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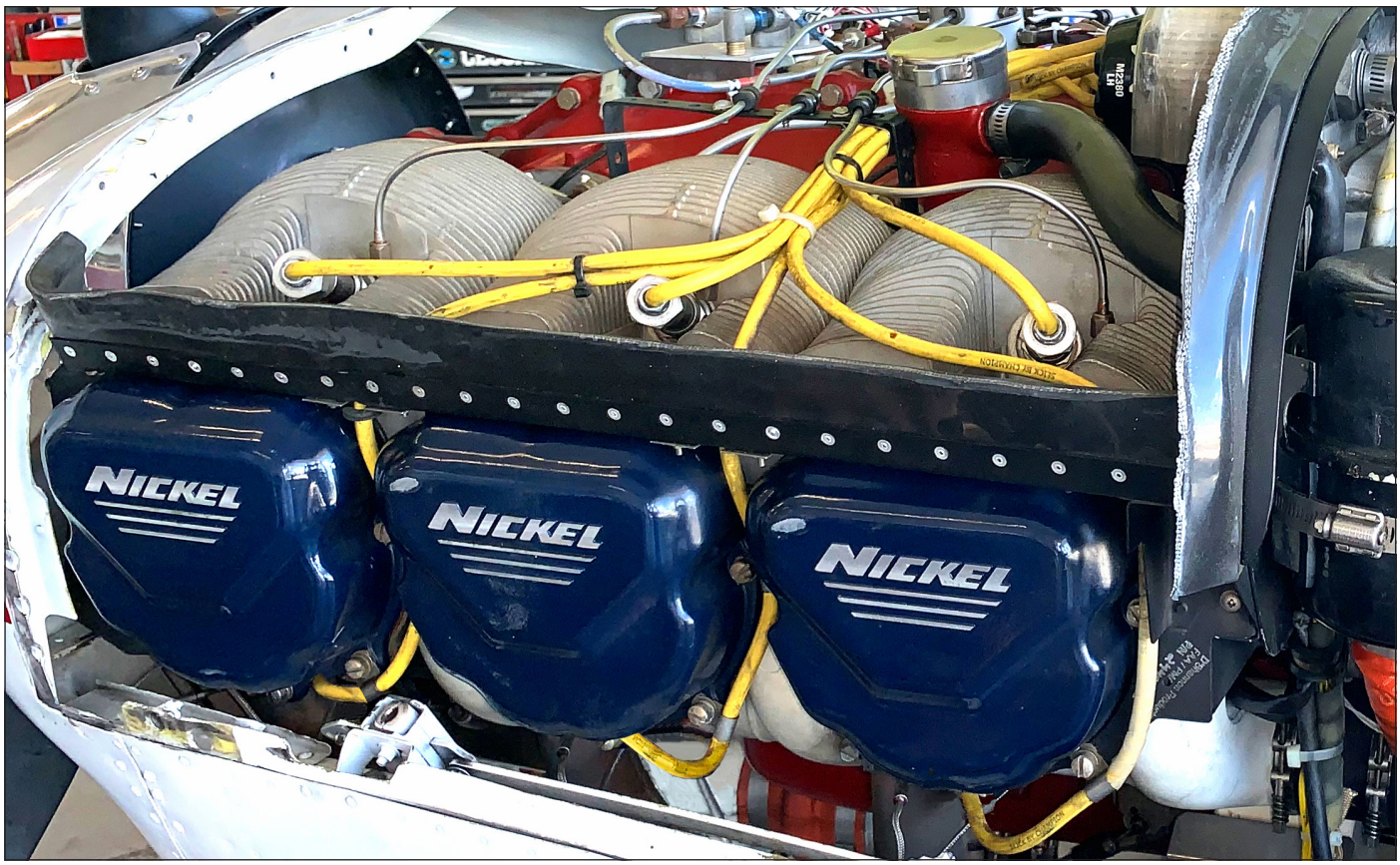
The following is excerpted from:

Airplane Engines

A Pilot-Friendly® Manual



How to get the most performance, dependability, and longevity from your engine.

(Click the image above to see more about this manual)

Do an Airborne Ignition Check

The traditional mag check done during the run-up can detect gross anomalies with the ignition. To see subtle problems, or ones that only manifest in flight, you'll need to check the ignition in the air with an engine monitor.

The common ailments listed here assume you had a *normal* ignition check during runup.

Get Established in Cruise Flight

An airborne ignition test should be done at or near cruise power, with as lean a mixture as possible. That's because a lean mixture is harder to ignite, so any ignition problem is more likely to appear.

If you're concerned about going LOP, or if you're unable to, choose a power setting around 60 percent power, where mixture setting can't hurt the engine.

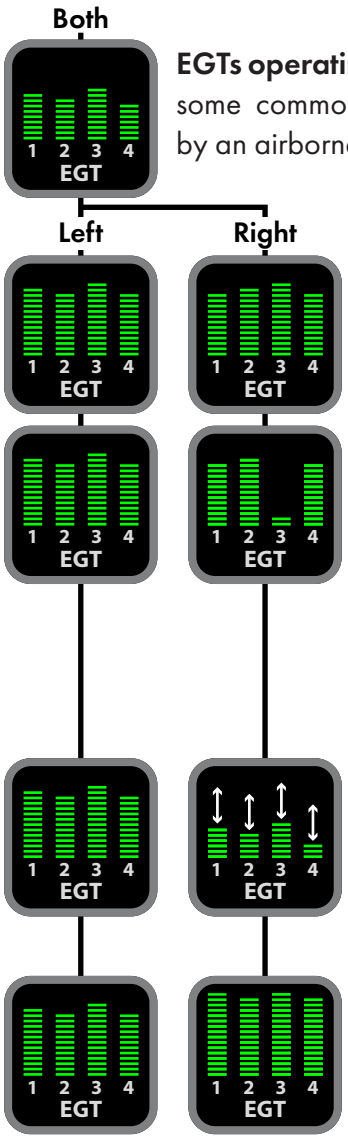
TIP

If your engine monitor doesn't have a digital readout or normalize mode, take pictures in flight of the display for later analysis. Take multiple pictures if it's an "orange bar" monitor, because sometimes bars won't appear in the photo if the timing of the exposure was just off. Taking a short video is also a good option.

Then, lean until the engine is just beginning to get rough. Next, enrichen as little as required for your comfort level.

You'll also want to fly at least 6000 feet MSL, though higher is generally better. That's because the lower air pressure inside the magneto can sometimes cause problems that are only revealed at high altitude.

Set your engine monitor to normalize mode for the ignition test if available. That centers all cylinders at mid-scale, which will make discrepancies between cylinders more apparent. Normalize mode may also increase the sensitivity of the readout.



EGTs operating on both mags. Below, some common problems are revealed by an airborne ignition check.

All EGTs rise 50°F-100°F on each mag. This is normal behavior. Your system is working as expected.

One EGT falls or is erratic, and the other EGTs rise as expected. The plug driven by the selected mag isn't firing correctly. This could be a fouled plug—and it's worth checking—but because the problem only shows up in flight it's more likely the resistance is too high (or connection is too poor) for the power creating the spark. A plug with too much resistance, a failing or contaminated spark wire, or corrosion in a magneto affecting only the tower driving that plug are all possibilities. Troubleshooting after landing still starts with the plug and works backward. The engine may run rough, but not always.

Erratic EGTs on all cylinders. You've probably got a rough engine with this as well. The magneto that's still working is having trouble delivering consistent spark under stress. If the EGTs stabilize and the engine smooths out a bit when enrichened, that would further support this conclusion. Turbocharged engines can have a special case problem with this. (See "High-Altitude Problems" on page 57.)

All EGTs rise more on one mag than the other. This could be a timing discrepancy. The hotter EGTs would be seen when running on the magneto with retarded timing.

(See page 60 for a more extensive list of engine monitor patterns.)

WHAT IF THE ENGINE QUITS? RESTART IT.

Pilots have a prudent fear of engines stopping unexpectedly in flight. This bleeds over into a reticence in risking even an *expected* engine stoppage. While understandable, the concern is probably unwarranted. Besides, wouldn't you rather find out one magneto can't keep the engine running on a day when you still have the other one working correctly?

It's entirely possible your engine could sputter or even stop during an airborne ignition check if one of your magnetos isn't capable of supplying a high-demand spark. If so, you'll hear a decrease in engine sound, see falling EGTs across the board, and you might hear and see the RPM start to wind down.

What do you do?

Don't panic. The engine will restart—however, even if it's just a few seconds, fuel has been pulled through the engine and into the exhaust system. If you simply turn the disabled magneto back on, it may create an "exhaust backfire." This won't hurt a healthy exhaust system, but it can damage a worn one.

To prevent the "pop," pull the mixture to idle cut-off, *then* switch back to both mags, and then enrichen the mixture. Your windmilling prop is spinning the engine far faster than a starter ever would. The engine should roar back to life, backfire-free. The entire time with the engine actually not running might be under 10 seconds.

All this said, it's still reasonable to do this test above an airport. You can't be too safe.

Switch to a single magneto. The engine will produce a bit less power but should run perfectly fine on a single mag. If it's rough, you can enrichen the mixture just a bit more, but ideally do not.

Wait at least 20 seconds. You need the EGTs to fully stabilize. Don't worry about running on a single magneto for that long. It won't hurt your engine.

The EGTs for each cylinder should have increased. That's because with only a single spark plug firing, it takes longer for the fuel/air charge to burn. As a result, it has less time to cool before it's pushed out the exhaust valve and past the EGT probe. A rise of 50°F to 100°F is typical when operating on a single spark plug. The specific amount will vary from cylinder to cylinder, but all should rise. How they rise—or don't—gives you much more insight into your ignition's health.

To catch more subtle ignition issues, export the engine monitor data from your airborne ignition check and upload it to a tool for analysis (page 79).

HIGH-ALTITUDE PROBLEMS

Because the air pressure inside the magneto itself decreases as you climb, turbocharged airplanes can run into ignition problems that might only appear up in the flight levels on a magneto that actually has no problem.

At really low air pressure, the spark finds a new path of least resistance and instead of jumping the gap at the spark plug, it jumps a different gap inside the magneto itself. This is called "arcing over." The result can be engine misfire, serious roughness, and even damage. The fix is to reduce manifold pressure, and then descend. After landing, ask your mechanic to inspect for damage.

To prevent this problem, some turbocharged airplanes are equipped with pressurized magnetos. Pressurizing the inside of the magneto eliminates the problem. However, pressurized mags (P-mags) come with their own complications and maintenance issues. If you fly a turbocharged airplane that's rough or just has poor performance at high altitude, that could very well be the problem. You could try the airborne ignition check at higher altitude to see.

As an aside, Bendix mags have larger internal spacing than Slick mags and generally perform better at high altitudes for this reason.