THE AOPA Pilot

Single-Grade Avgas On The Way

A check with the oil industry, engine manufacturers, and FAA surfaces trend to eliminate Grade 80/87 and pave way for use of new low-lead Grade 100/130 by all piston-powered aircraft

by LEW TOWNSEND / AOPA 376636

The concept of a single aviation gasoline for general aviation's predominantly piston-engine fleet of about 140,000 aircraft has been a topic of sporadic discussion and effort within the oil industry since the mid-1960s. It was at about that time when most airlines had completed their switch from gasoline-burning prop jobs to kerosene-burning jets, and overall avgas sales had dropped drastically.

The single avgas concept is closer to reality than most are aware. A recent survey by The PILOT of major fuel producers, along with interviews of appropriate FAA and engine-manufacturing officials, revealed there could be one single avgas for general aviation as early as mid-1973. It could come sooner.

Chances already are better than even that linemen at most major airports will shake their heads "no" when asked if Grade 80/87 is available. "Just Grade 100/130," is the word at a growing list of the big fields.

Latest information points to the fact that the avgas situation at the biggest airports merely represents the tip of a much larger marketing iceberg that is moving inexorably toward total consolidation of all aircraft gasoline needs (read general aviation) into one basic grade-level of fuel. And, there appeared little doubt that the one standardized avgas would be a Grade 100/130. Specifically, it is expected to be a new low-lead Grade 100/300 now being distributed and sold nationwide by most major oil companies.

Like all important actions affecting a wide range of people and companies, a move by the oil companies to meet all avgas requirements with a single grade of gasoline represents a tangled mixture of both good and bad features. Quite understandably, determinations of whether the benefits outweigh the disadvantages, are, for the most part, colored by how such a move personally affects the person or company making the determination.

In brief, two grade-levels of avgas basically are now available: Grade 80/87 and Grade 100/130. Grades 91/98 and 108/135 "have essentially been eliminated," according to the oil industry. Biggest users of Grade 80/87 are owners and pilots of general aviation's lower-powered aircraft, which include such aircraft as Cessna's Model 150s and 172s, Piper's *Cherokee 140s, Super Cubs* and *J-3s*, American Aviation's *Yankees*, and most of the sizable number of "homebuilts" that are now flying.

Without getting bogged down in statistics, FAA's engine specialists estimated about 85% of all piston engines certified by the agency over the past 10 years were certified to allow use of a minimum of grade 100/130 avgas. About 92% of all engines coming off today's production lines are designed to use a minimum of Grade 100/130 avgas, they said. These facts are interpreted as a clear trend that engine manufacturing has become concentrated on engines requiring at least Grade-level 100/130 gas.

Contacts with the various persons who are most intimately acquainted and involved with the move toward a single-grade avgas surfaced a unanimous view that Grade 80/87 definitely is marked for extinction by the oil companies. Officials of two major oil companies said they personally believed Grade 80/87 would be completely removed from the marketplace within 24 months. As a matter of fact, however, all of the major suppliers except one—Shell Oil Company—told The PILOT they had no immediate plans to stop making Grade 80/87 available at their outlets.

Shell, which has been prominent in the swing toward the single-grade avgas concept, did not say if it does or does not have a firm timetable for cutting off Grade 80/87 at its outlets. The company did strongly indicate, however, that a program had been launched to actively encourage Shell dealers to eliminate their 80/87 sales and to concentrate sales efforts on the company's new low-lead Grade 100/130 [Aug. 1970 PILOT, page 34]. Most of the major fuel suppliers said they are now supplying or developing a Grade 100/130 with a maximum of 2.0 milliliters (ml) tetraethyl lead (TEL). All indicated this avgas is the candidate for general aviation's future single-grade avgas.

Two basic questions naturally arise over moves toward a single Grade 100/130 to meet the fuel requirements of all piston-engine operators: What will it cost? How will it affect performance and maintenance of existing engines?

Briefly summarized, none of the oil companies indicated the introduction of a standardized, low-lead Grade 100/130 would be accompanied by a price increase for that grade-level of fuel. Opinions from all sources agreed the

Santa Barbara Aviation, Inc., Santa Barbara (Calif.) Municipal Airport, supplied test aircraft for Shell Oil Company's four-month, 2,000-hour-plus flight evaluation of new low-lead (2.0 milliliters TEL) Grade 100/130 avgas. The fuel was tested under actual flight-training conditions.
Shell Oil Company photos

lower lead content in the new Grade 100/130 is an advantage for regular Grade 100/130 users. Specifically, use of the new low-lead Grade 100/130 reduces lead-deposit buildups on spark plugs and combustion-chamber parts. Shell conducted a comprehensive 2,000-hour-plus flight evaluation program to substantiate contentions that the maximum 2.0 ml TEL Grade 100/130 was better than past grades of 100/130 and that it would perform satisfactorily in piston engines now using Grade 80/87. "In Grade 100/130 requirement engines," the new low-lead fuel "showed significant improvements in engine-deposit condition," Shell said.

No such benefits, however, can be accrued by Grade 80/87 users if they burn the new low-lead Grade 100/130 in their engines. Use of the higher-octane Grade 100/130, all the experts agreed, basically will only increase the Grade 80/87 users' fuel bills. Further, should the Grade 100/130 become general aviation's single-grade avgas, a substantial increase in lead deposits in the 80/87 engines can be anticipated over what these engines are now experiencing. This assessment, which was supported by Shell's flight evaluations, is due to the fact that existing Grade 80/87 avgas has an average of 0.5 ml TEL, compared to the 2.0 ml TEL in the new Grade 100/130.

Shell officially released its test findings on use of the new low-lead Grade 100/130 in Grade 80/87 rated engines at the 1971 Society of Automotive Engineers (SAE) meeting in Wichita, Kan. The title of the formal report, "Development of a Single-Grade General Aviation Avgas," indicated Shell's intention of eliminating Grade 80/87 from its supply lines. Flight tests were conducted from October 1969 through January 1970. The report concludes:

"Within those areas of primary concern, the spark plugs [in 80/87 engines] operated normally without any reported malfunctions, and the exhaust valves were in excellent condition without measurable erosion/corrosion of the valve stem. Combustion-chamber deposits were considered to be normal; that is, heavier than those expected in a Grade 80/87 engine, yet lighter than those in a typical Grade 100/130 engine." [Emphasis added.—Ed.]

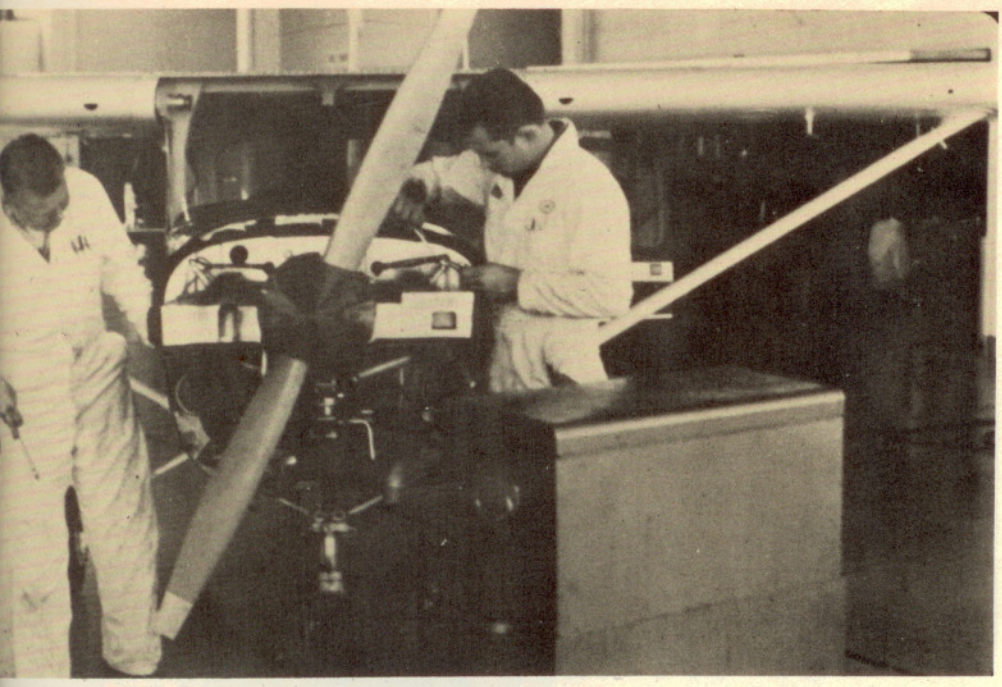
Two of the nation's three leading piston-engine manufacturers—Avco Lycoming Division and Franklin Engine Company—told The PILOT they evaluated the new low-lead Grade 100/130 in engines they produce and basically had concluded there would not be any deterioration in performance or excessive adverse effects. The third major producer of lightplane engines—Teledyne Continental Motors—expressed strong reservations over the single-grade avgas concept and the elimination of Grade 80/87.

Lycoming officials said they were in the process of putting out a new service bulletin on use of the new low-lead Grade 100/130 in their 80/87 engines. The most pertinent part of the bulletin reportedly will state: "Aviation Grade 100/130 with 2.0 ml tetraethyl lead (TEL) maximum per gallon is approved for continuous use in all Avco-Lycoming engines listed herein." The list reportedly will include the majority of all piston engines manufactured by Lycoming.

"You may get into a little more spark-plug fouling, but with the 2.0 ml level we didn't find anything too bad," a Lycoming engineer said. "Our biggest concern was the effect of the lead on the solid temp valve and exhaust system. We did run a test and couldn't find any adverse effect on the valves. However, we did find a little more spark-plug leading, as you might expect, and you might have to clean the plugs more often."

A pair of new American Aviation Yankees, including the one shown here, and two new Cessna 150 Commuters were refitted with premeasured cylinder assemblies, which included new valves, spark plugs, and piston rings, to check effects of low-lead Grade 100/130 in aircraft normally using Grade 80/87. A light twin, with standard Grade 100/130 in one engine and low-lead Grade 100/130 in the other engine, was also used in the test program.

Franklin Engine officials said they saw no problems, primarily because all but one of their 18 models of engines are certificated to use a minimum Grade 100/130 avgas. "We have one engine that is rated at 80/87, but its components are completely compatible with 100/130." Shell spokesmen also reported they had received a clean bill of health



Each Grade 80/87 rated engine used in Shell's test program was flown for 500 hours with the higher-octane, low-lead Grade 100/130. Post-test measurements were made to establish the degree of erosion/corrosion of engine parts directly traceable to the Grade 100/130 fuel. The test fuel, which has about four times more lead content than standard Grade 80/87, caused greater lead deposits.

from Pratt & Whitney officials for the use of the low-lead 100/130 in 80/87 engines.

A Teledyne Continental engineering official said: "Those engines that were designed to run on 80/87 in the first place will not gain anything by running on the higher-octane fuel. And what it apparently will do is bring about some reduction in intake-valve life. Particularly, and to a lesser extent, it could lead to some exhaust-valve problems."

Continental's spokesman said his company conducted a 150-hour test of the low-lead Grade 100/130 avgas in an 80/87 engine. "The test showed there was a definite buildup on the back of the exhaust valves and around the exhaust-valve seat.

"At the end of the 150-hour test, we found this buildup had not caused any harm at that point, but the mere fact that we got the buildup there, which we don't see with the standard 80/87, leads us to suspect that there is little doubt that the valve life will be reduced. We do have quite a bit of experience overseas using a somewhat higher lead-content fuel in these engines. There [overseas], the exhaust-valve life is very definitely reduced and we have recommended that the exhaust valves be changed if a higher lead-content fuel is used."

Asked to estimate the cost to the individual engine-owner for such modifications, he replied, "It isn't cheap, because the cylinders have to be pulled off and the seats have to be recut, plus the valves have to be changed. I can't really estimate the cost, but it would be pretty expensive. This is not a low-cost thing, when you have to pull all of the cylinders and change the valves."

Like Lycoming, Continental said it was preparing a new service bulletin that would be sent to various distributors and airframe manufacturers on the use of Grade 100/130 avgas in Continental engines that have been certificated by FAA for a minimum Grade 80/87 avgas. Wording of the bulletin was anticipated to be similar to that in an earlier Continental bulletin on the same general subject.

The earlier service bulletin, dated February 1968, states, "Engines rated on 80/87 octane fuel should be serviced with that fuel, whenever possible. However, in cases where the recommended fuel is not available and it is necessary to use a fuel with a higher lead content, it is recommended that the following application of exhaust-valve usage be utilized to minimize valve-stem erosion in the hot area." It then lists several Continental engine models and appropriate exhaust-valve replacement parts.

Without exception, those oil companies that were surveyed expressed a desire to soften as much as possible any problems that might arise for their individual customers if the industry does go to a single grade of avgas for general aviation. Most emphasized they planned to continue supplying Grade 80/87 to their dealers and indicated any elimination of this grade of fuel, if it does occur, would be on a gradual basis. Many of the oil industry officials also offered what amounted to a primer on the economic pressures within their industry and the role avgas sales play in their overall scheme of operations.

"If we were really charging 80/87 users today what it costs to distribute the product, they probably would be paying more than they are," was a general comment made by the oil companies. "To keep it in perspective," said one company, "you have to realize that the total consumption of avgas by civilian aviation, both commercial airlines and general aviation, dropped approximately 65% between 1959 and 1969. From a distribution point of view, these product lines are all housed in the same distribution system and when you have had this tremendous dropoff in overall volume, along with a general decrease in 80/87 sales, it's a problem."

One oil company said Grade 80/87 held a three-to-two sales advantage over Grade 100/130 in the early 1940s. Since then, the sales positions of the two grades reportedly have reversed and Grade 100/130 sales now exceed Grade 80/87 sales by a ratio of 75% to 25%, it was said. "You have to remember general aviation avgas sales are very small, when compared to the overall sales of fuel," one official said. Total aviation sales—airlines and general aviation—reportedly represent about 10% of the industry's total fuel sales' receipts.

"But of that 10%, only 4% is consumed by general aviation and of that 4%, somewhere around 70% to 75% is 100/130 sales. The balance is 80/87 and the few other lower grades still floating around." In what amounted to a plea for understanding by all aircraft owners and pilots, as well as an overall summary of the single-grade avgas program, one oil company official said, "When you keep all these facts in perspective, you can see that something has to give." □

Comparisons Of Standard Grades 80/87 And 100/130 With New Low-Lead Grade 100/130*

	Weight Increase (In grams)
Single-engine aircraft:	
Spark plugs—	
0.5 ml Grade 80/87 fuel	0.18
2.0 ml Grade 100/130 fuel	0.82
Twin-engine aircraft:	
Spark plugs—	
2.0 ml Grade 100/130 fuel	0.42
4.0 ml Grade 100/130 fuel**	0.68
Combustion chamber—	
2.0 ml Grade 100/130 fuel	22.7
4.0 ml Grade 100/130 fuel	31.8
Exhaust Valves—	
2.0 ml Grade 100/130 fuel	0.65
4.0 ml Grade 100/130 fuel	1.53

*Source: "Development of a Single-Grade General Aviation Avgas," by H. J. Foster and L. G. Olson, Shell Oil Company. The table was developed from a 2,000-hour-plus flight test to evaluate effects of new low-lead (2.0 ml TEL) Grade 100/130 on engine parts. Table does not show effects of low-lead Grade 100/130 on combustion chamber and exhaust valves of Grade 80/87 rated engines.

**Ed. Note: Shell's table uses an average of 4.0 milliliters (ml) tetraethyl lead (TEL) in standard Grade 100/130. For additional information on avgas, see Aug. 1970 PILOT, page 34, and Oct. 1969 PILOT, page 46.