ROAD MAP FOR ENGINE OILS

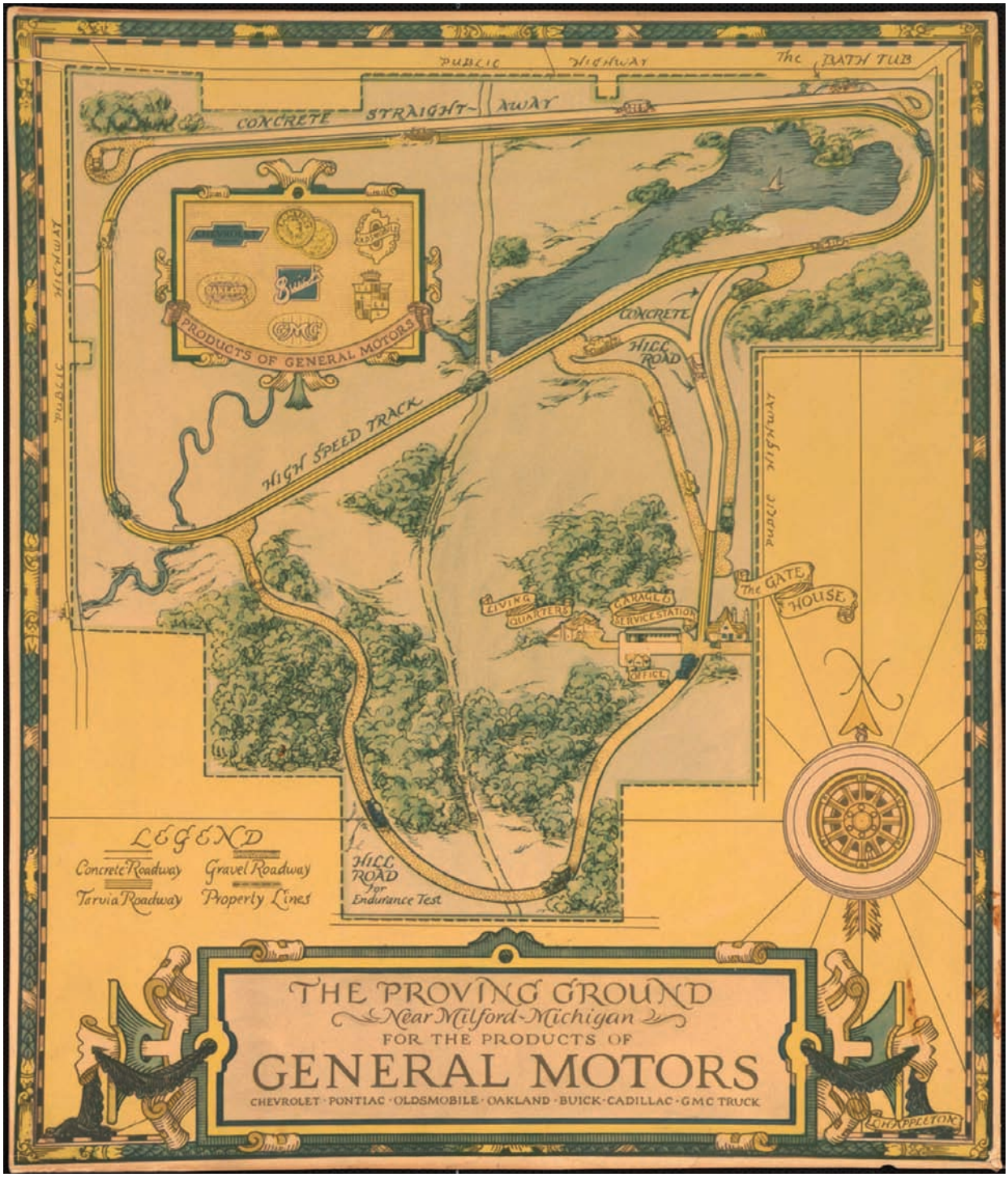

Photo: GM

Dynamometer testing at GM's Milford Proving Ground may hold the key to boosting the fuel economy effect of engine oils.

'Six D' Fuel Economy Test Points the Way

HANDS DOWN, THE MOST QUOTED PHRASE IN PRESIDENT BUSH'S JAN. 31 STATE OF THE UNION ADDRESS WAS HIS DECLARATION, "AMERICA IS ADDICTED TO OIL." RARELY QUOTED, HOWEVER, WAS HIS NEXT SENTENCE: "THE BEST WAY TO BREAK THIS ADDICTION IS THROUGH TECHNOLOGY."

Months earlier though, as if anticipating the President's technology focus, the auto industry's International Lubricant Standardization and Approval Committee (ILSAC) had embarked on a new technology initiative: to develop a gasoline engine sequence test that would more reliably, accurately and consistently measure the fuel economy provided by engine oil.

This fired engine test, called the Sequence VID ("Six D"), is urgently needed before 2009, the automakers say. That's when the next generation of gasoline engine oils, GF-5, are to debut. Their goal is a laboratory instrument that will prove the fuel economy gains that may come from optimizing engine oil viscosity and — maybe more importantly — from using high levels of friction modifiers, an important engine oil additive.

"We want the best fuel-efficient oils," stated Mike McMillan, a consultant to General Motors who also speaks on behalf of ILSAC. "The only way we will get them is if, during the GF-5 qualification process, there is a test that demands highly friction-modified oils and can measure the improvement.

"The current fuel economy test, the Sequence VIB, a GF-4 requirement, does not measure the full effectiveness of highly friction-modified oils in many engines," he said. "This position is widely supported in ILSAC."

A proven VID could open the door for the motor oil industry to do its bit to break the U.S. "addiction to oil" — and also to formulate, commercialize and promote higher-value engine oils that maximize fuel economy. And that opportunity is only a few years away.

Parallel Tracks The VID initiative is under way along two parallel tracks. On one track is the test's technical development, with oversight and funding by the Sequence VID Test Development Consortium, an interindustry task group. The second track — pursued by the auto companies — is developing data to correlate the new VID with results from the field, using Federal Test Procedure dynamometer testing.

Nine companies are in the VID Development Consortium, steering the effort and directly participating in the technical discussions and decisions. Seven oil and additive companies (Afton Chemical, Chevron, Chevron Oronite, ExxonMobil, Infineum, Lubrizol and R.T. Vanderbilt) joined by dint of contributing $300,000 each, and two auto companies (General Motors and Ford Motor) are members by virtue of contributing FTP correlation data. Other companies may join the Consortium by paying associated fees, but non-members are excluded from the technical debate and decisions.

Linden is the Consortium chairman, and Charlie Leverett of Intertek Automotive Laboratories is the program manager, with day-to-day oversight. The American Petroleum Institute is providing the Consortium with financial management and secretarial services, but neither it, nor ILSAC, the American Chemistry Council, the Japanese Automobile Manufacturers Association nor any other trade group is authorized to participate in the Consortium as an organization.

BY DAVID McFALL

Design work on the VID test has been under way since January, at Intertek and at Southwest Research Institute, both independent test laboratories in San Antonio, using a 2006 GM 3.6-liter V-6 engine, with dual overhead cams. VID proveout testing is scheduled to begin in early 2007, followed by a precision matrix ending before midyear 2007. The completed test will then be turned over to ASTM for consideration as an ASTM-supported standard and inclusion in the GF-5 specification.

The FTP Track The major FTP testing effort is being undertaken by General Motors, using four cars at its 4,500-acre Milford Proving Grounds in Michigan, about 40 miles west of Detroit. GM's investment in FTP data for the VID test represents about $2 million. Ford, too, is planning a $1 million test program using one car, and additional FTP testing may be carried out by Japanese automakers and DaimlerChrysler.

Today's fuel economy tests for motor oil were also based on FTP data — data that was generated three decades ago, pointed out Jim Linden, staff scientist at General Motors R&D. "Since that time there has not been fuel economy data obtained to correlate with subsequent fuel economy tests. Our new vehicle data will correlate with GF-5's new VID."

"The current test, VIB, is not a particularly sensitive test in terms of measuring the frictional characteristics of an oil," McMillan added. "The additive companies have told us that they have basically saturated the oils — in terms of its effectiveness in the VIB — at fairly low levels of friction modifiers. In other words, the benefits of additional friction modifier cannot be measured in the VIB.

"But," he went on, "GM and other auto companies are aware of oils currently in commercial use, especially in Japan, which, if run in an FTP program, will result in very good fuel economy improvement, up to at least 1 to 2 percent over currently available commercial oils. But if you run those same oils in a VIB, while you see clear viscosity discrimination and some measurable fuel economy improvement, it is not nearly the level you see in vehicle testing — that is, FTP testing."

By contrast, McMillan noted, the fuel economy improvement of today's ILSAC GF-4 oils over their predecessors, GF-3, was in the range of only 0.2 to 0.3 percent, as measured by the Sequence VIB. "Those are not insignificant numbers, but our evidence strongly indicates that a far larger fuel economy benefit is possible."

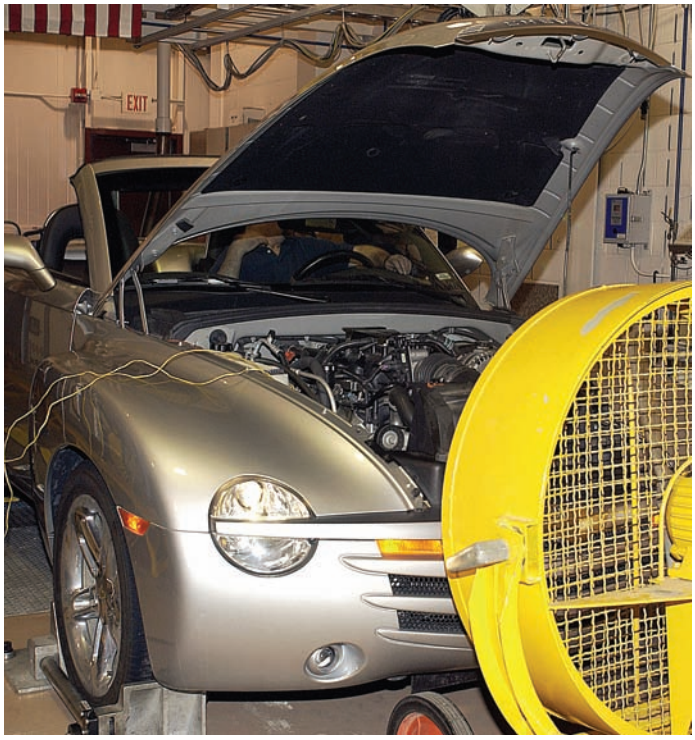

Photo: GM

A Chevrolet SSR goes through the FTP regime on a dynamometer at Milford, while sensors record every change in speed and power. GM is performing 500 FTP tests to amass fuel economy data.


Jim Linden

Linden's data confirms this point. "The VIB does not show the same level of responsiveness to highly friction-modified oils as do our FTP tests," he said. Hence, the massive push to come up with a valid VID.

What's an FTP? EPA established the Federal Test Procedure in 1975 as the standard test to measure emissions and fuel economy. This is the test used to determine each auto manufacturer's Corporate Average Fuel Economy (CAFE), and is the basis for the fuel economy figures shown on the window stickers of new cars.

There are two parts to the FTP test. The "city schedule" includes 23 stop-and-go driving cycles (including "cold" start and "hot" start portions), while the "highway" schedule involves about 10 miles of higher-speed driving.

Gus Mitsoupoulos, a GM employee for 55 years, manages the Milford R&D Chemical & Environmental Sciences Lab, where the FTP testing is taking place. "We'll have substantial resources in this lab devoted to FTP testing for the better part of a year," he declared to a visitor from *Lubes'n'Greases* in late January. "It is the most important effort under way here."

Linden, who's in charge of the FTP testing program, explained, "We're running multiple FTP tests here for the single purpose of providing up-to-date vehicle test data for GF-5. FTP testing for the GF-5 program at Milford is not related to an emissions goal. Its sole purpose is to develop baseline data that will be used to set conditions and weighting factors for the VID."

Four GM cars are being used (Chevrolet SSR, Pontiac G6, Buick LaCrosse and Saab 9-5),

representing a cross-section of engine design. Each car is mounted on a chassis dynamometer, where the car's driving wheels run on a rolling drum which records changes in speed, braking, etc.

The dynamometer cycles are EPA-defined to account for a variety of road conditions and situations, and GM is able comfortably to run at least two separate FTP tests per day, four days a week, for a total of eight FTP tests every week.

Ten oils are included in this test battery, each GF-4/API SM capable but otherwise varying by viscosity grade or friction modifier. A baseline oil, with no friction modifier or viscosity modifier, is run before and after each test. Then the fuel economy improvement of each test oil is measured as a percent improvement over the baseline oil at 2,000 miles and at 6,500 miles, to account for oil aging.

The test oils vary by detergent-inhibitor additive package, Linden pointed out, as well as viscosity grade, and types and levels of friction modifier. There are organic friction modifiers, molybdenum friction modifiers, and combinations thereof. There are also products without friction modifiers, to allow an evaluation of viscosity effects. (See table, right)

In all, more than 500 FTP tests are planned, and "the testing program is on schedule and is expected to be completed by September 2006," Linden reported. "Our goal is to run all 10 oils in all four vehicles. We expect to complete the two primary vehicles, the Buick LaCrosse and Pontiac G6, by the end of the third quarter. If we run into scheduling difficulties it may be necessary to not include all 10 oils in the two supplemental vehicles [the SSR and Saab 9-5] but our goal is all four vehicles tested with all 10 oils."

As testing of each oil is completed, the FM data goes to a panel of statisticians for analysis. Each major additive company has volunteered a statistician to analyze the data with feedback to the Consortium; oil company statisticians may also participate.

TEST OIL MATRIX

All Oils = ILSAC GF-4/API SM

DI Package 1

A 5W-20 (no FM)
B A + Organic FM-1
C A + Moly-type FM-1
D A as 5W-30
E A as 10W-30

DI Package 2

G D with DI-2
H G + Organic FM-2
I G + Moly-type FM-2

DI Package 3

J 0W-20 + Moly FM-3
K 5W-20 + Moly FM-3

Z Baseline oil (SAE 10W-30, with no FM and no VM)

Note: The procedure also uses a flush oil, which is the baseline oil with 5 times the detergent. DI=detergent inhibiter. FM=friction modifier. VM=viscosity modifier.

Market Impact Who wins if there's a VID in the GF-5 test battery that accurately and reliably measures the fuel economy benefit of oils made with high levels of friction modifiers?

Of course consumers will win, with better fuel economy, the automakers believe. Moreover, GF-5 oils will be backward compatible to all earlier gasoline engine oils, so the benefits of the Sequence VID will spread to all gasoline fueled vehicles on the U.S. roads — some 230 million in 2004. If applied to all of the gasoline-fueled vehicles in the United States, GM estimates, every 1 percent improvement in fuel efficiency would save 1.4 billion gallons of fuel a year.

For the oil and additive industries, the Sequence VID could open the door to marketing a premium oil that would conserve fuel, but would not necessarily impact on the volume of lubricants sold. Today, oil marketers say, the VIB test only allows them to claim minimal fuel economy benefits. If the Sequence VID proves an oil offers substantial discernible fuel economy gains, experience suggests that a defined market may very well emerge, similar to that for higher-mileage engine oils, synthetics and high-endurance products.

Finally, vehicle manufacturers will reap a direct benefit: demonstrably higher CAFE numbers. They can be expected to factory-fill the best fuel economy oils, and may also recommend them in owners' manuals.

As McMillan noted, "Improvement in CAFE is very important to all the auto companies. They continually look at the trade-offs to meet CAFE requirements. Except for engine oil, the trade-off alternatives to meet CAFE numbers are very expensive — a change in engine design, for example, or taking more weight from the vehicle. But fuel economy improvement from engine oil comes at minimal cost to an auto company."

He also cautioned, "There may not even be a trade-off opportunity. The car CAFE limit now is 27.5 mpg for the fleet. But we all know there are moves afoot in Washington to increase that limit, with some proposals recommending substantial increases. If the numbers are driven up very high, auto companies will need everything possible to meet them — from combustion improvements, weight reductions and engine oil fuel efficiency improvements. Everything." ▮

FUEL ECONOMY IMPROVEMENT

(Preliminary FTP Results)