OPERATING INSTRUCTIONS

Features

1. Instruments

The Electronics International line of single and multi-channel instruments offer the following features:

A. Digital Display - The digital display allows you to read absolute temperatures at a glance. It does not require interpretation of dials or tic marks. In a short period of time you will be come familiar with the normal operating temperatures of your engine. Abnormal temperatures will be easy to spot. The digital display is easily viewable in direct sunlight. If the instrument backlight has been permanently powered up (as recommended), the digital display will be easier to see during low ambient light conditions and at night.

B. 1 Degree Resolution - The digital display resolves temperatures to 1 degree. This allows you to interpret trends quickly. This can be very helpful in diagnosing problems and leaning your engine. Also, any unit may be ordered to display in degrees F or degrees C.

C. 1/2% Accuracy - Electronics International instruments are not affected by shake, shock, vibration, tilt, stick-slip, bearing wear, spring wear, lead resistance, probe resistance, magnetic fields or the many other factors that plague analog instrument accuracy. All E.I. instruments are temperature compensated to read cabin temperature when a probe is disconnected. E.I. instruments should never need recalibration.

Ice Zone Warning Light. Only available on the Carb. Temp/OAT instruments.

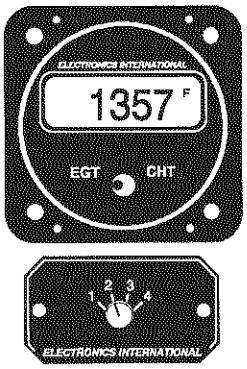
Digital Display.

Selector Switch.

D. Flexibility - Electronics International instruments are compatible with any type K ungrounded probe. This means any instrument, regardless of what is printed on the front panel (EGT, CHT, OAT, etc.), will work with any of our probes (i.e., an OAT channel can read EGT or CHT probes accurately). Also, lead resistance does not affect the accuracy of these units. You may use any length extension cable between the unit and the probe withoutaffecting the accuracy of the instrument.

E. Upgradable - Any single channel EGT and/or CHT unit may be upgraded to a full multi-channel analyzer by simply adding a remote switch to the system. The instruments, remote switches, extension cables and probes were designed in a modular fashion with slip-on connectors. This means a remote switch may be added to your existing system by simply mounting it into your instrument panel, installing the additional wires and probes and plugging it in. You do not have to buy a new system to upgrade to a full analyzer.

2. Remote Switches



Instrument displaying EGT for channel #2.

A remote switch may be connected to any channel on any Electronics International Instrument. This gives the instrument multi-channel capability. There are two types of remote switches available, single deck and double deck. If a single deck four channel remote switch (RS-4-1) is connected to the EGT channel on an EC-1, the instrument would be capable of measuring four EGTs and one CHT. The remote switch will select which EGT channel would be isplayed on the EC-1 instrument when the instrument's selector switch is placed in the EGT position. If a double deck four channel remote swithc (RS-4-2) is connect to the EGT and CHT channels on an EC-1, the instrument will be capable of measuring four EGTs and four CHTs. The EC-1 will select whether EGT or CHT will be displayed. The Remote Switch will select which channel will be displayed.

EGTs

1. Leaning

You will want to lean your engine in cruise. A rich running engine wastes fuel needlessly and tends to run rough. This creates vibration, which causes deterioration of engine accessories and engine mounts. Also, proper leaning at cruise and during descent means less spark plug fouling, longer life for the plugs, reduced maintenance costs and considerable fuel savings. Furthermore, good leaning techniques result in cleaner combustion chambers with fewer lead salt deposits on the pistons and exhaust valves. Under certain conditions, these deposits invite preignition and higher maintenance costs. Proper leaning at cruise during cool or cold weather aids in raising engine and oil temperatures to desireable minimums in order to evaporate the water and acids out of the oil. Water and acids attack the insides of an engine, causing rust and corrosion.

To properly lean your engine using a multi-channel analyzer perform the following steps:

A. Rough Leaning: Select the hottest EGT cylinder. Adjust the mixture control from the full rich position to a leaner setting that results in a slight drop in engine RPM or to a setting near peak EGT, as dictated by experience. The mixture control should be left at this setting until the EGT's stabilize. It will take about 20 seconds for the temperatures to stabilize within 1°F. This lag is due to the combustion walls and piston domes increasing in temperature, which affect the combustion and exhaust gas temperatures. **To correctly lean an engine you must wait for the engine to thermally stabilize.** Less sensitive gauges will not pick up these subtle changes, which are important in leaning and diagnosing problems.

B. Precision Leaning: Again select the hottest EGT cylinder. This cylinder may be different than the one you started with. This is the cylinder on which you should perform your precision leaning. Again, start leaning, making only very small adjustments and waiting 3 to 5 seconds between adjustments. As you approach peak, the exhaust gas temperature will rise much slower until it starts to decrease. When this happens you have reached peak EGT. The

1°F resolution of the digital display will be invaluable in helping you precisely detect peak EGT.

C. Finding The Cylinder That Peaks First: For most engines Step B (Precision Leaning) will result in a properly leaned engine. If you find this to be the case with your engine, this step will not be necessary. But if you want to verify that you have leaned to the cylinder that peaked first and your engine is operating properly, perform the following with the cylinder found in step B at peak EGT. Slightly enrich the mixture and quickly step through each cylinder. Any cylinder that shows a rising temperature is a leaner cylinder. Check that this cylinder does not rise more than 15°F before it starts decreasing in temperature. If a cylinder rises more than 15°F it may have a problem.

When installing a single channel EGT instrument in an aircraft there is no guarantee that the probe is installed on the leanest cylinder. Every engine operates a little differently. For the same make and model of engine installed in the same type of aircraft there can be differences between the leanest cylinders. Furthermore, there can be a difference between operating temperatures and the temperature spread between cylinders. Every engine has its own unique operating temperatures. To properly lean your engine **using a single channel EGT unit** perform the following steps:

A. Rough Leaning: Adjust the mixture control from the full rich position to a leaner setting that results in a slight drop in engine RPM or to a setting near peak EGT, as dictated by experience. The mixture control should be left at this setting until the EGT's stabilize. It will take about 20 seconds for the temperatures to stabilize within 1°F. This lag is due to the combustion walls and piston domes increasing in temperature and, therefore, affecting the combustion and exhaust gas temperatures. **To correctly lean an engine you must wait for the engine to thermally stabilize.** Less sensitive gauges will not pick up these subtle changes, which are important in leaning and diagnosing problems.

B. Precision Leaning: Again, start leaning, making only very small adjustments and waiting 3 to 5 seconds between adjustments. As you approach peak the exhaust gas temperature will rise much slower until it starts to decrease. When this happens you have reached peak EGT. The 1°F resolution of the digital display will be invaluable in helping you precisely detect peak EGT. You will then need to enrichen the mixture for an EGT reading 30°F lower than peak to insure there is no cylinder operating on the lean side of peak EGT.

If your engine runs rough before peak EGT is reached, note the temperature reading on the EGT instrument. When an engine starts to run rough (not when it loses power, but actually runs rough) the leanest cylinder has gone past peak EGT by 30 to 50 degrees F. The leanest cylinder is lean misfiring causing the engine to run rough. From this point enrichen the mixture to obtain a 50 degrees F lower EGT from the noted temperature. This will set the leanest cylinder slightly on the rich side of peak EGT. The rest of the cylinders will be running richer than the leanest by an amount dictated by the temperature spread for your engine. With this method you can reasonably lean an engine even when the probe has not been mounted on the leanest cylinder.

Electronics International's unique stable display allows you to precisely lean to peak EGT or to a specific temperature below peak for most engines. Peak EGT with a float-type carbureted engine is frequently a vague point because of the fuel/air distribution issues in these lower horsepower

engines. As a result, these engines tend to operate smoother at 25°F on the rich side of peak EGT. Fuel-injected engines will provide a more precise peak. Most engines normally operate within an EGT range of 1300°F to 1600°F at cruise power.

Some engine manufacturers allow leaning to peak EGT at 75% power and below on their direct drive normally aspirated engines. **For your engine, check the engine manufacturer's recommended procedures. It is not recommended to lean to peak EGT above 75% power settings.** The richer mixture is needed to cool the combustion temperatures and keep the anti-knock capability of the fuel high enough to prevent detonation from occurring at the higher power settings.

2. EGT Diagnostics

Since the EGT is directly related to the combustion temperature, it is an indication of the engine's ability to produce power. If the engine is not producing the correct amount of power, the EGT instrument can be a very valuable troubleshooting tool as well an early warning system before engine failure occurs. With 1°F resolution, our digital EGT instruments will react to the slightest changes in the combustion process. To detect a problem, become familiar with your engine's normal EGT readings during run-up, climb, cruise and descent. Any difference from the norm can be a sign of trouble.

During normal operation the EGT will stabilize to 1°F for a given throttle and mixture setting. If it does not stabilize, this can also be the first sign of trouble. With rate and trend information being displayed instantaneously and with temperatures being read to 1°F, few problems can escape the pilot flying one of Electronics International's analyzer systems. The following is a list of EGT/ CHT symptoms and possible problems:

Symptom		Possible Problem
One EGT reads abnormally high. The corresponding CHT reads lower than normal.	—	Burned valve or broken ring, defective plug, plug wire or mag.
One EGT reads abnormally high. The corresponding CHT reads higher than normal.	—	Plugged injector, intake leak.
One EGT reads abnormally low.	—	Over-sized injector, restricted exhaust, broken or leaky exhaust header.
High CHTs and/or high EGTs on all cylinders.	—	Excessive leaning with power settings over 75%. Detonation due to bad fuel. Closed or restricted cowl flaps. Missing or loose baffling.
High EGTs and/or low CHTs on all channels.	—	Timing problem or defective mag.
Jumpy readings on one channel.	—	This is not an engine problem. Check all connections and the probe for proper operation. See Troubleshooting Section of this manual.

It is not necessary to continually monitor the EGTs in order to detect a problem. Most problems worsen over a period of time and can be easily detected before they become a safety hazard by thoroughly checking the EGT readings at run-up and once or twice during a flight.

CHTs

1. CHT Operation

The Cylinder Head Temperature (CHT) instrument helps the pilot protect his engine against the threat of excessive heat. Most general aviation aircraft monitor the hottest CHT, as determined by extensive flight tests done by the airframe manufacture. Minimum in-flight CHT should be 150°F, and maximum in most direct drive normally aspirated Avco Lycoming engines is 500°F. Some of the higher powered, more complex engines have a limit of 475°F. Although these are minimum and maximum limits, the pilot should operate the engine at more reasonable temperatures in order to achieve the expected overhaul life of the powerplant. It would be normal during all-year operations in climb and cruise to see cylinder head temperatures in the range of 350°F to 435°F.

Sudden cooling of the CHT (known as shock cooling) is a problem that is common with aircraft engines. This is caused by fast descents with little or no power and rich mixtures. This may result in bent pushrods due to exhaust valves sticking, burned valves, spark plug fouling, broken piston rings, cracked cylinders at the spark plug and valve ports and warped exhaust valves. To avoid these problems, do not allow the CHT to cool more rapidly than 1°F every 3 seconds during in-flight operation. This can be easily detected with our 1°F digital display.

During climbs, the cylinder head temperatures will rise rapidly until the heat absorbed by the combustion walls is dissipated out the engine's cooling fins. At this point, the CHT will stabilize. Any change in throttle, mixture, cowl or airspeed will affect the CHT and the rate at which it will change. Since rate and trend information can be easily interpreted from our digital display, changing any one of these parameters to stabilize, slow or reduce the CHT is possible with almost immediate results. Our digital instrument takes the guesswork out of controlling your CHT.

2. CHT Diagnostics

The source of heat in an engine is from the combustion of the fuel/air mixture producing temperatures of approximately 4000°F. Some of this heat energy goes into heating the cylinder heads through radiation and conduction. This heat is sinked away from the engine by the air flow over the cylinder heads. When the heat being generated in the cylinder heads equalizes with the heat being sinked away, the cylinder head temperature will stabilize. If a problem arises in the combustion chamber or in the ability of the cooling system to sink away heat, the CHTs will be affected. To detect a problem, become familiar with your engine's CHT operating temperatures during run-up, climb, cruise and descent. Any differences from normal can be a sign of trouble.

Continuous change in the CHT can also be a sign of trouble. Because of the large thermal mass of the engine, the CHTs change slowly after the initial climb. Any continuous change in one or all of the CHTs after this initial climb can be the sign of trouble. The rate and trend of this change can easily be detected with Electronics International's 1°F resolution digital display. This information allows the pilot to make changes in flight attitude or engine operation and see the effects almost instantaneously.

Carburetor Temperature

Venturi affect and atomization of fuel can cause temperatures in the carburetor to drop 30°F or more. When the atmospheric conditions are right for the aircraft's current flight altitude (moderate to high humidity), the moisture in the carburetor venturi can freeze quickly. Within minutes ice can choke off the venturi and the engine will stop with little warning.

When Carb. Temp. is selected on the Electronics International Carb. Temp. instrument, the carburetor temperature is continuously monitored and the "Ice Zone" warning light over the display is activated for that channel. The "Ice Zone" warning light is only active for the channel selected. At 39°F (before ice can form in the venturi of the carburetor) the "Ice Zone" warning light will light up. When this happens, apply carburetor heat, making small adjustments to bring the carburetor temperature above 39°F, thereby avoiding any possible carburetor icing condition. An additional benefit of running carburetor temperatures 9°F above freezing is improved atomization of the fuel which results in fewer lead deposits, cleaner plugs and better economy. If the carburetor temperature is below 10°F the "Ice Zone" warning light will go off. Below 10°F there is not enough moisture in the air to form ice in the carburetor.

The "Ice Zone" warning light has the advantage of catching your attention without having to continuously monitor the unit. At night this light may be too bright. An LED Intensity Control Line is provided which may be connected to the aircraft panel rheostat. When the instrument panel lights are turned up the "Ice Zone" warning light will dim.

Monitoring carburetor temperature to 1°F can also help with hard to start engines. If the engine becomes flooded and fuel starts to drip from the carburetor, the unit will display a drop in carburetor temperature as the fuel starts to evaporate. If the engine backfires and a fire starts in the venturi, the unit will display a rapid rise in the carburetor temperature. The carburetor probe is rated for 700°F, so probe damage is not likely.

Outside Air Temperature

The Electronics International OAT instrument has three features that make it a valuable tool when measuring outside air temperatures. The first of these features is its superior accuracy and linearity over conventional gauges. Outside air temperatures have a big affect on your aircraft's ability to lift

and on engine horsepower. Accurate OAT readings are essential if you are looking for maximum performance from your aircraft.

The second valuable feature is the instrument's ability to detect small temperature changes (1°F). This gives the pilot rate and trend information (in what direction and how fast the temperatures are changing) at a glance. This is valuable for detecting changing atmospheric conditions and avoiding thunderstorms and icing conditions. It can also help to find cooler flying conditions in warm weather.

The third feature is the instrument's Ice Zone Warning Light. This light will come on when the OAT drops to 39°F and stays above 10°F. This feature can be very useful to a pilot by warning him of the possibility of structural ice if weather conditions are right.

The Electronics International OAT instrument resolves outside air temperatures to 1°F and is very sensitive to air temperatures changes. For this reason, when the OAT probe is in still air and near a heat source, such as hot asphalt, a hangar heater, etc., the unit will read the actual temperature to which the probe is subjected. When the engine starts and there is a flow to air over the probe, the unit will read the air temperature accurately and display changes quickly.

INSTALLATION INSTRUCTIONS

1. Important Information and Initial Check Out

A. The installer and aircraft owner must read the Warranty before starting the installation. There is information in the Warranty that may alter your decision to install this instrument. **If you do not accept the terms of the Warranty, do not install this instrument.**

B. If you are not an FAA Certified Aircraft Mechanic familiar with the issues of installing aircraft EGT, CHT, Carb Temp and/or OAT instruments, Do Not attempt to install this instrument. The installer should use current aircraft standards and practices to install this instrument (refer to AC 43.13).

C. Check that any necessary FAA Approvals (STC's, etc.) are available for your aircraft before starting the installation. STC's are located at the back of this manual.

D. Read the entire Installation Instructions and resolve any issues you may have before starting the installation. This may eliminate any delays once the installation is started.

E. THIS INSTALLATION MAY REQUIRE SOME PARTS UNIQUE TO YOUR AIRCRAFT THAT ARE NOT SUPPLIED IN THE KIT. Acquire all the parts necessary to install this instrument before starting the installation.

F. Check that the instrument make and model are correct before starting the installation.