very close collaboration."

Remember that the then-revolutionary Audi A8 had just come to market, representing the first modern production application of aluminum chassis technology. Alcoa was at the foundation of that development process, and it only made sense for the company to begin shopping its capabilities around the automotive community.

"We'd earned our stripes with the Audi A8 project," notes Rick Milner, president of Alcoa Automotive." They [Ferrari] would have known what our involvement [with Audi] was through the late '80s and early '90s, so we were received with at least some creditability that we knew how to design an aluminum body structure for a car. There was a lot of mutual discovery as we went along."

Adds Winter: "It also gave us an opportunity to test out some new technology. While admittedly at low-volume applications, these things become rolling test beds, and then we could look for ways to take that to higher volumes. On a whole bunch of fronts, this matched up very nicely with what we wanted to do."

Perhaps the most interesting aspect of the process, both from a relationship and physical standpoint, can be found on the floor of the Scaglietti body facility in Modena, where the 360 chassis/body structure is built up. According to Milner, "To be specific, we have an Alcoa facility inside Scaglietti. It's staffed by Alcoa employees, [and this portion of the facility is] run by Alcoa with our safety standards, people values and all the rest." Truly a plant within a plant.

Winter elaborates: "Our employees there manufacture the body/frame, and various and sundry assemblies. Then it's wheeled through the door, onto Ferrari's body assembly line."

This certainly must be one of the more unique supplier-to-customer handoffs in the automotive industry. The Alcoa-built chassis is mounted on a wheeled dolly and rolled through a curtain, at which point Scaglietti employees in the Ferrari-owned and -run portion of the line take over.

And it all takes place under one roof: "We are integrated right into their body assembly line," says Winter. "We build up the front assemblies, the rear assemblies, the passenger cell, weld them all together, go through all the checks and machinings. The rest of the Scaglietti plant puts on the remaining panels and skins, and then it's out the door."

The completed body structure proceeds to Ferrari's computer controlled coordinate measuring unit, where a total of 531 body points are checked to verify the dimensional accuracy of the overall build and machining processes. Completed body/chassis assemblies are then shipped to Maranello for the rest of the assembly processes.

It's interesting to note that the chassis, once complete, requires no additional heat treatment, thanks mostly to its use of 6000-series aluminum alloys, primarily 6008. "There is no additional thermal process," notes Winter. "We don't bake the body after it's assembled. The heat-affected zones, joints and members have all been designed and sized to be able to carry the final loads with the structure as it is. There's no 'full-body age' or full-body heat treatment to try to get [metallurgical] properties into a different state or condition. These properties are more than adequate as they are."

Four to five different aluminum alloys, each possessing different metallurgical properties, are found in the 360's

ALL DOWN THE LINE: After the frames are welded together in Alcoa's plant-within-a-plant, Scaglietti takes over to install the sheet metal, itself a product of Davenport, Iowa. The aluminum is hand-finished before the bodies leave Modena for Ferrari's paint shop in Maranello.

structure: one for extruded pieces, a few different mixes for cast pieces plus another "sheet alloy" that's used for the exterior body panels—the latter made by Alcoa in Davenport, Iowa. Yes, one of this most Italian sports car's essential coachwork elements is made in the United States—a far cry from the old days of Italian body craftsmen beating out aluminum panels over the proverbial tree stump! All corrosion-proofing coatings, paint and other finishes are applied to the structure on Ferrari's own paint lines in Maranello.

Many lessons learned on the A8, and some of the processes developed therein, found their way into the 360 project. One is called AVDC, or Alcoa Vacuum Die Casting process. Notes Milner:

"It's a process that can make reasonably large, thin-wall castings with historically high elongations, so that they could be part of the crash structure. This is so the parts will fold rather than break in a crash. This enables them to be part of any car's crash. management system."

Headaches? Amazingly few, according to Winter: "I wouldn't use the word headache, but both sides had a lot of learning to do. Strictly speaking, we were not an Italian-literate company, at least from an engineering standpoint. And Ferrari was not an English- and German-literate company, so we worked on building relationships and communications early on, and that helped a lot. We've done a lot of remote work here in North America and in Europe, and both sides had to learn how to deal with the data, and pushing things back and forth.

"We credit Ferrari's engineering group; they were more than willing to meet us halfway in terms of talking through what they were trying to do, and keeping us in the loop. We were in and out of Maranello and Modena quite regularly, and they visited our locations as we went along."

Another headache that didn't happen: The techs and specs of Alcoa's involvement in the 360 could have become the subject of some interesting litigation. An August 2001 article in *Auto Week* magazine describes Ferrari's filing of petitions to stop the importation of Euro-spec, "gray market" 360s (and other models) into the U.S. In brief, Ferrari's position is that its cars, while substantively the same, are not identical for all markets, and that a "gray" cannot be properly retrofitted to meet North American safety and emissions requirements. The opposition, mainly dealers and privateers who've been importing these vehicles for resale and profit, allege that Ferrari is effectively attempting restraint of trade.

The *Auto Week* piece states that one dealership, Berlinetta Motorcars in Huntington, New York, alleges that "Ferrari planned to say aluminum used to produce European and U.S. 360 chassis differed, making the European model unsafe for U.S. use."

The operative words are "*planned to say*." In fact Ferrari has *never* made such a statement, and while it maintains that there are many differences between the Euro- and U.S.-spec cars, none of them relate to the aluminum used in the chassis or bodywork.

SPOTLIGHT

The Stuff That Dreams Are Made Of

The 360 Modena's body structure is composed of the following aluminum components:

— Twelve sand castings produced in Ferrari's Maranello foundry.

— Six Alcoa Vacuum Die Castings (AVDC) produced by Alcoa Automotive in Soest, Germany.

— Forty-seven extruded components for the main spaceframe and nine for the greenhouse structure, all produced from extrusions supplied by Alcoa Europe in Drunen, The Netherlands, and finished in Alcoa's plants in Soest and Modena.

— Seventy sheet stampings and assemblies produced in Italy from automotive body sheet made by Alcoa in Davenport, Iowa.

Sand Castings

The Modena utilizes 12 sand castings manufactured in Ferrari's Maranello foundry. These castings are 100% X-rayed to ensure freedom from porosity. They display a high degree of fracture toughness because they must contribute to the crash-worthiness of the overall body structure.

Die Castings

Six die castings produced by Alcoa Automotive in Soest, Germany using the AVDC process are used in the greenhouse structure. This casting process was developed by Alcoa for body structure castings used in the Audi A8. AVDC castings are thin wall (2mm or less), have very little porosity and a high degree of elongation and fracture toughness.

Extruded Components

A total of 56 (47 + 9) extruded components are used in the body structure of the 360. Of the 47 main spaceframe extruded components, three are bent using a rotary draw bending process and the rest are straight length. All of the bending and much of the required machining is performed by Alcoa Automotive in Soest, Germany. Of the nine extruded components in the greenhouse, seven are formed in Soest using the stretch-bending process to achieve the complex geometries required of the car's design.

Sheet Components

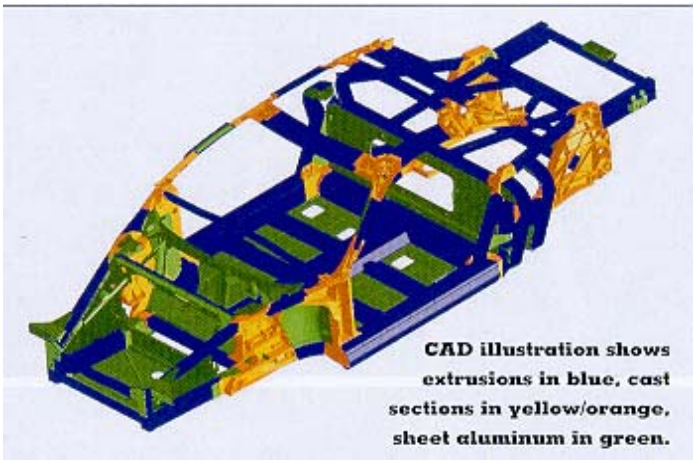
The 360 spaceframe includes 70 sheet stampings and assemblies attached to the structure by Alcoa in Modena before the body structure is delivered to Ferrari's body-in-white production line. These components include the main floor assembly and the close-out panels for the luggage and engine compartments. All of the sheet is produced by Alcoa in Davenport, Iowa, and shipped to Italy.

Note: These figures are for the 360 Modena; the 360 Spider's structure is fundamentally the same, though it differs in the exact number of panels due to the open roof and tonneau cover.

Alcoa has confirmed the same: "Fact," states Alcoa public relations spokesman Philip Morton, "there are no alloy or any other metallurgical differences in the aluminum frame we manufacture for Modena, relative to what we would deliver in the U.S." While Ferrari's legal jockeying with DOT continues, it does not involve Alcoa or the 360's underpinnings.

In the grand scheme of things, the amount of aluminum consumed by 360 Modena and Spider chassis production—at something like 2,400 units per year—must be a mere drop in the bucket to a large, multinational company like Alcoa. Why would such a tiny contract be of any importance? Milner identifies three factors.

"First, we had only done the A8 so far. We were still trying to understand what the actual applications for aluminum in cars would be, and here was a willing partner. Second, Ferrari is a world leader in terms of design, performance and the like, and having our favorite metal be on a car like that would give us extensive visibility and PR. Finally, from a strategic standpoint, they're part of the Fiat group. Fiat makes lots of cars, and is now connected with GM. We want to put more aluminum on higher-volume cars, and we felt this was also a good way in. Most of these applications whether they're automotive, aerospace or whatever, tend to start at the top end and work their way down [into lower-cost, higher-volume products.]"



CAD illustration shows extrusions in blue, cast sections in yellow/orange, sheet aluminum in green.

What about the financial side? Many businesses will take on such projects at a break-even, or even a loss, just for the PR buzz they generate. Is that the case here?

"No. It's a profit center," Milner says. "We're a $25 billion company, so from a [pure dollar] standpoint, it doesn't move the needle much. But more than that, it's a very important relationship. What's really unique here is the depth of the cooperation, how early it started and the openness of both sides to understand what the other could do. With other clients, it's sometimes been tough, because there were so many fixed requirements before we went in that we were not able to optimize the use aluminum. Ferrari is as good an example as we've had with early-on, in-depth, all-eyes-on- the-same-goal cooperation, and that's why it's a success."

The numbers certainly attest to that: By using aluminum instead of steel, the Ferrari/Alcoa engineers were able to reduce the weight of the 360's chassis by 28% compared to that of the F355, while interior volume was increased by 10% and structural rigidity by 40%. Even the 360's wheels benefited from advanced aluminum technology: Each of the 360's aluminum wheels is 2.2 lbs. lighter than its *magnesium* counterpart as fitted to the F355.

Overall, the dry weight of the 360 is 220 lbs. lighter than that of the F355. Combined with the power increase that the Ferrari engineers were able to attain— 25 additional horsepower from a displacement increase of just 90cc—the weight-to-power ratio in the 360 drops to just 7 lbs. per horsepower vs. nearly 8 lbs. in the P355. In short, Ferrari achieved all of its design and performance goals for the 360 Modena, thanks to the use of aluminum and a fortuitous partnership with Alcoa.

And not a tree stump in sight! •