



**Model 4000 Turbine/Turboprop
ENGINE INFORMATION SYSTEM
User's Manual**



**Grand Rapids Technologies Incorporated
3133 Madison Ave
(616) 245-7700 Fax (616) 245-7707**

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- 10/18/07 - Corrected an error that referenced N1_100% setting for N2 RPM calculation. Corrected to show N2_100% is used.
- 5/23/11 - Typical tachometer configuration settings added.

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Figure 1 - Description of Pages

Figure 2. Operation

Congratulations on your purchase of Grand Rapids Technologies' Engine Information System (EIS). We are pleased that you have chosen our product to meet your aircraft instrumentation needs. You will find this system will enhance your flying pleasure while increasing your level of safety.

1. Read This First!

Note for those upgrading the software with a new computer chip. After installing the chip, it may be initialized to factory default settings by pressing and holding the right button when turning the instrument on. After a delay of a few seconds, this will set the user-defined pages to the factory configuration.

Advice Before Starting Your Installation: Three steps to make your installation easier.

Step 1. Determine how you would like to arrange your EGT/CHT connections. The EGT/CHT inputs are numbered 1-4 (1-6 for the Model 6000). You may simply connect EGT1 & CHT1 to cylinder number one (according to the engine manufacturer's cylinder numbering). This is common, and works well. For four cylinder engines there is also an alternate method. You may wish to connect the EGTs and CHTs so they correspond to their position on the digital display pages. That is, connecting EGT 1 & CHT 1 to the front left cylinder (since it appears on the top right position of display page), EGT 2 & CHT 2 to the front right cylinder (since it appears on the top left position of the display page), and so on. (Figure 1 illustrates the position of the data on the display pages.) Either option works well. The main point is to make sure you know which cylinder corresponds to each of the readings on the instrument so that you will perform maintenance on the correct cylinder when it becomes necessary.

Step 2. Plan which functions you will wire to each of the 6 auxiliary inputs. Recall that manifold pressure, fuel pressure, fuel level, vacuum, coolant pressure, ampmeter, torque, and any other sensor inputs that do not have a dedicated input to the instrument, must be connected through one of the auxiliary inputs. (The auxiliary inputs may be used for other functions also, but these are the most common uses.) All auxiliary inputs are functionally identical.

For convenience, the default settings in the EIS for turbine and turboprop engines are configured for fuel pressure via Aux2, and torque via Aux3. These default settings affect the labels used for Aux2 and Aux3 (FPr and Trq respectively), as well as the configuration of the user-definable combination pages. If desired, these default settings can be altered to allow fuel pressure and/or torque to use any of the 6 aux inputs.

Step 3. Remember that you have complete control over what will be displayed on the two combination pages, and the digital data displayed on the bar graph pages. You will find this useful for conveniently displaying the exact data you would like available during your flight

...now on to the installation!

2. An Overview of Installation & Setup

Installation of the EIS includes the physical mounting of the instrument into the airplane's instrument panel, making the electrical connections from the pre-wired cables to the various sensors, and finally setting entries in the instrument to customize your instrument for your installation. The first two steps are quite obvious. The entries made to the instrument for your installation tells the instrument such things as how many pulses per revolution of your engine, units (Fahrenheit or Celsius), etc.

Following these steps, operation of the instrument will be verified by applying power to it. Finally, you will set your engine limits, and customize the display pages to your liking.

During flight you will use the leaning functions to accurately lean your engine. During the cruise portion of your flight you will use the tracking functions to continuously monitor your engine for even momentary signs of developing engine problems. Now let's get started with the installation by turning to the section "Installation" which begins on page 11

3. Using the Engine Information System

Refer to figure 1 for a description of the various display pages, and to figure 2 for an illustration of the use of the EIS from panel keys to control the operation of the instrument.

3.1 The Basics of the Engine Information System Operation

- **Power to EIS when starting the engine.** It is good practice to turn on the EIS before starting the engine, and verify a low oil pressure warning is generated. This verifies the oil pressure sensor is able to sense zero pressure correctly. The instrument may be left on, and the engine started, at which time the warning light should go off, indicating oil pressure is within limits. While the oil pressure sensor is very reliable, this procedure is recommended because it requires little more than turning the instrument on before starting your engine.
- **The Display button and your favorite page.** Double-clicking the "Display" key will immediately change screens to the page you have selected as your favorite display page. This provides a quick and simple means of returning your instrument to your favorite page, after you have been reviewing other display pages. To make your selection of which page is to be displayed by the "Display" key, see the "Set Pages" section.
- **The Display button and On-Screen Labels.** Pressing and holding the "Display" button while on a user-configurable page (a combination page or bar-graph page) will replace the numeric data with labels, making it easy to identify the data on the screen. Releasing the button returns the display to numeric data.
- **The Alarms – The most important part!** The instrument's alarm function will alert you to out-of-limit conditions by flashing the warning light (to get your attention), and simultaneously changing pages to a labeled screen and flashing the reading above its label to identify it. If the problem can not be fixed immediately, the alarm should be acknowledged by pressing the "Next/Ack" button on the EIS. (When the alarm light is flashing, the instrument will ignore the other buttons.) Acknowledging an alarm returns the instrument to the page it was previously on, and allows it to alert you to the next problem. After acknowledging an alarm, the warning light will remain continuously on as long as any out-of-limit condition exists. The warning light will go out when everything is within limits. An alarm that goes away, and then returns, is treated as a new warning, and will again generate the response described here. Multiple alarms are presented according to priority, one at a time.
- **Determining Alarm Status** – After acknowledging one or more alarms, the warning light will stay continuously on indicating as long as one or more functions are out-of-limits. To make the instrument show you the current out-of-limit conditions, select the "Set Pages", then simply hold the right button depressed until the instrument returns to the normal display pages. Upon leaving the set pages, the instrument will clear the acknowledgement of all alarms, causing it to re-annunciate all current alarm conditions as if they were new alarms. Turning the power of and back on will also accomplish this action, but will reset the flight timer.
- **Set Unused Limits to Zero.** By setting a limit to zero, the alarm function for that limit will be turned off. It is a good idea to set limits for all unused functions to zero so that the instrument does not inadvertently generate nuisance warnings for signals you are not using.

3.2 Before Each Flight

1. If the instrument includes the altimeter option, set it before each flight.
2. If the instrument includes the fuel flow option, review or update the fuel quantity setting as necessary. (Pressing the outer two buttons of the EIS will bring up the fuel quantity set page. While on this page, pressing the "UP" and

"DOWN" (left and center buttons) will set the fuel quantity to whatever you have entered on the "MAX Fuel" setting on the configuration set pages.)

All engine limits are stored with a checksum. If the instrument determines a user setting has been lost, it will generate a "Check Entries" message at power-up. If you see this message, carefully review all user settings.

At power-up, the EIS will automatically select the page you have set as your favorite in the "DISPLAY" set page. If an alarm is active, the instrument will first annunciate the alarms (requiring you to press the right button to acknowledge them) before going to your favorite page.

Suggestion! Include in your checklist a step to turn on the instrument before starting the engine. Verify you get a low oil pressure warning (and possibly others). This is a simple way of verifying the oil pressure sensor is correctly measuring zero oil pressure. This is recommended not because the sensor is prone to failure (it is actually very reliable), but because it is a very easy test to verify the most critical engine monitoring function.

NOTE: It is possible for the instrument or its sensors to suffer various kinds of failures that can not be detected by the self-test. It is good practice to review the various display pages periodically as necessary to verify that the instrument and its sensors are operating normally.

4. SET PAGES – Setting Engine Limits and other User Entries

The "Set" pages are used to enter engine limits and other selections into the EIS. These pages are accessed by simultaneously pressing the two keys marked "SET LIMITS", as illustrated in figure 2. The use of the engine limits, and the other features controlled on these pages, are described below. All entries on these pages are retained when the instrument is turned off. No electrical connection to the instrument, or battery is required to maintain these settings.

Since all limits can be entered easily by the pilot at any time, it is practical to set engine limits lower than those indicated by the engine manufacturer, but slightly higher than encountered in normal operation. In this way, a change in normal engine operation may be detected earlier.

Minimum and maximum limits are included for most functions, even when some of the limits may have no everyday practical use. This allows additional flexibility to assist with engine troubleshooting, especially to help alert you to intermittent problems that would otherwise be hard to detect.

All limits must be set in the same units selected on the "UNITS" page. If you change the units (from Fahrenheit to Celsius for example), the limits will not change, making all temperature limits incorrect unless reset to Celsius.

NOTE: Limits that are not used should be set to zero. This disables the limit to prevent nuisance false warnings. Some limits may not have a practical use for routine flying, but have been included to provide additional flexibility in diagnosing engine problems. Normally these limits are set to zero.

CAUTION: While the "Set" pages are selected, the automatic warning feature of the instrument is disabled. This is necessary to allow the pilot the ability to change an engine limit in the presence of an engine parameter that is intermittently outside of its limit. The warning light is illuminated while the "Set Limits" pages are selected to remind you that the warning feature has been disabled---and as a convenient means of testing this light.

All alarms will be annunciated as described in "Using the Engine Information System", unless otherwise noted in the table below.

4.1 Set Page Table of Limits.

Setting	Use	Recommended Setting
Cont	Contrast - Adjusts screen for maximum readability based on viewing angle and instrument temperature. *See end of table for more information about this setting.	2 or 3
Back_Light	Sets the intensity of the backlight. Lower settings correspond to lower intensity, with zero corresponding to backlight off.	Set this to maximum level acceptable for night flying.
Alt	Altimeter - Adjusts altimeter to account for current barometric pressure. Note that the barometric setting is displayed directly below the "Baro" label, and altitude below the "Alt" label.	Set to airport's elevation or current altimeter setting.
Fuel	Fuel quantity calculated by the fuel flow function. After adding fuel to the airplane, set this to match the quantity in the airplane. Note: Pressing "Next" and "Display" buttons together jumps you directly to this page from a normal display page. Pressing the left and center button together while on this page sets the fuel quantity to the Max Fuel entry.	Set to match amount of fuel in the airplane. Not applicable if the fuel flow option is not installed.
Max Time	Alerts pilot when flight time exceeds this limit. Useful as a warning to check fuel. Limit is entered in minutes, so 2 hours is entered as 120, etc.	30-45 minutes less than airplane's endurance.
Interval	Provides a warning that repeats at the interval entered in minutes. Useful as a reminder to perform periodic tasks such as switching fuel tanks. Acknowledging this alarm cancels the warning completely, therefore the warning light will not remain on after acknowledging this alarm.	As required. Typically 30-60 minutes is used for changing fuel tank selection.
Max Flow	Maximum Fuel Flow – Generates a warning when the fuel flow (rate of fuel burn) exceeds this limit. Useful for detecting badly leaking fuel lines, loose connections to fuel injectors, etc. Very useful safety feature for all engines, but especially fuel injected engines. Be sure to use it!	Set about 10-20% above max fuel flow rate at full takeoff power. Applicable only if the fuel flow option is installed.
Max OilP	Maximum Oil Pressure. Useful as a reminder to reduce RPM when warming a cold engine, especially in winter conditions, to avoid excessive oil pressure.	98 or less. Max oil pressure displayed by the instrument is 99 psi.
Min OilP	Minimum Oil Pressure – Essential! Be sure to use this one! Warns of loss of oil pressure. As this is the most serious alarm, some pilots may take drastic action when seeing this alarm. Consider you situation carefully if you get this alarm. An instrumentation failure (sensor failure) is possible, as is complete engine stoppage or anything in between. Use your judgement!	As recommended by the engine manufacturer, or 20 psi.
Min Crz_OP	Minimum Cruise Oil Pressure - Generates a warning when the oil pressure is below this limit. This limit is active only when the engine RPM is above the min Lim-RPM setting. This allows setting a low oil pressure limit that apply only at higher engine RPM.	As recommended by engine manufacturer, if available. If not provided, set based on experience.
Max OilT	Maximum Oil Temperature	As recommended by engine manufacturer.
Min OilT	Minimum Oil Temperature – Intended for troubleshooting engine problems. Also useful as an "engine not warmed up yet" reminder.	Set limit based on experience.
Max N1%	Warns when engine exceeds maximum N1%	Set according to engine manufacturer's recommendation.

Min N1%	Warns when engine N1% RPM falls below this entry.	Set limit based on experience.
Max N2% or N2	Warns when N2 RPM exceeds this limit. For the turbine version, this is in percent, and the turboprop version is prop RPM.	Set according to engine manufacturer's recommendation.
Min N2% or N2	Warns when N2 RPM falls below this limit. For the turbine version, this is in percent, and the turboprop version is prop RPM.	Set limit based on experience.
Min Fuel	Minimum Fuel Quantity – Generates a warning when the fuel flow function's fuel quantity drops below this limit.	Set to at least enough useable fuel to provide 30-60 minutes of fuel at cruise power. Applicable only if the fuel flow option is installed.
Min Aux (1-6) Max Aux (1-6)	Minimum & Maximum for Aux input.	Set limit as needed depending on the use of the auxiliary input. Some uses of the auxiliary inputs do not require limits (such as manifold pressure) and some do, such as fuel pressure.
Max H2O	Maximum water temperature limit	Set limit as recommended by engine manufacturer
Min H2O	Minimum water temperature limit. Intended for troubleshooting engine problems. Also useful as an "engine not warmed up yet" reminder.	Set limit based on experience.
Max Volt	Maximum Voltage Limit – Allows for detection of failed regulator. Loss of correct voltage regulation resulting in overcharging (and subsequent high voltage) will greatly shorten the life of the battery, and could be dangerous.	Start with 15.6 volts. Lower as much as possible without getting false alarms. Typical limit should be 14.6 Volts.
Min Volt	Minimum Voltage Limit – Allows for detection of loss of charging. This limit is only tested when the engine RPM is greater than the EGT-RPM setting. This prevents false alarms on final approach (low RPM) with landing lights on.	Set limit to about 12.8 volts to get immediate alerting of loss of charging, although this will cause low voltage alarm whenever instrument is on while engine is not running. Set to 12.4 volts or less to avoid alarm when engine not running, but still gives alarm shortly after battery discharging has begun.
Max Carb	Carb temp warning is generated when the carb temp falls between the Max Carb and Min Carb Limit.	40-60 deg F
Min Carb	See Max Carb	0-20 deg F
Max EGT	Maximum EGT – Not all engines have published limits, nor do all engines require a maximum EGT limit. This alarm can be useful for troubleshooting engine problems also.	Set limit according to engine manufacturer recommendation, or based on experience.
Min EGT	Minimum EGT – This alarm is active only when the engine RPM is above the entry for EGT-RPM. This alarm is useful to detecting the loss of a cylinder, or for troubleshooting engine problems.	800-1200 deg F, depending on sensitivity desired. If false alarms are consistently generated, reduce the limit to less than 800 deg F, or set to 0.
Lim-RPM	Defines the RPM at which the following RPM dependant limits become active. These are: Min EGT, Min Volt, Min Crz_OP	Set limit to an RPM slightly less than the RPM used for the MAG check. This allows the Min Volt test to become active during the MAG test to automatically test for charging.
Max EgtSpan	Maximum difference between the highest and lowest EGT. This limit can be used to help detect changes in normal engine	Set this limit based on experience. It may take some trial and error to

	operation. It is also useful when leaning using the digital leaning pages, as it is possible to not notice a EGT that is abnormally low when using these pages to lean the engine. (Its more obvious on the bar graph pages.)	arrive at a good limit. After establishing a limit that rarely generates alarms, activation of this alarm may indicate developing engine problem.
Max EGT-Inc	Maximum Increase in EGT from the Lean Point. This alarm is active while lean point is active. This alarm will often generate a false alarm when the load on the engine significantly reduced during descent. To avoid this false alarm, reset the Lean Point. (Selecting “Set Lean Page” and “Yes” activates alarm; “Reset” de-activates alarm.)	Set limit based on experience. A small value will allow sensitive detection of EGT increases, which is useful for detection of intermittent problems. Normal operation may require a larger setting to prevent false alarms due to normal EGT fluctuation caused by turbulence or other small power/load fluctuations.
Max EGT-Dec	Maximum Decrease in EGT from the Lean Point. See also Max EGT-Inc description.	Set limit based on experience. You may find that this limit is significantly different from the Max EGT-Inc. See also Max EGT-Inc description.
Max CRate	Maximum Cooling Rate for CHT – The alarm is provided in degrees/minute, and corresponds to the maximum rate of decrease in CHT. No limit applies to the maximum rate of increase. All cylinders are checked for this limit.	Set limit based on engine manufacturer’s recommendation. If no limit is provided, establish a limit based on experience.
Max CHT	Maximum Cylinder Head Temperature. Often engines will normally operate significantly lower than the engine manufacturer’s limit. Consider setting this limit lower than the maximum to get early warning of abnormal CHTs.	Set according to engine manufacturer’s recommendation.
Min CHT	Minimum Cylinder Head Temperature. Intended for engine troubleshooting problems. Also useful as an “engine not warmed up yet” reminder.	Set limit based on experience or to zero if not used.
Display	Define which page number is your favorite. The instrument will select this page at power-up, or when leaving the set pages, after all alarms (if any) are acknowledged. This page is also selected by double clicking the “Display” button. See figure 2 for page numbering. This is a very useful feature. Be sure to use it!	Set the your favorite page number.

***Contrast** – The contrast of the LCD display is set on this page. Four levels of contrast may be selected, 0-3, with the lower settings best for higher ambient temperatures, and the higher settings best for normal and cooler temperatures. Make your selection to achieve the most desirable appearance of the display. It may be necessary to change it in response to large ambient temperature changes, although this is rare. The contrast setting will automatically reset to level 2 at power-up if it is set below level 2.

5. INSTALLATION

5.1 Mounting the Instrument – Position and other considerations

The first step in mounting the instrument is selection of a suitable location in the aircraft. The location must be selected such that it is not exposed to water or fuel, and preferably away from other devices that generate heat. The instrument does not generate electrical noise that will interfere with radios, nor is it affected by transmissions from radios or engine ignition systems. It is not likely to affect a magnetic compass.

The excellent readability making in non-critical as to where the instrument is mounted with respect to the pilots eyes. The instrument uses an anti-glare window to minimize reflections. Of course the instrument should be positioned to allow easy access to its front panel buttons.

The instrument should be secured using the mounting holes in the faceplate. Figure 4 provides the physical dimensions of the instrument and a full-size mounting template. If the mounting template is used, its dimensions should be verified, as paper may expand and contract with humidity.

NOTE: No special consideration must be given regarding protection from vibration. The mechanical design of the instrument is very rugged. This is of course not true of other instruments, especially mechanical airspeed indicators and altimeters. The instrument does not emit electrical noise that will interfere with any radios, and can be mounted next to a radio without concern. A magnetic compass may also be located next to the instrument if desired, with no measurable effect, on or off.

5.2 Wiring

Figure 5a & 5b illustrates all electrical connections made to the EIS. The “Detailed Wiring Description” below provides additional information about wiring the instrument into your aircraft. Review this material to familiarize yourself before proceeding further.

Using this figure, start the wiring process by carefully planning and **DRAWING A WIRING DIAGRAM** for your aircraft. The wiring diagram is essential in planning a successful installation. Install the wiring, routing all wires required by the EIS to its planned location. A high-quality 22-gauge stranded wire, 7 or 19 strands, is recommended for all connections other than those made to the CHT and EGT probes. Solid conductor wiring is not acceptable. Thermocouple extension wire must be used for the CHT and EGT probes to prevent the introduction of errors into these measurements.

CAUTION: Use a separate ground wires for the ignition kill switches and the remainder of the electrical system if possible. These separate ground wires should attach to different places on the case of the engine so that both sets of grounds could not disconnect from the engine while remaining connected to each other. This provides additional protection for the instrument (although its internal protection is usually more than adequate), but more importantly, protects other electronic equipment in your airplane from potential damage. See the sheet at the back of the manual for more information.

All electrical connections are made to the EIS via two 25-pin sub-D type connectors. Pre-wired, color-coded cables are supplied with the instrument.

1. Start by making the power and tachometer connections as illustrated in figure 7. Note that 10.5-20 Volts DC, 0.20 Amperes is required to power the instrument. The instrument includes an internal thermally activated fuse that protects the instrument. A fuse should be used in the aircraft wiring so that a short in the wiring external to the instrument does not cause an electrical fire. Typically a fuse up to 5 amps may be used for this purpose, depending on the wire gauge and lengths. This fuse may be shared with other items, such as radios and such.
2. For proper operation of the instrument, the ground (black wire) from the instrument must be connected to the case of the engine. Since most engines are grounded to allow operation of the electric starter, only the connection from the instrument to the negative (-) terminal of the battery must be considered. Ideally, the ground wire for the instrument should not be shared with other electrical devices. If other devices share the ground wire used by the instrument, use a digital voltmeter to verify the voltage difference between the case of the EIS, and the negative terminal of the battery is less than 20 mV with all electrical devices which share this ground wire turned on.
3. Do not use the same ground lead for the instrument, and the ignition kill switch(es). Be sure these separate ground leads do not connect to the engine in such a way that they could become disconnected from the engine, but remain connected together.

4. The remainder of the signals are now connected. Accuracy of these sensors is not affected by the length of the leads. Refer to figure 5a & 5b for an illustration of these connections.

5.2.1 Outside Air Temperature Sensor

The sensor for this unit is mounted using the plastic clip. This clip is attached to the airplane, and the sensor snaps into it. To assure maximum accuracy, do not install the sensor such that it is in the path of engine exhaust gases or cooling air outputs. Also avoid attaching it to aircraft structure that is warmed by the sun. The ideal location is under the wing, or under the fuselage for pusher-engine installations. It is very easy for the probe to get warmed by the engine if it is installed behind the engine, usually resulting in readings that are 5-10 deg F too high. Avoid routing the wires to this sensor near radios, ignition systems, or other electronic devices as much as practical. Ground the sensor near then instrument To help prevent electrical noise from affecting the sensor, twist the entire length of leads from the instrument to the OAT probe.

The outside air temperature is displayed in degrees Fahrenheit and Celsius as shown on figure 1.

5.2.2 Water Coolant/Oil Temperature Sensor

Start by installing the sensor in the engine according to the recommendations of the engine manufacturer. After installation, route the wires through engine compartment, making certain the wire is supported so that it will not be chaffed. A connector or terminal strip may be used between the aircraft wiring and the sensor to enhance maintainability if desired. Single-wire type sensors, (those which have a one electrical connection to them) require that their cases be connected to ground. For these sensors pipe thread compound should be used to seal the sensor. Teflon tape should be avoided because it may electrically insulate the case of the sensor from ground. If practical, connect the ground wire to the same point where the instrument is grounded to minimize differences in ground voltages.

5.2.3 Voltmeter

The voltmeter senses its voltage through the power input to the instrument, and thus does not require a separate connection.

5.2.4 Oil Pressure Sender

The oil pressure sender should first be installed on the engine. This sender uses an 1/8-27 NPT pipe thread fitting, but may be adapted to any engine with the appropriate pipe fitting adapters. The sender may also be mounted remotely, using suitable hose connections. This is necessary with some engines, especially Lycoming.

The electrical connections are made through the case of the sender (ground) and the electrical terminal opposite the pipe thread fitting. Ground is normally provided by the engine when the sensor is mounted directly to it, but a separate ground wire may be necessary for remote installations.

5.2.5 Magnetic Tachometer Sensor

See instructions with this sensor for installation recommendations.

5.2.6 External Alarm Output

This output is used to control the external warning light included. The output is an OPEN/GROUND type output. This means that when this output is off (the alarm is not active), this line is equivalent to an OPEN circuit. When this output is on, this output is switched to GROUND. Thus, the external warning light (or annunciator) is connected to this output and +12 Volts. The maximum current this output can control is 0.11 Amperes, or 110 mA. Exceeding 110 mA will normally cause this output to go to the open state, although it is possible to damage this output if the condition is not corrected.

5.2.7 Auxiliary Inputs

Your instrument includes 6 auxiliary inputs. Wire these inputs to your sensors for the auxiliary inputs according to the sheets included with the auxiliary input sensors. Refer to the “Advice Before Starting Your Installation” section at the front of this manual regarding assignment of the auxiliary inputs to the various functions.

If you are using the auxiliary input for your own custom application, this input must be in the range of 0-5 Volts DC, and must not exceed 5.5 Volts. The scaling of this auxiliary display number *n* is set using the “nSF” and “nOff” as described in the “Configuration Set Pages” section. If this input is not used, the Aux limit should be set to zero on the “Set Limits” pages to prevent nuisance warnings.

CAUTION: This input must not exceed 5.5 Volts. Although no damage will occur the accuracy of the instrument will be adversely affected while an aux input exceeds 6.0 Volts.

5.2.8 Cylinder Head Temperature Probe Installation

Ring-terminal type CHT probes are installed by removing the spark plug, placing the sensor under it, and re-installing the plug into the engine. Orient the sensor so that as much clearance as possible is provided between its leads and the engine structure.

Bayonet type CHT probes (for Lycoming and Continental engines) are retained by a bayonet adapter. This adapter is screwed into the engine, in a threaded hole near the bottom spark plug. This hole can be identified by its solid bottom. ***Do not use the primer hole to mount this adapter! If you are in doubt, consult an expert!*** The CHT probe is adjusted by turning the locking collar on the spring so that its tip is pressed against the bottom of the CHT probe well when it is locked onto the adapter.

NOTE: To prevent false readings for inputs that are not used, it is recommended that unused CHT inputs be shorted together. Unused EGT inputs may also be shorted together, or may be hooked up in parallel with another EGT input so that the EGT Span calculation remains meaningful.

5.2.9 Exhaust Gas Temperature Probe Installation

Start by drilling an 1/8-inch diameter holes at the appropriate position in the exhaust manifold as indicated by the engine manufacturer. If the manufacturer provides no guidance on the location of the EGT probes, we recommend the following:

1. Position the probe 2-8 inches from the cylinder.
2. Although not critical, it is preferable to position all probes the same distance from the cylinder.
3. If possible, position the probes so that they are mounted on a straight (not curving) portion of the exhaust manifold. The hose clamps fit slightly better on straight portions of the manifold.
4. Position the hole around the manifold so that the probe does not interfere with the cowl, and takes into consideration practical needs related to maintenance (does not interfere with the access to the oil filter, etc.), inspections, or probe mounting.

Insert the probe into the exhaust manifold and secure it by tightening the clamp firmly. Do not over-tighten.

CAUTION: Secure installation of the exhaust gas temperature sensor is critical to safe operation of your engine. Failure of this sensor to remain installed in the exhaust manifold could result in an exhaust leak of hot exhaust gases containing carbon monoxide. This poses a potential fire and/or cabin air-contamination threat. Inspection of the installation by a licensed A&P mechanic is recommended.

It may be necessary to safety wire the EGT probe such that it is impossible for the probe to come in contact with rotating engine parts or the propeller should its attachment fail. This is especially of concern with pusher-type engine installations.

It is necessary for this probe to be grounded. In most cases no special provisions are required to achieve this, since the exhaust manifold is normally connected to ground via the engine, and the EGT probe clamp typically makes a good electrical connection to the exhaust manifold. An ungrounded probe may cause erratic EGT readings.

5.2.10 Carburetor Temperature Probe

The carburetor temperature probe is mounted in the carburetor such that it senses the air temperature in the venturi. See the sheet that accompanies this probe for further details about its mounting.

5.2.11 EGT & CHT Extension Wire

All models of the EIS correct the EGT and CHT inputs (the thermocouple inputs) for the ambient temperature. This is called “cold-junction compensation”. To perform this compensation accurately, all models of the EIS, except those marked with the “Ext CJ” designation, or those using the temperature compensating terminal strip, require thermocouple extension wire.

Unlike other types of wire, thermocouple extension wire is polarized. Each conductor is made of a different alloy, and is identified by the color of the insulation. It is necessary to use matching extension wire for thermocouple probes, and to observe this polarity, for accurate readings. For example, the EIS requires type J thermocouple for sensing cylinder head temperature. To extend the leads of the cylinder head temperature probe, type J extension wire is required.

Extension wire type is identified by the color of the insulation on the two wires.

Type	Color of Insulation on the Wires	Use
J	Red and White	Cylinder Head Temperature
K	Red and Yellow	Exhaust Gas Temperature

Leave slack in the wire between the engine and airframe to account for engine motion. To avoid confusion, it is a good idea to label each wire to identify which cylinder it is to be used for.

Crimp the mating connectors onto the extension wire. Plug the color-coded leads onto the matching color extension wires. Secure the probe leads with suitable wire clamps to prevent them from chaffing against the engine or airframe. Heat shrink tubing can be used to protect the leads from abrasion, and insulate the electrical connections to the probe.

NOTE : The length of wire on the EGT & CHT probes, or the extension wire may be shortened as desired for your installation.

5.3 Verify the Wiring – A Quick Check

Take a moment now to review all wiring connections you have made to the EIS. Double check the following wiring:

- power
- ground
- tachometer connections
- Verify that the same ground wire is not used as both a ground to the engine for the EIS, and as a ground for the ignition kill switches. Verify that these separate ground leads do not connect to the engine in such a way that they could become disconnected from the engine, but remain connected together. Do not use the same connection to the engine for these ground leads.

Finally, install the connector backshell using the supplied hardware. Secure the wiring, using cable clamps to the aircraft structure so that no strain is transmitted to the connector. Plug the connectors into the EIS and secure them to the instrument with the screws included with the backshell.

6. Check-Out

6.1 Initial Application of Power to the Instrument

Apply power to the system. Verify that the LCD display becomes active. The instrument will be on display page 0. If this operation is not observed, immediately turn off power to the EIS and recheck all wiring---especially power, ground, 4.8V excitation output and 12V fuel flow power output.

At this point, you may wish to completely configure the instrument for your installation. Refer the section “Configuring the EIS for your Installation”.

6.2 Tachometer Initial Test

Note: This test applies only to N2 (propeller RPM) for the turboprop version.

A simple test to help verify the RPM readings are accurate can be made by running the engine at night, and looking through the propeller at a florescent or mercury vapor light. The pulsation of the light will make the propeller to appear to stopped at various RPMs. Verify the propeller appears stopped at the RPMs shown in the following table. Note that this applies to lights powered by 60 Hz electrical power, such as that used in the United States and Canada. Also remember that this is the propeller RPM, and the engine RPM will be higher by the reduction ratio if the engine includes a propeller speed reduction unit.

2-Blade Propeller	3-Blade Propeller
600	240
720	300
1200	480
1440	600
1800	1200
3600	2400

CAUTION : If there is ANY DOUBT that the tachometer is working correctly, use another tachometer that is known good to verify the EIS is giving the correct tachometer reading. Attempting a take-off with an inaccurate tachometer could result in less than full power being available, and this could be very dangerous.

6.3 Other Checks

CAUTION : Verify that no leaks are observed around the coolant temperature sensor (if so equipped), as well as the oil pressure and temperature sensors. Loss of engine oil or coolant will severely damage your engine, and will result in sudden stoppage.

The remainder of the functions should now be checked out by observing the measurements displayed by the EIS. Any measurements that appear unreasonable should be checked to verify their accuracy.

Your EIS is now ready to use. Please refer to the “Before Each Flight” section.

7. Configuring the EIS for your airplane.

Configuring the EIS for your airplane simply involves setting various entries in the “Configuration Set” pages. These settings tell the instrument details about your engine (such as how many pulses per revolution for the tachometer, units, etc.), how the auxiliary inputs are used, the desired units, etc. The best way to set these items is to work your way through the list describing these settings below.

To access the “Configuration Set” pages, press and hold the center and right button until the screen shows “UP DOWN NEXT” on the bottom row. The display will momentarily show the “Set Lean Pt” page while holding these buttons. This is normal. After about 5-10 seconds, the “Configuration Set” pages will be displayed. This deliberate action is required so that anyone unfamiliar with the instrument will not inadvertently alter the configuration of your instrument.

The settings shown on the “Configuration Set” pages are as follows. The order has been altered by grouping everything related to the auxiliary inputs at the beginning, with the remainder of the settings, in order, following the auxiliary section.

7.1 Setting up your Auxiliary Inputs – Labels and Scaling

You may prefer to wire certain auxiliary functions to particular auxiliary inputs so that they show up together on the labeled page. Aux 1, 2, & 3 are displayed on one labeled page, and Aux 4, 5, & 6 on another. (Of course this data may also be displayed on a programmable page.) After determining this, wire up the auxiliary input as shown on the sheet included with it. Then set the following entries on the configuration set pages.

7.1.1 Aux1, Aux2, Aux3, Aux4, Aux5, Aux6

These page allows you to define the labels to be used for auxiliary inputs. You may create any label you wish. It may be desirable to use a label with the appropriate number of characters to fit in the space you have defined for it on the combination page.

To change the label, press the left and center button together to enter the “edit” mode. The first character will begin flashing. Use the left and center buttons individually to select the desired character for this position. Use the right button to edit the next character. After editing the last character, the instrument will leave “edit” mode. Pressing the right button when not in edit mode will take you to the next character.

Suggestion! Use 3 character labels for auxiliary inputs configured as integer, since the combination screen will allocate 3 spaces on the screen for auxiliary inputs configured as integers. (Auxiliary inputs configured as decimal numbers will be allocated 4 spaces, making it practical to use 3 or 4 character labels.)

7.1.2 Auxiliary Scale Factors and Offsets (1SF, 1OFF, 2SF, 2OFF...)

These entries are used to calibrate the auxiliary input so that the value displayed on the instrument has meaningful units and is accurate. Each auxiliary input includes a sheet that tells you the values for the Auxiliary Scale Factor (sometimes abbreviated AuxSF) and the Auxiliary Offset (sometimes abbreviated AuxOff). This instrument uses the labels 1SF & 1OFF for the AuxSF and AuxOff for auxiliary input 1, 2SF & 2 OFF is for auxiliary 2, and so on.

7.1.3 Auxiliary Forward/Reverse Sensing Selection (+/-)

This selection tells the instrument whether each auxiliary input will be sensed forward (increasing voltage = increasing value) or reverse (increasing voltage = decreasing value). The sheet included with the auxiliary input sensor will tell you if forward or reverse is required. In most cases, forward sensing is used.

This page displays all 6 forward/reverse selections on one page. Use the left and center buttons to select the combination that fits your needs. The +/- signs apply, from leftmost to rightmost, auxiliary 1 to auxiliary 6 respectively. The following screen shows auxiliary 2 set to reverse sensing, with all other inputs set to forward sensing.

+	/	-								+	-	+	+	+	+
			U	P		D	O	W	N		N	E	X	T	

7.1.4 Auxiliary Decimal/Integer Selection (D/I)

This selection allows you to chose whether the display includes a decimal point before the last digit (the D selection), or not (the I selection). The decimal selection is useful for displaying such values as Manifold Pressure (inches and tenths of inches of mercury), or possibly fuel level (gallons and tenths of gallons). Integer values are typically used for most auxiliary input functions, including fuel pressure, coolant pressure, ammeter etc. As with the Forward/Reverse sensing function, the leftmost D or I character on the right of the screen applies to auxiliary 1, and the rightmost to auxiliary 6. Use the UP and DOWN buttons to select the desired combination.

7.1.5 Transfer function

The transfer function mathematically defines the relationship between the auxiliary input voltage, and the numeric data displayed on the instrument. This function is of no use to most users, but is provided here for those interested in creating custom applications for the auxiliary inputs.

$$AuxDisplay = (AuxVoltage * AuxScaleFactor / 2.5) + AuxOffset$$

Where the *AuxDisplay* is the value shown on the screen, *AuxVoltage* is 0-5 Volts, the *AuxScaleFactor* is the number entered into the 1SF, 2SF, 3SF or 4SF entry. The *AuxOffset* can be a positive or negative value. Negative values are entered into the corresponding 1Off, 2Off, 3Off or 4Off entry as twice their magnitude – 1. Positive entries are entered as twice their values. Thus, if the desired offset is –5, a value of 9 is entered into the instrument. Similarly, if the desired offset is +8, 16 is entered.

7.2 Units – (Fahrenheit/Celsius and Gallons/Liters)

Two characters are displayed on this page. This first (leftmost) selects the units for temperature. The second character applies to the units used by the fuel flow option.

To select temperature in units of degrees Fahrenheit, select the “F” selection ; for Celsius select “C”.

To select fuel flow units (applies to flow rate & quantity) of U.S. Gallons, select “G”; for Liters select “L”

CAUTION: The limits entered for all temperature data are not changed by this option. Be sure to enter temperature limits in same units as you have chosen for display.

7.3 FC1 & FC2 (Fuel Flow Activation Codes)

For instruments that include the fuel flow option, these entries have no use. For instruments originally ordered without the fuel flow option, these codes are used to activate the fuel flow function, without the need for returning the instrument to the factory for upgrade. In this way, you may easily add the fuel flow option at any time by contacting Grand Rapids Technologies and ordering the fuel flow option. We will supply you with the FC1 & FC2 codes, and a fuel flow sensor.

7.4 FloCal (Fuel Flow Calibration)

This entry allows for fine tuning the accuracy of the fuel flow function. The typical setting for entry is 200. To adjust the FloCal entry to maximize the accuracy of the fuel flow function, keep track of the amount of fuel burned by noting the amount of fuel added to the airplane over a period of time (at least 100 gallons), and the amount of fuel used according the fuel flow function. If the amount of fuel used according the fuel flow function is 1% low, increase the FloCal entry by 1%. Similarly, decrease the FloCal entry by the percentage the fuel flow function is over-reporting fuel used.

The final FloCal entry should typically be within the range of 190-210. If your FloCal entry is outside this range, you may have calculated it incorrectly, or you may have a problem with the fuel flow function caused by flow fluctuations.

7.5 Tachometer Scaling - TachP/R, N1_100%, N2_100%

Typically, Grand Rapids Technologies will provide the settings for TachP/R, N1_100% and N2_100% for your engine. (They may also be provided in the next section.) The following information is provided to explain the operation of the tachometer calculation to allow you to calculate these required values for these settings, however we recommend you contact us to confirm your settings if you have calculated them yourself.

Two entries are used to set up the tachometer to read correctly for N1 and N2. The first entry, TachP/R, affects both N1 and N2. This entry defines how many pulses per revolution are generated by the tachometer generator. Typically the TachP/R setting is set to 2, as most tachometer generators will generate 2 pulses per revolution of their shaft.

The next two entries, N1_100% and N2_100% affect only N1 and N2 respectively. The RPM calculated by the EIS is:

$$N1 = \text{Tachometer Shaft RPM} / N1_{100\%}.$$

Thus, N1_100% is set to the tachometer shaft RPM corresponding to 100% N1.

For the turbine engine version of the EIS (Model 4000N), N2 is also calculated similarly. Specifically:

$$N2 = \text{Tachometer Shaft RPM} / N2_{100\%}.$$

Thus, N2_100% is set to the tachometer shaft RPM corresponding to 100% N2. *This setting may be different than the N1_100% setting.*

For the turboprop version of the EIS, N2 is scaled to display propeller RPM. The N2 RPM display is calculated by the EIS as follows:

$$\text{RPM} = \text{tachometer shaft RPM} * N2_{100\%} / 1000$$

CAUTION: If there is any doubt about the accuracy of the tachometer reading, verify the reading using another tachometer. Attempting to take-off with less than full power can be very dangerous. In general, if the EIS tachometer reading is not erratic, and the TachP/R setting is correct, the tachometer will be accurate to 5 RPM.

7.5.1 Typical Tachometer Settings for Selected Engines:

L39 Turbojet

N1_100% = 2533

N2_100% = 985

TachP/R = 2

Walters 601 Turboprop

N1_100% = 2100

N2_100% = 985

TachP/R = 2

Pratt & Whitney PT6-76A (Turboprop)

N1 and N2 are displayed in %RPM

N1_100% = 2100

N2_100% = 1000

TachP/R = 2

Allison Turbine

N1 100% = 4210 RPM

N2 100% = 4188 RPM

TachP/R = 1

N1_100% = 4210

N2_100% = 995

7.5.2 TachP/R Table

Tach P/R Setting*	Pulses per Revolution	Typical Use
0	1.5	6 -cylinder 4-strokes
1	1	4-cylinder 4-strokes
2	2	Turbine/Turboprop Tachometer generators, Rotax 2-cylcle non-cdi
3	3	
4	4	Jabiru 6-cylinder
5	5	Jabiru 4-cylinder
6	6	Rotax 2-cycle CDI
7	7	
8	8	
9	9	
10	10	
11	0.5	
12	1.5	
13	2.5	
14	3.5	
15	4.5	
16	5.5	
17	1.25	5-cylinder 4-stroke
18	1.75	7-cylinder 4-stroke
19	2.25	9-cylinder 4-stroke inc. M14 Radial
Larger than 19 not valid.	Don't use TachP/R Settings above 19.	Don't use TachP/R Settings above 19.

7.6 Peak – Leaning Function Sensitivity Adjustment

This entry serves as a sensitivity adjustment for the digital leaning functions. For a detailed description of its use, refer to the section “Digital Leaning Page”.

7.7 Max Fuel – (Fuel Capacity Entry for Fuel Flow Option)

This entry is used by the fuel flow function to provide a simple means of resetting the fuel quantity to the airplane’s usable fuel capacity. By pressing the left and center button together while on the FUEL set page, it will be set to the entry made on this page.

7.8 Hours (Setting Hourmeter)

This function allows you to set the hour meter so that it matches the actual time on your engine. The hour meter may be set to any value between 0 and 6553.5 hours. The hour meter will advance only when the tachometer is above the TIM-RPM entry. It will reset to zero after 6553.5 hours.

7.9 Tim-RPM (Hourmeter & Flight Timer RPM Threshold)

This entry controls the RPM that will activate the Hourmeter and Flight Timer. While the engine RPM displayed by the EIS is less than the entry on this page, the hourmeter and flight timer will not advance. Setting this entry slightly above the power setting used for taxi will more accurately measure the actual flying time, and will more closely match the tach time. Setting this entry to zero will allow the hourmeter and flight timer to run whenever the engine is running.

7.10 AspdLo, AspdHi, TachLo, TachHi (Landing Checklist Reminder/RPM Range Limit)

These entries can be used to generate a landing checklist reminder, or as an alarm when operating within a restricted RPM band. The landing checklist reminder is especially desirable in aircraft with retractable landing gear, or for those of you like myself that just can't remember to perform a pre-landing checklist. This is an excellent feature, and I encourage you to use it. It's the kind of automation that helps overcome the unreliability of the human pilot.

7.10.1 Landing Checklist Reminder

The landing checklist reminder function will generate an airspeed and/or tachometer warning when the following condition is met.

- The airspeed must exceed the AspdHi setting, and then go below the AspdLo setting. This will generate an airspeed warning (the red warning light will flash, the page will change to the labeled page that includes airspeed, and the airspeed will flash). (Of course, this requires that your instrument includes the airspeed option.)
- The N1% tachometer must exceed the TachHi setting, and then go below the TachLo entry. This will generate an tachometer warning (the red warning light will flash, the page will change to the labeled page that includes tachometer, and the tachometer will flash).

Acknowledging this alarm (by pressing the "Ack" button") results in the following:

- After the warning has been acknowledged, the function is reset, requiring the Hi setting to be again exceeded before the alarm is generated again.
- The warning light will go out when the landing checklist reminder warning is acknowledged.

The recommended setting for AspdLo and TachLo is a setting that is below what you normally encounter in takeoff, climb, cruise, and descent, but above what you encounter when entering the pattern, or while in the pattern. (If you set the "Lo" threshold too low, you may not get the warning until you have already landed, if too high, you may get it long before you are planning on landing.)

The recommended setting for AspdHi and TachHi is a setting that is above what you normally encounter while in the pattern, but reasonably below what you would encounter in takeoff, climb, cruise, or descent. (If you set the Hi threshold too high, you may not ever go above it, preventing a landing checklist warning from being generated, and if you set it too low, you may get the alarm repeated due to power/airspeed changes made while in the pattern.)

You may find some trial and error is necessary to fine tune your settings so your reminder is generated reliably, and not more than once.

An example of the use of this function may best illustrate how to use it. I have found from experience, that based on my flying habits, my RPM does not go below 1900 until I am in beginning my descent in the pattern for landing. I have also noted that while in the pattern, even when making large power changes, my RPM does not go above 2400, although it always goes above 2400 during takeoff. I set my TachLo entry to 1900, and my TachHi entry to 2400. With my flying habits I consistently get an RPM warning (landing checklist reminder really), when I enter the pattern.

Caution : At power-up of the instrument, the checklist function is reset. This means if the instrument is turned off and on again while in-flight, and you do not exceed the "Hi" threshold again, you will not get the warning. Also remember that if something unusual happens (such as partial power loss, staying in the pattern, etc.) , you may not go above your

"Hi" threshold, and thus will not get a landing checklist reminder. ***Do not rely solely on the landing checklist reminder function to perform your pre-landing checklist.***

7.10.2 RPM Range Limit

This function is available in software version 5.0 and above, only.

The TachHi, and TachLo settings are also used to specify an RPM range for which an alarm will be generated. When used in this manner, these entries will not function as a checklist reminder.

To use the TachHi and TachLo entries as an RPM range alarm, the TachHi setting must be a lower value than the TachLo setting. When the EIS detects that you have set them in this way, these entries define the RPM range within which it will generate an RPM alarm. For example, if you wish an alarm when the RPM falls between 2000 and 2250 RPM, set TachHi to 2000, and TachLo to 2250.

7.11 AltCor (Calibrating the Altimeter/Barometric Pressure)

To calibrate the altimeter so that the barometric pressure it registers is correct, the follow procedure should be followed. This procedure must be performed with a new instrument, and should be re-checked on an annual basis.

- Turn on the instrument and allow 5 minutes or more for its internal temperatures to stabilize.
- Using the Altimeter Set page, set the altimeter so that the barometric pressure display matches the current altimeter setting. Note that this is the 4 digit number immediately after the ALT label on this set page. No decimal point is provided, so an altimeter setting of 29.92 will be displayed as 2992
- Adjust the ALTCor setting on the configuration set pages so that the altitude display (in feet) matches the local elevation. The nominal value of the ALTCor is 128. Increasing this number by one will change the altimeter display by 6 feet.
- If your ALTCor falls outside the range of 50-200, you may have made a mistake in your calibration.

7.12 User Definable Combination Pages

7.12.1 1D1, 1P1, ... GD9, GP9

These entries are used to setup your user-definable combination display pages. They are used in pairs (although they appear to 2 successive screens), with the first item of the pair defining the data to be displayed (thus the "D" in the label), and the second item defining the position (thus the "P" in the label) of the item. Two sets of twelve pairs of entries are used to allow up to twelve items to be displayed on each of 2 user-definable combination pages. Nine pairs of entries are provided to allow up to nine items to be displayed on the bar graph pages.

An example of the labels used to identify these page is as follows:

- 2D1 => 2nd combination page, Displayed item, entry 1
- 2P1 => 2nd combination page, Position of item 1, entry 1

Note: The items set up for the graphical leaning pages (that is, the pages with the bar graphs), apply to both of the bar graph pages.

Three or four letter identifiers are used to define the data that can be displayed, and a numeric entry describes the position on the screen where this data appears. In addition to numerical data, several characters may be selected to enhance the readability of your user-defined combination pages. The following table describes these items.

EASY TIP: If you would like to restore the instrument to the factory default setup for the user-definable pages, starting from a normal display page (not a set page) turn off the instrument, and press and hold the right button and turn the EIS back on. This will cause the EIS to restore the factory default settings for these pages.

7.12.2 Table of User-Definable Page Entries.

Data to be Displayed	Name used to select this data on the Configuration Set Page.	Number Of Spaces Required	Notes
Nothing displayed	Off	0	This entry is skipped, and nothing is printed to the screen. Set unused entries to "Off".
EGT1	EG1	4	
EGT2	EG2	4	
EGT3	EG3	4	
EGT4	EG4	4	
EGT5	EG5	4	
EGT6	EG6	4	
CHT1	CH1	3	
CHT2	CH2	3	
CHT3	CH3	3	
CHT4	CH4	3	
CHT5	CH5	3	
CHT6	CH6	3	
AUX5	AX5	3 or 4	User selections allow the data to be displayed as an integer (no decimal point), which requires 3 spaces, or a decimal number which requires 4 digits.
AUX6	AX6	3 or 4	
OILT	OT	3	
OILP	OP	2	
VOLT	Volt	4	
AUX1	AX1	3 or 4	User selections allow the data to be displayed as an integer (no decimal point), which requires 3 spaces, or a decimal number which requires 4 digits.
AUX2	AX2	3 or 4	
AUX3	AX3	3 or 4	
AUX4	AX4	3 or 4	
Coolant Temperature	H2O	3	
Not Used	N/U	-	
Not Used	N/U	-	
UNIT	Int	3	This is the internal instrument temperature
QPH	QP		Factory Use Only
FUEL Flow	Flow	4	
N1%	N1%	3	N1 RPM
Highest CHT	CHH	3	
	CHS		Factory Use Only

CHT Rate	CHR	3	
Highest EGT	EGH	4	
EGT Span	EGS	4	
Highest EGT Change	EGPk	4	Leaning info (EGT or delta from peak EGT) for first cylinder to peak. (FRST2PK indicates which cylinder was first to peak.)
FRST2PK	1P	1	Cylinder number of first to peak while leaning.
ROC	VS	2	Vertical speed magnitude – unsigned. Use the ROCSGN below to display an up or down arrow next to this value to show climb/dive
ROCSGN	+	1	This is the vertical speed sign (an up or down arrow)
Airspeed	ASP	3	Airspeed
Hourmeter	Hours	6	
Fuel Remaining according to the fuel flow calculation.	Fuel	4	
Altitude	Alt	5	
Flight timer hours	Hr	2	Use a : to separate hours and minutes (and seconds)
Flight Timer Minutes	Mn	2	
Flight Timer Seconds	Sc	2	
Fuel Flow Function's Endurance - Hours	EH	2	Use a : to separate hours and minutes.
Fuel Flow Function's Endurance Minutes	EM	2	
Cylinder number with highest CHT	#C	1	This is not the temperature, but which cylinder has the hottest CHT, such as cylinder #2
Cylinder number with highest EGT	#E	1	Cylinder number with highest EGT
Outside Air Temperature	Oat	3	The outside air temperature will be displayed in deg F only.
Carburetor Air Temp	Crb	3	
Barometric Pressure setting for altimeter	Baro	5	
N2 or N2%	N2 or N2%	3 or 4	N2 RPM Units of percent for turbine, RPM for Turboprop. Turbine uses 3 digits, turboprop uses 4
ROCSGN (rate of climb sign - up arrow for climb, down arrow for dive)	+	1	This is the vertical speed sign (an up or down arrow)
Colon symbol	:	1	Allows printing of a : to the screen.
Apostrophe	' (foot symbol)	1	Allows printing of a ' to the screen.
degrees symbol	degrees symbol	1	Allows printing of a degree symbol to the screen.
"/"	/	1	Allows printing of a / to the screen.

The following illustration shows the numbering of positions on the display screen for the user-defined pages. Note how the 32 character positions are numbered from 1-32 starting in the upper left corner.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

7.13 Example Worksheet for setting up your custom pages.

The easiest way to create your custom pages is to plan them on page, and then translate you plan into the entries that you will make in the instrument. To illustrate this, lets create a simple page.

1. Start with a blank worksheet. Fill in typical numbers to illustrate the data you want displayed. Use the table entry of “Number of Spaces Required” to allocate the required space for the items you have selected to display. In this example, the N2 tachometer, oil temperature, oil pressure, altitude and airspeed are displayed as shown.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
N2 Tachometer	2	5	0	0							1	8	0	/	4	5
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Altitude	1	0	5	0	0	'								1	2	5
																Airspeed

Oil Temperature/Oil Pressure

2. Once satisfied with the layout, create a list of the entries. Use the table above to determine the identifier used by the instrument for each of the items. Fill out the list.

- 1D1 = TACH
- 1P1 = 1
- 1D2 = OT
- 1P2 = 11
- 1D3 = /
- 1P3 = 14
- 1D4 = OP
- 1P4 = 15
- 1D5 = ALT
- 1P5 = 17
- 1D6 = ‘
- 1P6 = 22
- 1D7 = ASP
- 1P7 = 30
- 1D8 = Off
- 1P8 = 0
- 1D9 = AUX1
- 1P9 = 8
- 1D10 = Off
- 1P10 = 0
- 1D11 = Off
- 1P11 = 0
- 1D12 = Off
- 1P12 = 0

Note that this number corresponds to the start of the data being displayed.

The entries set to “Off” are ignored.

3. Enter these into the instrument’s “Configuration Set” pages.

7.14 Worksheet for Planning User-Definable Pages

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

Combo Page #1

1D1 =
 1P1 =
 1D2 =
 1P2 =
 1D3 =
 1P3 =
 1D4 =
 1P4 =
 1D5 =
 1P5 =
 1D6 =
 1P6 =

1D7 =
 1P7 =
 1D8 =
 1P8 =
 1D9 =
 1P9 =
 1D10 =
 1P10 =
 1D11 =
 1P11 =
 1D12 =
 1P12 =

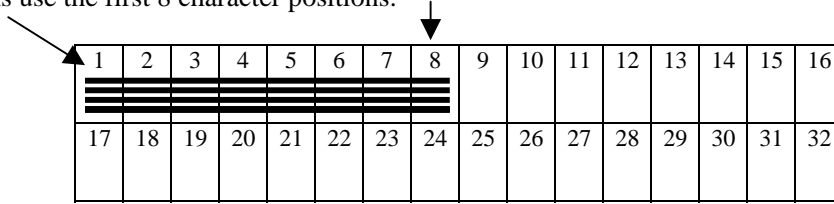
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

Combo Page #2

2D1 =
 2P1 =
 2D2 =
 2P2 =
 2D3 =
 2P3 =
 2D4 =
 2P4 =
 2D5 =
 2P5 =
 2D6 =
 2P6 =

2D7 =
 2P7 =
 2D8 =
 2P8 =
 2D9 =
 2P9 =
 2D10 =
 2P10 =
 2D11 =
 2P11 =
 2D12 =
 2P12 =

Bar Graphs use the first 8 character positions.



Graphical (Leaning) Pages

Note: Don't assign any items to position 1-8, as this space is reserved for the bar graphs. The setup for this page applies to both bar graph pages.

- GD1 =
- GP1 =
- GD2 =
- GP2 =
- GD3 =
- GP3 =
- GD4 =
- GP4 =
- GD5 =
- GP5 =
- GD6 =
- GP6 =
- GD7 =
- GP7 =
- GD8 =
- GP8 =
- GD9 =
- GP9 =

8. Disabling Pages

Up to 10 display pages may be disabled so that they do not appear when pressing the "Next" and "Previous" buttons. Disabling pages can make it easier to get to the pages that you find the most useful. You may find it useful to disable labeled pages which include information also shown on your programmable combination pages. You may also find it useful to disable the fuel flow page if you do not have the fuel flow option, and/or the altimeter/VSI - Airspeed - Water Temperature page if you do not use these features. Note that the alerting function will not be disabled from using this pages, so that alarms will be annunciated using the appropriate labeled page.

It is recommended that pages are disabled after you have gained some operational experience with the instrument, and after you have settled on the configuration of your user-programmable pages.

To disable a page, determine its page number from figures 1a and 1b. Enter this page number into one of the 10 "Disable Page #" entries which appear immediately after the user-definable page data.

Note: Ten "Disable Pg #" pages are provided. Each of these pages allow one entry. The entry may be either "Off" (indicating this particular "Disable Pg #" page is not disabling any pages), or it may be a number between 0 and 15 corresponding to the page being disabled. The ten "Disable Pg #" pages look identical, with the possible exception of the entry on the page. This gives the appearance that the page is not changing as you page through each of the 10 pages, but in fact there are ten of these pages.

The turbine and turboprop versions of the EIS include all the functionality of the Model 4000 for piston engines, although some of this functionality, and the corresponding display pages, may not typically have any use with a turbine or turboprop engines. For this reason, the factory default configuration of the EIS for turbine and turboprop engines have the following pages disabled. If desired, these pages may be re-enabled.

Default Configuration Disable Page Number	Function
6	Leaning Page
7	Cruise Monitor Page
8	CHT Page
15	Shock Cooling, EGTSpan, Carb Temp
3	EGT Bar Graph Page
4	EGT Tracking Page

9. Engine Analysis Functions

The engine analysis function includes functions to track your EGTs to detect subtle changes in your engine performance, and functions to help you lean your engine.

9.1 The EGT Tracking Function

Imagine you had a way of watching your engine for the slightest change in its operation for every second of the cruising portion of your flight. Imagine this function was sensitive enough to detect a single spark plug just beginning to foul, or a valve intermittently sticking, or a minute intake manifold leak, or a host of any other problems which could not possibly be detected by the human senses. Imagine the confidence you will feel as you set out over forests, mountains, or a body of water, knowing that your engine has been subject to this scrutiny. This is the real power of the EGT tracking function. Please read on....

The tracking function is normally activated during the cruise portion of the flight. This is because the exhaust gas temperatures will vary with the mixture, power setting, and load on the engine. During the cruise portion of the

flight these variables are fixed, making changes in exhaust gas temperature due to engine problems easier to detect. This is especially true during flight in smooth air, where there is no turbulence to cause fluctuations in engine power

To activate this function, call up the “SET LEAN POINT?” prompt by momentarily pressing the center and right buttons. Press the button under the “YES” selection to activate the function. This will store the current exhaust gas temperatures internally, and calculate the change from these temperatures for each cylinder. You will now see a graphical representation of the change in exhaust gas temperature on the EGT Cruise graph, and a digital representation of the change on the page identified with CZ (cruise) identifier. The exhaust gas temperatures stored internally for this function may be updated at any time during the flight by repeating this sequence. (This can be necessary if your cruise conditions change, such as power settings, mixture, etc.). Note that it is not necessary to lean the engine to activate this function.

Separate limits may be set for the increase and decrease in exhaust gas to alert you when any cylinder varies by more than you expect. These are the EGT-INC and EGT-DEC entries on the set pages. These limits may be tight (a few 10’s of degrees) to alert you to very subtle changes, possibly at the expense of false alarm in turbulence, or loose (50 degrees or more). Experience will dictate the best settings for your engine/airplane combination.

The tracking function may also be activated during climb or descent if desired. This is especially useful when troubleshooting an intermittent problem. (It may be necessary to re-activate it during this phase of the flight to account for the change in exhaust gas temperatures resulting from the new power setting.)

9.2 Leaning Functions

For those with engines having adjustable mixture controls, the leaning functions are probably what attracted you to the EIS, and you will not be disappointed. The EIS provides a bar graph page for those who prefer this method, and a digital leaning page (identified by an “L” in the lower right corner). It is recommended that you try both methods several times to determine which one is your favorite. In general I prefer the digital leaning pages because they provide finer resolution (1 degree vs. 15 degrees per bar graph segment), but this can be a matter of taste, as the bar graph page can make it easier to visualize the EGTs.

9.2.1 Leaning with the Bar Graph

Using the bar graph page to lean is simply a matter of selecting the page, and adjusting the mixture while observing the EGTs via the bar graphs. You may find it useful to customize the bar graph pages to include information that could make it easier to lean, such as MAP, RPM, Fuel Flow, or the special leaning functions, such as the First-to-Peak and EGPK.

9.2.2 Digital Leaning Page

To understand the digital leaning page, (the page with the “L” in the lower right corner), it is first necessary to understand a few basic rules about the data shown on this page.

- *When a cylinder is close to its highest EGT, the cylinder’s EGT is displayed.*
- *When a cylinder’s EGT is more than the amount specified on the “PEAK” setting below the highest EGT, a negative value will be displayed showing how far this cylinder’s EGT is below its highest.*
- *The highest EGT for a cylinder is continually updated. That is, whenever an EGT goes above the internally stored value for the highest EGT, it is updated.*
- *Selecting the “Track TIT?” page, and selecting “RESET”, will reset the highest EGT for each cylinder to its current temperature.*

In light of these rules, the typical procedure for leaning is as follows:

1. Select the digital lean page. This is the page with the “L” in the lower right corner.
2. Select the “Track TIT?” window, and select “RESET”. This resets the highest EGTs to the current temperatures. You will note that immediately after doing this, the lean page will show all positive values since all EGTs will be the newly stored highest. This also causes the First-to-Peak indicator to reset to 0.
3. Slowly lean the engine. As you do, the EGTs should all increase (unless you have a cylinder already operating past peak EGT, in which case it will decrease, indicating an engine problem exists). As the EGTs increase, the instrument will be updating its internal highest for each cylinder, and the numbers on the page will show EGTs.
4. As leaning continues, a cylinder will reach its peak EGT, and then begin to fall. Once it has fallen by more than your setting for “PEAK” below its highest, the value shown on the screen will switch to a negative number. The First-to-Peak function will now indicate which cylinder number was the first to peak.
5. Typically the engine is then enriched to 50 degrees rich of peak (although this is a matter of your preference). As you enrich, all EGTs will drop, except those that were leaned past peak. The cylinders which were leaned past peak with first increase, and then decrease. The key to making it simple, it to ignore all but the first to peak (the first to go negative). Use this cylinder to adjust mixture to your desired setting (such as 50 degrees rich of peak).

Note that the leaning page is typically most meaningful while leaning, and for several minutes after leaning. This is because of the effect of the highest EGT always being re-computed. Consider for instance the scenario where you leaned a hour ago, but during the last hour you made some power changes, encountered turbulence, changed altitude, or similarly caused the EGTs to reach new highs. Once re-stabilized in cruise, even if the EGTs returned to the same temperatures they were at immediately after leaning, the new highs for the EGTs stored internally will cause the lean page to show different values than that showed immediately after leaning.

The “PEAK” setting allows you to specify how sensitive the instrument will be to detecting the first cylinder to go past peak. As you lean, an exhaust gas temperature could go down a few degrees during the leaning process due to varying engine loads (turbulence) or other factors. The instrument will not declare a cylinder to be the first to peak unless it is the first cylinder to fall by the amount specified in the “PEAK” setting from the maximum temperature that cylinder has achieved.

9.2.3 Special leaning functions

Two special functions are provided that are helpful when leaning. These functions are selectable on the user-definable pages, and are provided on the factory default bar graph pages.

9.2.4 First-Cylinder-to-Peak (FRST2PK)

This function indicates which cylinder peaked first during leaning. This function will display 0 after selecting “RESET” from the “Track TIT?” page. It will remain as 0 until a cylinder has peaked (fallen by more than the “PEAK” setting from its highest EGT). Once the first cylinder has peaked, this function will show which cylinder was the first to peak. It will not change until “RESET” is selected from the “Track TIT” page.

9.2.5 EGpk (First-Cylinder-to-Peak Leaning Status)

This function displays the leaning page information for whichever cylinder was the First-to-Peak. The function will display 0 until a cylinder peaks, and then displays either the current exhaust gas temperature for this cylinder if it is currently less than the “PEAK” setting of its maximum EGT, or the number of degrees below the peak EGT detected.

Note that it is perfectly feasible (depending on your leaning preference) to lean the engine using only the EGpk display. Using this display alone, you can lean until the first cylinder peaks, and enrichen (or not) as desired.

9.3 Shock Cooling Detection

The cylinder head rate-of-cooling (in degrees/minute) for the cylinder head temperature that is dropping the fastest is provided by this function. This information is provided on a labeled page above the “CRate” label. A maximum cylinder head rate-of-cooling limit may also be set. Consult your engine manual to see if such a limit is published for your engine. If no limit is published, you may determine a limit by trial and error. While not all agree that shock cooling of the cylinders is a real problem, there is no doubt that internal stresses in the cylinders can be reduced by avoiding shock cooling. In addition, some of our customers with glider towing operations are convinced that shock cooling can cause cylinder cracking.

10. Detailed Description of Other Functions

10.1 Flight Timer

At power-up of the EIS, the flight timer shows the length of the previous flight in hours and minutes. This makes it easy to recall the last flight time if power is turned off to the instrument before the time is noted. This time will be displayed until 3 minutes into the next flight, at which time it will be replaced with the length of the current flight in hours, minutes and seconds. It is especially useful for measuring the progress on cross country flight since it never forgets to start! For those who forget to wear a watch, and who don't have a clock or a GPS, this timer can be handy for navigation purposes also!

10.2 Unit Temperature

This function is displayed on the hourmeter page, and shows the internal temperature of the instrument. It is used by the instrument for cold-junction compensation of the EGTs and CHTs. It is also useful for estimating the cabin temperature, as it tends to stabilize at about 30-35 degrees F above the ambient temperature.

The unit temperature can also be checked to see if the instrument is being exposed to excessive heat. Unit temperatures above 170 degrees F can degrade the readability of the display. (The display will return to normal when it is cooled to normal temperatures.) Temperatures above 200 deg F can activate the internal thermal fuse, shutting down the instrument.

10.3 H2O (Water Temperature Function)

This function is provided for those using water-cooled engines. It may also be useful for measuring other temperatures in the range of 80-300 degrees F, such as under cowl temperatures, especially for composite airplanes.

11. Check Entries Message

The “Check Entries” message will be displayed immediately after power-up if the EIS determines that any user entry (including all limits and all configuration data) was lost or is incomplete. When this message is the EIS will force you to review all entries by taking you to the Set Limits and Configuration Set pages. Carefully review and correct any entries as necessary.

Note: This message will be generated if any user entry is changed, and the instrument is turned off before returning to the normal display pages. This message then serves a reminder that you were in the process of setting user entries when the instrument is last turned off.

If this message appears frequently, this is most likely due to the instrument getting poor quality electrical power. This is most common if the instrument is on while engaging an electric starter, or if it is turned on before the engine is started in airplanes without batteries, or when power or ground connections are loose.

12. Troubleshooting Common Problems

Instrument does not turn on. Warning light is on steady.	Either the instrument is not receiving power, or the 12V or 4.8V output from the instrument is shorted to ground. A simple test is to make a cable with only power and ground wires, and power the instrument via this cable. (This test cable available at no charge.)
Instrument does not turn on. Warning light never comes on.	Open ground connection to instrument, or the voltage provided to the instrument is too low (less than 9V).
One EGT or CHT is erratic.	One of the two wires is unconnected between the instrument and the probe. Most commonly, a crimp connection on the quick disconnect on the probe, or the cable it plugs into, is loose. A visual inspection will usually be enough to find the problem. Another simple test is to use a continuity tester, and verify each pin at the instrument end of the cable has good continuity to the engine case, since each probe is grounded to the engine. The pins numbers are listed on the wiring diagram in the back of this manual.
All EGT and CHT are erratic.	This is caused by an open ground connection to the case of the engine on engines which do not include an electric starter.
Oil Pressure Reads 99 with engine off.	Connection to oil pressure sensor is open circuit. A quick test is to touch the oil pressure lead to ground. This should cause the oil pressure to read 0. If it does, check connections and ground to oil pressure sensor (case must be grounded.) If this test does not cause a 0 reading, check the connection between this wire and the input to the instrument.
Oil or Coolant Temperature shows 59 deg F all the time.	The connection to the oil or coolant temperature probe is open, or not grounded. A quick test is to touch the coolant temperature sensor lead to ground. If the EIS show a high temperature, the connection to the instrument is good. If it does not change, check the wire between the instrument, and the oil or coolant temperature sensor, especially the crimp on the quick-disconnect that plugs onto the coolant temperature sensor.
Tach Reading is zero when one mag is turned off.	This is normal, as the tach signal is generated by one of the mags.
Tach is erratic.	Tachometer resistor is not installed, or its value is too low. See wiring diagram for tachometer connection.
Tach reading is steady, but too low or too high.	TachP/R is incorrectly set. See "Configuration Set Pages" section.
Voltmeter reads to high. All else OK.	An "update" version of software has been installed, and the setting on the Units page (the H/N setting) is incorrect.
Voltmeter reads above 20 V and other readings incorrect.	More than 5 volts is being applied to an auxiliary input. This can be caused by an incorrectly calibrated capacitance fuel fuel probe, a open ground wire to the manifold pressure sensor, or similar. Check the aux inputs be see if any are above 5 volts using a voltmeter.

13. Warranty

Grand Rapids Technologies Incorporated warrants this instrument to be free of defects in material and workmanship for 2 years from the date the system is first used, or 5 years from date of purchase. This warranty includes parts and labor. The instrument includes a lifetime warranty for any manufacturing defects. Grand Rapids Technologies expressly reserves the right to repair or replace a defective unit with new or reconditioned parts or equipment, of the same or

similar design. This warranty is void if damage to the instrument is caused by incorrect connection of the tachometer lead, or is otherwise installed incorrectly. This warranty also does not cover the following:

- Damage during shipment
- Damage from accident, misuse, negligence, lightning, or water
- Damage caused by alteration or unauthorized repair

Legal Rights/Limitations of Liability

Grand Rapids Technologies Incorporated is not liable for incidental or consequential damage, commercial loss, or any other loss or damage not specified in this warranty. Some states do not allow limitations on the length of implied warranties, or exclusion or limitation of incidental or consequential damages. The above limitations or exclusions may not apply to you. No individual or company may extend this warranty. This warranty is valid only for the original purchaser.

Service may be obtained by returning the instrument to this address:

Grand Rapids Technologies
889 76th St SW Unit #2
Byron Center, MI 49508
Attention: Service Dept.

When returning the instrument for service, please specify the nature of the problem. Include a copy of your proof of purchase for warranty repairs.

For service questions or repair rates, call 616-583-8000.