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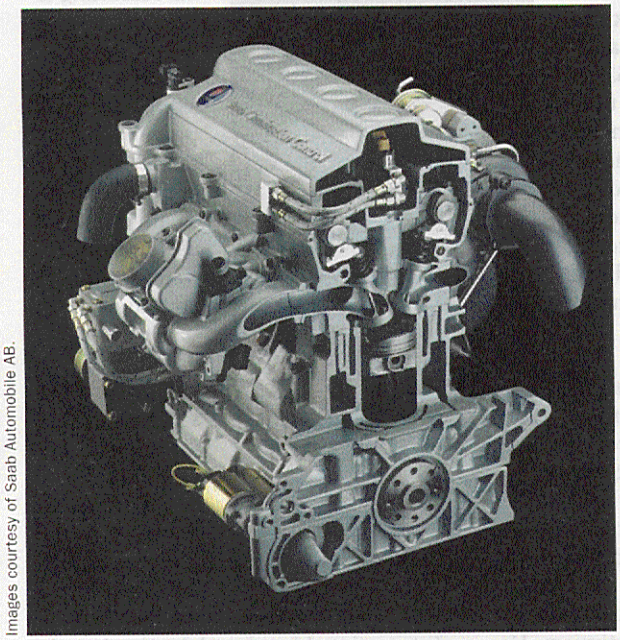
A Green Internal Combustion Engine

THE road to tomorrow's automobile engine is filled with many potholes and winding curves. Perhaps the most interesting curve is a new internal combustion engine developed by Saab and General Motors engineers (Fig. 1). Saab Automobile AB is a Swedish automobile-manufacturing subsidiary of General Motors. As of January 2001 GM owns 100 percent of Saab. GM has given Saab the green light to research and develop new cleaner and leaner internal combustion engines.

The SCC system removes most engine emissions by pumping exhaust gases back into the combustion chambers for re-burning with just a few drops (about 1 percent) of new gasoline. This process reduces gas consumption by about 10 percent without adversely affecting the car's performance. The gasoline percentage in the combustion chamber is variable and determined by engine load. It incrementally increases when the car accelerates and it decreases when the engine idles.



Images courtesy of Saab Automobile AB.

Fig. 1—Saab and GM's new internal combustion engine.

Technology friendly to the environment is often referred to as "green." A car with this engine could be called a mean green driving machine since the engine actually exceeds the U.S. Ultra Low Emission Vehicle Standards (ULEV2) that go into effect in 2005. The engine's power performance is slightly better than a conventional internal combustion engine's even though it uses less gas and produces very low emissions. Figure 2 shows the engine's internal structure.

Eric Olofesson, chief Saab engineer on this award-winning project, tells me that the average 2001 Saab internal combustion engine produces 75 percent more nitrogen oxide emissions and twice as much hydrocarbon and carbon monoxide emissions than this new SCC engine.

To run green, this engine does a lot of things that engineers haven't thought of in the past. It is a direct, compressed-air-assisted gasoline-injection engine that adjusts its fuel to exhaust fumes ratio based on the performance needs of the vehicle.

The engine's camshafts allow driving conditions to change the valve timing. Here the inlet and exhaust valves change their timing to adjust the mixture of gases in the combustion chamber. The air, gas, and exhaust fumes mixture will often contain up to 70 percent exhaust fumes, which would create major ignition problems if not for a variable spark plug gapping system.

The SCC engine's spark plugs have a variable gap that is electronically controlled to match the spark intensity needed to explode the variable gas mixture in the combustion chamber. At the end of the process, the fumes that do make it out of the tail pipe contain mostly water vapor, nitrogen, and carbon dioxide.

You can learn more about the SCC engine at **www.saab.com/home/GLOBAL/en/pressreleases.xml**. You can also enter ULEV2 into your internet search engine to gain further insight into the technology behind this engine.

Why are engines like the SCC so important? At inspection an automobile must meet the emission standards that were in effect when the car was manufactured. Legal emissions are constantly being reduced. California's Air Resources Board has on its books the strictest air pollution standards in America. By 2010 California expects automobile manufacturers to produce cars that will reduce smog-forming emissions in the greater Los Angeles area by 57 tons a day. You can learn more about LEV2 at **www.dieselnet.com/news/9811carb.html**.

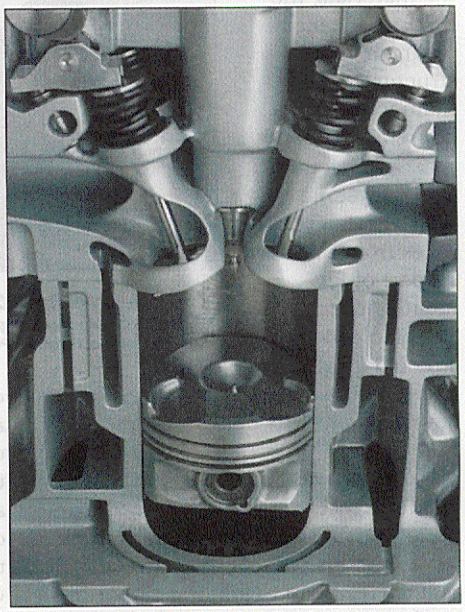


Fig. 2—Internal structure of the new engine.

Recalling the Facts

1. Why does the SCC engine pump exhaust fumes back into the combustion chamber?
2. What determines how much exhaust fumes are pumped back into the combustion chambers?
3. In the area of engine performance, fuel economy, and environmental emissions, how does the SCC engine compare to a standard internal combustion engine?