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PONTIAC AWD 6000

Engineering 'SWAT Team' relied on mockups to develop new drivetrain design

Lars G. Soderholm, V.P. & Editorial Director

Warren, MI—When General Motors decided to produce an all-wheel-drive version of the 1988 Pontiac 6000, the company was determined to design its own system rather than going outside and purchasing one.

The engineering task was to modify the front-wheel-drive Pontiac 6000 so it would have an automatic transmission along with a full-time AWD. What was different about

this project was that the system had to handle the 3.1ℓ 138-hp V6 engine slated for the 6000 STE. Most of the existing AWD cars at the time had 2ℓ engines or smaller.

What also made this project special was that it skirted the conventional organization at GM and relied on the talents and energies of a select group of engineers and support people—a technical "SWAT team" if you will.

On their own

The person selected as the AWD program manager was Dave Hensley of GM's Advanced Vehicle Engineering unit. Acting with the approval of V.P. Advanced Engineering Don Runkle, and Chief Engineer Jack Turner, Dave assembled a small group of people whose efforts were dedicated entirely to the AWD modification effort. The entire group did not exceed 35 people,



Engineering 'SWAT Team' developed the AWD system so that the Pontiac 6000 STE models equipped with the option could be assembled right along with other models. About 2000 will be produced this year.

AUTOMOTIVE

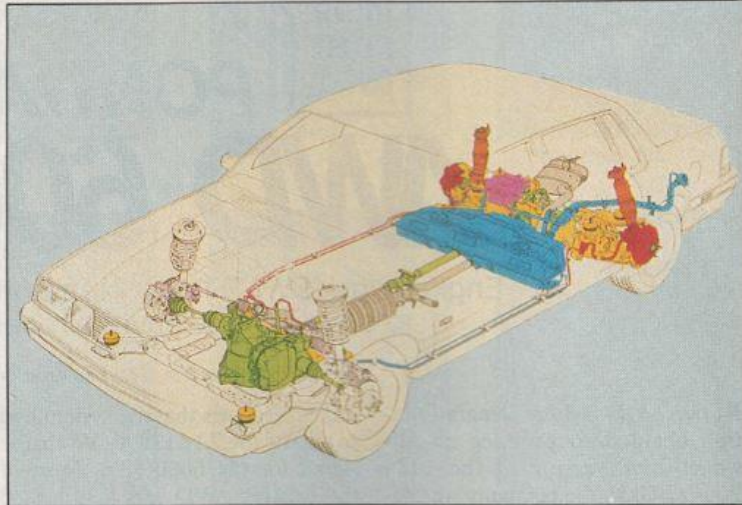
and this included engineers, technical support personnel, accountant, and bookkeepers.

To make the concentrated effort easier, the entire group was moved to a location away from the GM Technical Center. There, engineers worked to design an active mockup of the underside of the Pontiac 6000 vehicle. The mockup consisted of everything from the beltline down, and it was mounted upside down so everyone concerned with the modification project could try their ideas on it, as the work of fitting and positioning new drivetrain components began.

Hensley's team included Jim Steele and Laslow Nagy, both veteran powertrain and vehicle engineers who had earlier design experience in the all-wheel-drive program. Joining them on the project were two chassis engineers, a body engineer, and an electrical engineer.

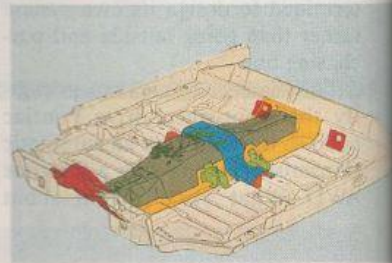
The word got around about this engineering "SWAT Team," and soon more people volunteered to join the group. Hensley asked each of them: "What are you going to do for me and the project and do you have any unique ideas on how to accomplish our task?" If the applicant did not have a logical answer to the question, that person was sent away. There were a lot of volunteers, recalls Hensley, who simply thought that working off by themselves would be nice. "I knew it was going to require hard work," he adds, "and I wanted those people who considered the project as a challenge and had something to contribute."

Hensley found himself in the role of an entrepreneur, in effect running a "company" within a company. He had responsibility for nearly every aspect of the project—budgets, scheduling, and contacts with vendors and other departments in the company. As part of the process, he also had authority to bypass or modify some of the



Pontiac 6000 STE is first GM passenger car application of full-time all-wheel drive. The design team used existing components where possible and packaged new parts of the drivetrain and suspension to fit existing space. Colored sections show major elements of the system, including redesigned two-part drive shaft and fuel tank with capacity increased from 15.7 gal to 18 gal.

Stock floorpan had to be modified to accept larger exhaust system and propeller shaft.



stops outlined in standard operating procedures. This speeded up response time, but everybody wasn't happy. "I irritated some people by shortcutting conventional methods," says the engineer, "but if you didn't do this, you couldn't get anything new or different done."

A packaging problem

The engineering job was simple enough to state—but tough to attain. It was primarily a packaging problem and required additional parts to convert a standard two-wheel front-drive car into an all-wheel-drive car. The design was to be used on a limited production vehicle, but one of the rules was that it had to be assembled on a regular production line, along with the standard Pontiac 6000 cars. This meant that the AWD car could not be drastically altered in any way.

It could not be raised to accommodate the extra drivetrain parts. The modification had to produce a car that looked the same as the standard car and assemble very nearly in the same way.

The packaging of parts began the very first day on the mockup in the engineering "SWAT Team" quarters. The mockup provided a focal point for new ideas and the testing of those ideas on an actual installation. Since everyone was located near the mockup, all members of the team could overhear plans, problems, and action decisions. And they could enter the discussion if they were concerned with any aspect of it.

Actual parts were set in place and powertrain connections tried and varied to get a good combination. The mockup was also the meeting place for discussions with vendors,

purchasing department people, and anyone else associated with the project. Discussions were often long, loud, and sometimes heated as the design team developed a unity of

GM10, and a Hydramatic produced AWD transfer unit.

But assembling these parts didn't guarantee a working AWD unit, and the work required to get all the

the right length/angle combination for the shaft.

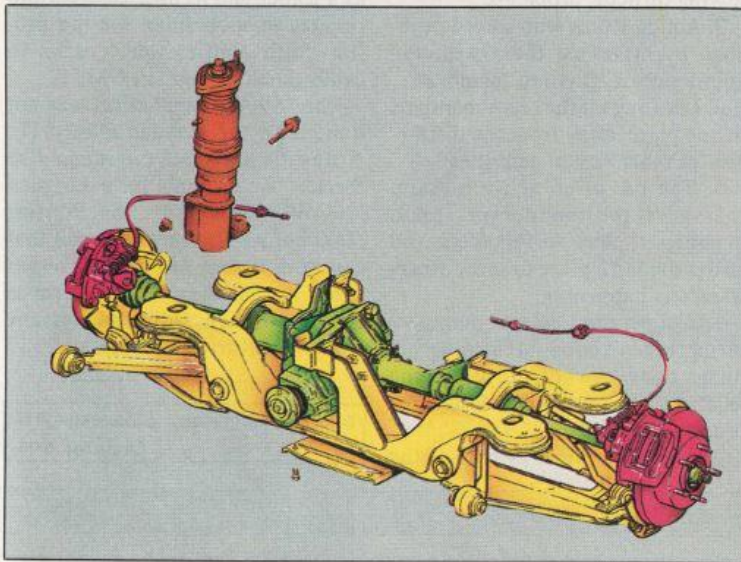
Designed for assembly

Since the production vehicle was to be built on a regular assembly line, the prototype vehicles were also built on a regular assembly line. So assembly line personnel had to be told that somewhere among the standard Pontiac 6000 vehicles a different version would show up and would have to be put together. The manufacturing group was briefed, and they were ready. "It was amazing how hard these people worked to assemble the AWD car," says Hensley. "They would pitch in when things got tough and would point out to us things we could do to make the car easier to assemble."

More often than not, the SWAT team incorporated these suggestions in the final design plan.

The AWD project started in July, 1986. The first pilot prototype was made just five months later in December at the Tarrytown, NY, plant. The design team continued with its work, generally adhering to Hensley's schedule. Finally, in November, 1987, the first pre-production car was made in the Oklahoma City plant. The first production Pontiac 6000 AWD cars rolled off the Oklahoma City assembly line in March 1988. About 2,000 of the model will be built in 1988.

It took some unorthodox methods, but Hensley and his engineering "SWAT Team" got the job done. But any suggestion that Hensley is a maverick doing things his own way is discounted quickly by Dave himself: "I am a company man and the team concept I used has been discussed in corporate planning sessions. I used a practical approach to solving a design problem involving a limited production car. This is now part of the corporate experience and the same approach can be used to solve problems elsewhere." →



Rear drive module consists of stamped steel carrier insulated by rubber pads. Housed in carrier is an axle unit used in GM T-series trucks. Independent rear suspension is incorporated in AWD system.

purpose and battled anyone they thought was not doing an adequate job or did not understand their needs.

The job of packaging the drivetrain components went slowly. To accommodate the new AWD drivetrain, the stock floorpan had to be modified to accept the larger exhaust system and the propeller shaft. In front, it was discovered that the stock engine cradle had to be redesigned to allow space for shifting the position of the power steering rack, the AWD transaxle, and the tailshaft. To save critical space, a three-speed THM 125 automatic transmission was installed instead of the THM 440 four-speed transmission that is standard on the Pontiac 6000.

Many of the rear drive parts were existing parts like the S/T truck differential, suspension struts from

components together in proper fit was tedious and frustrating. "We were lucky to have a lot of young engineers who didn't know it couldn't be done," notes Hensley.

The hard work of the design team was aided by efforts of the vendors. Hensley's team didn't tell the vendors what they wanted; they simply took them to the mockup and showed them what the problem was. Soon, they joined the GM team in seeking solutions.

Several parts had to be designed for the AWD modification. In addition to the engine cradle, a new saddle fuel tank had to be developed. The tank had to accommodate the exhaust system and propeller shaft. It even included a pumping system for even fuel distribution inside the tank. Another new design was the two-piece propeller shaft. Engineers spent considerable time designing

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TIME LINE FOR DESIGN

1986

JULY AWD project begins.

1986

DECEMBER First prototype system manufactured in Tarrytown.

1987

NOVEMBER First pre-production car AWD produced in Oklahoma City.

1988

FEBRUARY First production AWD cars roll off assembly line.

When asked what he thought was the key to successful completion of the AWD project, Hensley cites several things—

1. Good up-front engineering by capable engineers who persisted in solving difficult problems.
2. Action teams who solved problems by attacking them with the knowledge of all group members.
3. Locating all the team members in one place, away from the distraction of other design activities.
4. The use of an active mockup that gave the engineering team members a place to test ideas and also provided a place to show others what was happening.
5. Cooperation of the manufacturing organization in helping get things done quickly and providing feedback on improving design for process capability.
6. Using suppliers as part of the

design team and asking for their help as partners in design.

Hensley might also have added two other important ingredients: the dedication of a small group of engineers and his own skills both as a leader and as an articulate and persuasive spokesman for the project. Such abilities were crucial in dealings with others in GM.

The "SWAT team" effort was not limited to the Pontiac 6000 STE. Notes Powertrain engineer Jim Steele: "We not only have designed an AWD system for the Pontiac 6000 but we also have a design that can work for any of Pontiac's bigger cars." An observer can also surmise that the design will work on any front-wheel-drive GM car. □

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