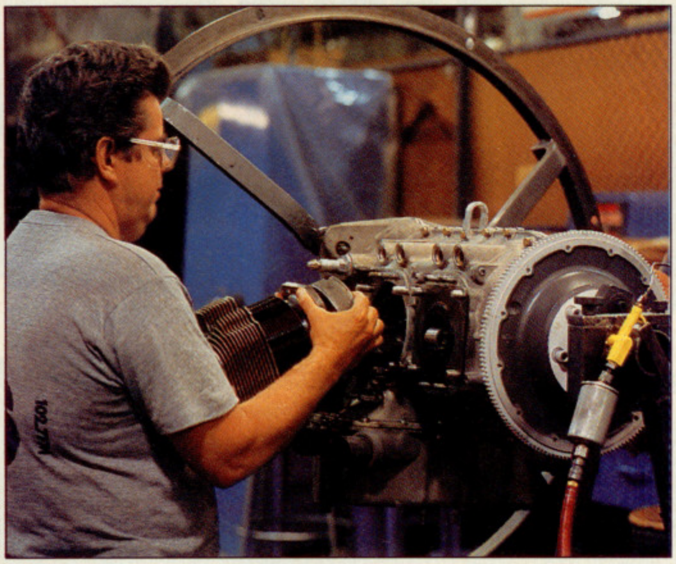
FIRST NEW 172

POWER FOR THE NEW CESSNAS

Old-fashioned engines sprinkled with new(er) technology

BY PETER A. BEDELL

When Cessna announced that it would restart production of its 172, 182, and 206, one question—among many others—was the brand of engines to be used. The 172 has run on a Lycoming since 1968, so logically it will be reborn with a Lycoming. But what about the new 182 and 206? The fixed-gear 182 and all 206s finished production with Continental engines. Would Cessna defect from its parent company, Textron—also the parent company of Lycoming—in lieu of a potentially easier certification process with the time-proven Continentals, or would it recertify the "new" 182 and 206 with Lycoming engines? ■ Cessna chose what may prove to be the hard way, certification-wise, but it was, according to the company, a response to a market preference for Lycoming engines, not the influence of Textron's owning Lycoming. According to Pat Boyarski, recently named general manager of Cessna's single-engine aircraft business, an engineering analysis by Cessna and an independent market analysis prompted the company to choose Lycoming engines exclusively.



MIKE FIZER

The 172 will receive an IO-360, which replaces the O-320 used in the last model produced in 1986. The 182 will get an IO-540, and the 206 gets a new IO-580 (a bored-out 540 that will produce about 300 horsepower).

AOPA has taken great interest in this project for two reasons: One, the return of the world's most popular general aviation airplanes marks a new beginning for a long-troubled industry. Two, AOPA is set to receive the very first 172 and 182 off the line to award as its 1995 and 1996 sweepstakes prizes. The prize in 1995's First New 172 sweepstakes is indeed the first Skyhawk off the new assembly line.

Cessna has been flying a "prototype" of the revived 172. Actually, it's a 1978 N-model Skyhawk that has been outfitted with an IO-360 engine and a new 50-usable-gallon wet-wing fuel system (see "First New View," June *Pilot*). Its first flight occurred in April and achieved a top speed of 135 knots at 5,000 feet, about 15 knots faster than the last 172 produced in 1986. That achievement turned out to be no huge feat, though. The engine was turning 2,700 revolutions per minute instead of the targeted 2,400-rpm redline. At 2,700 rpm, an IO-360 will produce on the order of 180 horsepower, compared to about 160 hp at the intended 2,400 rpm.

Why a 2,400-rpm redline? Noise, says Cessna. This theory has some people puzzled, though. The O-320 that powered the last Skyhawks achieved 160 hp at 2,700 rpm. With its fixed-pitch propeller, a current Skyhawk can achieve only 2,700 rpm in a high-speed cruise configuration. During a normal takeoff (most noise tests are taken just off the end of the runway), the prop turns only about 2,300 rpm, hardly a big noisemaker, with a 75-inch diameter propeller.

Nevertheless, European noise restrictions are the principal reason Cessna is so adamant about quieting the 172's engine. To achieve the same 160 hp *and* limit noise, Cessna believes the only solution is to step up to a bigger engine and derate it. This has been successful in other aircraft like the Piper Dakota. And, because the bigger engine isn't working as hard, derating has become a popular way for manufacturers to achieve exceptional reliability and long time between overhauls. Although not finalized yet, Cessna and Lycoming are planning a program that that could extend TBO out to 2,200 hours if the airplane is flown more than 40 hours a month.

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Proponents of efficiency will grumble about the fact that the new 172 will be hefting around an engine that is heavier than necessary. This is a legitimate gripe, considering that the new engine could weigh some 30 pounds more than the just-as-powerful O-320 it's replacing. However, when one considers how slowly technology enters general aviation, there are not many choices. Importing automotive technology into GA would be great for power and efficiency but, stepping back to reality, that's not going to happen in the near future. To achieve the low noise requirements *and* maintain the last model's performance, there is really no other route for Cessna to choose.

Another reason to derate has to do with fuel flexibility. Current 100LL may have a limited future in aviation. If so, an unleaded (read lower octane) fuel will be powering aviation engines. Low octane means lower compression ratios, which ultimately mean lower power output. Testing of a new 82-octane unleaded avgas developed by Phillips Petroleum is being conducted by the company and the FAA. Lycoming is confident the 172's IO-360 can run on the new fuel because of its low 7.5:1 compression ratio. The 206's IO-580, however, will run only on 100LL or its eventual replacement. "There's no way we can get that kind of power [300 hp] without going to a higher-compression piston," said Mike Wolf, Lycoming's vice president of marketing and sales.

All of the new piston-powered Cessnas will have fuel-injected engines. Another independent market survey said that pilots prefer fuel-injected powerplants over carbureted ones. Even the staple of simplicity, the Skyhawk, will have fuel injection. Advantages: no carburetor icing, better efficiency, and higher overall reliability. Disadvantages: hot starts and the added complexity of fuel boost pumps may take the "simple" out of the Skyhawk.

To address this problem, Cessna is introducing an electronic ignition system from Unison, maker of Slick magnetos, as standard equipment on the 172. Besides reducing starting woes, either hot or cold, the system should make the engine run smoother and more efficiently throughout its power spectrum.

The Lasar (Limited Authority Spark Advance Regulator) electronic ignition system is scheduled to be installed on the new singles when production begins in the fall of 1996 (see "Airframe and Powerplant," February *Pilot*). The system employs two standard engine-driven magnetos that are connected to a regulator box. The box determines the best timing for any combination of engine parameters. Using standard magnetos as part of the system makes it fail-safe. If the electronics fail, the mags will take over automatically. The mags will then operate like those we currently use, the only difference being that they won't be timed electronically. However, neither mag has an impulse coupling; so, if the electronics fail, you will not be able to restart the engine until repairs can be made.

Currently, Unison is testing the Lasar system in its O-320-equipped 172 and in *Pushy Galore*, the Formula One racer that currently holds speed and time-to-climb records for its class. The 172 tests are being done in conjunction with the FAA for certification purposes. "We're hoping to have it certified by Oshkosh," said Brad Mottier, vice president of Unison's Jacksonville, Florida, plant.

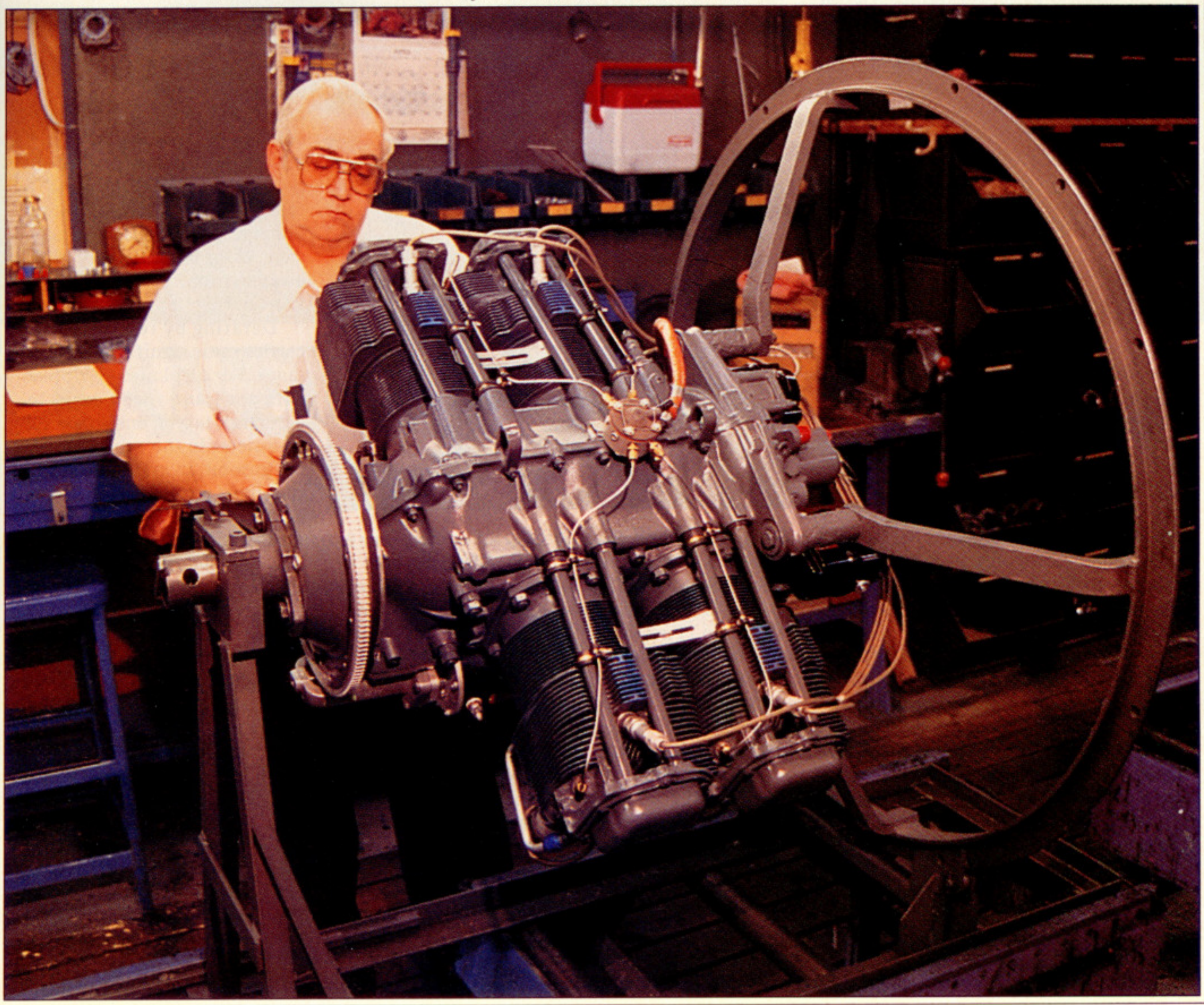
What improvements can electronic ignition bring to the archaic but time-proven engines being used in general aviation airplanes?

Better efficiency is the main advantage. Lasar is preprogrammed at the factory to run a specific engine. For example, on the IO-360 powering the new 172, the optimum spark timing and the duration of the spark have been set for every manifold pressure/rpm combination. With this information, the box will automatically determine when and how long it should fire the respective plugs. This results in a more complete combustion that will allow a pilot to lean the engine more aggressively. This will save fuel but raise cylinder-head temperatures.

At the lower end of the power spectrum, Lasar should allow for better starting and idling characteristics, thanks to its automatic timing adjustment. The fixed timing on a standard mag is set to give maximum power at takeoff with sufficient detonation margins. Unfortunately, this does no good for idling and starting—or anything less than takeoff power, for that matter. For starting, the spark advance must be retarded significantly. Impulse couplings and shower-of-sparks systems are the current methods of retarding the spark advance. However, they are among the crudest ways to achieve that goal. Lasar will automatically choose the best timing for the task at hand, which should ameliorate the effects of hot starts, cold starts, and rough idling on the Skyhawk's new injected engine—or any engine, for that matter.

Unison's Lasar system is to be installed on the 182 and 206, as well. Since details of those projects are much more scarce, the engine debate

Art Tompkins, a quality control inspector at Lycoming, takes a last look at an IO-360 before it heads out to the customer.



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leaves many questions unanswered.

By the time you read this, Lycoming should have finished building the prototype of the new 182 engine. Horsepower and rpm limits will not be set in stone until the prototype airplane is flying, said Lycom-ing's Wolf. The 182 powerplant will probably have 230 horsepower, the same as its Continental O-470 provided for so many years. It, too, will have a fairly low compression ratio and will run on the lower octane unleaded fuel. There is the possibility, though, that the redline may have to be tweaked a little higher than the Skyhawk's 2,400 for the engine to generate 230 hp. Lycoming assured us that it would not be near 2,700 rpm. The installation of the Lycoming engine in the 182 should be fairly painless, since the Skylane RG and Turbo models of old were powered by Lycoming 540s. Installation of the 206's IO-580 will require some modifications but nothing excessive, said Cessna's Boyarski.

Cessna's new singles will contain a reasonable mixture of past and present technology to bring what will hopefully be a safer, more reliable, and more efficient airplane than was previously offered. Cessna will begin building two or three prototypes of the new 172 in Wichita this fall to approve the production tooling. The Independence plant will take over after that, possibly churning out as many as 2,000 airplanes a year by 1998. □

THE DERATING GAME

How Lycoming will tailor the IO-360 for Skyhawk life

Derating an engine comes down to this: The manufacturer, seeking reduced noise or greater longevity, sets the maximum output at a point below that which the powerplant is thermodynamically capable of producing. That is, the engine in the derated installation simply puts out less power than it might make in other installations. On the plus side, you end up with an engine that isn't working particularly hard or producing a great deal of heat. Minuses include the inefficiencies of hauling around a physically larger and heavier engine than is ideal, and some loss of peak fuel efficiency.

Maximum potential power is determined by a number of factors—among them, individual cylinders' breathing ability, total displacement, compression ratio, maximum speed, and optional use of a turbo- or supercharger. Total power is dependent upon the size and duration of each combustion event and the number of explosions over time. Make each explosion more powerful and torque increases. Ways to increase the amount of energy released from the fuel include having more of it around (commonly, by increasing displacement or turbocharging) or by increasing its compression in the combustion chamber before it is ignited by the spark plugs. Compression ratio is the degree to which the fuel and air charge is squeezed. Finally, you can increase the engine's maximum speed so that more events take place over time, which results in increased power. In simple terms, horsepower is torque times revolutions per minute.

Often an engine design starts out at a power level commensurate with its ability to shed heat and simply to stay together. As the engine design matures, power can be increased incrementally. Typically, the powerplant manufacturer will increase the maximum rpm or the compression ratio to get more power in a normally aspirated setup. In a turbo installation, the simplest path to greater thrust is through increased maximum boost pressure. Cooling and detonation suppression become limiting factors.

With the IO-360 slated for the reborn Cessna 172, Lycoming has applied two main methods of derating to an engine capable of 180 horsepower. (Don't confuse this IO-360 with the variants found in the Piper Arrow and Mooney 201/MSE; the 200-hp IO-360 is a substantially different powerplant, with different and more efficient cylinder heads and a higher compression ratio.) First, maximum rpm has been reduced from 2,700 to 2,400. Cessna says the reduced speeds will cut fly-over noise; we know that it will also help to keep the cabin quieter in cruise. The rpm drop results in a 10-hp loss.

Cessna also wanted the new 172 to be capable of running on a proposed 82-octane unleaded avgas. Retaining the IO-360's normal 8.5:1 compression ratio would have left the detonation margins too thin on the proposed 82-octane unleaded fuel that is supposedly part of the new Skyhawk's future. Instead, Lycoming will create a variant of the engine with a 7.5:1 compression ratio. Though this is a first of its kind in this iteration, you can guess by the effects of compression ratio on the other midrange Lycomings that this move is responsible for the other 10-hp cut—leaving us with the same 160 hp found in the last-generation Skyhawk's carbureted O-320.

Incidentally, the fuel injection system to be fitted to the 172's Lycoming really does nothing for total power output; both the injected and carbureted versions of the O-360 produce 180 hp. The main advantage will be improved mixture distribution, which will allow more aggressive leaning before the onset of lean misfire rears its ugly head. In this way, Lycoming hopes to get back some of the fuel efficiency given away with the lower compression ratio.

Derating by reducing rpm carries some significant advantages. For airplanes equipped with constant-speed props in particular, takeoff and climb will be quieter in the cabin and on the ground. In many cases, the rpm limit means that the prop control may be all but ignored. For example, in both the Cessna 182Q and the Piper Dakota—whose engines achieve rated power at 2,400 rpm—takeoff, climb, and cruise could all be tackled at the rpm limit. Maximum cruise power could also realistically be held to a higher altitude in a derated installation. That's because few pilots tolerate spinning a large engine to the 2,600- or 2,700-rpm setting that gives 75-percent power above 8,000 feet. More likely, they'll pull the prop back to 2,400 or 2,500 rpm and accept a 65-percent power setting instead.

Cessna and Lycoming hope that the 172's new IO-360 will be a better engine in the real world than the admittedly stone-ax-reliable and simple O-320 it replaces. In that sense, it's got some pretty big shoes to fill. *—Marc E. Cook*