EDM-700 is Precision Engine Performance

Why Measure Temperature?

An old and common misconception that other manufacturers of EGT monitors promote is that it is not necessary to know the exact exhaust gas temperatures of your aircraft's engine. However, if you have read recent reports, shock cooling can be catastrophic! The EDM alerts the pilot of those conditions which are most vital to the maintenance of well performing engine. The value in measuring EGT lies in finding the ideal ratio of fuel to air that results in complete combustion, and in long-term trend monitoring.

Long Term trend Monitoring:

Trend monitoring will identify thosesmall problems before they turn into serious engine damage. It is the most important tool for diagnosing engine problems, and it works! Digital displays make all the difference obvious. Trend monitoring is simply not possible with just a bar graph indicator. Yet, with only a digital indicator, quick glance temperature recognition is not possible either. With a digital display, engine data can be recorded by the pilot in a log book on a monthly basis. EGT and CHT will group themselves into a tight pattern at specific MAP & RPM. As a problem begins to develop in one or more cylinders, the EGT span will start to enlarge. The DIFF mode "dot" will identify the problem cylinder causing the large span. Factory new injected engines have a typical span of 80ºF, carburated 140ºF.

Leanfind Mode:

The EDM-700 identifies the optimum mixture accurately and automatically. After cruise power has been established, the pilot just presses the function button of the LEANFIND "LF" mode. As the pilot begins to lean the mixture, the EDM-700 is checking all cylinders, using a propriety algorithm looking for the first cylinder to achieve peak EGT. "PEAK EGT" will be displayed when the first cylinder to peak is detected. The display will also then flash the cylinder column and show peak EGT. The pilot has the option to increase (the richness of the mixture) or operate at peak. Leaning faster than the engine can respond will cause the display to flash "2 FAST." The EDM is monitoring all alarms in the background and if the TIT limit is exceeded during the Lean Find process, the TIT column will flash first. Some turbocharged engines do peak TIT before the EGT peaks.

Since 1995, pre-ignition and detonation have become more prevalent with the new fuels available. Therefore it is of the utmost importance to monitor ALL EGT's at one time during climbing, and leaning. Pre-ignition once started, causes an extreme temperature rise and is self sustaining until engine failure occurs, which can be in less than one minute. Pre-ignition will cause the EDM's bar graph to reach maximum height on that cylinder. Seeing all cylinders at once will permit the immediate action required by the pilot.

Lean Find Mode—“Lean of Peak” LOP
To use the “lean of peak” method, tap LF and then immediately hold both Exit and RoP/LoP until you see LeanL. You may toggle back to LeanR by holding both buttons again. Once you begin leaning (blinking square) you cannot change leaning method. Upon power up, the EDM 700/800 always defaults to Rich of Peak mode.

Leaning Lean of Peak (LOP)
In the “lean of peak” method the columns will invert with the first to peak progressing down from the top of the display, looking like icicles. The “icicle” scale has higher sensitivity. As you continue to lean past peak the number of the each successive cylinder will blink as it peaks. The peaks will be shown as an icicle graph; when the last cylinder peaks its column will blink. The analog display is an icicle graph showing where each cylinder peaked. When the RoP/LoP button is held the display will show the delta fuel flow between the first and last to peak (GAMI Spread), as well as the richest peak EGT.

Turbocharged Engines
The leaning process for turbocharged engines is by reference to the first cylinder or TIT to reach peak. However, the TIT factory red line may limit the leaning

process. TIT red line is generally 1650°F, and up to 1750°F in some installations. In the LeanFind mode the T column—TIT—is included in the procedure. If during leaning the TIT exceeds red line by less than 100° for less than one minute, the LeanFind procedure will continue to operate, allowing you to complete the leaning process. Otherwise the digital display will show, for example, 1650 TIT and TIT will blink. You may notice that in some cases the TIT reads 100°F hotter than the hottest EGT.

Consider Economics:

For example, a Beech Bonanza with an 0-470 engine at 10,000 ft. @ 65% power and fuel at $4.20 per gal. At a true airspeed of 160 mph and at PEAK EGT, this engine consumes 11 GPH. This means that if you fly 500 hours a year, the Bonanza will consume $23,100 in fuel.

Most pilots not knowing which cylinder peaks first, operate at a 75 to 100 degrees rich of peak. Too rich of a condition causes vibration and carbon deposits in the engine. Flying under such conditions, a very rich mixture would result in an increase airspeed of 2 mph, while the fuel burned would increase by 2.2 GPH. If the EDM was used to lean the engine only 10 degrees rich of the peak, the plane would cost 20% less to operate or $4620. Again if you are injected and run LOP (Lean of Peak) by 50 degrees you could save 30% in fuel or $6930 a year and lose 2 Kts.

EDM-700 Data Recorder:

A complete engine data recording system. Capable of recording not only EGT and CHT as some less sophisticated systems do, but also can record all 24 engine temperatures, plus all engine pressures, RPM and can calculate percent of horsepower. The ability to print out alarm conditions, with three dimensional color data analysis of your computer, is also a feature.

Additional Functions Required for Automatic Data Recording:

Diagnosing an engine problem is a very complex task, requiring the data from several engine instruments. Recording EGT & TIT temperatures is only the start. In order to fully understand the engine, RPM, MAP, OIL TEMP., are also required. This is why you should not be misled by less sophisticated copies that claim data recording capabilities. These gauges simply don't record the necessary information to make a thorough engine problem diagnosis. For example, a large drop in EGT could be a serious problem developing or just the addition of full throttle. JPI realized this at the beginning of the development of its EDM data recorder.

Percent of Horsepower:

JPI's proprietary algorithm calculates and displays percent of horsepower from carburated, normally aspirated, high performance injected, turbocharged and inter cooled engines. Try taking off from a high density altitude airport by setting maximum HP before releasing the brakes.

Record Mode:

The EDM-700 Data recording model automatically records as many as 36 engine temperatures and 4 pressures, recording one set of readings every second, hour or however you program its preferences. All engine data is "time stamped" with total engine starts, Hobbs time, day, month, year and time of day, and are permanently stored within the CPU module.

Instead of carrying your home computer to your airplane to retrieve data, a credit card size memory device (Data card) is inserted into a slot in the CPU module and instantly, 100 hours of flight data are copied. The original data stored in the CPU is not destroyed during this process. Once the data report is printed out, you have a printed log to dispute any engine warranties that could arise. This data card format allows for time, day, month, year and time tracking plane usage, by giving each pilot a data card and using it to retrieve data and get an instant printout of the flight parameters. JPI probably has more engine data, on different

aircraft engines than the major manufacturers have themselves. Our experienced technicians know what to look for when reviewing engine data. As a service to our customers, JPI can copy your engine data onto floppy disk, in a spreadsheet format for viewing on a PC compatible computer. Also available from JPI, a unique diagnostic software package for diagnosing your own engine data if that is what you prefer. World renowned pilot and aircraft designer, Dick Rutan chose the EDM for his Pond Racer Project, after having researched many EGT manufacturing companies. When referring to this engineering feet of a project, Dick said "We could not have done it without the EDM." One of Alaska's largest air cargo companies has logged over 800 recorded hours on their fleet of DC-6's.

Snapshot Mode:

Press the snapshot button to instantly record all diagnostic data when you suspect an engine abnormality. Imagine being able to show your maintenance department the proof of an intermittent problem occurring in flight. Now, that's high tech!

Alarm Mode:

Exceedence conditions are always recorded. The EDM-700 is shipped with conservative generic preprogrammed factory alarm limits. The alarm limits can be fine tuned by the owner, but any changes in limits are instantly recorded to show the new limits on the next print out. Limits can not be changed without the owner knowing. All probes are also checked 3 times per second for actual alarm conditions. False alarms are minimized by the self diagnostic routine in the EDM system. The probes (sensors), are compared to real engine conditions and are removed from the display if they fall out of the real alarm boundary. Should any limit be exceeded, (EGT, CHT, CHT COOL RATE, SPAN, RPM, Hi/lo Oil Temp/Pressure, Hi/Lo VOLTS and TIT) a recording of all engine parameters is taken. The duration and maximum value of each exceedence, along with the exact time and date are recorded.

Alarm conditions have display priority, and all of the EDM instruments display the type of alarm and its value. Twin engine aircraft require two displays and two computers, but JPI now has a single 3 1/8" unit available for twin engines, that displays both engines on one display simultaneously.

Benefits of Recording:

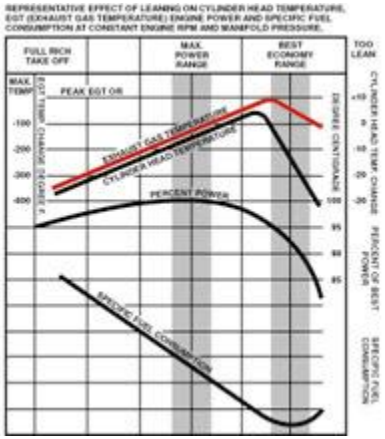
The bottom line on data recording is that it is a very powerful tool. The EDM-700 makes long term trend monitoring easy and easily verifiable on paper. The real benefits are longer engine life and reduced engine maintenance costs. A complete diary of an aircraft's flight profile is now available for analysis by yourself or JPI. This permanent and unalterable record will highlight individual performance variations and allow for corrections before damage occurs. How many time has the going got rough and later, you wondered what affect it had on the engine? Engine warranty claims and resellers will look for the EDM-700's total recorded hours.

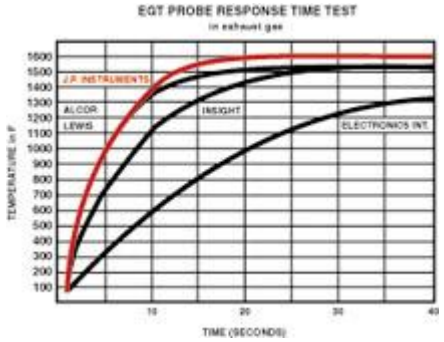
Peak EGT

One of the most important-yet misunderstood-controls on your aircraft is the mixture control. The most effective way to achieve optimal fuel/air mixture is by measuring the temperature of the product of combustion, exhaust gas. As you lean the mixture, the Exhaust Gas Temperature (EGT) rises as the excess fuel is decreased and the combustion is more complete. By measuring the EGT of all cylinders simultaneously, you can determine the first cylinder to peak. Manually by trying to watch all EGT's at the same time is very difficult. The EDM-700 gives you help in three ways: (1) "LeanFind" identifies the first cylinder to peak, (2) "PeakFind" captures the peak value, eliminating over shoot and (3) JPI's fast-response probes are the keys for the LeanFind mode to function properly. The diagram above shows that as the mixture is leaned from full rich position, the EGT increases as the excess fuel decreases. Leaning must stop on the first cylinder to peak, and not the hottest. If you lean to the hottest, some cylinders will be too lean of peak, and could cause detonation

Probe Response

Fast probe response is very important for the LeanFind mode to function properly. Probe response is the time it takes for the probe to react to an engine temperature changes. Response time is primarily affected by (1) Probe mass--low mass for fast response, (2) type of Thermocouple junction--grounded is faster, and (3) Sheath material--copper is fast, stainless steel is slow (like JPI's CHT copper tip probes). JPI probes are fabricated out of a space age material, Hastaloy-X, that can withstand the harsh sulfur atmosphere of high exhaust gas. JPI probes are grounded to eliminate a layer of insulation that would slow the probe response time. At JPI we have found that while leaning an engine, the EGT can change at a rate of over 15 degrees F per second. With slow response probes, you will not be able to find peak EGT. If the EGT increases faster than a slow probe can respond, peak overshoot will occur, giving a false or flat peak indication with engine sputter.





Thermocouple Probes JPI temperature probes are type K thermocouples. Thermocouples are the simplest and most reliable remote temperature measurement transducers available. The principle of operation is based on a property of metals that a bimetallic metal wire with a different temperature at each end will develop a small voltage along the length of the wire proportional to the difference in temperature. The EDM-700 measures this voltage, corrects it for non-linearity (linearized) of the thermocouple material and display the temperature. A reference junction corrects for the ambient temperature at the instrument.

Fuel Flow Option

After extensive testing of many fuel flow measurement products, JPI engineering concluded that all the systems presently on the market were not capable of supporting the EGT leaning process due to their slow response times. JPI has developed a fast response system that permits you to simultaneously view peak EGT and minimum fuel flow. As the pilot leans the engine he will see simultaneously fuel flow and peak EGT. Enrichen the engine 20 degrees and note the fuel flow in Gal/Hr. Their will be an optimum EGT enrichment vs. fuel flow for your engine, giving maximum range and power. The EDM-700 Data Port will include fuel flow data in the data stream. A throttle change with GPS will display fuel required to next GPs fix. Don't be worried about having too much data to deal with, because the EDM can be set to monitor EGT or Fuel Flow only or both simultaneously with the flip of a switch. The bar graph is always displaying EGT/CHT and if the EDM is set to read Fuel flow only a temperature alarm will be displayed immediately. This is not a fuel pressure gage, but a true fuel flow turbine transducer mounted in the fuel line. The fuel flow option takes no additional panel space and is STC'd for most aircraft.