

# How to Fly the SavvyAnalysis Flight Test Profile

## Expanded Procedures

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**NOTE:** *Before conducting these flight test profiles, please program your digital engine monitor to utilize its fastest available sample rate – but no faster than 1 sample per second. This will provide the highest possible resolution in the data that is dumped from the engine monitor after the test flight. If you have a JPI EDM-series engine monitor, please follow the instructions at the end of this document for setting the sample rate.*

## GAMI Lean Test

The GAMI lean test is a test of mixture distribution, and is used to help diagnose incorrect fuel nozzle sizing, dirty/clogged fuel nozzles, etc. Its purpose is to measure the difference in fuel flow between where the leanest-running cylinder reaches peak EGT and where the richest-running cylinder reaches peak EGT. That difference (measured in gallons-per-hour) is called the “GAMI spread.” In our experience, the GAMI spread must be under 1 GPH for the engine to operate smoothly when lean-of-peak (LOP). For fuel-injected engines, the goal should be to reduce the GAMI spread to 0.5 GPH or less for optimum LOP operation. For carbureted engines, the sweeps can help us detect induction leaks and leaky primers.

Perform the GAMI lean test procedure by setting up the airplane in normal cruise – use your autopilot if you have one.

JPI users – we get better data if you’re not in Lean Find mode

**IMPORTANT: Cruise power setting for this test should be 65% or less at wide open throttle (WOT) to avoid excessive CHTs and stress on the cylinder assemblies.**

Then perform the following procedure:

- For normally aspirated engines: Climb to an altitude that allows 65% power or less at WOT.
- For turbo engines: After picking a MAP and RPM that represents 65% power or less, climb to the altitude where ambient air pressure is very nearly equal to your chosen MAP. (Assume ambient sea level pressure of ~29.92 drops 1" with every 1000 MSL of altitude.)
- For carbureted engines with fixed pitch props and without MAP: You can approximate these settings by climbing to about 6,000 MSL and pulling the power to about 65%. Please give us two rich-to-lean mixture sweeps with carb heat off, then two more with partial (30-40%) carb heat. Partial carb heat often improves mixture distribution on carbureted engines. Lean to the onset of roughness for the mag check – even if you're not LOP.
- Start with a rich mixture of at least 100°F ROP.
- Retard the mixture control as slowly and steadily as you possibly can until the onset of roughness. Try to do this slowly enough that it takes no less than 3-4 minutes to move from the rich mixture to the lean one. The slower and smoother you can move the mixture control, the better. Note the fuel flow in GPH or PPH. For turbos that do not have automatic waste gate, do your best to maintain your target MAP as you lean the mixture by adjusting MAP as necessary as you change mixture.

**There's no value added by leaning past the onset of roughness to the point of engine stumble or flame-out.**

- Reverse the process, richening very slowly until you get back to about 100°F ROP. Then reverse again and lean to your previously noted GPH or PPH lean point. Again, try to do this slowly enough that it takes 3-4 minutes to do the sweep while maintaining your target MAP.
- Repeat this rich-to-lean-to-rich mixture sweep procedure; preferably 3 times. (This allows us to obtain an average of several sweeps, which provides more accurate information than one sweep alone and allows us to discard sweeps with poor data e.g., moving too quickly through peak.)
- On your last rich-to-lean sweep, and while still on the lean side, do not simply go back to a cruise ROP or LOP cruise setting but instead transition to the LOP Mag test before changing anything. (The reason for this is we want to be able to tell precisely how LOP the engine is when the LOP Mag test is done.)
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## In-Flight LOP Mag Check

The in-flight lean mag check is a test of ignition system performance, and is used to help diagnose problems with magnetos, ignition harnesses, spark plugs, ignition timing, etc. A lean mixture will reveal a weak plug that might be masked with a richer mixture. Our goal is to select a mixture that will identify weak spark – without inciting it.

Perform the in-flight lean mag check procedure by setting up the airplane in normal cruise – use autopilot if so equipped. Then perform the following procedure.

- Begin by performing at least one GAMI Lean sweep as described above from ROP to LOP – OR – at the last of your multiple GAMI Lean sweeps from ROP to LOP above, continue to lean to 50° LOP if you are able, or to the onset of roughness. If you leaned to the point of first roughness, slowly richen just enough to get back to a smooth running engine. (50° LOP is about the maximum LOP you should ever need to run and we see no value in suggesting maintenance to run leaner than necessary.)
- For a key or rotary style magneto switch (as found in most singles), select BOTH-LEFT-BOTH-RIGHT-BOTH, leaving the mag switch in each of these positions for at least 10 engine monitor sample times or at least 30 seconds; including in the BOTH position. (If your sample interval is 6 seconds, that will be a full minute; if your sample interval is 1 second, then use the minimum of 30 seconds.)
- For individual magneto toggle switches (as found in most twins), turn off the L engine RIGHT MAGNETO (so that only the left magneto will be firing) switch for at least 10 engine monitor sample times or a minimum of 30 seconds, then turn it back on so that both are firing and wait for at least 10 engine monitor sample times or a minimum of 30 seconds. (If your sample interval is 6 seconds, that will be a full minute; if your sample interval is 1 second, then use the minimum of 30 seconds.) Repeat this procedure by turning off the L engine LEFT MAGNETO (so that only the right magneto is firing.) Then perform the same test on the R engine.

**NOTE:** It is normal for engines to run a bit rougher on one magneto than they do on two, but they should not run “change-of-underwear” rough. Please report on the level of perceived roughness during phase of the test. (e.g. smooth, moderate, severe).

**NOTE:** If the engine quits while switching to single mag operation, pull the mixture to idle cut off, then switch to the other mag, then slowly advance the mixture until the engine restarts.

**NOTE:** For turbocharged engines, TIT may rise to or above red-line during single-magneto operation. This is normal and will not be harmful for the short duration of the flight test.

**NOTE:** RAM engines or Experimental engines with uneven or split timed magneto timing and unconventional spark plug wiring. Please tell us if your engine is a RAM engine or has uneven mag timing and the pertinent details. (For example RAM VII engines time the L mag @ 23° BTDC and R at @ 21° BTDC and the left mag fires all the top plugs.)

**NOTE:** For engines with Electronic Ignition. For those with both a conventional mag and an electronic mag, please use the same order of LEFT-BOTH-RIGHT but be sure to tell us which magneto is the conventional one and which is the electronic one and what type of electronic mag is being used. Additionally, if the wiring harness is unconventional, i.e. electronic mag firing all top plugs, please inform us of the details.

## Options for the Cockpit

Now that you're armed with the details of the Savvy Test Profile, here are the options for taking the information into the cockpit with you. You can find these documents by going to the [www.SavvyAviation.com](http://www.SavvyAviation.com) website and navigating to Resources > Other Resources.

- A **printable kneepad-sized crib sheet** to refer to in flight.
- A **digital crib sheet** that you can import into ForeFlight.

## Instructions for setting JPI EDM-series monitor sample rate

(Applies only to JPI EDM-series digital engine monitors)

- Hold the STEP and LF buttons simultaneously for five seconds to put the EDM into programming mode.
- Tap STEP repeatedly until the display shows “DUMP? NO”, except on the JPI 830 you'll see RECORD TIME 6. Change that to 2 and skip the next three steps on this list.
- Hold the STEP and LF buttons simultaneously for five seconds to access long-term memory.
- You should see “TIME n” denoting the current sampling rate of the instrument. “TIME 6” means that the instrument is set to its default 6-second sampling rate.
- Tap or hold LF until the display reads “TIME 2” indicating that the sampling rate is 2 seconds (which is the highest rate supported by the EDM).
- Tap STEP to sequence through the rest of long-term memory. While doing this, you may want to check and possibly set the time clock (month, day, year, hour and minute) to accurate UTC time, and make sure that your N-number is entered correctly. Tap or hold LF to make changes to any of these values.
- When you reach “END Y” tap STEP to end the programming procedure.
- To set the sample rate back to the default 6-second rate after the test flight, repeat this procedure.

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