

Honeywell Engines

TREND *PLUS*⁺

Performance Trend Monitoring System
for Honeywell Turboprop Engines

Version 2.5

User Manual

A PRODUCT OF:

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Manual revision 2.5

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1 Introduction

Welcome to Trend Plus+, the most advanced aircraft engine performance trend monitoring software available!

This program is relevant to the Honeywell engines shown in the Applicable Engines Appendix, and should not be used with other engines.

1.1 How to get help

Trend Plus+ was developed for Honeywell Engines by ACES, the aviation division of TEC. TEC will be responsible for providing software support for Trend Plus+. If you experience a problem when installing or using Trend Plus+, and you cannot find the solution in this manual, please see the Troubleshooting Appendix for technical support instructions and telephone numbers.

If you experience a performance problem with your Honeywell engine or if you need help interpreting trend information, call your Honeywell Field Service Representative or Honeywell's 24-hour Customer Information Center at 1-800-338-3378.

1.2 Requirements

For best results with Trend Plus+, you need the following:

- ◆ A computer running a recent version of Microsoft Windows: Windows 98, Windows ME, Windows 2000, or Windows XP.
- ◆ Hard disk with 5 megabytes of free space. (The program requires 3 MB to install and approximately 250 KB per engine per year on your hard disk.)
- ◆ Mouse or other compatible pointing device.
- ◆ Color video display.
- ◆ At least 500 kilobytes of free DOS low memory; 550 kilobytes are recommended for full functionality.

1.3 Getting started with Trend Plus+

Before using Trend Plus+, you must install and set it up. Then, before beginning your trend program, enter supporting information—aircraft, engine serial numbers, pilot names, etc. After this is done, you are ready to use Trend Plus+ on a daily basis. Sections below list each of these uses. The shaded column at the right refers you to the section of the manual that will describe the step in detail.

1.3.1 General information

Performance Trend Monitoring	2.0
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1.3.2 Installation and setup

Install Trend Plus+ on your hard drive	3.0
Learn how to operate Trend Plus+	4.0
Configure Trend Plus+ for your needs	5.0

1.3.3 Add supporting information

Enter the registration number of any new aircraft on which Honeywell engines are or will be installed	6.1
Enter the serial numbers of any new Honeywell engines added to your fleet	6.2
If you will be tracking Stations, Pilots, or Technicians, enter their names	6.3-6.5
If you need an new Maintenance Items, add them	6.6

1.3.4 Daily use

Record Flight Data	7.0
Enter flight data	8.1
Enter ground run data	8.2
Import IEC data	8.3
Reduce data	8.4
Record engine maintenance	8.5
View trend reports and plots; print them if desired	10.0
Analyze trend data	11.0

1.3.5 Typefaces and conventions

A vertical bar character (|) is used to separate choices from a series of menus. For example, when the text says “Choose File | Exit,” it means to choose the File on the main menu bar, then choose Exit on the popup menu which will appear.



Instructions for using the mouse will be printed in paragraphs like this one.



Instructions for using the keyboard will be printed in paragraphs like this one.

Keyboard key names will be shown in brackets. Here is a list of examples:

Key name in this manual	Possible keyboard markings
[Insert]	Ins
[Delete]	Del
[Escape]	Esc
[Home]	Home
[End]	End

Key name in this manual	Possible keyboard markings
[Page up]	PgUp
[Page down]	PgDn
[Enter]	Return ↵
[F1]	F1
[Tab]	→
[Shift]	↑
[Ctrl]	Ctl
[Alt]	Alt
[Up arrow]	↑
[Down arrow]	↓
[Left arrow]	←
[Right arrow]	→

When the names of two keys appear in brackets, the first key acts like a shift key; you hold it down while pressing the second. For example, [Shift-Tab] means “hold down [Shift] while pressing [Tab],” and [Alt-X] means “hold down [Alt] while pressing [X].”

2 Performance Trend Monitoring

As a TPE331 engine accumulates time in service, its gas path components such as impellers, cross-over ducts, and turbine blades are exposed to factors which could degrade their efficiency. Dirt or sand ingestion over a period of time can erode component surfaces causing a slow degradation in efficiency; hot starts or inlet foreign object damage (FOD) can result in abrupt mechanical problems, causing a step degradation in efficiency. By regularly recording certain engine parameters and using the Trend Plus+ program, deterioration due to these types of environmental and operational factors can be identified, ideally at an early stage. The scope of the Trend Plus+ program is, therefore, to help TPE331 operators understand how to identify engine deterioration so that proper corrective action can be taken.

In addition to monitoring a single engine's deterioration, Trend Plus+ can also monitor the deterioration status for a fleet of engines. This is done by creating a report of engines in the database ranked according to how much they have deteriorated since their date of installation or since their latest ground run. Trend Plus+ also provides ways to create databases for other fleet information such as maintenance activities, technicians, and pilots.

Experience with Trend Plus+ will ultimately give operators confidence in quantifying and correlating engine deterioration to operational events; correlating maintenance activities to successful troubleshooting; and prioritizing engines for heavy maintenance. These are the goals of the Trend Plus+ program. But trend monitoring alone is only part of an approved FAA on-condition maintenance program. In addition to trend monitoring, operators should refer to their appropriate aircraft and/or engine maintenance manual, and to all pertinent FAA bulletins, in order to comply with such programs and realize their benefits.

2.1 Trend monitoring philosophy

The philosophy of using in-flight data together with periodic ground runs to trend monitor TPE331 engines is presented here. In-flight trending is discussed for its value in monitoring engine deterioration over time. Ground runs are discussed for their value in establishing an engine's readiness for takeoff conditions.

2.1.1 In-flight trending

In order to meet rated power, engine parameters such as turbine temperature—either inter-turbine temperature (ITT) or exhaust gas temperature (EGT)—and fuel flow (Wf) must achieve certain levels that depend on flight condition. When these levels increase, it is an indication that an engine is experiencing some form of deterioration. In order to identify whether an engine's turbine temperature or fuel flow levels increase at rated power, the Trend Plus+ program trends (compares) each engine against a typical engine on a point-by-point basis. The typical engine is represented by a computer model that is very predictable since it never deteriorates. By calculating and plotting an engine's turbine temperature and fuel flow margins relative to the typical engine model, it becomes possible to visualize an individual engine's deterioration rate.

For trending purposes, turbine temperature and fuel flow margins are based on direct comparisons to the typical engine at the same ambient conditions. The comparison is made by matching the typical engine to the same torque and speed (RPM) as for the subject engine, taking into account bleed flow, accessory power requirements, and other aircraft specific installation effects.

After an engine is installed in the database, Trend Plus+ requires a minimum of 15 in-flight points to establish turbine temperature and fuel flow relative margins. With in-flight data only, the term relative is used because the margin calculated by the program is normalized to zero after the first 15 in-flight data points. This is done by using the average turbine temperature and fuel flow margins for the first 15 points as an offset relative to the typical engine model. Once a ground run is added to the database, relative margins can be adjusted to represent takeoff margins (see the Ground Runs section, below).

Without a ground run, the engine is said to be baselined to its relative margins, which start at zero and hold constant until some degree of deterioration occurs. As more in-flight data is added to the database, a 15-point running average with data acceptance bands is included on the trend plots to smooth over noise and eliminate large errors. Trend Plus+ uses the data acceptance bands to automatically eliminate bad points that would otherwise confuse the running average.

CAUTION:

The first 15 in-flight data points should be reviewed carefully for data quality, since any errors can significantly impact an engine's relative margins and possibly lead to misinterpreted trends. For these early trend points, Trend Plus+ cannot automatically eliminate bad data. If an error occurred within these early points and it cannot be corrected, the erroneous point(s) should be deleted by the user.

2.1.2 Ground runs

After establishing relative margins from in-flight trending, Trend Plus+ is designed to accept optional ground runs to establish an engine's actual margin for takeoff conditions. Best results are achieved when initial ground runs are made soon after establishing relative margins. This is to ensure that the ground run is representative of the engine's takeoff margin within its first 100 hours of on-wing service.

In this role, the typical engine inside Trend Plus+ is designed to represent the minimum engine requirements as defined in the aircraft operator's manual, otherwise known as the pilot's operating handbook (POH). Based on these minimum requirements, the program computes actual ground run margins for turbine temperature (ITT/EGT) and fuel flow.

CAUTION:

On cold days at maximum rated power with ITT or EGT below redline, an engine may meet its takeoff power requirements for the specific conditions. However, actual turbine temperature margin calculated by Trend Plus+ can be less than zero. This is an indication to the operator that on hot days or at higher altitudes where the turbine temperature redline is encountered, the engine may not make POH power.

When ground runs are added to the program, Trend Plus+ can customize trend plots by forcing the in-flight relative margin running average to fit a specified ground run. This process is known as baselining to a ground run. (The procedure for baselining with Trend Plus+ is discussed in the Trend Plots section of the Trend Reports chapter of this manual.) When a baseline ground run is chosen, the relative margin running average will shift up or down as required, and Trend Plus+ will project when an engine's actual turbine temperature margin will cross zero. Assuming no events which cause step changes in margin, operators will then have a date in mind for when an engine will require maintenance.

To confirm the accuracy of turbine temperature and fuel flow trends, operators should make follow-up ground runs every 600-800 operating hours or every six months, whichever is most convenient. This will show the operator whether the Trend Plus+ projections are correct in terms of predicting the engine's deterioration rate.

2.1.3 Turbine temperature compensation

Most TPE331 engines are fitted with a turbine temperature compensating resistor. The purpose of this resistor is to normalize an engine's turbine temperature redline to correspond with the minimum required power, or to the engine's maximum allowable operating temperature. Most customer data sheets (DSCs) for TPE331 engines include settings for both a minimum compensation and a maximum compensation.

When a compensator is set to minimum, the engine is trimmed so that at its indicated redline temperature, the engine produces the minimum power called out on the DSC. When a compensator is set to maximum, the engine is trimmed to its maximum operating temperature, and as a result produces more than the minimum power called out on the DSC. This approach means that the difference between minimum and maximum compensation is equal to the reserve compensation.

As an engine deteriorates, operators usually make compensator adjustments until the reserve is zero or maximum setting is achieved. This is a way of increasing the indicated margin of the engine. These types of adjustments show up as positive step changes in turbine temperature margin.

Trend Plus+ does, however, provide ways to trend reserve compensation. Doing so requires the operator to have engine logbooks or DSCs available when setting up the Trend Plus+ database, and to have reliable procedures in place to make note of any compensator adjustments. Once the database is set up, Trend Plus+ will report both indicated and total turbine temperature margin. Indicated margin will correspond to the engine's as-compensated condition, and total margin will correspond to the engine's condition assuming the compensator were adjusted to the maximum. Unlike indicated margin, positive step changes due to these adjustments will not show up in total margin if operators use Trend Plus+ to keep track of reserve compensation.

2.1.4 Definition of terms

Actual Margin—the difference in an engine’s turbine temperature (either ITT or EGT) or Wf as compared to the typical engine (computer model) at the same torque and engine speed (RPM). This represents margin available based on ground run performance.

Two types of actual margins are calculated by Trend Plus+:

$$\text{ITT/EGT margin (}^{\circ}\text{C)} = \text{model ITT/EGT} - \text{engine ITT/EGT}$$

$$\text{Wf margin (\%)} = (\text{model Wf} - \text{engine Wf}) * 100 / \text{model Wf}$$

(“Model” values in the equations above represent characteristics of the typical engine computer model.)

CAUTION:

On cold days at maximum rated power with ITT or EGT below redline, an engine may meet its takeoff power requirements for the specific conditions. However, actual turbine temperature margin can be less than zero. This is an indication to the operator that on hot days or at higher altitudes where the turbine temperature redline is encountered, an engine may not make rated power.

Baseline—the point of reference for the deterioration process. Without ground data, a baseline is normalized to zero using the first 15 in-flight points as an average offset from the typical engine. After a ground run is added, the baseline can be shifted to represent trending actual takeoff margin.

Compensation—the amount of temperature conditioning ($^{\circ}\text{C}$) being applied to the raw ITT/EGT measured by the ITT/EGT harness. Less conditioning means higher turbine temperatures and more power.

Minimum Compensation—ITT/EGT conditioned to give minimum required power.

Maximum Compensation—ITT/EGT conditioned to give maximum operating temperature (always less than minimum compensation).

Reserve Compensation—The difference between minimum and maximum compensation.

Hot Section Inspection—a maintenance action for determining the disposition of all turbine-related hardware per engine maintenance manual requirements. Referred to as HSI.

Indicated ITT/EGT Margin—the difference in an engine’s ITT/EGT compared to the typical engine model at the same torque and engine speed (RPM). If a ground run is entered, this represents the engine’s actual margin, but does not account for reserve compensation. When the compensator is adjusted to maximum, indicated margin is the same as total margin.

Recompensation—the procedure (on-wing or propstand) used to recompute an engine’s minimum and maximum compensation settings. Usually carried out after HSI or overhaul maintenance. Refer to Engine Maintenance Manual.

Relative Compressor Efficiency—a measure of the change in compressor efficiency level (percentage points) required to meet rated power. Applicable to in-flight data only. For an engine with deteriorating compressor performance, this parameter decreases.

Relative Compressor Pressure Ratio—a measure of the change in compressor pressure ratio (ratios) required to meet rated power. Applicable to in-flight data only. For an engine with deteriorating compressor performance, this parameter decreases.

Relative Compressor Work—a measure of the change in compressor work (corrected T3, $^{\circ}\text{C}$) required to meet rated power. Applicable to in-flight data only. For an engine with deteriorating compressor performance, this parameter increases.

Relative Margin—a measure of the change in an engine’s health (deterioration) based on its initial 15-point average which is normalized to zero using the typical engine model.

Total ITT/EGT Margin—the sum of indicated ITT/EGT margin and the reserve compensation ($^{\circ}\text{C}$). If a ground run is entered, this represents the actual margin available assuming the ITT/EGT compensator were adjusted to the maximum setting.

Typical Engine Model—a computer representation of expected engine performance for all flight conditions. For ground runs, this represents the aircraft flight manual requirements for engine takeoff performance.

3 Installing Trend Plus+

3.1 Running the install program

Insert the Trend Plus+ Installation CD into your computer's CD drive. Use **My Computer** or Windows Explorer to explore the CD. Find the program Setup.exe, and double-click to run it. Follow the Setup program's prompts to install the software.

3.2 The README file

Your Trend Plus+ installation directory will contain an important file named README, which you can examine with any text file editor or viewer, or by printing it out. README will contain the latest information about Trend Plus+, and should be read carefully before you run the Trend Plus+ program. It may, for example, contain details about additional steps required in order for Trend Plus+ to run on some computers.

3.3 Entering your license number

The first time you run Trend Plus+, it will ask for the license number which can be found on the label of your Trend Plus+ installation diskette.

You cannot use the program until you have entered a valid license number.

If you have already followed any additional instructions found in the README file, you are ready to enter your license number now, if you wish:

- ◆ Get out your installation disk; your license number is printed on the label.
- ◆ Change to the drive where you installed Trend Plus+.
- ◆ Change to the directory where you installed Trend Plus+.
- ◆ Type TRENDP and press [Enter]. Trend Plus+ will start and begin checking its databases. This will take several seconds.

Note: If you have little free RAM memory, you may get a warning message at this point. Press [Enter] to clear the message. If you do not have enough free memory to run Trend Plus+, the program will stop at this point.

- ◆ If the program continues normally, a box will appear in the middle of the screen, asking you to enter your company name and license number.
- ◆ Type your company name in the first blank, but do not press [Enter] yet. Instead, press [Tab] to move the cursor to the second blank.
- ◆ Type your license number into the second blank, then press [Enter]. If the license number you entered is invalid, you will see an error message. Press [Enter] to go back to the license number entry screen, then press [Tab] to skip to the license blank. Retype the number carefully, and press [Enter].
- ◆ When you have entered a valid license number, Trend Plus+ will continue normally. Press [Alt-X] to quit.

3.4 What next?

Please read the next chapter, **Using Trend Plus+ Screens**, to get a feel for how menus, windows, and dialog boxes work. After you have that basic understanding, you'll be ready to move on to **Configuring Trend Plus+**, where you will learn how to set up Trend Plus+ to work most efficiently for you.

4 Using Trend Plus+ Screens

Please read this section of the manual carefully before attempting to use the program. Trend Plus+ uses menus, windows, and controls that are similar to those found in IBM OS/2, Microsoft Windows, or Apple Macintosh programs. These objects will require some explanation if you are unfamiliar with them.

4.1 Mouse techniques

If you have a mouse installed on your computer, Trend Plus+ will display a mouse cursor when the program starts. The mouse cursor looks like a block that changes the color of whatever character it is resting on. The instructions in the following sections will mention several mouse techniques, which are described below:

☞ **To click on an object:** Use the mouse to move the mouse cursor to rest on the object, then tap (press and release) the *primary mouse button* once. The primary mouse button is always the left button, unless you have specifically reconfigured your mouse driver to change it.

To double-click on an object: Use the mouse to move the mouse cursor to rest on the object, then tap the primary mouse button twice, in quick succession. To do this properly, you must hold the mouse perfectly still while tapping the button.

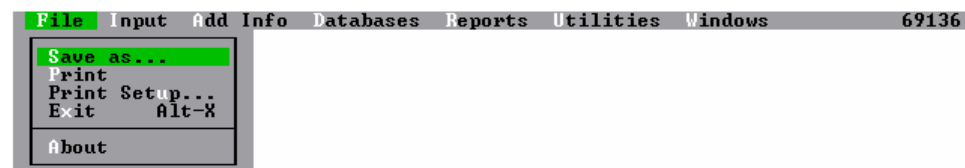
To drag an object: Use the mouse to move the mouse cursor to rest on the object, then hold down the primary mouse button. This will “pick up” the object. Then, as you continue to hold down the mouse button and use the mouse to move the mouse cursor around on the screen, the object you have picked up will be carried with the mouse cursor. When you have moved the mouse cursor to the spot where you want to put the object, release the mouse button to “drop” it there.

4.2 Trend Plus+ menus

File Input Add Info Databases Reports Utilities Windows 83936

The *menu bar* is an area at the top of the screen, which contains several *menu items*, from which you can choose. When chosen, these items present *popup menus* containing more related items to choose from. The menu system can be thought of as the program’s table of contents; items on the menu bar itself are the program’s “chapters,” and the popup menus reveal each chapter’s “subheadings.” This is a way to make a lot of information easily accessible, only showing the information you want for whatever you want to do at a given time.

The figure below shows an example of the popup menu revealed when the **File** item is chosen from the main menu bar:




Because this menu belongs to the File item on the menu bar, it is called the File Menu. Similarly, the Database item and the Window item on the menu bar reveal the Database Menu and Window Menu, respectively.

In this manual, a vertical bar (|) will be used to separate selections from subsequent menus. For example, when you see the text “choose File | Exit,” it will mean to choose File from the menu bar, then choose Exit from the File Menu.

☞ **To choose an item from the menu bar or a popup menu:** Click on the desired item.

To dismiss a popup menu without making a selection: Click anywhere on the screen except on the popup menu or menu bar.

 **To choose an item from the menu bar:** Hold down [Alt] while pressing the key of the item's highlighted letter. For example; to choose the **File** item from the menu bar, press [Alt-F].

To choose an item from a popup menu: Press the item's highlighted letter (without using the [Alt] key). You can also use the [Up arrow] and [Down arrow] keys to move to the desired item, then select it by pressing [Enter].

To dismiss a popup menu without making a selection: Press [Escape].

Note: If you look again at the picture of the File Menu, you will notice that the Exit item is followed by *Alt-X*. This means that pressing [Alt-X] will quit the program, just as if you had chosen **File | Exit**. The [Alt-X] keystroke is a shortcut that you can use to leave the program quickly, without having to choose anything from the menu bar. There are shortcut keys on the Window Menu as well. As you see them, note them and try them out; you may find that they save effort over using the menu system or the mouse.

At the extreme right end of the menu bar, a number is displayed which represents the number of bytes of free memory in the system. This display will constantly be updated by the program.

4.3 Trend Plus+ windows

Most of the information in Trend Plus+ is shown as tables inside *windows*, which can be moved around on the screen like pieces of paper on a desk. You can have several windows open (visible) at once, limited mainly by the amount of memory in your computer. Below is a screen with an example window opened. The window is the bordered rectangle in the center of the screen.

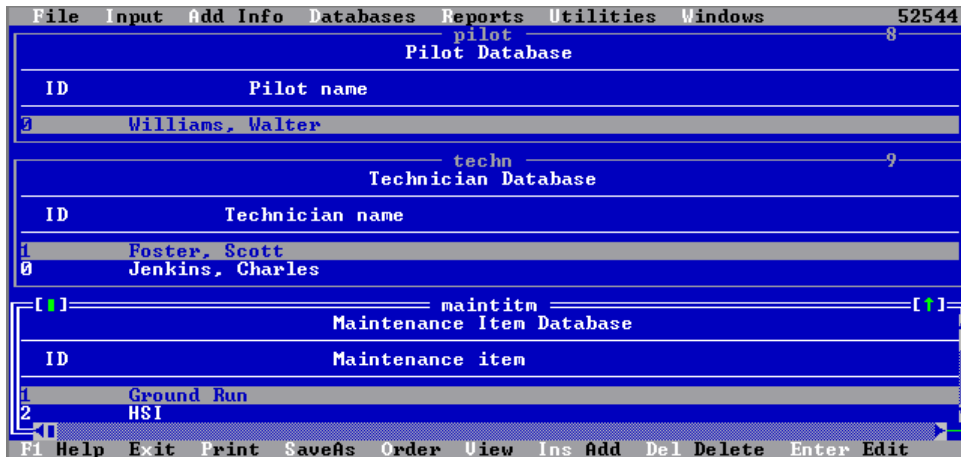


4.3.1 Window management

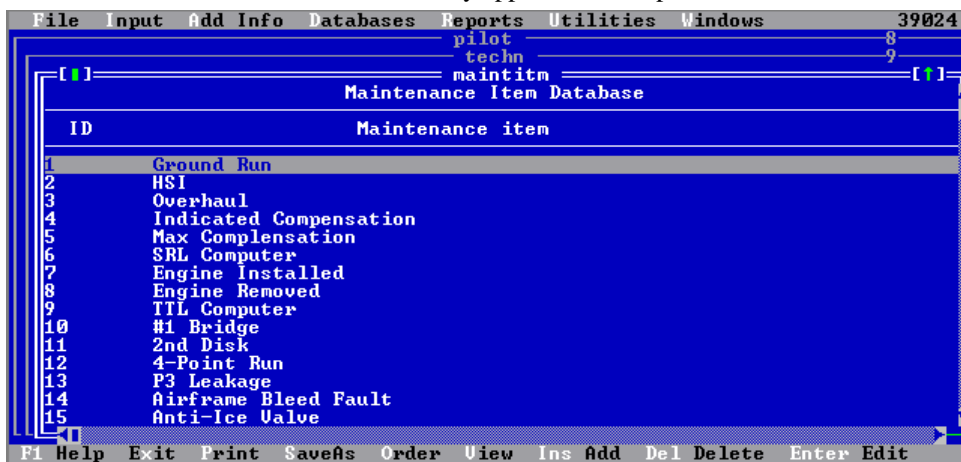
As you open each window, it will become the *active window*; its border will be highlighted, and Trend Plus+ will attempt to apply any subsequent keystrokes you enter to that window's data. For example, if you open the Pilot Database window, it will appear with a highlighted border and a cursor bar on the first Pilot in the database. If you press [Down arrow], the cursor bar will move to the next pilot. If you press [Delete], Trend Plus+ will ask you if you're sure you want to delete the current pilot (the one currently highlighted by the cursor bar).

If you have several windows open, you can change the active window at will; the newly-activated window will be redrawn with a highlighted border, and any part of it previously obscured by other windows will be made visible.

Windows can be *tiled* on the screen automatically, dividing the screen up among the windows so that each is as large as possible without overlapping:



Windows can also be *cascaded*, so that they appear as in the picture below:



If you want to keep several windows open at once, but see as much as possible in one at a time, you can temporarily *zoom* a window to full screen.

☞ **To change the active window:** Click inside the window you desire to activate.

To move a window: Move the mouse cursor onto its title area (the top border, just to the right of the close box) and hold down the primary mouse button. Drag the window to a new position on the screen. When you are satisfied with the window's position, release the mouse button to drop the window in its new place.

To resize a window: Move the mouse cursor onto the bright, single-line corner—called the *sizer*—at the lower-right corner of the window, and hold down the primary mouse button. Drag the sizer until you are satisfied with the window's size, then release the mouse button to drop the sizer in its new place.

To tile all windows: Use the mouse to choose **Window | Tile**.

To cascade all windows: Use the mouse to choose **Window | Cascade**.

To zoom a window: Click on the *zoom button*, which should appear in the window's upper-right corner. (It looks like an arrow inside brackets.) Clicking on the zoom button a second time will return the window to its former position.

☞ **To change the active window:** If you have nine or fewer windows open, each window will have a number near the upper-right corner of its border. If you hold down [Alt] and press the corresponding number key, the window will be activated.

If you have more than nine windows open, pressing [F6] will activate one of the currently inactive ones; press [F6] repeatedly until the desired window is activated.

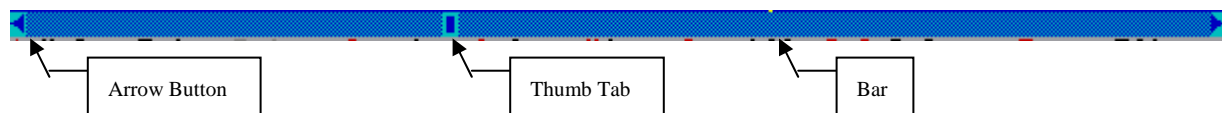
To move or resize a window: Choose **Window | Resize/Move** (or press [Ctrl-F5]). Then, use arrow keys to move the window to a new position on the screen, or hold down [Shift] while using the arrow keys to change the window's size. When you are satisfied by the window's new appearance, press [Enter] to accept the new size and position.

To tile all windows: Choose **Window | Tile**.

To cascade all windows: Choose **Window | Cascade**.

To zoom a window: Choose **Window | Zoom** (or press [F5]). Choosing **Window | Zoom** a second time will return the window to its former position.

Windows will often contain *scroll bars*. If more data is present than will fit inside the window, scroll bars may be used to move the data around inside the window so that different parts can be seen. Scroll bars can be vertical or horizontal. They have several parts: At each end of the scroll bar is an *arrow button*. Between the arrow buttons lies the actual *bar* part of the scroll bar, and lying on the bar is a small square, known as the *thumb tab*. The thumb tab is placed on the bar at a position relative to where you are within the data in the window: For example, suppose you are examining the list of pilots in the Pilot Database. If the window's cursor bar rests on the first pilot, the thumb tab will be at the top of the vertical scroll bar; if the cursor bar rests on the last pilot, the thumb tab will be at the bottom of the vertical scroll bar. If the cursor bar is somewhere between these pilots, the thumb tab will give you an idea of where that is.



To scroll data in a window: Clicking on the arrow buttons will move the thumb tab by a small increment—usually one line of text—in the desired direction. Clicking on the bar above and below the thumb tab will cause it to “jump” by a larger increment—usually one full page of text. Or, you may simply drag the thumb tab to a new position, as you desire.

To scroll data in a window: Moving the cursor bar will cause any data that is offscreen to be scrolled on automatically, as necessary. Move the cursor bar with these keys:

[Up arrow] / [Down arrow]	One line or column in the desired direction
[Page up] / [Page down]	One screen up/down
[Home] / [End]	To the beginning/end of the current line

When you are done with a window, close it to return its temporary memory back to the system. On machines with little RAM memory, having too many windows open at once can slow down or hinder the operation of Trend Plus+.

To close a window: Click on the close button. The window will vanish and memory it used will be returned to the system until you next open the window.

To close a window: Choose **Window | Close** or press [Alt-F3]. The window will vanish and memory it used will be returned to the system until you next open the window.

4.4 Trend Plus+ dialog boxes

Sometimes Trend Plus+ will have to ask for more information before it can complete a task or open a window. For example, if you choose to save information to a new data file, Trend Plus+ will need to know what filename to use before it can proceed. In such instances, it will present what is known as a *dialog box* (or simply *dialog*) which is like a form with blanks to be filled in. Dialog boxes are different from windows in one important way: They are

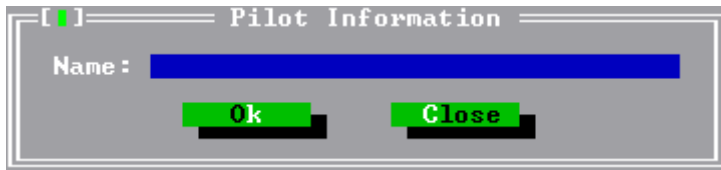
active as long as they are visible. You cannot change the active window, make choices from the menu bar, or even exit the program until you accept or cancel a dialog box.

To make dialog boxes easy to recognize, they are visually distinct from windows. They have a different background color; they do not have a window number; and they ordinarily lack scroll bars, the zoom button, and the sizer. They cannot be resized.

A dialog box may contain plain text, such as an error message, but it will also contain one or more *controls*, such as data entry fields and various types of buttons. These are described below.


4.4.1 Labels

The simplest type of control is the *label*. Most types of objects found in a dialog boxes will have labels attached. In the picture below, *Name* is a label attached to a data entry field:



Label text is usually printed in black, but when the cursor is resting on the control which is attached to the label, the label text will be printed in white.

Not only do labels describe other controls and indicate where the cursor rests, they are also a quick means of moving the cursor with the keyboard:


 **To have the cursor “jump” directly to a particular control:** Hold down the [Alt] key and press the letter drawn in yellow on the label.

4.4.2 Command buttons

Typically, a dialog box contains at least one command button, which appears as a rectangle with text inside and a shadow below. To leave the dialog box, a command button must usually be pressed. For example, if an error is detected by Trend Plus+, the program halts while a dialog box containing the error message appears on the screen. Below the message is a button marked *OK*. After you have read the error text, continue by “pressing” the OK button.

At other times, a dialog box may appear which contains some data entry fields (the blanks to be filled in) and two buttons: *OK* and *Cancel*. Fill in the form and press OK to continue, or press the Cancel button to abort the operation.

 **To press a command button:** Click on the command button to press it.

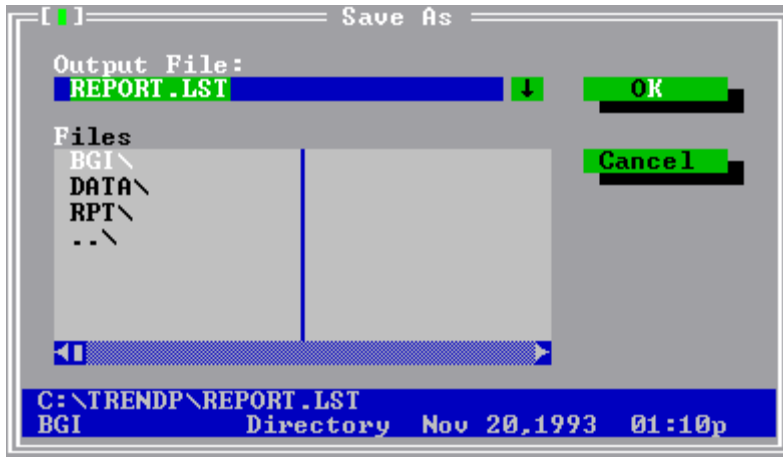
 **To press a command button:** If the button has a bright yellow letter, hold the [Alt] key down while typing that letter to press the button. (The OK button can always be pressed by typing [Alt-K].)

If the button does not have a highlighted letter, press the [Tab] key repeatedly until the cursor rests on the button (the button’s text will then be highlighted). Hit [Enter] to press the button.

Usually, pressing [Escape] on the keyboard is equivalent to pressing the Cancel or Close button in a dialog box.

4.4.3 Data entry fields


Data entry fields are blanks to be filled in on the form. For example, if you choose to save data to a new file, this dialog box will appear:



This is how Trend Plus+ asks what the new file will be named. Type the name in the text entry field, then press OK.

Some entry fields may require numbers or dates; others may contain any text you wish to enter. The type of entry expected should be clear from the format of the entry field or the way it is labeled. If you enter data in the wrong format—for example, entering “12A7X” in a numeric entry field—you will get an error and be asked to try again.

 **To move to a particular field:** Click on the desired field.

 **To move to a particular field:** Press [Tab] to cause the cursor to jump forward from one field to the next. Use [Shift-Tab] to jump backward. Press [Tab] or [Shift-Tab] repeatedly until the cursor is in the desired field.

Of course, if the field you want to move to has a label, you may type the label’s [Alt-letter] combination to jump directly there.

Some data entry fields have additional features for very specialized tasks:

4.4.3.1 Numeric fields

These fields accept only valid numbers. Some fields will have limits—a range of acceptable values. When you click on OK to accept the dialog, Trend Plus+ checks all numeric fields to assure that they are within any defined limits. If any numbers are invalid, an error message will appear. Correct the number and press OK again.

While the cursor is on a numeric field, the following keys perform special functions:

[Up arrow]	Increment whole number value if it is less than upper limit
[Down arrow]	Decrement whole number value if it is greater than lower limit

4.4.3.2 Date fields

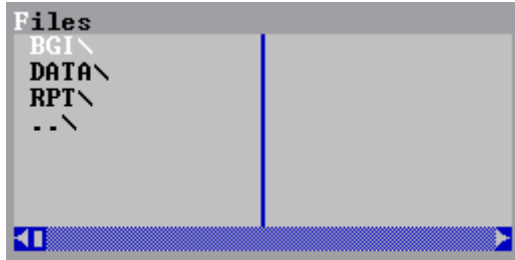
These fields accept only valid calendar dates, entered as numbers. You can enter the number as a string of six digits (i.e., 010104), or with slashes (01/01/04). While the cursor is on a date field, the following keys perform special functions:

[Up arrow] or [+]	Increment day
[Down arrow] or [-]	Decrement day
[Page up]	Increment month
[Page down]	Decrement month


4.4.4 List boxes

A list box presents a list of items to select from. If the list contains more items than can be presented within its box, a scroll bar may appear beside or below the box; this scroll bar operates just like a window’s scroll bar, but it only

affects the list in the box. Highlight the desired item to select it. In the Save As dialog, the area marked “Files” is a list box:




 **To select an item from the list:** Click on the desired item.

 **To select an item from the list:** While the cursor rests on the list box, a highlight cursor will appear within it. Use [Up arrow] or [Down arrow] to move the highlight to your selection. ([Page up] and [Page down] also work if the list has a scroll bar.) You may then press [Tab] or [Shift-Tab] to leave the list box.

4.4.5 Drop-down list boxes

One very useful type of data entry field is called the *drop-down list box*. It is a combination of a data entry field and a list box. You may fill it in by typing in it normally, or you may command the field to present a list of valid entries, from which you can simply select the one you want. This saves typing and helps prevent errors. In the Save As dialog box, the area marked “Output File” is a drop-down list box:



 **To command a drop-down list box to display its list:** Click on the down arrow button which appears to the right of the box.

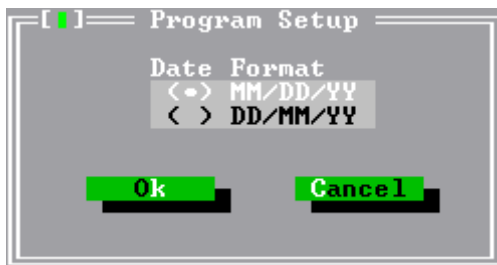
 **To command a drop-down list box to display its list:** Press [Page down].


To choose from the list without displaying it: [Up arrow] and [Down arrow] will move to the previous/next item in the list.


The drop-down list box shown above functions as a *history list*. Each time you enter a file name, the name is added to a list that the drop-down list box “remembers” until you quit the program. If you want to overwrite a file you just created, you can choose **File | Save As**, and use the drop-down list box to quickly reselect the file’s name.

4.4.6 Option buttons

Option buttons appear in groups, called *option groups*. They allow you to select from a set of mutually exclusive choices. Individual option groups look like sets of parentheses, one of which contains a dot. In the picture below, you can see two groups of option buttons. The dot inside the parentheses indicates the currently selected option.



 **To select an option:** Click on the desired option to select it. The previous selection will be cleared.

 **To select an option:** While the cursor rests on the option button group, press the option's highlighted letter to select it, or use [Up arrow] and [Down arrow] to move the selection dot to the desired item. Then press [Tab] or [Shift-Tab] to leave the option group.

Option buttons are also sometimes known as “radio buttons,” since they function like the preset buttons on an automobile radio.

4.4.7 Check boxes

Check boxes allow you to select from a set of choices that are not mutually exclusive. Check boxes look like brackets, any of which may contain an X. In the picture below, the user has chosen all the options indicated by X's inside the check boxes:

Serial #	Tail #	Pos
63203	412UE	2

Acceptance Band

Curve	Band	Unit
<input checked="" type="checkbox"/> Indicated Temp. Margin	20.0	(°C)
<input checked="" type="checkbox"/> Total Temp. Margin	20.0	(°C)
<input checked="" type="checkbox"/> Fuel Flow Margin	15.0	(%)
<input type="checkbox"/> Compr. Work		
<input type="checkbox"/> Compr. Pressure Ratio		
<input type="checkbox"/> Compr. Efficiency		
<input checked="" type="checkbox"/> Oil Temperature		
<input checked="" type="checkbox"/> Oil Pressure		

Time Scale

- Date
- Engine Hours

Show

- Data Points
- Acceptance Bands
- Trend Projection
- Maintenance Activities
- Ground Runs

Range

- All Data
- Since Overhaul
- User Specified

To change the state of a check box: Click on the check box.

To change the state of a check box: While the cursor rests on a group of check boxes, press an item's highlighted letter to change its state. You can also use [Up arrow] and [Down arrow] to move to the desired item, then press the space bar to change its state. When the choices you prefer are checked, press [Tab] or [Shift-Tab] to leave the check box group.

4.5 The status line

At the bottom of the Trend Plus+ window is an area called the *status line* or *status bar*, which works like the menu bar. It can contain several items that are chosen by holding down [Alt] and pressing the item's highlighted letter key.

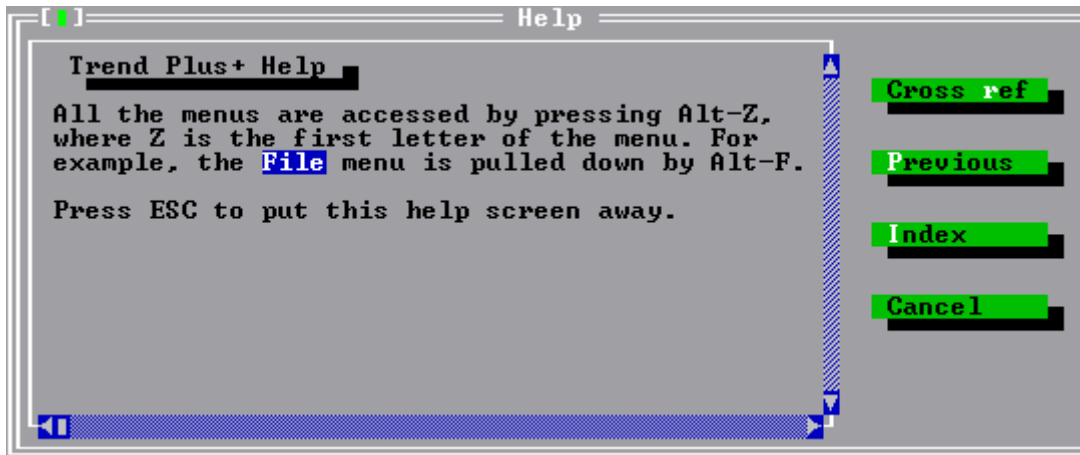
Items on the status line are activities valid for the currently active window. If no window is open, the status line will remind you of the help and exit shortcuts.

The picture below shows an database window and the items appearing on its status line:

Engine Serial Number	A/C Reg. Number	Wing Position	Install Date	TAT at Install	TSN at Install	TS Ins
63142	414UE	1	11/03/93	12225.0	11256.0	
63155				12176.0	12612.0	
63157	420UE	1	10/06/93	9485.1	12710.0	
63168	419UE	1	08/10/93	8972.8	8858.3	
63176	420UE	2	11/13/93	9698.2	12596.0	
63183	428UE	2	06/04/93	8526.3	12722.0	
63184				12623.0	12769.0	
63185	411UE	1	12/26/93	14269.0	9094.5	
63186	423UE	2	08/09/93	8452.3	7826.9	
63201	711HH	1	04/28/93	3696.4	3696.4	
63202	711HH	2	11/12/93	4872.5	4532.4	
63203	412UE	2	12/20/92	11270.0	10111.0	
63213	427UE	2	11/14/93	8879.7	12773.0	

4.6 The help system

If you have a problem while using Trend Plus+, you can get help by pressing the [F1] key. This will bring up a help box that will discuss the screen you are on. The help box is itself a dialog box, as you can see:



Help text will appear in the box with scroll bars; you can use the arrow keys and [Page up] or [Page down] to scroll the help text. Some words in the help text will be highlighted; these are cross-references. If you place the cursor on one of these and press the *Cross Ref* button, the help text will “jump” to an explanation of the cross-referenced word. Press the *Previous* button to get back from a cross reference.

If you would like to see an index of all topics in the help system, press the *Index* button.

When you have finished reading text in the help box, you can press [Escape] or click on *Cancel* to close it.

 **To look up a cross-reference or indexed word:** Double-click on the highlighted word you want to look up.

 **To look up a cross-reference or indexed word:** Press [Tab] until the cursor comes to rest on the highlighted word you want to look up, then type [Alt-R] to press the *Cross Ref* button.

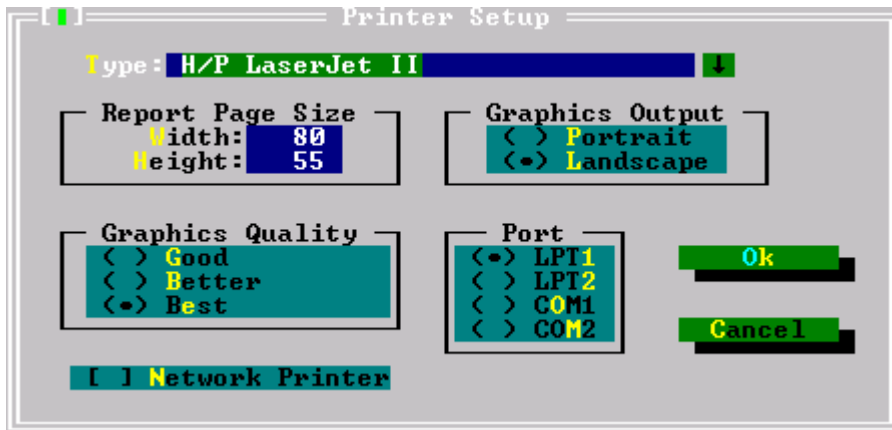
5 Configuring Trend Plus+

Before you implement your trending program with Trend Plus+, you will want to consider what pieces of data you are actually interested in tracking, and how you want Trend Plus+ to accept and present that data.

The Flight Data Entry and Ground Data Entry forms contain some optional data fields. When Trend Plus+ is first installed, it defaults to tracking all the optional data. You can use the configuration screens to “turn off” tracking of unwanted optional data, but it does not hurt to leave everything on at first, until you get a clear idea of what Trend Plus+ can do for you. You can always go back and turn fields off later.

5.1 Printer

Access the Printer Setup dialog box by choosing **File | Print Setup**.



What type of printer do you use?

Trend Plus+ will need to know what printer you have before it can print graphical reports. If your printer is not listed, consult your printer’s user guide for compatible printer types which may be listed.

Do you want plots to be wide (landscape) or tall (portrait)?

This setting affects only graphic printouts (plots).

What is your printer’s page size, in characters per row (width) and rows per page (height)?

These settings affect only textual printouts.

What level of print quality do you want?

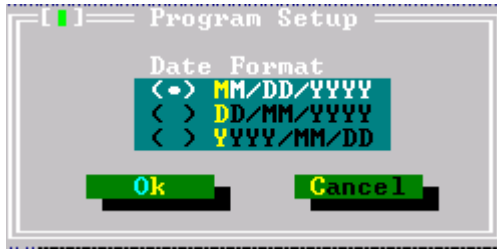
This setting affects only graphic printouts (plots). *Good* quality is suitable for economical high-volume printing. *Better* or *Best* is useful for reports to management or publications. Higher-quality plots take correspondingly more memory and more time to print.

What computer output port is your printer connected on?

Is your printer a network printer (connected to another computer)?

5.2 Date format

Access the Date format dialog box by choosing **Utilities | Program Setup | Date Format**.

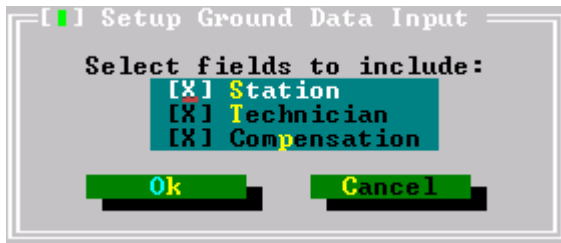


Do you want to use the American (MM/DD/YY), European (DD/MM/YY), or (YYYY/MM/DD) form for entering dates?

Use the option buttons on this screen to select the date format you will use. These formats apply to all date displays, and also affect how Trend Plus+ interprets entry of dates.

5.3 Ground data entry form

Access the Setup Ground Data Input dialog box by choosing **Utilities | Program Setup | Ground Data Form**.



Will you be tracking ground runs performed at several stations?

Will you be tracking which technician performed the ground run?

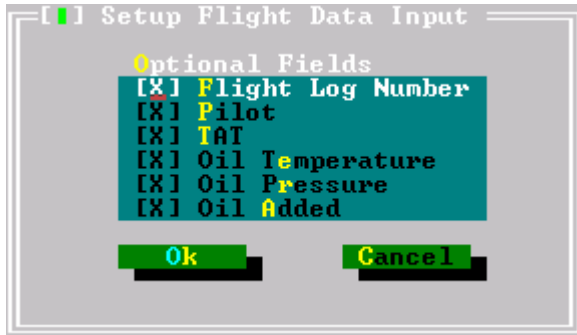
Do you want to enter compensation on ground runs?

Use the check boxes on this screen to indicate which optional fields you want to appear on the Ground Data Entry form.

5.4 Flight data entry form

5.4.1 Format

Access the Setup Flight Data Input dialog box by choosing **Utilities | Program Setup | Flight Data Form | Format**.



Will you be tracking flights by log number?

Will you be tracking data for several pilots?

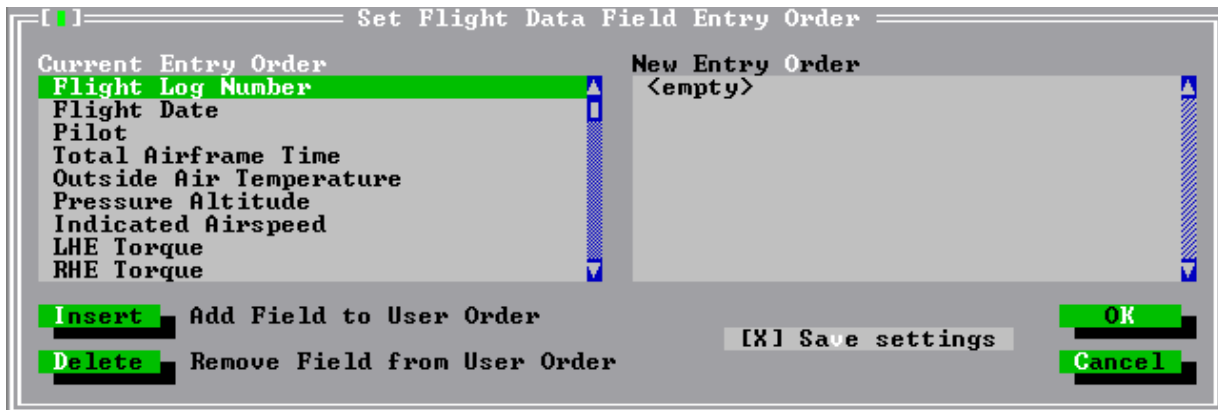
Will you be tracking total airframe time (TAT)?

Will you be tracking data on oil temperature, oil pressure, or oil added?

Use the check boxes on this screen to indicate which optional fields you want to appear on the Flight Data Entry form.

5.4.2 Data entry order

Access the Set Flight Data Entry Order dialog box by choosing **Utilities | Program Setup | Flight Data Form | Data Entry Order**.



What entry order is most efficient for the Flight Data Entry form?

If you will be entering data from a flight log sheet, you can use this dialog box to change the way the cursor moves from field to field on the Flight Data Entry form. This will allow you to enter data quickly, in the order it appears on the log sheet.

The dialog box contains two lists, labeled *Current entry order* and *New entry order*. The *Current entry order* list contains the names of all fields, including the optional fields (discussed in the **Format** section, above).

Use the arrow keys to move the highlight cursor to the name of the first field you want the cursor to appear in. Then press [Insert] or use the mouse to click on the Insert button. The field name will move to the *New entry order* list.

Then, use the arrow keys to highlight the name of the field you want the cursor to jump to after data is entered in the first one. Press [Insert] again.

If you make a mistake, you can highlight fields in the New entry order list and press [Delete] to move them back to the Current entry order list.

Continue until you have moved enough fields to define your desired sort order. When you are satisfied with the order of fields in the New entry order list, press the OK button. Trend Plus+ will memorize the new order. (Any fields remaining in the Current entry order list will not be “forgotten”; The Flight Data Entry form will behave as if you had placed them, in order, at the end of the New entry order list.)

You can click on the Cancel button to cancel your changes and retain the Current entry order.

Note: If you want to try out a new order before making permanent changes, you can set up the order as described, then uncheck the *Save settings* check box before pressing the OK button. When you do this, the Flight Data Entry form’s order will be changed, but **only** until you exit Trend Plus+. The next time you start Trend Plus+, it will return to the old order. If you decide to keep the new order, choose **Utilities | Program Setup | Flight Data Form | Data Entry Order** again, make sure the *Save settings box* is checked, then press the OK button.

5.5 IEC Import Filter

If you have a Honeywell engine equipped with an integrated electronics control (IEC) computer, such as a –14 engine, you can use the Honeywell GDM Terminal package (part number 10-700-0096) to transfer data to a floppy disk and later import this data into the Trend Plus+ software. To improve the data quality and reduce the quantity of data stored in Trend Plus, you may define a filter to limit the imported data to certain flight conditions. To define this filter, choose **Utilities | Program Setup | IEC Import Filter**. The IEC Import filter screen will appear as:

	Lower	Upper	
Altitude	12.00	18.00	kft
RPM	95.5	99.0	%
T2/OAT	-30.0	30.0	°C

Accept One Point/Day
 Accept All Points
 Ignore Bad T3/P3

Define the Altitude, RPM and T2 range that is desired. You may also select to store a single point each day or multiple points each day. Finally, you may ignore data sets with an invalid T3/P3 reading. When the settings are correct, press the OK button to save the filter.

6 Setting Up Your Trend Plus+ Database

Use the tasks on the Add Info Menu to prepare your database before recording trend data, and to add to the databases later on.

Choose any of the tasks below to bring up a dialog box for data entry. After you enter the data and press OK to accept it, the data will be added to the database and the dialog box will briefly disappear. Then, it will reappear to allow you to enter more data. When you are through entering new data, press [Escape] to close the dialog box.

6.1 Aircraft

Choose **Add Info | Aircraft** to create a database of the aircraft you will be tracking in Trend Plus+.

Use the drop-down list box to select the aircraft model. This field will be defaulted to the last type of

aircraft that was entered.

Enter the aircraft registration (tail) number. If you want, you can enter engine data here by pressing the Engine Info button, or you can just press OK to accept the new aircraft without entering engine data. If you do press the Engine info button, you will be presented with the same screens as in **Add Info | Engine**. After entering data for the left engine, the dialogs will appear again so you can enter data for the right engine.

6.2 Engine

When you choose **Add Info | Engine**, you will first be asked for the engine serial number. Then, the appropriate Engine Information dialog will appear. (Sample engine data sheets can be found in the **Sample Forms Appendix**.)

Here is a standard Engine Information dialog:

If the serial number you enter corresponds to an engine with an IEC computer installed, you will see the “Engine (-14) Information” dialog:

```

[ ] Engine <-14> Information
Engine Serial No: 75000
Installed on A/C:
  Wing Position: 1 LHE
Date Installed: 05/27/2004 mm/dd/yyyy
  Station:
Date of Last HSI: 05/27/2004 mm/dd/yyyy
Date of Last CAM: 05/27/2004 mm/dd/yyyy
  TSN @ Last CAM: 0.0 hhhh.d
Max Compensation (DSC): 0.00 °C
Max Compensation Date: 05/27/2004 mm/dd/yyyy

  Ok      Close

```

The *Station* field will not be shown if there are no stations in the database.

For the -14 engine, Time Since New (TSN) is indicated in the IEC computer's data records. Time Since Overhaul/Continued Airworthy Maintenance (TSO/CAM) is calculated using TSN, as follows:

$$\text{TSO/CAM} = \text{TSN} - \text{TSN @ Last Overhaul/CAM}$$

You should make sure that all fields requiring dates and hours are entered accurately, since they are used in trend calculations and graphical reports. If you supply incorrect values for TAT, TAT @ Install, etc., the engine hours calculations throughout the system will be incorrect.

6.3 Pilot

If you will be recording pilot names with the flight data, choose **Add Info | Pilot** to create the list of pilots.

```

[ ] Pilot Information
Name : _____
  Ok      Close

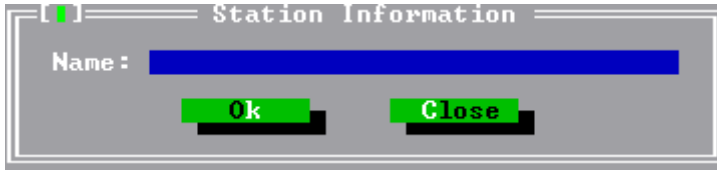
```

Because the pilot list will be stored and manipulated in alphabetical order, you should decide on a method of entering pilots in a last-name-first format, such as: "Public/John" or "Public, John Q." Or, you might choose instead to enter employees by an employee ID number: "00181," "00181:Public/JQ," etc. Once you have selected the format you like best, use it consistently so that the pilot list will be sorted correctly whenever you need to select from it. (If you choose to use employee ID numbers, enter the same number of digits for every employee: 00011, 00020, and 00002 will sort correctly; 11, 20, and 2 will not.)

As a convenience for data entry, if you do not enter pilots, pilot entry fields will be disabled on other dialog boxes.

6.4 Station

If you are recording data for multiple maintenance stations, choose **Add Info | Station** to create the list of stations.



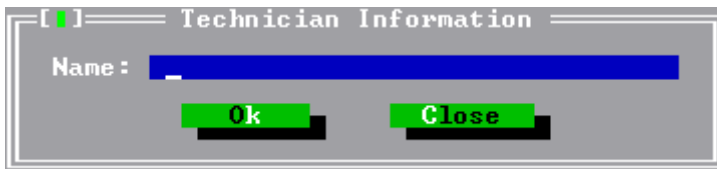
The screenshot shows a dialog box titled "Station Information". It has a title bar with a small icon on the left and a close button on the right. Below the title bar, there is a label "Name:" followed by a blue text input field. At the bottom of the dialog, there are two green buttons: "Ok" and "Close".

As with the pilot list, the station list will be stored and manipulated in alphabetical order.

As a convenience for data entry, if you do not enter stations, station entry fields will be disabled on other dialog boxes.

6.5 Technician

If you will be recording technician names with maintenance activities, choose **Add Info | Technician** to create the list of technicians.



The screenshot shows a dialog box titled "Technician Information". It has a title bar with a small icon on the left and a close button on the right. Below the title bar, there is a label "Name:" followed by a blue text input field. At the bottom of the dialog, there are two green buttons: "Ok" and "Close".

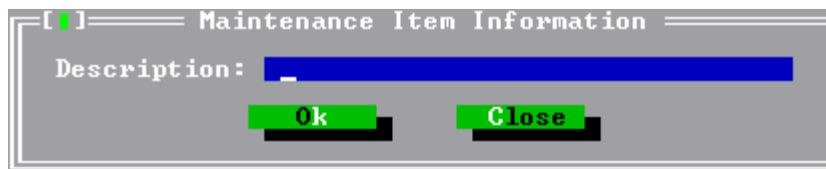
As with the pilot list, the technician list will be stored and manipulated in alphabetical order; enter technicians in the last-name-first format you selected for the pilots.

As a convenience for data entry, if you do not enter technicians, technician entry fields will be disabled on other dialog boxes.

6.6 Maintenance item

When Trend Plus+ is installed, it will already contain a list of common maintenance items, such as "oil change," or "ground run." When maintenance is performed, you may simply select from the Maintenance Item list instead of typing a description of the activity. There is a "comment" item you can use to record other information, such as symptoms of an engine problem.

To see the list of maintenance items, choose **Databases | Maintenance Item** from the main menu. If you need to add a new maintenance item, choose **Add Info | Maintenance Item** to add to the list.



The screenshot shows a dialog box titled "Maintenance Item Information". It has a title bar with a small icon on the left and a close button on the right. Below the title bar, there is a label "Description:" followed by a blue text input field. At the bottom of the dialog, there are two green buttons: "Ok" and "Close".

7 Recording Trend Data

Procedures used to record trend data both in flight and on the ground can determine whether a trend interpretation is successful in finding an instrument indication error or an engine problem. General guidelines are discussed which emphasize the need for regular trend data recordings, for an engine stabilization period, and for consistency in setting bleed and accessory loads while recording data.

7.1 Recording in-flight data

In-flight trend data should be recorded as often as possible, but on a *regular* basis. Typically, this is at least once every day or every 4-6 operating hours. Operators should avoid intermittent periods of data recording since this may complicate trend interpretation or may bias trends to a fixed period in time.

Data should be recorded during cruise after the engine has stabilized for 5 minutes or more. Best results are achieved if data can be taken at similar flight conditions, such as \pm 5000 feet of typical cruise altitude and \pm 10 knots of typical cruise airspeed. Also, it is best if data can be taken at \pm 1.0% RPM of typical cruise engine speed (RPM). This is 97% RPM for some TPE331 models, and 96% for others. These conditions are summarized for reference in the table below:

Best conditions for recording in-flight data	
Altitude	\pm 5000 feet of typical cruise altitude
Airspeed	\pm 10 knots of typical cruise airspeed
Engine RPM	\pm 1.0% of typical cruise engine speed (RPM)
<i>Allow engine to stabilize for at least 5 minutes before taking data.</i>	

Nominal bleed and accessory power loads on both engines should be set prior to beginning the stabilization period. Use of anti-ice bleed, or recording trend data in icing conditions, is not recommended. Conventions should be established among pilots in order to maintain a consistent approach when it comes to setting bleeds. This may, for example, include always setting bleeds to position 5 or to *HIGH*. In general, it is not the level of bleed settings that is important, but rather the *consistency* of bleed settings when recording trend data.

CAUTION:

Trend Plus+ assumes the same flight conditions (altitude, airspeed, and outside air temperature) for both engines. If a convention is established which calls for stabilizing one engine with bleed set to *OFF*, recording its trend data, stabilizing the other engine with bleed set to *OFF*, then recording its trend data, pilots must be responsible for holding the same flight condition.

Having satisfied the stabilization requirements, the parameters listed below should be recorded. A sample flight data form is provided in the **Sample Forms Appendix**. Special attention should be given to methods used in reading aircraft gauges. Gauges with poor resolution or gauges located in positions difficult to read can lead to trends which can be misinterpreted. The *human factor* and the *parallax effect* can also contribute to misinterpreting trends.

Trend data parameters

1. Outside air temperature (OAT)
 - Units: °F or °C
 - On aircraft equipped with an IEC, this parameter is Total air temperature (T2)
2. Pressure altitude (PALT)
 - Units: feet
 - Altimeter should be set to 29.92 in-Hg
3. Indicated airspeed (IAS)

- Units: knots
4. Engine torque (TQ)
 - Units: %, ft-lbs, or PSI
 - On Aero Commander 690 aircraft, this can be shaft horsepower (SHP)
 5. Engine speed (RPM)
 - Units: % or RPM
 6. Turbine temperature (ITT for TPE331-3/5/6 engines, or EGT)
 - Units: °F or °C
 - On aircraft equipped with single-redline controls, this parameter is also called SRL
 7. Fuel flow (Wf)
 - Units: lb/hr or kg/hr
 8. Bleed setting
 - Typically OFF, ON, HIGH, or some setting number (0-10)
 9. Anti-ice setting
 - Typically ON or OFF (recommended OFF)

Attention, Jetstream 41 operators:

For Jetstream 41 aircraft engines, data recording is done automatically by the Integrated Engine Control (IEC). Recording is initiated by pressing the ETM (engine trend monitoring) button as described in the Jetstream 41 operator's manual. The IEC also records compressor discharge pressure (P3, psia) and discharge temperature (T3, °C) in addition to the parameters mentioned above. The OAT is replaced by the engine's T2 sensor (total air temperature), and altitude and airspeed come to the IEC via the aircraft's air data computer. For information on downloading Jetstream 41 IEC data, refer to the GDM Terminal User's Manual (ACES part number 10-700-0096).

7.2 Recording ground run data

Procedures for making ground runs are described in **Service Information Letter (SIL) 331-116**. These are summarized in this manual for brief discussion purposes only. Please refer to the SIL for more detailed discussion.

Note: This version of Trend Plus+ does not support ground runs with breakout box P/N 294562-2. Only cockpit gauge data is required.

Just as with flight data, a *3-5 minute* stabilization period is required for each point recorded. Bleed and accessory loads should be minimized prior to stabilization. Cowling should be in place as usual. Where possible, the aircraft should be pointed into the wind.

Four points are recommended. The first point should correspond to the aircraft flight manual target torque of the day. If target torque cannot be achieved, the first point should correspond to the turbine temperature redline of the day. Each successive point should be recorded in decrements of 10°C in turbine temperature. A sample data sheet for recording ground data is provided in the **Sample Forms Appendix**.

Attention, operators of engines equipped with Single-Redline (SRL) (TPE331-8/10/11/12):

Trend Plus+ provides a way to verify SRL computer functionality. After recording stabilized data with SRL operative, deactivate the SRL computer so that compensated EGT is displayed in the cockpit. No power lever or condition lever adjustments should be made. No stabilization period is required. Simply record the value displayed after deactivating the computer. When finished, reactivate the SRL computer and proceed to the next point.

After ground run data is entered into the Trend Plus+ program, it is automatically reduced and the operator is presented with results. Refer to the **Interpreting ground runs** section of the **Trend Data Analysis**

chapter of this manual to see the results expected for healthy engines. SRL functionality is also discussed in that section.

8 Entering Trend Data

The Input Menu has options for entering flight data, ground data, and maintenance records manually, and for reading data downloaded to floppy disk by an IEC computer.

8.1 Flight data

You will use the Flight Data Entry form to key in data from flight log sheets. (Sample flight log sheets can be found in the **Sample Forms Appendix**.) When you choose **Input | Flight Data**, Trend Plus+ will ask you to choose an aircraft or engine on which to enter data. If you choose an engine, the Flight Data Entry form will contain one set of engine data entry fields. If you choose an aircraft, the form will have two sets of fields, and will require data entry for both engines on the aircraft.

Then the Flight Data Entry form will appear:

The screenshot shows the 'Flight Data Information' form. It is divided into several sections:

- Flight Log Information:** Flight Log Number, A/C Reg. Number (424UE), Date of Flight (02/14/94), Pilot, Total Airframe Time (0.0 hhhh), Outside Air Temp. (0.0 °C), Pressure Altitude (0.0 feet), and Indicated Air Speed (0.0 knots).
- Engine Data:** Two columns for LHE Pos 1 and RHE Pos 2. Each column includes S/N (63319 and 63260), ISO, TSN, Torque, Prop RPM, EGT/ITT, Fuel Flow, Oil Temperature, Oil Pressure, Oil Added, Bleed Setting (5), and Anti-ice (Off).
- Maintenance:** A box containing 'Engine 1', 'Engine 2', 'Ok', and 'Close' buttons.

There are a few things to be aware of when using the Flight Data Entry form:

- You must press the OK button to save data entered on this screen. The Flight Data Entry form can be configured to appear repeatedly, allowing you to enter several sets of flight data on an engine; if the "blank" Flight Data Entry form reappears after you have entered all data for an engine and pressed OK, just press the Close button to dismiss the screen and end data entry.
- The first time data is entered for an engine, several parameters may be entered in a variety of engineering units. For example: Torque may be entered in %, ft-lbs, or hp; oil temperature may be entered in °C or °F. These parameters have a units selection field at the right of the data entry fields. To change the units, select the units field with the mouse (or hold down [Tab] until the cursor moves into the field). Then use [Up arrow] and [Down arrow] to cycle through the list. **Note:** After you enter the first screen of flight data on an engine, the units will not longer be editable, so make sure they are correct before you leave the screen.
- Time Since Overhaul (TSO) and Time Since New (TSN) are calculated using Total Airframe Time (TAT), as follows:

$$\text{TSO} = \text{TAT} - \text{TAT @ Install} + \text{TSO/CAM @ Install}$$

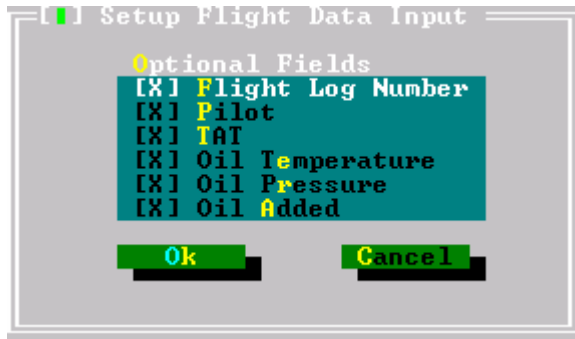
$$\text{TSN} = \text{TAT} - \text{TAT @ Install} + \text{TSN @ Install}$$
- If you supply incorrect values for TAT, TAT @ Install, etc., the engine hours calculations throughout the system will be incorrect.
- If you have maintenance information for an engine, press the Engine buttons inside the maintenance box to activate the Maintenance Activities dialog box. If you don't do that now, you can always enter the same data later by choosing **Input | Maintenance Activities**.

When you finish entering the data, Trend Plus+ will ask if you want to reduce the data. You can select “No” if you have more data entry to perform; select “Yes” when you are ready for the program to take several minutes to reduce the newly-entered data. (It takes a few seconds per data point to reduce data.)

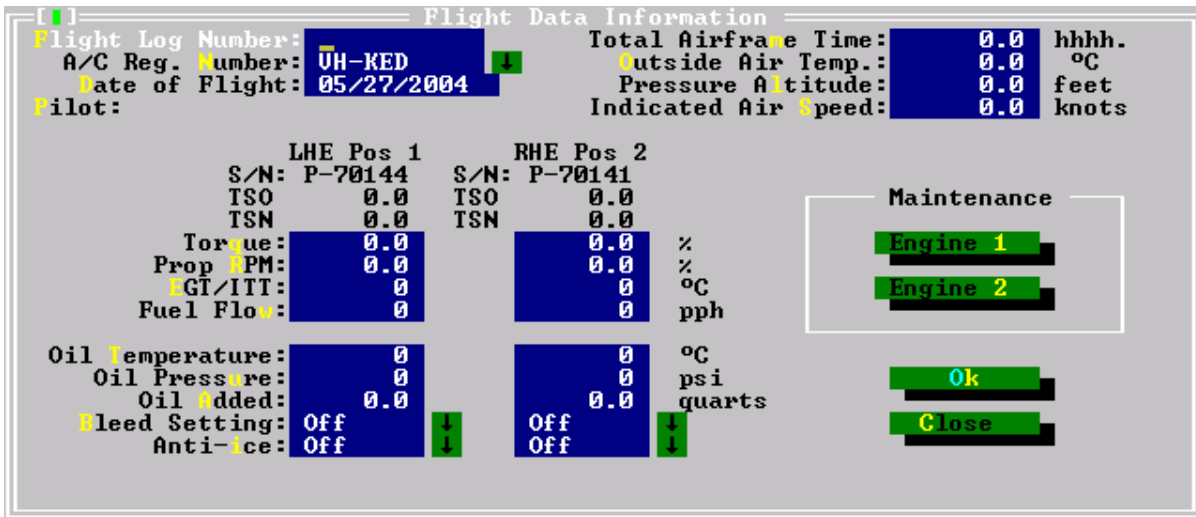
Sections below discuss various configuration options that will speed data entry for most users.

8.1.1 Optional data

The goal of the flight data entry form is efficient data entry from your flight log sheet. If your flight log sheet does not contain one or more of the optional fields shown on the dialog that appears when you choose **Utilities | Program Setup | Flight Data Form | Format**, you can deselect the appropriate check boxes to make the fields disappear from the flight data entry form.



Here is a picture of the flight data entry form as it appears when Trend Plus+ is first installed:



Here is a picture of the flight data entry form as it appears when all optional data is unused:

Trend Plus+ will only ask you to identify the engine once before entering data from a series of flight data forms. Select the engine and proceed to the data entry form. When the data is entered, select Ok. Trend Plus will automatically assume that you have more data to enter for this engine/aircraft. If you do not, press ESC or Close to return to the engine selection screen.

8.1.2 Data entry order

As you enter data in each blank on the flight data entry form, the cursor jumps to the next blank. Sometimes, however, the next blank on the screen asks for a piece of information that you have to search for on the flight log sheet. Wouldn't it be more efficient to have the data ordered the same way in both places?

While you can't do much about the *appearance* of the flight data entry form, you can change the way the cursor moves between the blanks: You can make it jump around on the screen so that data is asked for in the same order it appears on the flight log sheet. Do this by choosing **Utilities | Program Setup | Flight Data Form | Data Entry Order**. (See the **Data entry order** section of the chapter entitled **Configuring Trend Plus+** for a complete explanation of how it works.)

8.2 Ground data

You will use the Ground Data entry form to key in data from ground run log sheets. (Sample ground run log sheets can be found in the **Sample Forms Appendix**.) It operates in a manner similar to the Flight Data entry form.

Here is a picture of the Ground Data entry form as it appears when Trend Plus+ is first installed:

```

===== Ground Run Information =====
Date: 05/27/2004 mm/dd/yyyy          Pressure Altitude: 0 feet
A/C Registration: UH-KEU             Indicated Compensation: 0.0 °C
Wing Position: 2 RHE                 Bleed Setting: Off ↓
Engine Serial No.: 70166             Anti Ice: Off ↓
Station:                              Total Airframe Time: 1112.2 hours
Technician:                           TSN: 10492. hours
Outside Air Temp.: 0.0 °C            TSO: 72.5 hours

Prop RPM: Point 1 Point 2 Point 3 Point 4 %
Torque:    0.0    0.0    0.0    0.0    %
Fuel Flow: 0.0    0.0    0.0    0.0    pph
EGT - SRL on: 0.0  0.0  0.0  0.0  °C
EGT - SRL off: 0.0  0.0  0.0  0.0  °C

Note: Run point 1 to Flight Manual target torque. If target torque can not
be reached, run to redline. Drop EGT by 10°C for each successive point.

Ok Cancel
    
```

Space is provided for up to four ground run points. Point 1 is required; points 2 through 4 are optional.

The first time ground run data is entered for an engine, several parameters may be entered in a variety of engineering units. For example: Torque may be entered in %, ft-lbs, or hp; oil temperature may be entered in °C or °F. These parameters have a units selection field at the right of the data entry fields. To change the units, select the units field with the mouse (or hold down [Tab] until the cursor moves into the field). Then use [Up arrow] and [Down arrow] to cycle through the list.

The indicated compensation you enter on this screen will automatically be stored in the engine database, and will override the previous value. Therefore, the indicated and total EGT margin will be based on the most recently entered value for indicated and max compensation.

When you enter a ground run for an engine, Trend Plus+ will automatically use that ground run as the “baseline” for subsequent trend plots. **Note** that it uses the *most recently entered* ground run—which may not be the most recently performed! However, you can change the baseline ground run later on the trend plot screen (see the **Trend Plots** section of the **Graphic Reports** chapter).

When you press OK, the data reduction program is run and the Ground Run Data and Results dialog box is displayed. Press the Cancel button or [Escape] to exit this dialog and return to the menu.

As with the flight data entry form, the ground data entry form contains some optional pieces of data: station, technician, and compensation. If you wish to remove them from the dialog, choose **Utilities | Program Setup | Ground Data Form**.

```

===== Setup Ground Data Input =====
Select fields to include:
[X] Station
[X] Technician
[X] Compensation

Ok Cancel
    
```

8.3 Automatic IEC data

If you have an Honeywell engine equipped with an integrated electronics control (IEC) computer, such as the -14 engine, you can use the Honeywell GDM Terminal package (part number 10-700-0096) to transfer

data from the IEC to a floppy diskette. To transfer data from that floppy diskette to Trend Plus+, choose **Input | Automatic IEC Data**. The following dialog box will appear:



Place the diskette in the appropriate drive, select the drive from the list, and press the dialog's OK button.

Trend Plus+ will search the diskette for data files named "IECDATAN.???" (where "???" is a sequence number). Each file will be read and stored into a temporary database. As each trend set is read, it is classified as either Flight, Ground, Filtered, or "Bad" (erroneous) data, according to the following rules:

- If the recorded airspeed is between 120 and 300 knots, all of its parameters are compared to the acceptable ranges for in-flight data. If the record passes these tests, it will be marked as a Flight record.
- If the recorded airspeed is between -10 and 10 knots, all of its parameters are compared to the acceptable ranges for ground run data. If the record passes these tests, it will be marked as a Ground record.
- If the record has not met the above conditions for in-flight or ground run data, it is marked as Bad data.
- If the record is a flight data record and it is outside the bounds established by **Utilities | Program Setup | IEC Import Filter** it will be marked as filtered.

When a data file has been processed in this manner, Trend Plus+ renames it to "IECDATAX.???", so that it cannot accidentally be reprocessed later.

After all of the IEC data files have been processed, a window will appear to show the results. Records marked as Bad are displayed for informational purposes only; Trend Plus+ will not store them in its trend databases, so it is not necessary for you to delete Bad records. However, if you want to manually delete a record marked as Flight or Ground data, just move the cursor bar onto it and press [Delete]. You will be asked if you're sure before any Flight or Ground record will be deleted.

If you do not want to store this imported data into your Trend Plus+ database, press [Alt-C] now to cancel the import operation.

If you do not cancel, when you close this window, the remaining good data records will be stored in your Trend Plus+ database. Duplicate records will not be stored. Flight data will automatically be reduced. Ground data records taken on the same engine within a time span of *one hour* will be grouped in sets of up to four records to form ground runs, if the following parameters are consistent: tail number, wing position, engine hours, compensation, and altitude.

If the IEC data contains records for engines or aircraft that do not already exist in the database, Trend Plus+ will create the new engines or aircraft. **Note:** IEC import data does not contain information for max compensation. You will need to edit the new engine records to correct the value for max compensation.

8.4 Reducing data

Trend data must be "reduced" before it can be used for plotting and some reports. This can take several minutes if you have entered very much data. (It takes several seconds per data point to reduce data.)

If you have more than one type of data to enter—flight or IEC data—you may wish to enter all the data before letting the computer pause for data reduction. When you are asked if you're ready to reduce data, you can answer "no" as long as you have more data to enter. When you're ready to reduce, just choose **Utilities | Reduce Data** from the menu.

8.5 Maintenance activities

You can use Trend Plus+ to keep a record of engine maintenance. This can be useful, because maintenance is indicated on the graphical reports to help explain changes in engine performance.

You can record information that is closely related to maintenance, such as symptoms an engine exhibits, by entering a maintenance action with “comment” as the maintenance item.

The following dialog appears when you choose **Input | Maintenance Activities**:

Date	Action	Item	Info
05/27/2004	Adjust	#1 Bridge	

You will also see this dialog if you press one of the engine maintenance buttons on the Flight Data Entry form.

9 Database and Report Viewers

Items on the Database Menu and Report Menu will allow you to interactively view reports and the content of databases. When a report or database is displayed in a window, it is called a *view*. You can instruct the view to hide columns of unnecessary data or change the way the view is sorted. After modifying a view as desired, you may print it or copy it to a diskette file.

9.1 Using cursor keys to see the entire view

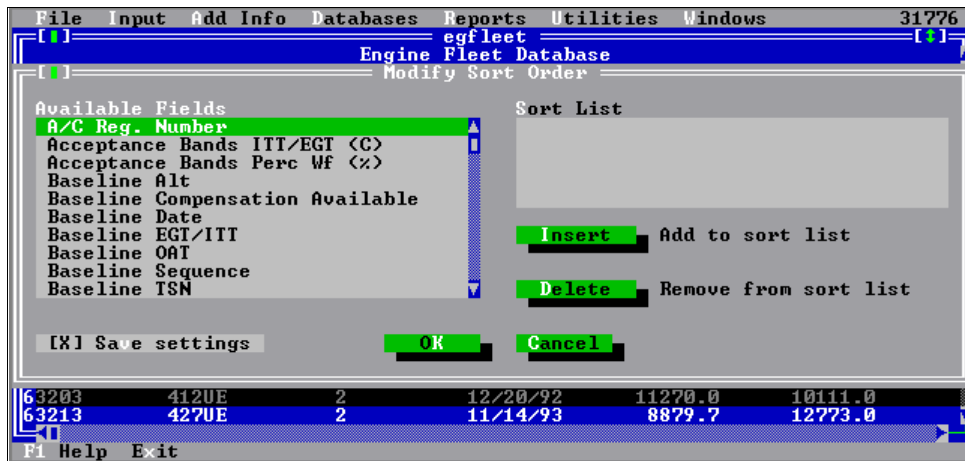
Upon activation, a view is presented as a full screen display window containing the requested data, with the cursor bar highlighting on the first row of data. Usually, there will be more data than can be shown on one screen, so you can use the cursor keypad (or the scroll bars) to display portions of the view that are offscreen.

[Home]	Move to leftmost column
[End]	Move to rightmost column
[Right arrow]	Move right one column
[Left arrow]	Move left one column
[Page up]	Move up one screen
[Page down]	Move down one screen
[Ctrl-Page up]	Move to first record
[Ctrl-Page down]	Move to final record

9.2 Changing the view

9.2.1 Sort order

One of the most useful ways to modify a view is to change how it is ordered. For example, the Engine Database view defaults to sorting by the engine serial number. You may wish to have the engines ranked by installation date, instead. While the Engine Database view is the active window, you change the sort through use of the *sort order* dialog box:



☞ **To bring up the sort order dialog box:** Click on the word *Order* in the status line.

To select the new sort order: Place the mouse cursor just above the down arrow button on the scroll bar beside the Available fields list box. Click, and the list will scroll down a page. Continue clicking on the scroll bar until you see the words *Install Date* inside the box. Place the mouse cursor on Install

Date and double-click. Install Date will move from the Available fields box to the Sort list box. Use this same procedure to pick *Engine Serial Number*, as the second item in the Sort list box. (You can sort on up to four fields.)

To implement the new sort order: If you want the Engine Database view to sort on these fields every time you use it from now on, leave the *Save settings* check box checked. If you want the change to be temporary, click on the Save settings check box to uncheck it. Click on the OK button. The sort order dialog box will disappear and the Engine Database view will redisplay itself in the new order.

☞ **To bring up the sort order dialog box:** Press [Alt-O].

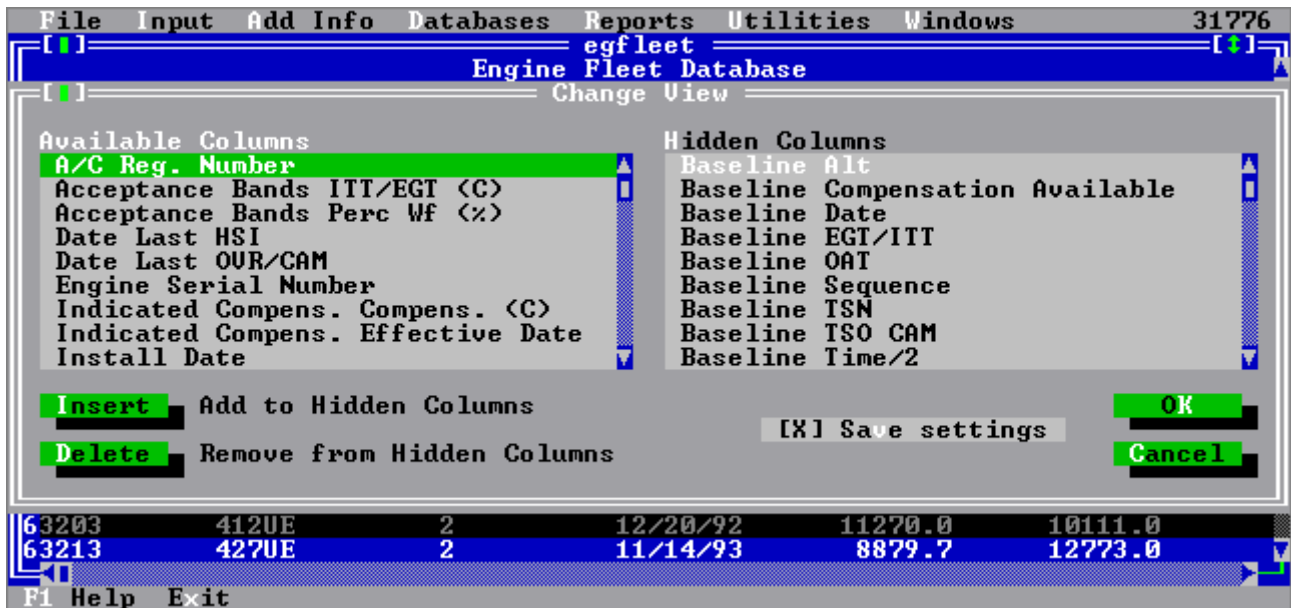
To select the new sort order: With the cursor currently inside the Available fields list box, press [Page down] until you see the words *Install Date* inside the box. Use the [Up arrow] or [Down arrow] key to move the highlight to Install Date, and then press [Insert]. Install Date will move from the Available fields box to the Sort list box. Use this same procedure to pick *Engine Serial Number*, as the second item in the Sort list box. (You can sort on up to four fields.)

To implement the new sort order: If you want the Engine Database view to sort on these fields every time you use it from now on, leave the *Save settings* check box checked. If you want the change to be temporary, press [Alt-V] to uncheck the Save settings check box. Type [Alt-K] to press the OK button. The sort order dialog box will disappear and the Engine Database view will redisplay itself in the new order.

Sorting is not available for views of the Flight Data, Ground Data, and Maintenance History databases.

9.2.2 View control

You may want to print a report containing just a few relevant columns of information. You can instruct the view to hide unwanted columns, then print the report. While the view is the active window, you can change it through use of the *view control* dialog box:



☞ **To bring up the view control dialog box:** Click on the word *View* in the status line.

To hide unwanted columns: Use the scroll bar beside the Visible columns list box to locate the name of a column you wish to hide. Place the mouse cursor on this name and double-click to move the name

from the Visible list to the Hidden list. Continue in this manner until all the columns you want to hide have been moved to the Hidden list.

To reveal hidden columns: Use the scroll bar beside the Hidden columns list box to locate the name of a column you wish to reveal. Place the mouse cursor on this name and double-click to move the name from the Hidden list to the Visible list. Continue in this manner until all the columns you want to reveal have been moved to the Visible list.

To implement the new view: If you want changes to the view to be made permanent, leave the *Save settings* check box checked. If you want the changes to be temporary, click on the Save settings check box to uncheck it. Click on the OK button. The view control dialog box will disappear and the view will redraw itself according to your settings.

 **To bring up the view control dialog box:** Press [Alt-V].

To hide unwanted columns: With the cursor in the Visible columns list box, use [Page up], [Page down], and the arrow keys to locate the name of a column you wish to hide. Place the cursor bar on this name and press [Insert] to move the field from the Visible list to the Hidden list. Continue in this manner until all the columns you want to hide have been moved to the Hidden list.

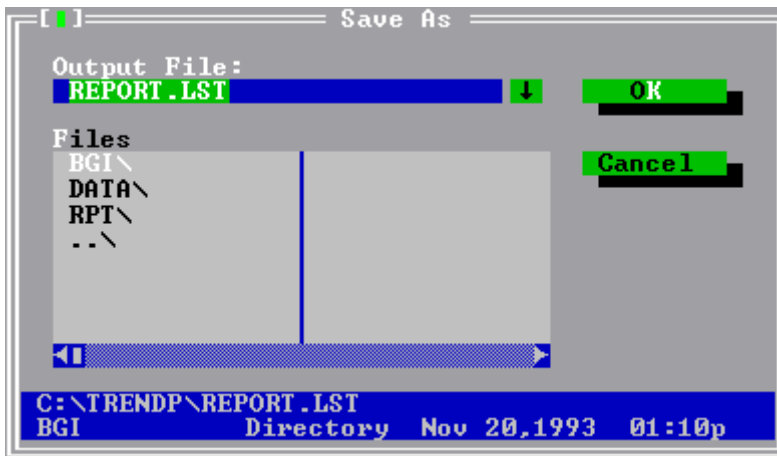
To reveal hidden columns: Type [Alt-H] to move the cursor to the Hidden columns list box. Use [Page up], [Page down], and the arrow keys to locate the name of a column you wish to reveal. Place the cursor on this name and press [Delete] to move the field from the Hidden list to the Visible list. Continue in this manner until all the columns you want to reveal have been moved to the Visible list.

To implement the new view: If you want changes to the view to be made permanent, leave the *Save settings* check box checked. If you want the changes to be temporary, type [Alt-V] to uncheck the Save settings check box. Type [Alt-K] to press the OK button. The view control dialog box will disappear and the view will redraw itself according to your settings.

9.3 Printing the view

Type [Alt-P], to print the view to the currently selected print device. If the view's width exceeds your printer's page width, the printout will be automatically separated into multiple pages.

9.4 Copying the view's data to a file



Type [Alt-S] to bring up the *Save as* dialog box.

In the field labeled *Output file*, type the name of the new file you want to create. (If you enter the name of an existing file, that file will be replaced with the new one. Its previous contents will be lost.)

Press the OK button, and the contents of the current view will be saved to the output file, in plain text format.

9.5 Viewing a database

You have access to additional functionality when viewing information from the Database Menu: You can add, edit, or delete database records.

[Insert]	Add a new record
[Delete]	Delete the current row
[Enter]	Edit the current row

When you add or edit a record, the usual dialog box for that record type will appear and allow you to make changes. When you delete a record, you will be asked if you are sure before the record is deleted.

Note: When you add, edit, or delete records, *these changes are made to the actual database*, not just the view.

10 Trend Reports

10.1 Fleet performance ranking

Choose **Reports | Fleet Performance Ranking** to generate and display a performance ranking report of all engines in the database. This report ranks the engines in descending order based on the total estimated margin on a particular date. (You will be asked to enter the date before the report is generated.)

You can use the performance ranking to quickly tell which engines need further examination due to degrading performance margins. Use the trend plots described later in this chapter to perform analysis of the suspect engines. The **Trend Data Analysis** chapter of this manual discusses the basic techniques used to analyze engine performance trends.

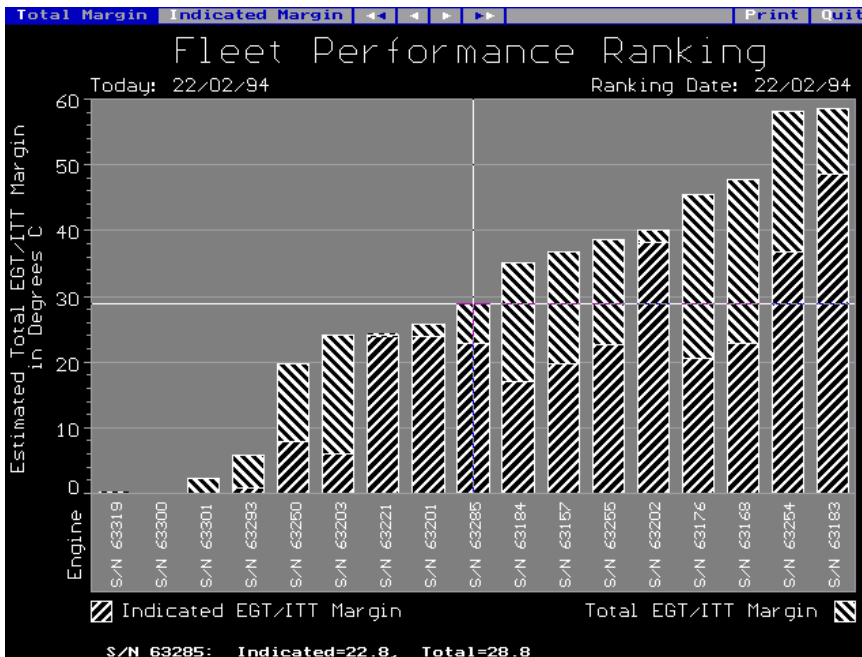
The fleet performance ranking is a text report which will be displayed in a report viewer; the chapter on **Database and Report Viewers** discusses how to interact with Trend Plus+ report screens.

10.2 Fleet performance graphic


Choose **Reports | Fleet Performance Graphic** to generate and display a performance ranking graph of all engines in the database. This graph ranks the engines in descending order based on the total estimated margin on a particular date. (You will be asked to enter the date before the graph is generated.)

You can use the performance graphic to quickly tell which engines need further examination due to degrading performance margins. Use the trend plots described later in this chapter to perform analysis of the suspect engines. The **Trend Data Analysis** chapter of this manual discusses the basic techniques used to analyze engine performance trends.

Here is an example of the fleet performance graphic:




Use the cursor to inspect individual bars on the graph. If there are more engines than can be shown on a single screen, the graphic can be scrolled.

 **To move the cursor to a bar:** Click on the bar.

To scroll the graphic: Click on << or >>.

To print the graphic: Choose Print from the menu bar.

 **To move the cursor or scroll the graphic:** Press [Left arrow] or [Right arrow]. The graphic will scroll as necessary.

To print the graphic: Press [Alt-P].

10.3 Trend plots

You can view data for an engine in graphical form by choosing **Reports | Trend Plots**. The following dialog box will be displayed:

The screenshot shows a dialog box titled "Engine Trend Report". At the top, it displays engine information: "Engine: P-70182", "Tail #: UH-KDT", and "Pos: 1". Below this is a table for "Acceptance Band" with three rows: "Indicated Temp Margin" (20.0 °C), "Total Temp Margin" (20.0 °C), and "Fuel Flow Margin" (5.0 %). To the right of the table are "Ok" and "Cancel" buttons. Below the table are three sections: "Curves" with a list of items (all checked), "Time Scale" with "Date" selected, and "Range" with "Everything" selected.

Serial #	Tail #	Pos
P-70182	UH-KDT	1

Curves	Acceptance Band	Unit
<input checked="" type="checkbox"/> Indicated Temp Margin	20.0	(°C)
<input checked="" type="checkbox"/> Total Temp Margin	20.0	(°C)
<input checked="" type="checkbox"/> Fuel Flow Margin	5.0	(%)
<input checked="" type="checkbox"/> Compr. Work		
<input checked="" type="checkbox"/> Compr. Pressure Ratio		
<input checked="" type="checkbox"/> Compr. Efficiency		
<input type="checkbox"/> Oil Temperature		
<input type="checkbox"/> Oil Pressure		

Time Scale
 Date
 Engine Hours

Range
 Everything
 Since Overhaul
 Since Install
 User Specified

Show
 Data Points
 Acceptance Bands
 Trend Projection
 Maintenance Activities
 Ground Runs

You use this dialog to choose the engine data and time span to view. After selecting an engine, you use the *Curves* check boxes to select which of the following data to plot on the graph:

- Indicated temperature margin (indicated ITT/EGT margin): °C
- Total temperature margin (total ITT/EGT margin): °C
- Fuel flow margin (Wf): %
- Compressor work (corrected T3): °C
- Compressor pressure ratio
- Compressor efficiency
- Oil temperature: °C or °F
- Oil pressure: psi

Note: The compressor work, pressure ratio, and efficiency curves apply *only* to engines equipped with an IEC computer.

You may specify *acceptance bands* for the indicated temperature margin, total temperature margin, and fuel flow margin. Acceptance bands indicate how far a data point may vary from the running average and still be considered valid. If a data point falls outside the acceptance bands, all points in that set (from the same log sheet) will be considered suspect. Suspect points are not used in averages or trend projection calculations.

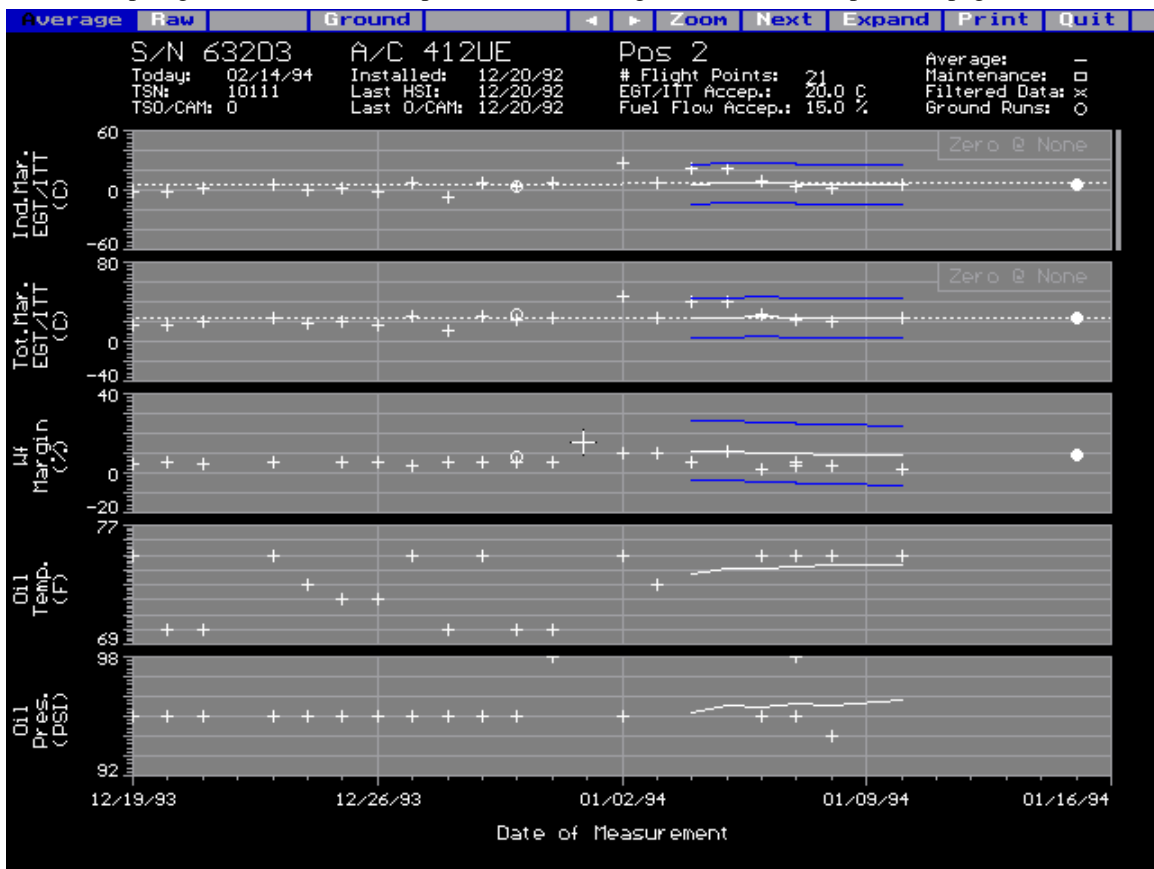
Un-check any of the *Show* check boxes to hide curve information you are not interested in viewing. By default, each graph will show data points considered valid (as green + marks); data points considered suspect (red x marks); the running average (a solid yellow line); acceptance bands (solid blue lines); and the trend projection (a dashed white line).

Use the *Time scale* option group to indicate whether you want to view time in calendar dates or engine hours. Please note that if you intend to view data by engine hours, it is important that you enter correct values on engine hours and TAT fields on the flight and ground data entry forms! The graphs should be very similar whether you choose to view by date or engine hours, but inaccurate entries can cause great differences. For example, if you enter a ground run with the correct date, but specify the wrong engine hours, the ground run will appear on the graphs at different points in time, depending on the chosen time scale.

Use the *Range* option group to indicate any particular range of data you're interested in. If you choose the *User specified* option, fields labeled *Start* and *End* will appear. Use them to indicate your desired range (expressed as dates or engine hours, according to the time scale you chose).

After making the appropriate selections on this dialog, press OK to generate the plot screen. The plot screen will be divided into multiple, horizontal graphs—one for each curve you have elected to view. The graphs all share the same x-axis (your chosen time span), but each graph's y-axis is scaled in units appropriate to the graph's data.

Here is the plot generated when OK is pressed on the dialog box shown on the previous page:




As you can see, the plot screen contains its own version of the menu bar. However, it is not necessary to hold down [Alt] when choosing items from the plot screen's menu bar.

One of the graphs on the plot screen will have a vertical bar drawn beside its right edge. This is the *current graph*. The screen can temporarily zoom in on the current graph, so that it is drawn to fill the screen.

 **To select the current graph:** Click on the desired graph.


To zoom in on the current graph: Use the mouse to choose **Zoom** from the menu bar. Choosing **Zoom** a second time will un-zoom the display.

 **To select the current graph:** Choose **Next** from the menu bar or press [Tab].

To zoom in on the current graph: Choose **Zoom** from the menu bar. Choosing **Zoom** a second time will un-zoom the display.

In the upper-right corner of each graph is a small “value box.” On temperature margin graphs, this box will contain the label “Zero @.” If you have elected to see the trend projection on your plot and the engine’s performance is trending down, the Zero @ value will be an estimate of when the engine’s temperature margin will reach 0.

Use the cursor, which looks like a vertical bar on this screen, to determine exact values for points on the graphs. When the cursor rests on a point, its y-axis value (“Y:”) will be displayed in the value box.

 **To place the cursor on a point:** The mouse cursor appears as a small white crosshair on this screen; move it to the desired point and click to place the plot cursor there. Or, choose the left or right arrow on the menu bar to move the cursor in the chosen direction.


 **To place the cursor on a point:** Use [Left arrow] or [Right arrow] to move the cursor.

If you choose **Raw** from the menu bar, values will be displayed when the cursor rests on data points (+’s and x’s). If you choose **Average** from the menu bar, the moving average value will be displayed when the cursor rests on the running average line. In either case, the cursor’s position in time is indicated at the bottom of the plot screen, both as a date and as engine hours.


If you choose **Maintenance** from the menu bar, maintenance descriptions will be displayed at the bottom of the plot screen when the cursor rests on a maintenance activity. This option will not appear on the menu bar if maintenance activities are not marked on the plot.

If you choose **Ground** from the menu bar, moving the cursor will cause it to “hop” from ground run to ground run on the plot. Ground runs appear as circles on the graphs (○), and the baseline ground run is filled in (●). While **Ground** is selected, you can change the baseline ground run by moving the cursor onto it and choosing **Baseline** to select it. The graphs will be recalculated and redrawn.

You can use the cursor to select a time span on the graphs, then choose **Expand** from the menu bar to magnify the trend data in that span. When the plot is expanded, trend projections are recomputed using only the data that appears on the expanded graphs. Repeat the select-and-expand process to expand further. Choosing **Expand** when no time span is selected will return you to the original plot.

 **To select a time span:** Move the mouse cursor to the earliest point you wish to see on the expanded plot, then hold down the primary mouse button and drag the cursor to the end of the desired time span. Release the primary button.

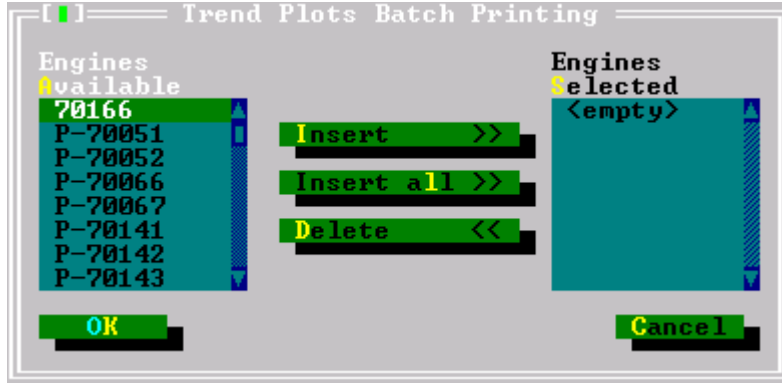
If the time span you select is too small—less than a tenth of the width of the plot—Trend Plus+ will assume that you meant to click, not drag, but the mouse wiggled a bit before you could release the button. The time span will not be selected. To zero in on a very small length of time, expand a larger area containing that time span, then expand again, as necessary.

 **To select a time span:** Move the mouse cursor to the earliest point you wish to see on the expanded plot, then hold down [Shift] pressing [Right arrow] repeatedly to drag the cursor to the end of the desired time span. Then release the [Shift] key.

If you have setup your printer correctly (under **File | Print setup**), when you are satisfied with the appearance of the plot screen, choose **Print** from the menu to generate a printout.

10.4 Batch trend plots

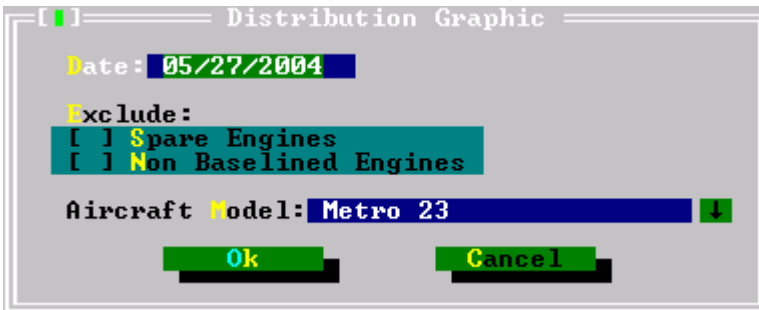
When you choose **Reports | Batch Trend Plots** from the menu bar, you will be presented with a list of available engines as shown below.



Select the engines you would like to plot and print from the list of available engines. Use the Insert button to move highlighted engines to the selected list. When you have the desired list of engines selected, press OK to begin plotting and printing your trend graphs.


10.5 Fleet distribution graphic

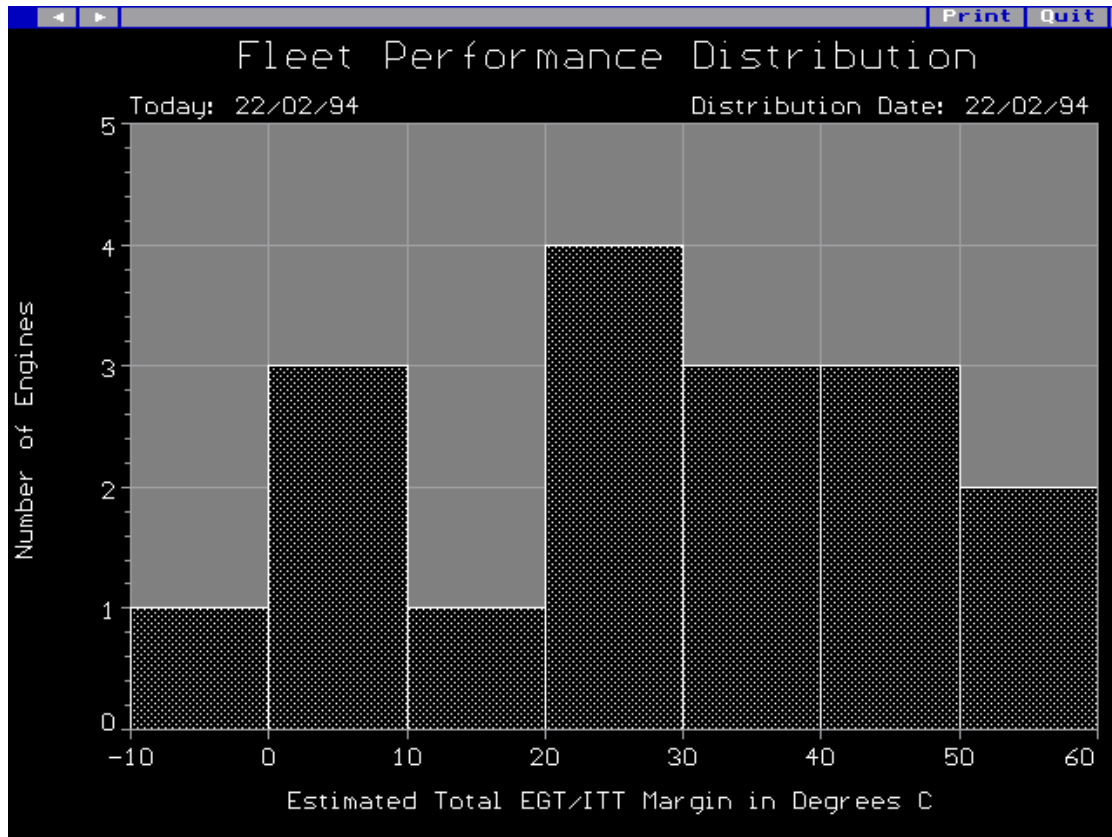
When you choose **Reports | Fleet Distribution Graphic** from the menu bar, you will be presented with the following dialog box:




After entering the date and pressing OK, a graphic will be drawn which visually displays the overall health of the fleet. The x-axis lists the temperature margin, and the y-axis lists the number of engines that have that margin.

Use the cursor to inspect individual bars on the graph.

 **To move the cursor to a bar:** Click on the bar.



To print the graphic: Choose Print from the menu bar.

 **To move the cursor:** Press [Left arrow] or [Right arrow].

To print the graphic: Press [Alt-P].

10.6 Fleet usage

Choose **Reports | Fleet Usage** to generate and display a usage report of all engines in the database. This report shows summary trend information about each engine in the database, including the number of trend readings, date ranges for trend readings, engine hours elapsed, and oil consumption.

You will be asked to enter the range of dates you are interested in before the report is generated.

This is a text report which will be displayed in a report viewer; the chapter on **Database and Report Viewers** discusses how to interact with Trend Plus+ report screens.

10.7 Ground run status

Choosing **Reports | Ground Run Status** to see a summary of the current ground run status of each engine. It lists the number of ground runs performed on the engine, the date of the baseline ground run, and the date of the last ground run.

This is a text report that will be displayed in a report viewer; the chapter on **Database and Report Viewers** discusses how to interact with Trend Plus+ report screens.

11 Trend Data Analysis

General guidelines are provided for interpreting results from ground runs and trend plots.

11.1 Interpreting ground runs

Interpreting ground runs requires knowledge of what results are expected for healthy engines. General guidelines have been provided below for three groups of TPE331 engines. Single-Redline functionality is discussed as well.

11.1.1 General

Below is a matrix of expected fuel flow (Wf) and turbine temperature (ITT or EGT) margins for healthy TPE331 engines. If a new engine or an engine fresh out of HSI exhibits results which are outside of the expected ranges stated here, it is possible an indication error is causing the problem. The operator should then consult **SIL 331-116** to further troubleshoot the subject engine.

Engines	Wf Margin (%)	Indicated ITT/EGT Margin (°C)	Total ITT/EGT Margin (°C)
TPE331-3/5/6	3 to 9	0 to 20	0 to 30
TPE331-8/10/11/12	3 to 9	0 to 20	0 to 50
TPE331-14	0 to 6	0 to 20	0 to 40

Note: These values do not apply to *continued-time* engines.

Note: For Metro I/II aircraft equipped with TPE331-3 engines, this version of Trend Plus+ does not account for reduced power takeoff capability.

11.1.2 Engines equipped with Single-Redline (TPE331-8/10/11/12)

Engines equipped with single-redline (SRL) can have their SRL computers functionally checked if EGT with SRL-OFF was recorded during the ground run. If so, Trend Plus+ returns a value for EGT margin with SRL-OFF. If not, Trend Plus+ returns a meaningless number (999.9).

The operator should compute the *difference* in EGT margin with SRL-ON vs. SRL-OFF, then review the recommendations below.

SRL functionality check	
Difference within +/- 5°C	SRL function acceptable No action required
Difference outside +/- 5°C	SRL function not acceptable - Check T2 sensor - Check delta P/P transducer - Check delta P/P lines - Check engine speed monopole - Verify with breakout box (P/N 294562-2)

11.2 Interpreting trends

11.2.1 General

ITT/EGT margin is the most significant variable in trend monitoring TPE331 engines. This is because:

- It is a direct indication of whether an engine will have problems making rated takeoff power.
- It is the one parameter that responds most readily as an engine deteriorates, either in the compressor or in the turbine.

Wf margin is a variable of lesser significance than ITT/EGT margin, but is still very useful. For example, A decrease in ITT/EGT margin accompanied by a decrease in Wf margin is a sign that compressor and/or combustor deterioration may be taking place. When ITT/EGT margin decreases and Wf margin holds steady or decreases only slightly, it is a sign that the problem may be confined to the turbine.

Of course, there are a multitude of factors which can influence an engine’s ITT/EGT and Wf trends, but have nothing to do with the engine’s true performance. These include:

- Gauge miscalibrations
- Leaking aircraft bleed circuits
- Drifting torque calibrations
- Incorrectly adjusted ITT/EGT compensators
- Incorrect sensor inputs to engine controls

CAUTION:

All of these possibilities must be checked thoroughly before concluding that an engine requires recompensation, hot section inspection (HSI), or overhaul. A complete ground run per SIL 331-116 should be performed first!

11.2.2 Corrective actions

When an operator has ruled out indication errors and aircraft problems as the source for deteriorating trends, or for step changes in trends, it is time to consider what has happened to the engine and what action is required. The recommendations given here are based on experience and should be considered *general* such that levels of deterioration can be associated with most *probable* causes.

1. Up to 15°C decrease in indicated or total ITT/EGT margin and little or no change in Wf margin.

Probable causes	Actions
<ul style="list-style-type: none"> • Initial turbine distress • Possible ITT/EGT indication error 	<ul style="list-style-type: none"> • Adjust compensator as required • Check ITT/EGT harness and associated wiring.

2. A 15-35°C decrease in total ITT/EGT margin and a 0-3% decrease in Wf margin.

Probable causes	Actions
<ul style="list-style-type: none"> • Continued turbine distress • Compressor interstage seal wear • Compressor Foreign Object Damage (FOD) • Streaking fuel nozzles (ITT or EGT shift) 	<ul style="list-style-type: none"> • Adjust compensator to maximum setting • Inspect first impeller • Clean fuel nozzles • Perform 4-point per SIL 331-116 • Recompensate, if possible

3. A 35°C+ decrease in total ITT/EGT margin and a 3-6% decrease in Wf margin.

Probable causes	Actions
<ul style="list-style-type: none"> • Severe turbine distress • Severe compressor FOD • Compressor interstage seals totally worn • Compressor cross-over duct contaminated 	<ul style="list-style-type: none"> • Boroscope gas path • Perform HSI if target torque cannot be achieved • Overhaul engine if target torque cannot be achieved

11.2.3 Step changes

Negative step changes in both ITT/EGT and Wf margin trends occur when torque and/or engine speed indications have shifted low, or when an engine experiences an event such as a hot start, an over torque, an overspeed, or a bird strike. A negative step in both margin trends can also occur when a bleed line or anti-ice line fails.

Positive step changes in ITT/EGT and Wf margin trends occur when torque and/or speed indications have shifted high. Positive steps in ITT/EGT margin (indicated) only can occur when an adjustment is made to the ITT/EGT compensator.

Note: This version of Trend Plus+ does not automatically report step changes. It is the responsibility of the operator to view trend plots to determine whether a step change has occurred.

It is therefore recommended that operators review engine trends at least every 5-10 entries or once a week so as to not overlook significant events due to step changes. This way, an operator does not solely rely upon the running average to send out an alert. In the case of a step change due to an instrumentation error, for example, the problem can be corrected and the points can be deleted from the engine's history.

11.2.4 Sample trends

On the following pages is a collection of sample plots intended as general guidelines for determining what corrective action, if any, is required as a result of changes observed in an engine's ITT/EGT and Wf trends. As operators become more familiar with Trend Plus+, their experience will build to the point where they may develop their own associations of events to changes in margin trends.

To introduce operators to typical turbine temperature and fuel flow trends, some examples are presented prior to discussing details about indication errors and engine faults. Figures 1-4 contain fictitious trends which are intended to introduce to operators the concepts of TPE331 trend monitoring. They contain symptoms (or trend observations), as well as a listing of probable explanations and/or solutions. They also show how ITT/EGT compensator adjustments can affect trends.

11.2.4.1 Indication errors

Examples of changes in trends due to indication errors are presented in figures 5 through 22. These examples are based on sensitivities of TPE331-14 engines. For other TPE331 engines, these examples may slightly over- or under-represent the sensitivity magnitude to a particular indication error, but the sense of the sensitivity is the same. For discussion purposes, it is assumed that indicated and total ITT/EGT margin are one and the same (i.e., ITT/EGT compensator is set to maximum).

Trend parameters applicable to all TPE331 engines:

- Relative Total ITT/EGT Margin (°C)
- Relative Fuel Flow Margin (%)

Trend parameters applicable to TPE331-14 engines only:

- Relative compressor work (corrected T3, °C)
- Relative compressor pressure ratio (ratios)
- Relative compressor efficiency (%)

11.2.4.2 Engine faults—TPE331-14GR/HR engines only

Trend Plus+ is primarily a tool for identifying an engine's rate of deterioration so that corrective action can be scheduled ahead of time. This is done by trending an engine's turbine temperature (ITT or EGT) and fuel flow margins. For most TPE331 engines, these two parameters are all that can be trended. This is because the TPE331 engine is a single-spool engine which operates at a constant physical speed. There is no second spool (i.e., gas generator/power turbine combination) that would otherwise provide a third trend parameter, such as gas generator speed margin. As a result, reliable fault detection is not within the current capabilities of the Trend Plus+ program.

For TPE331-14GR/HR engines, however, Trend Plus+ introduces additional capabilities designed to help operators determine whether an engine's deterioration is compressor-related or turbine-related. Such capabilities are the result of the addition of compressor discharge pressure and temperature measurements recorded by the engine's IEC. These measurements are used to trend the engine's compressor work, pressure ratio, and efficiency against the typical engine model.

Some general examples are provided to show operators basic deterioration characteristics due to reduced compressor and turbine performance. An example of an engine overboard bleed leak is also presented.

Figure 23: Deterioration due to *reduced compressor performance* characterized by

- Reduced ITT/EGT and Wf margins
- Increased compressor work
- Reduced compressor pressure ratio
- Reduced compressor efficiency

Figure 24: Deterioration due to *reduced turbine performance* characterized by

- Reduced ITT/EGT and Wf margins
- Constant compressor work, pressure ratio, and efficiency

Figure 25: Perceived deterioration due to an *overboard bleed leak* characterized by

- Reduced ITT/EGT and Wf margins
- Reduced compressor work and pressure ratio
- Constant compressor efficiency

Note: Experience with trending these additional compressor parameters is currently very limited. Future versions of Trend Plus+ will build on this capability as more experience is obtained.

List of trend data analysis figures

Sample trends (figures 1-4)

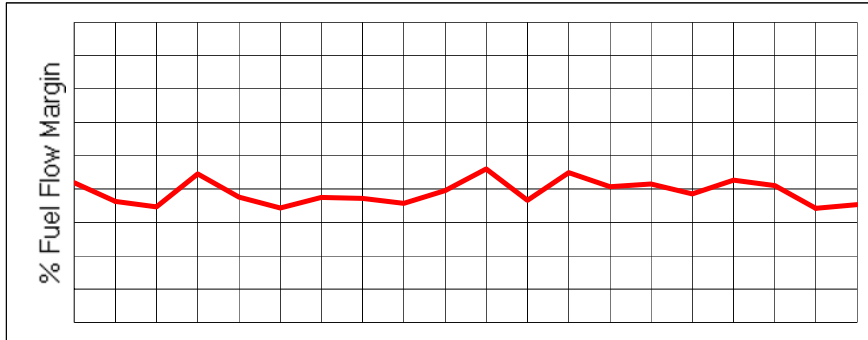
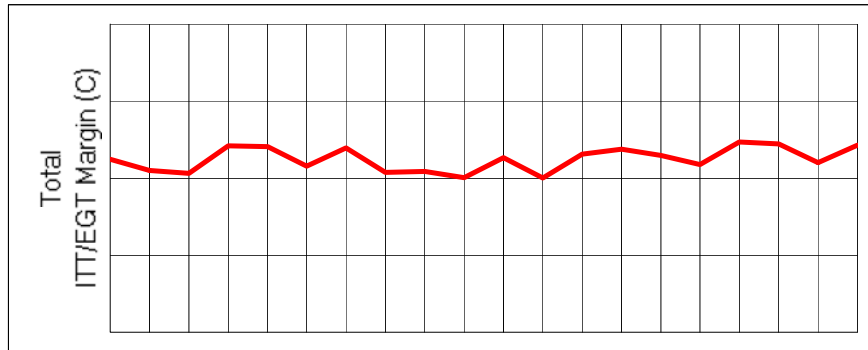
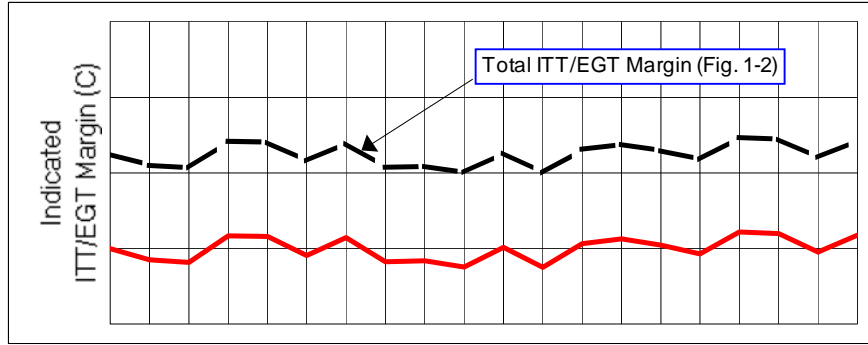
- Figure 1: Sample trend with no deterioration
- Figure 2: Sample trend with some deterioration (ITT/EGT compensator adjusted slightly)
- Figure 3: Sample trend with severe deterioration (ITT/EGT compensator adjusted to maximum)
- Figure 4: Sample trend with severe deterioration (ITT/EGT compensator incorrectly adjusted)

Indication errors (figures 5-22)

- Figure 5: Torque 3% too high
- Figure 6: Torque 3% too low
- Figure 7: Engine speed 1% too high
- Figure 8: Engine speed indication 1% too low
- Figure 9: Fuel flow 20 lb/hr too high
- Figure 10: Fuel flow 20 lb/hr too low
- Figure 11: FTT/EGT 10°C too high
- Figure 12: ITT/EGT 10°C too low
- Figure 13: OAT or T2 10°C too high
- Figure 14: OAT or T2 10°C too low
- Figure 15: Pressure altitude 1000 ft. too high
- Figure 16: Pressure altitude 1000 ft. too low
- Figure 17: Indicated airspeed 10 knots too high
- Figure 18: Indicated airspeed 10 knots too low
- Figure 19: Compressor discharge temperature (T3) 10°C too high
- Figure 20: Compressor discharge temperature (T3) 10°C too low
- Figure 21: Compressor discharge pressure (P3) 10 psi too high
- Figure 22: Compressor discharges pressure (P3) 10 psi too low

Engine faults (figures 23-25, Jetstream 41 only)

- Figure 23: Characteristic compressor deterioration
- Figure 24: Characteristic turbine deterioration
- Figure 25: Perceived deterioration due to overboard compressor leak



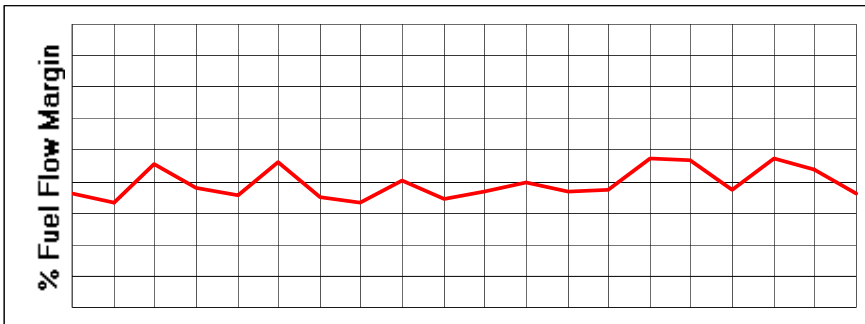
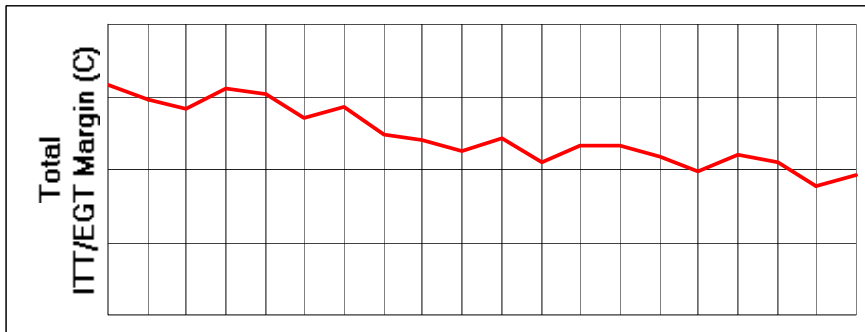
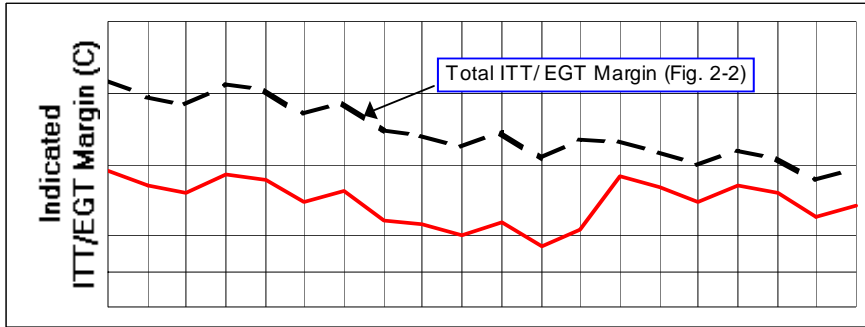
Symptom(s):

- Indicated and total ITT/EGT margins holding steady
- Fuel flow margin also holding steady

Probable Explanation(s)/Solution(s):

- Engine not deteriorating, no action required
- Total ITT/EGT margin greater than indicated ITT/EGT margin, ITT/EGT compensator not set to maximum
- If total ITT/EGT margin is less than indicated, the engine record's definition for max compensation may be wrong in your Trend Plus+ database

Figure 1: Sample Trend with No Deterioration



Symptom(s):

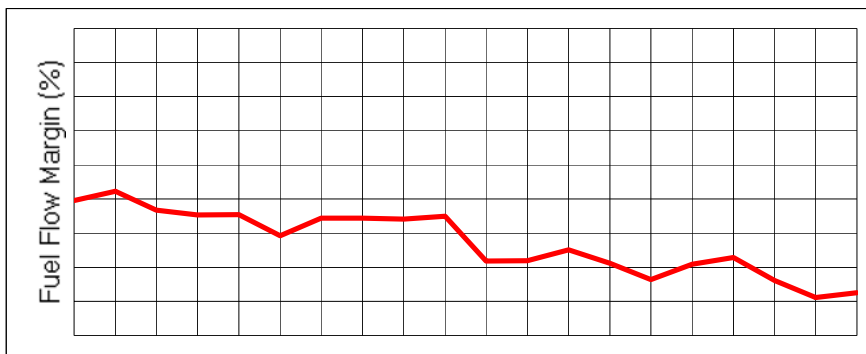
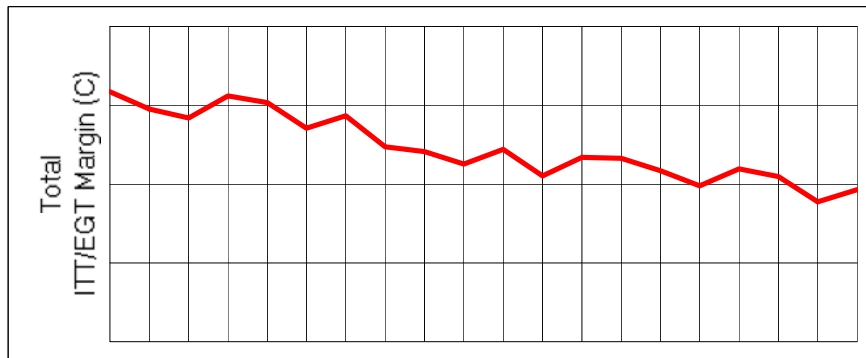
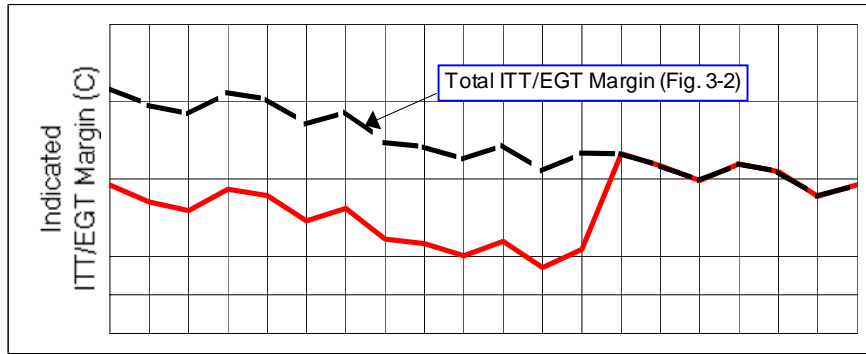
- Indicated and total ITT/EGT margins declining
- Fuel flow margin holding steady
- Positive step change in indicated ITT/EGT margin, but not in total ITT/EGT margin

Probable Explanation(s)/Solution(s):

- ITT/EGT harness is deteriorating, or engine is deteriorating slightly
 - Check Ohms resistance on harness
 - Adjust ITT/EGT compensator as necessary

Note: Correct ITT/EGT compensator adjustments show up as positive step changes in indicated ITT/EGT margin.

Figure 2: Sample Trend with Some Deterioration (ITT/EGT compensator adjusted slightly)



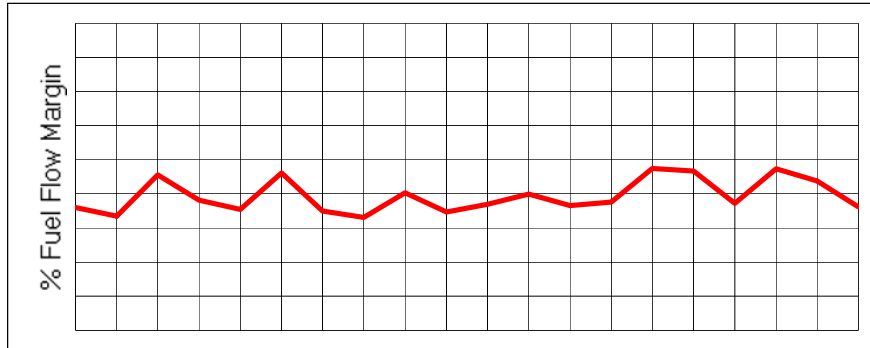
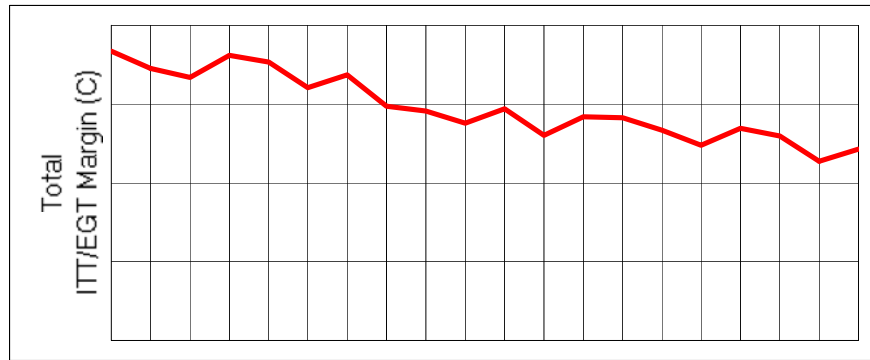
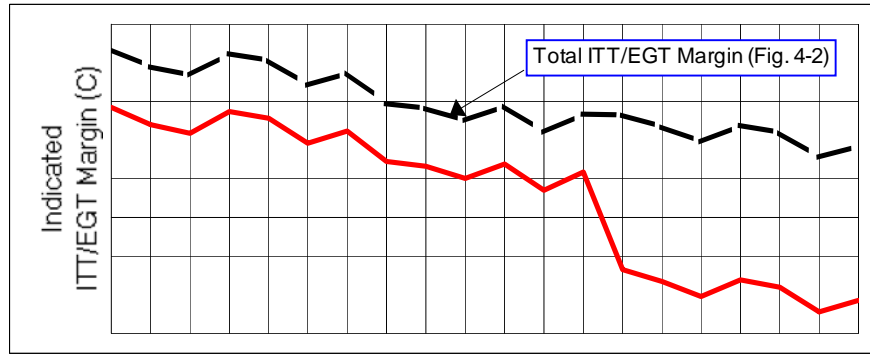
Symptom(s):

- Indicated and total ITT/EGT margins declining
- Fuel flow margin also declining
- Positive step change in indicated ITT/EGT margin, but not in total ITT/EGT margin

Probable Explanation(s)/Solution(s):

- Torque calibration drifting (low), bleed system progressively leaking, or engine deteriorating
 - Check torque calibration
 - Check bleed system components
- If torque calibration good and bleed system good, engine deteriorating severely
 - Set ITT/EGT compensator to maximum
 - Recompensate if possible
 - Clean fuel nozzles
 - Boroscope compressors

Figure 3: Sample Trend with Severe Deterioration (ITT/EGT compensator adjusted to maximum)



Symptom(s):

- Indicated and total ITT/EGT margins declining
- Fuel flow margin holding steady
- Negative step change in indicated ITT/EGT margin, but not in total ITT/EGT margin

Probable Explanation(s)/Solution(s):

- ITT/EGT harness deteriorating, or engine deteriorating slightly
 - Check Ohms resistance on harness
 - Adjust ITT/EGT compensator as necessary

Note: Incorrect ITT/EGT compensator adjustments show up as negative step changes in indicated ITT/EGT margin.

Figure 4. Sample Trend with Severe Deterioration (ITT/EGT compensator incorrectly adjusted)

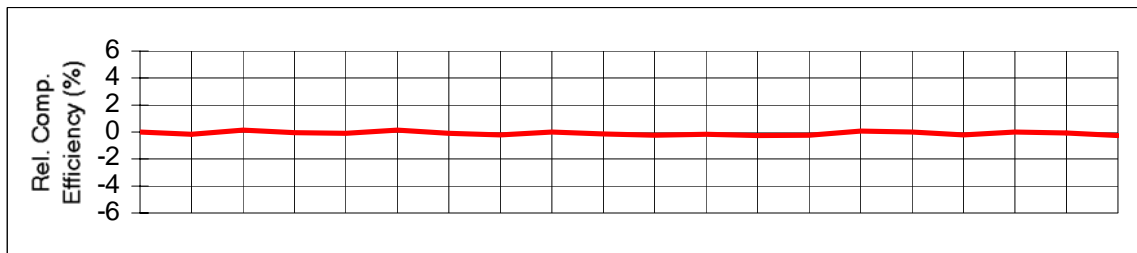
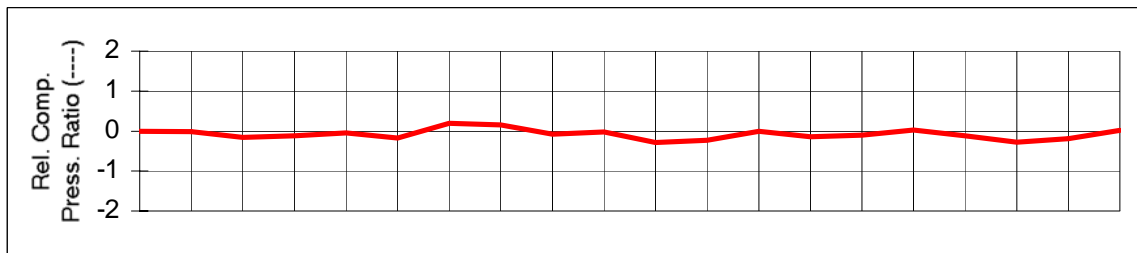
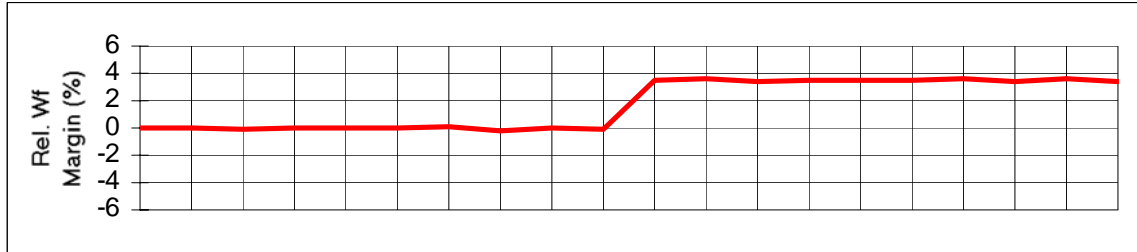
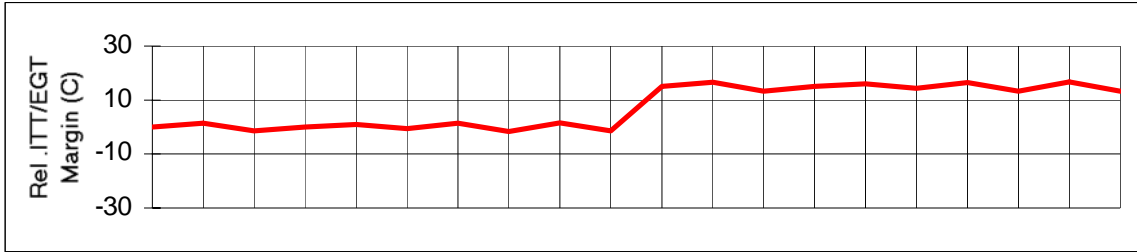


Figure 5. Torque 3% too High

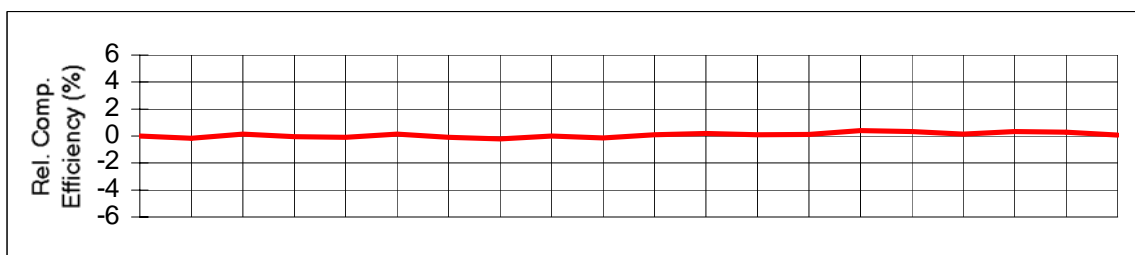
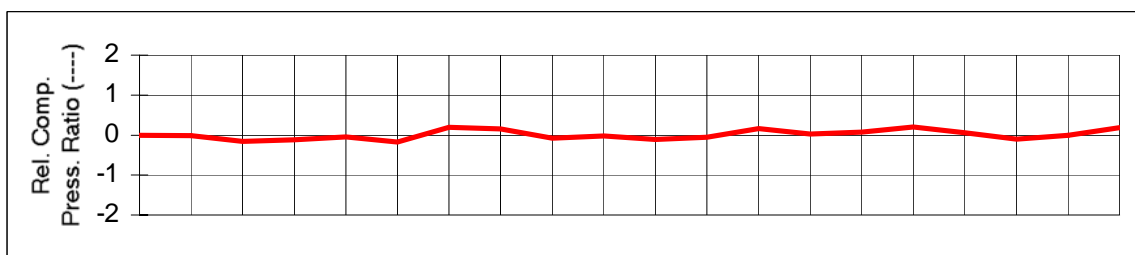
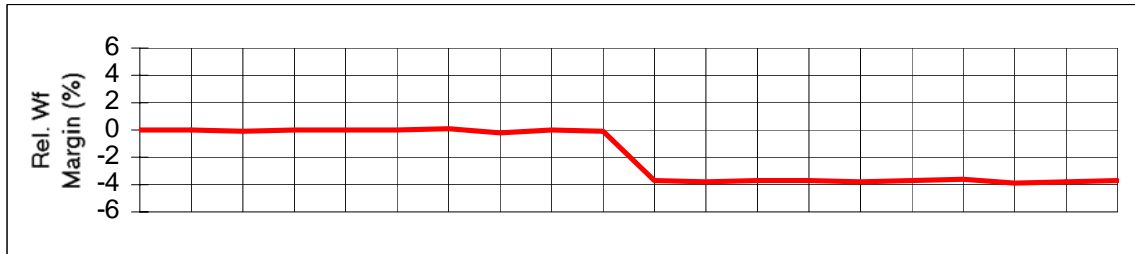
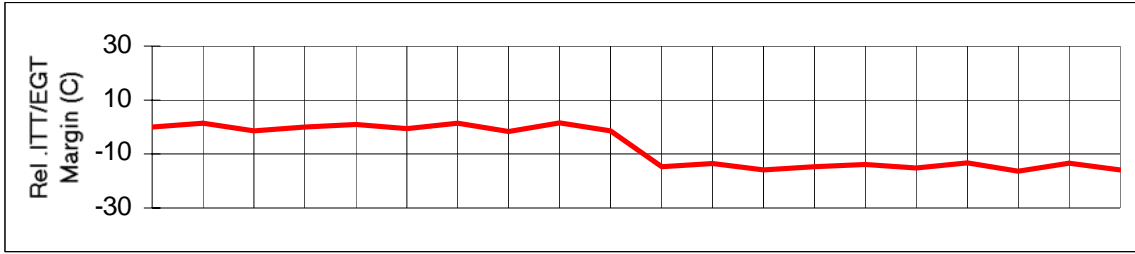


Figure 6. Torque 3% too Low

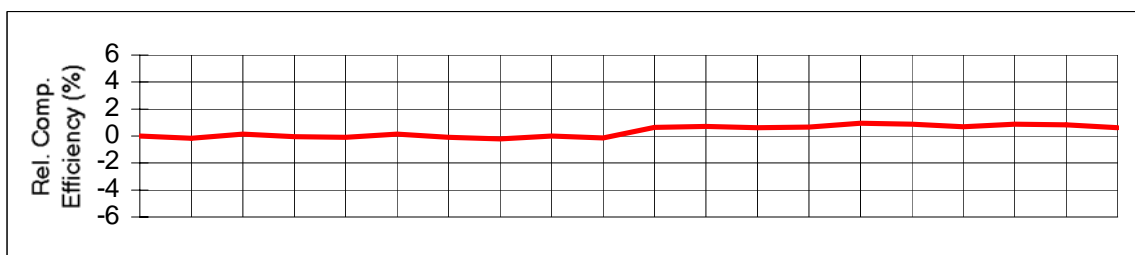
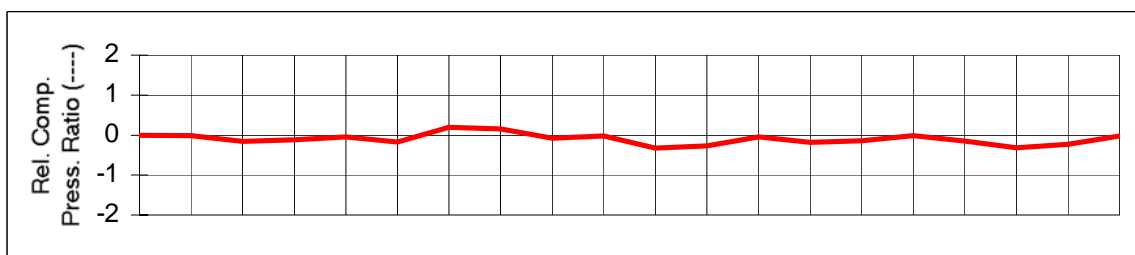
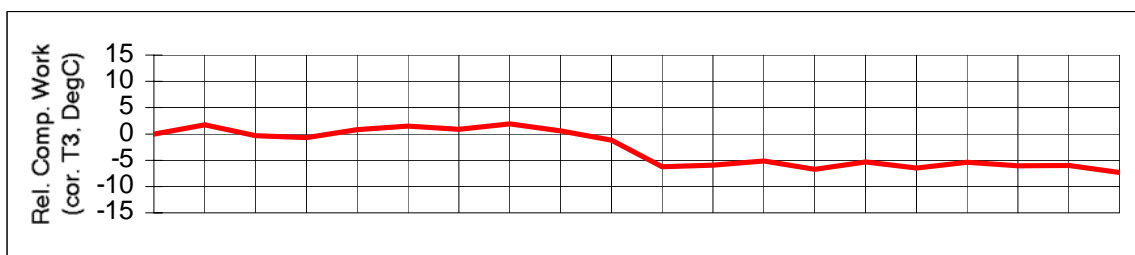
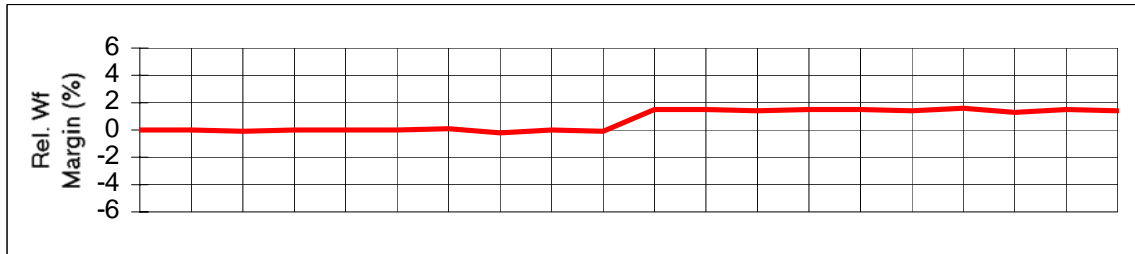
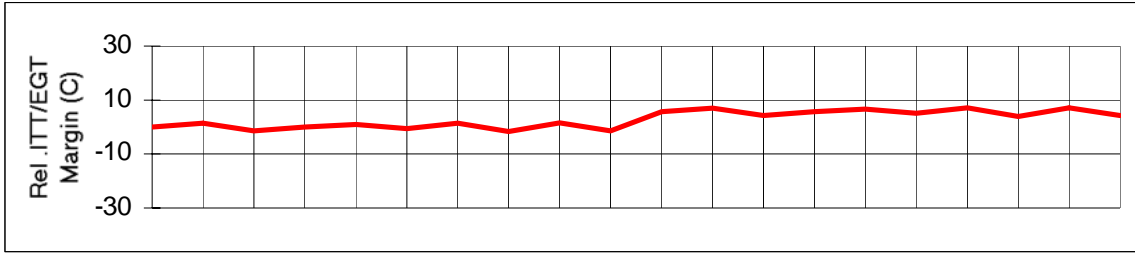


Figure 7. Engine Speed 1% too High

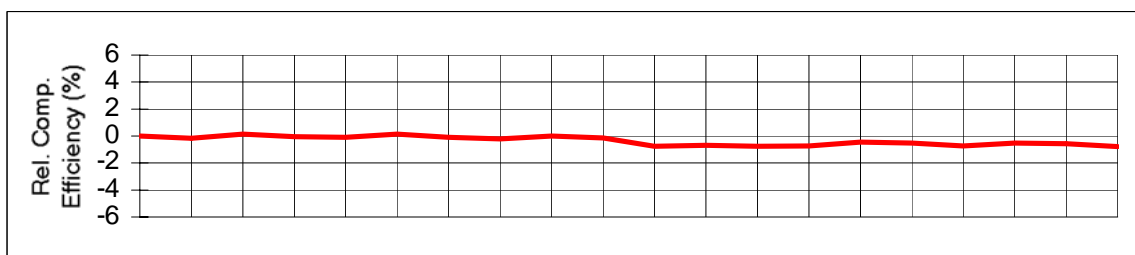
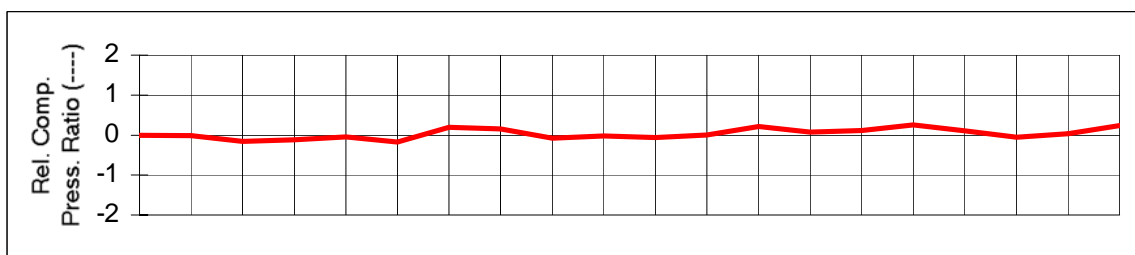
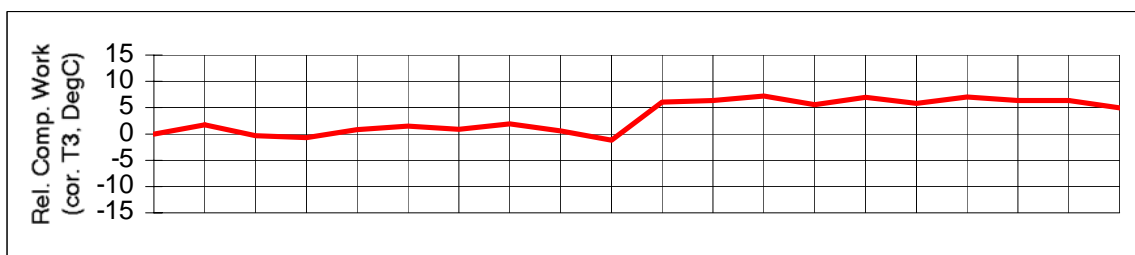
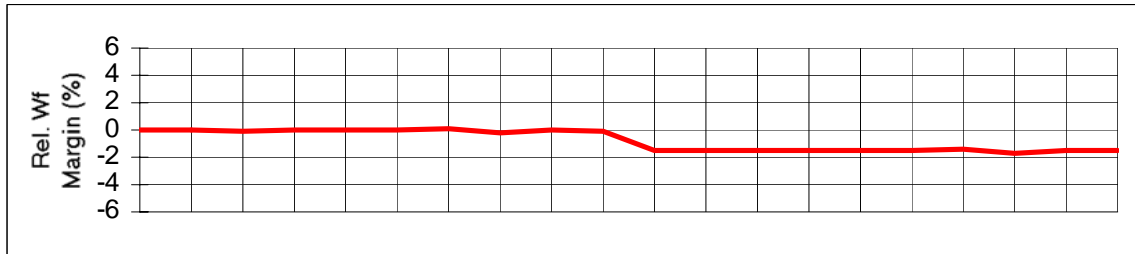
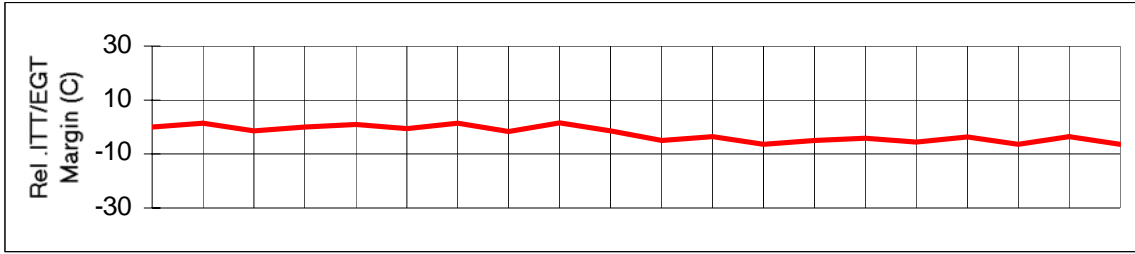


Figure 8. Engine Speed 1% Too Low

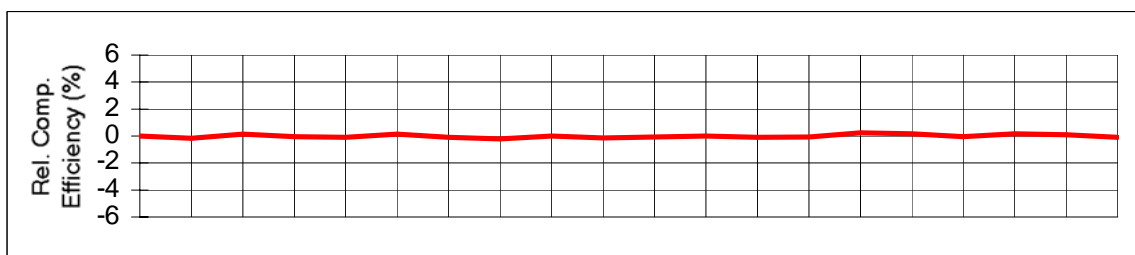
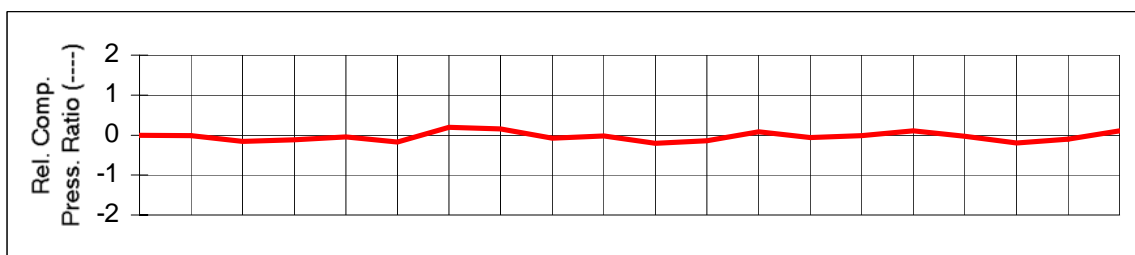
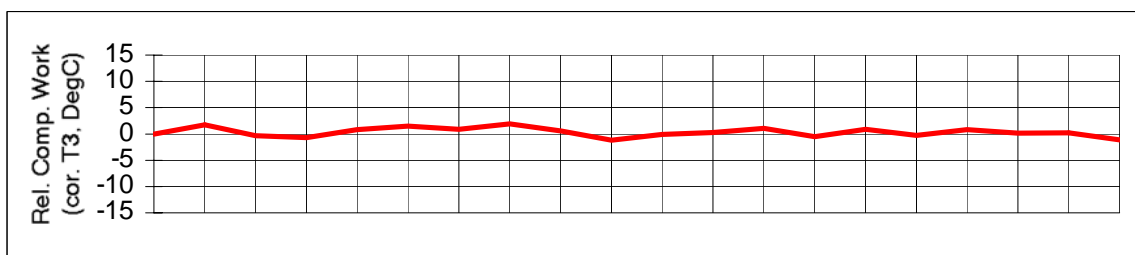
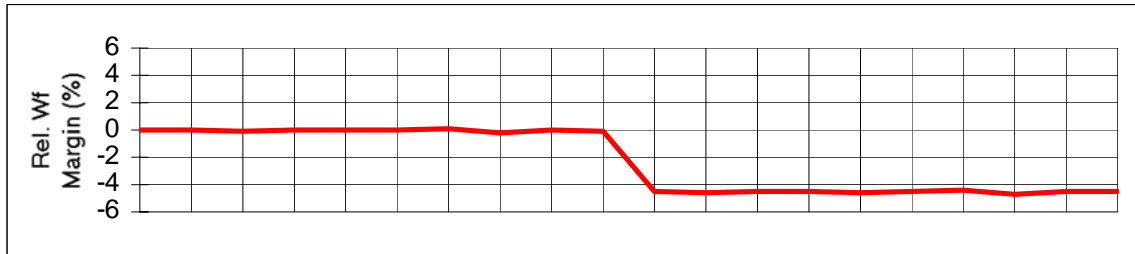
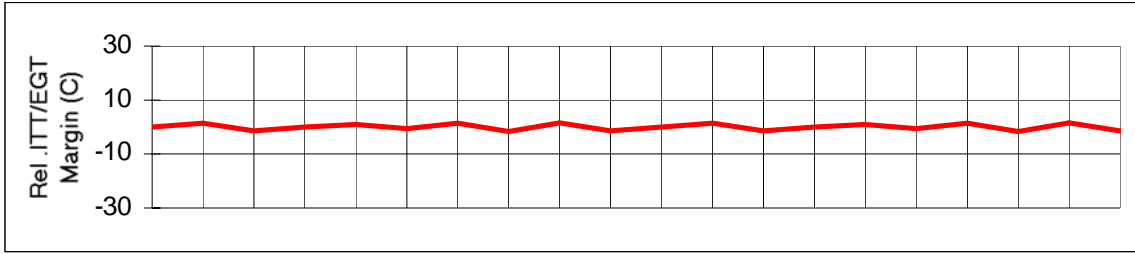


Figure 9. Fuel Flow 20 lb/hr Too High

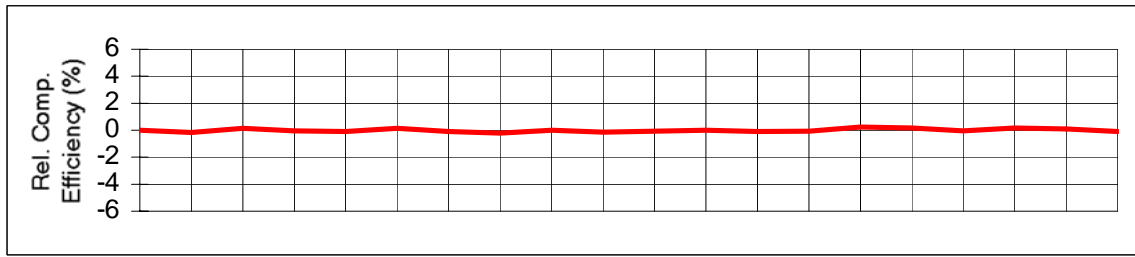
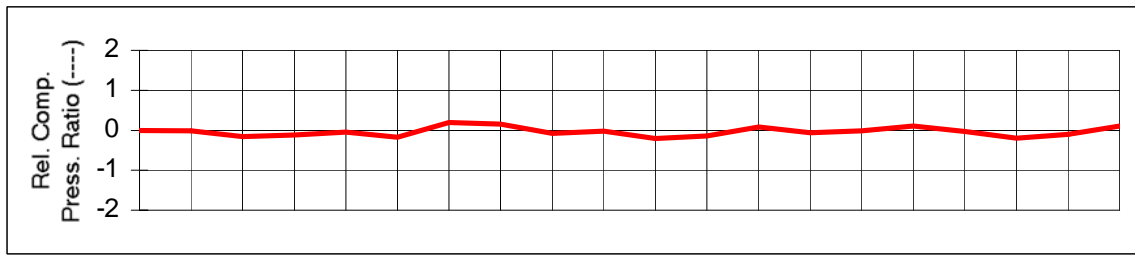
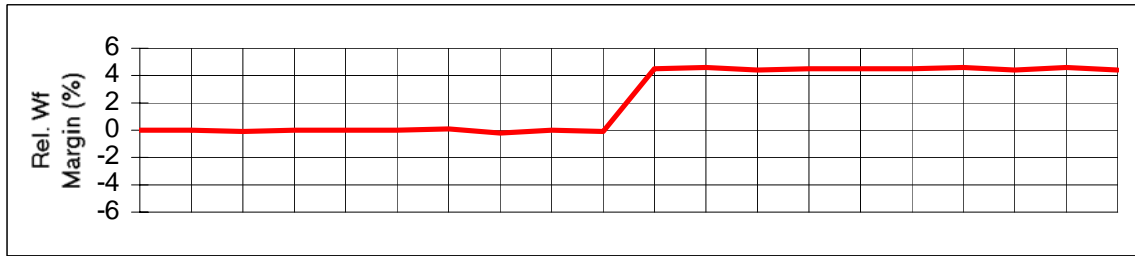
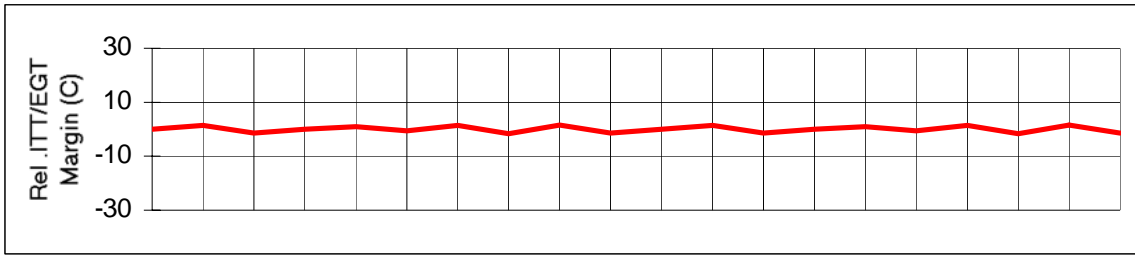


Figure 10. Fuel Flow 20 lb/hr Too Low

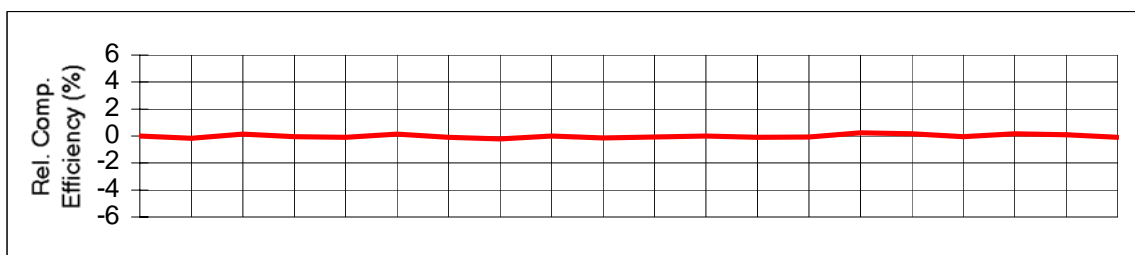
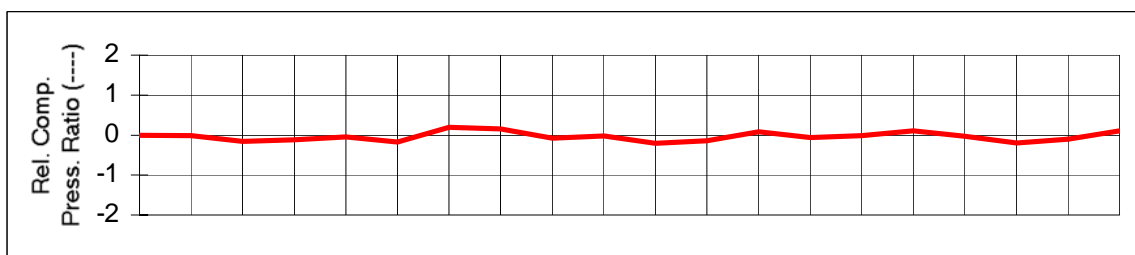
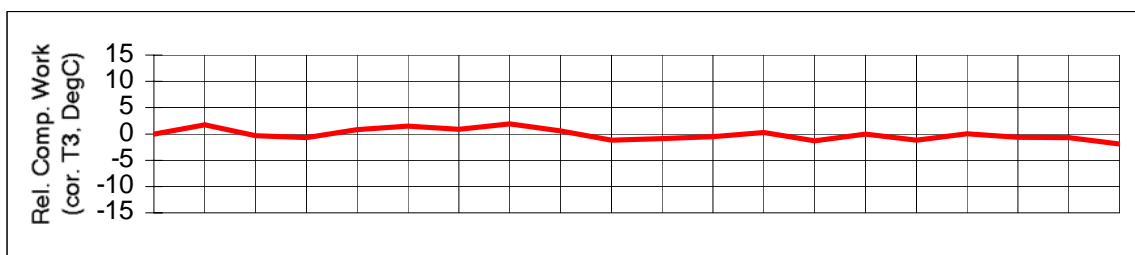
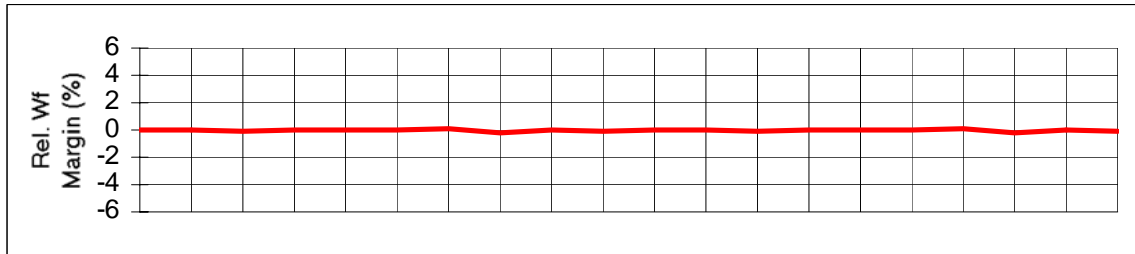
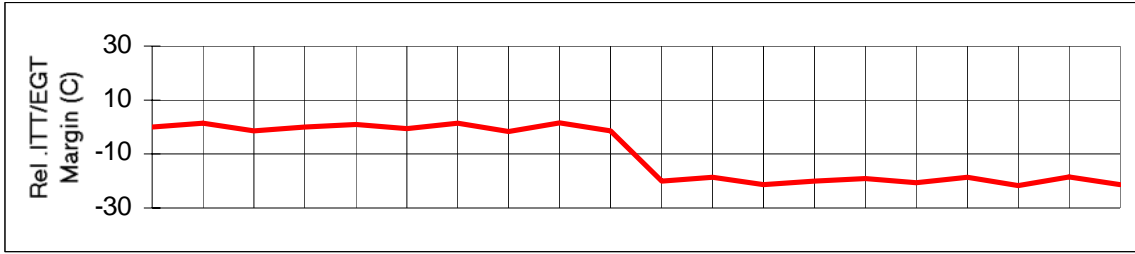


Figure 11. ITT/EGT 10°C Too High

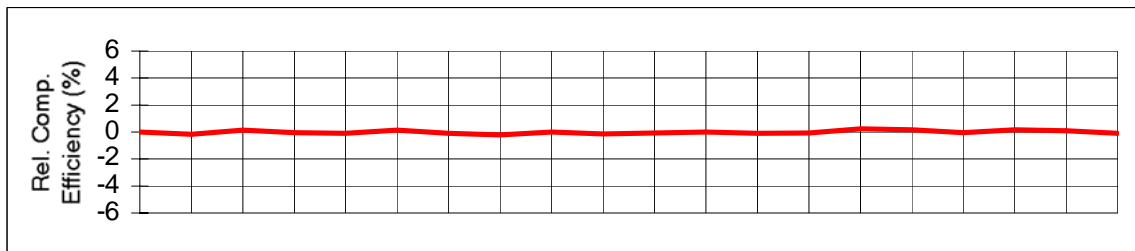
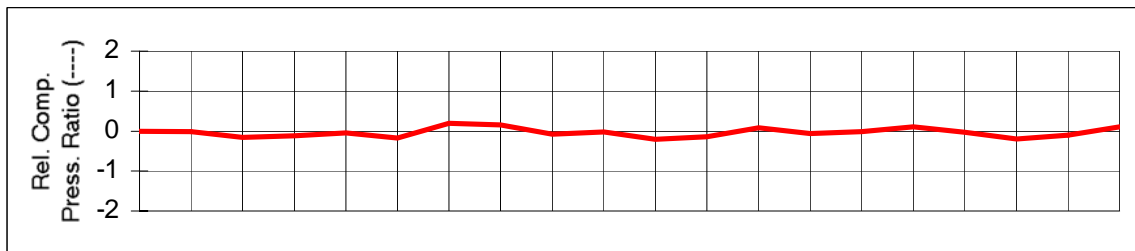
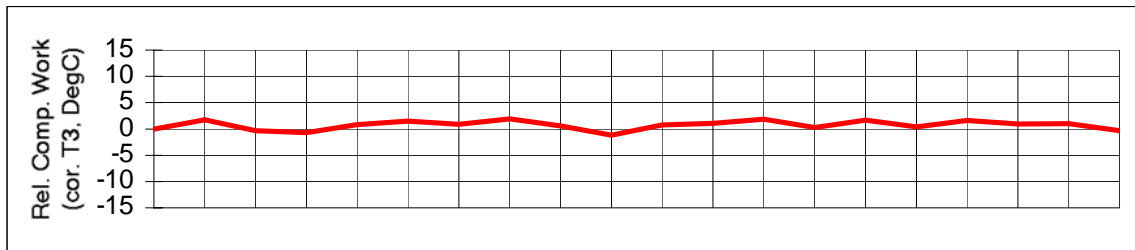
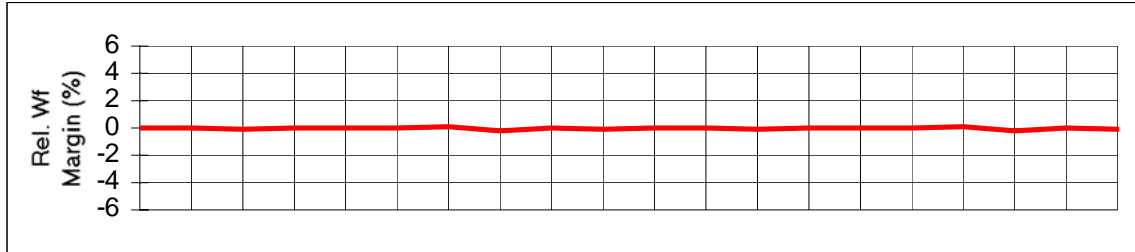
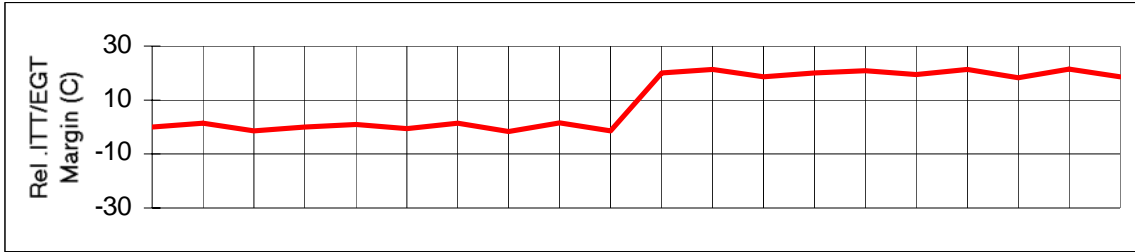


Figure 12. ITT/EGT 10°C Too Low

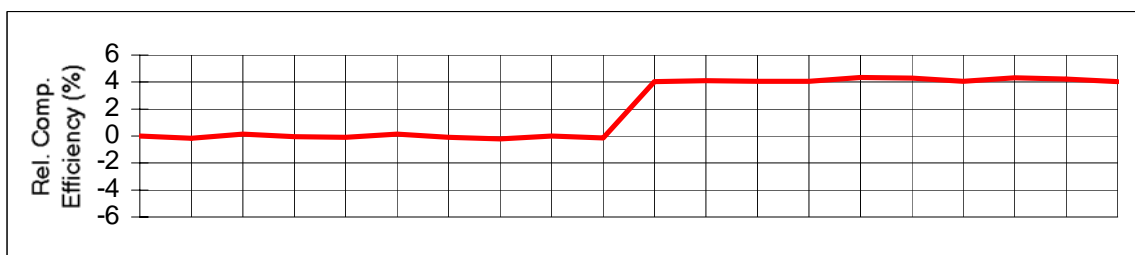
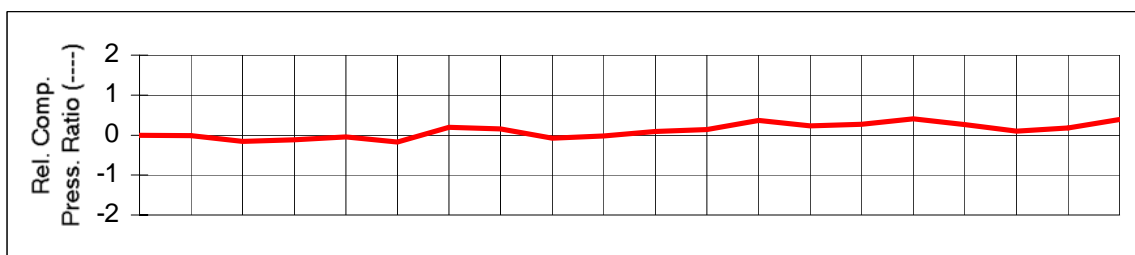
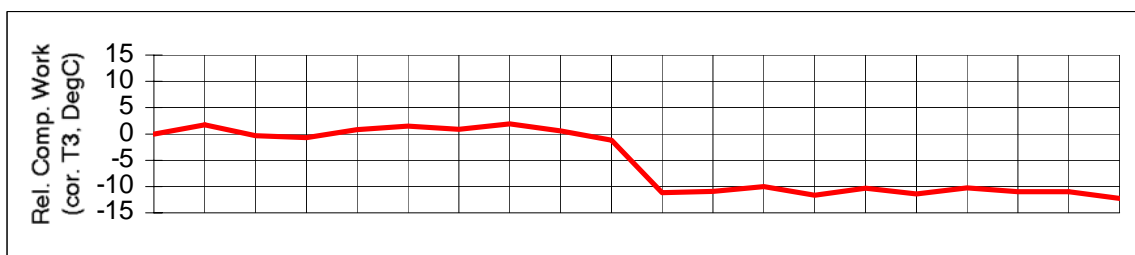
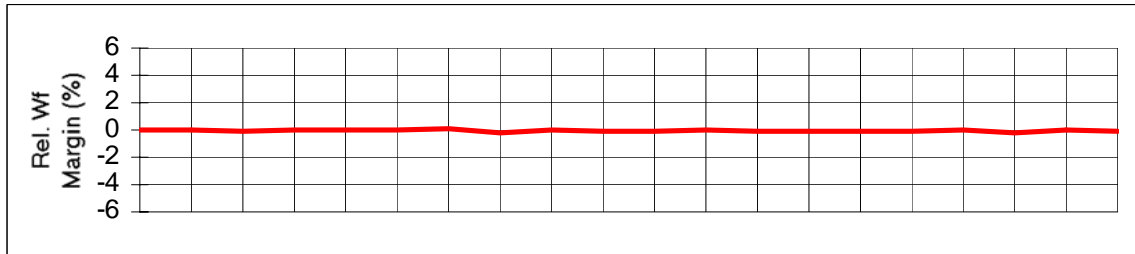
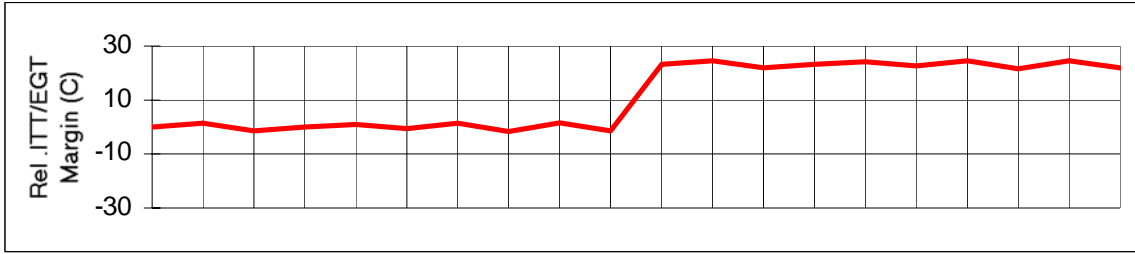


Figure 13. OAT or T2 10°C Too High

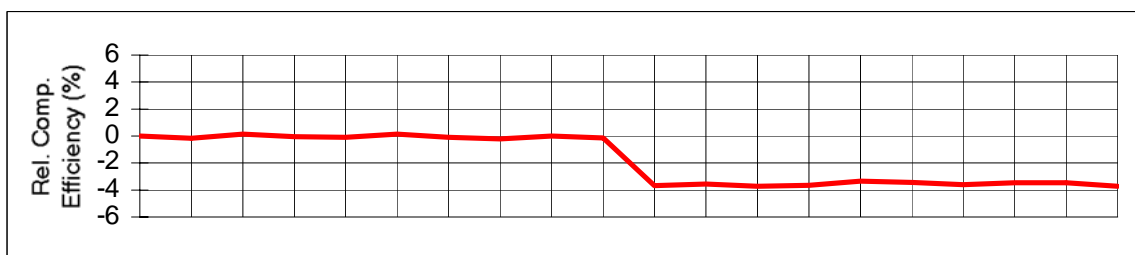
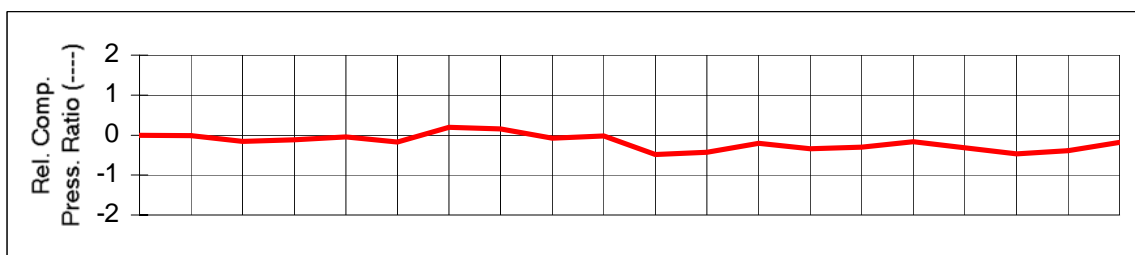
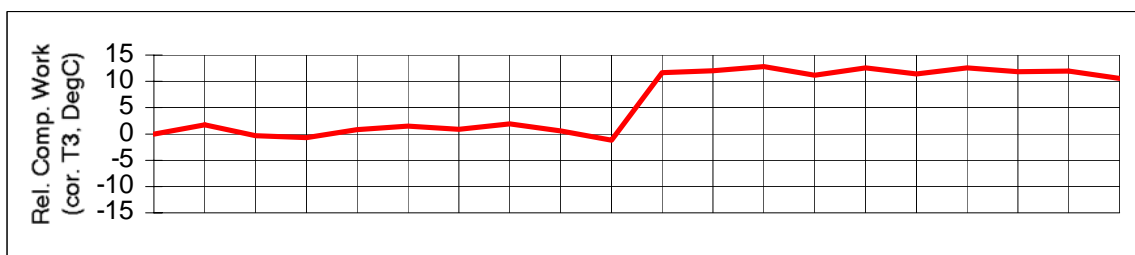
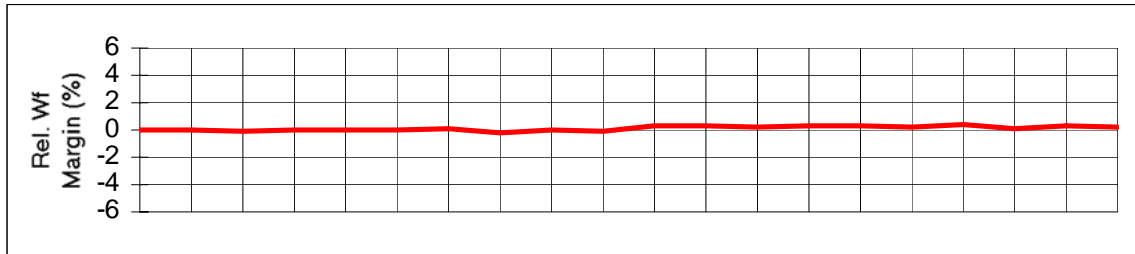
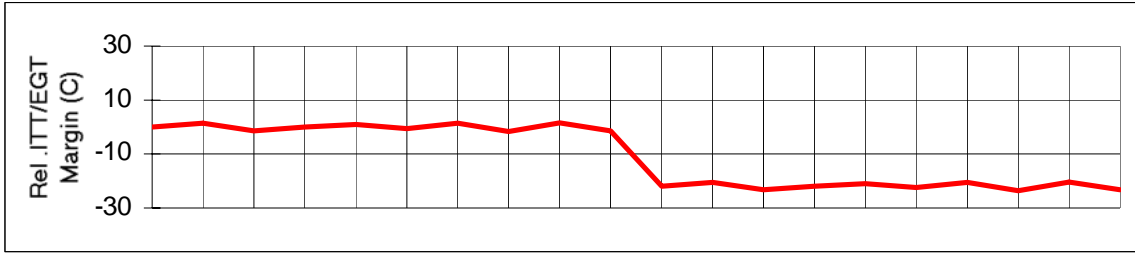


Figure 14. OAT or T2 10°C Too Low

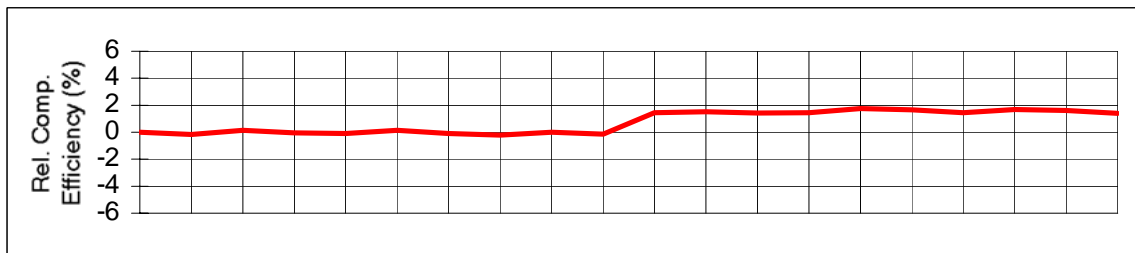
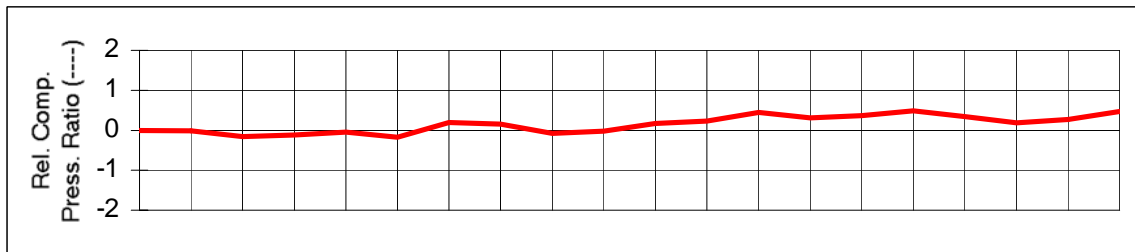
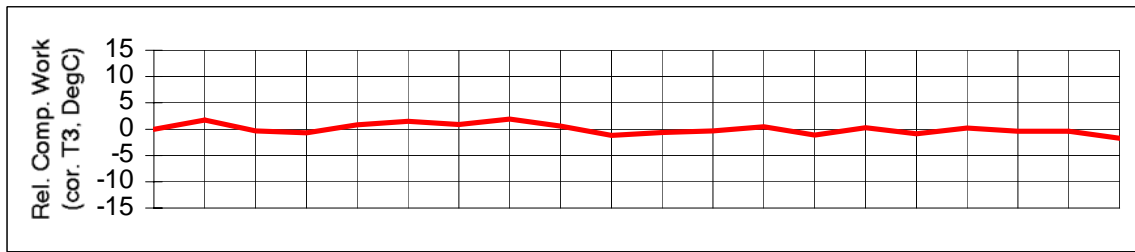
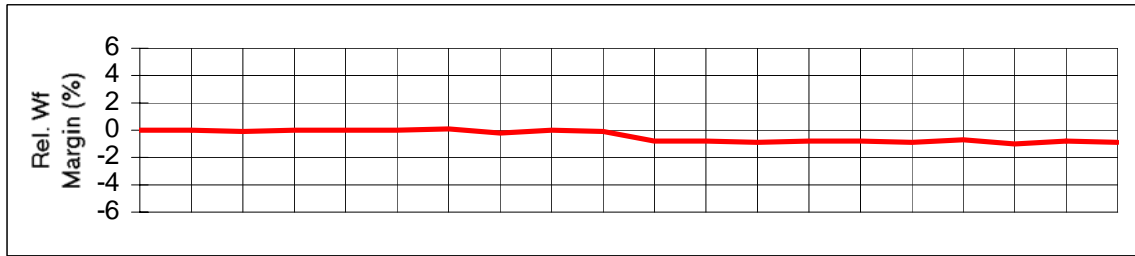
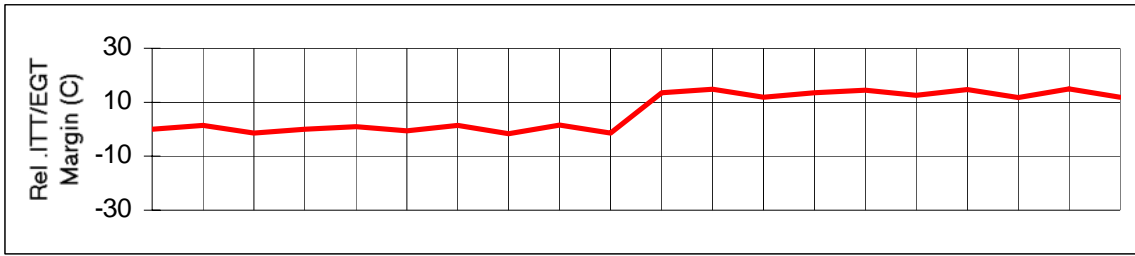


Figure 15. Pressure Altitude 1000 ft. Too High

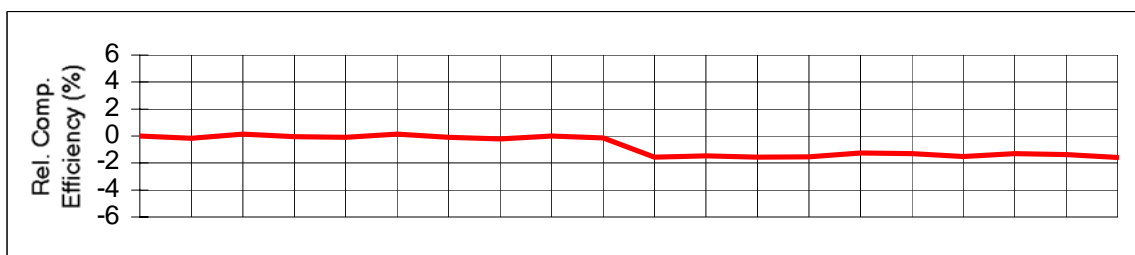
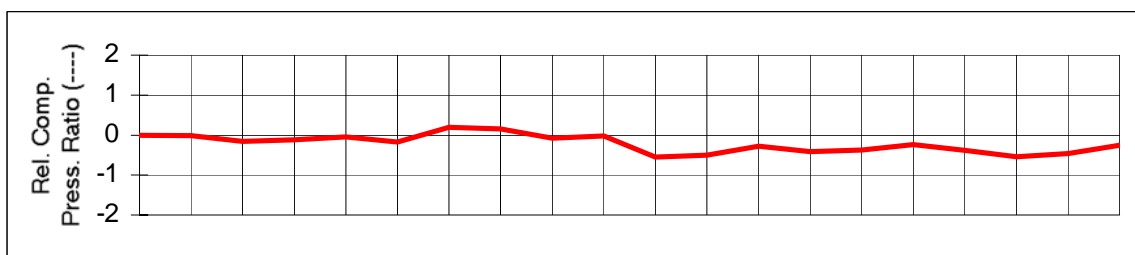
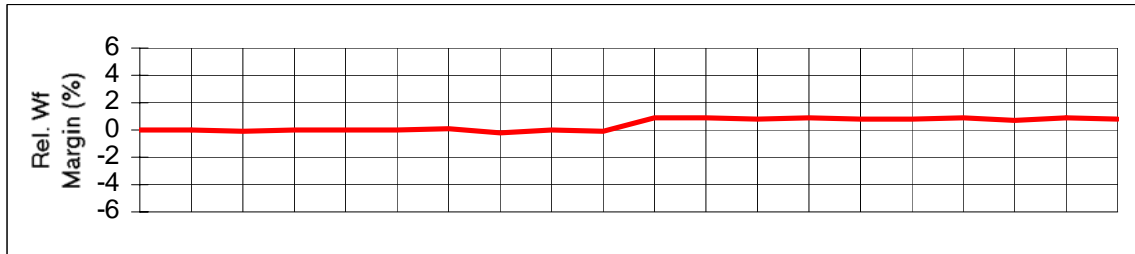
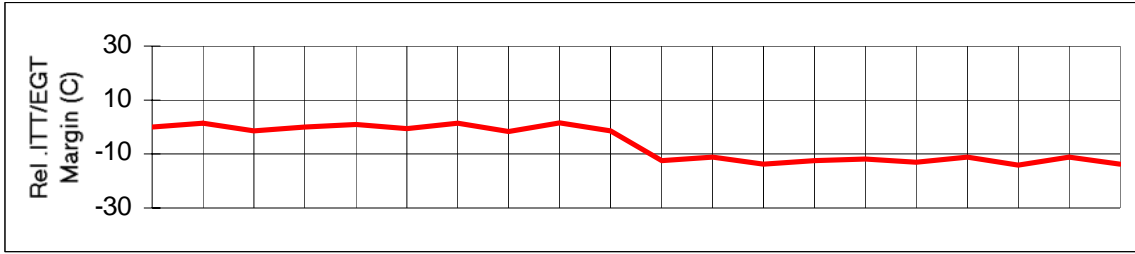


Figure 16. Pressure Altitude 1000 ft. Too Low

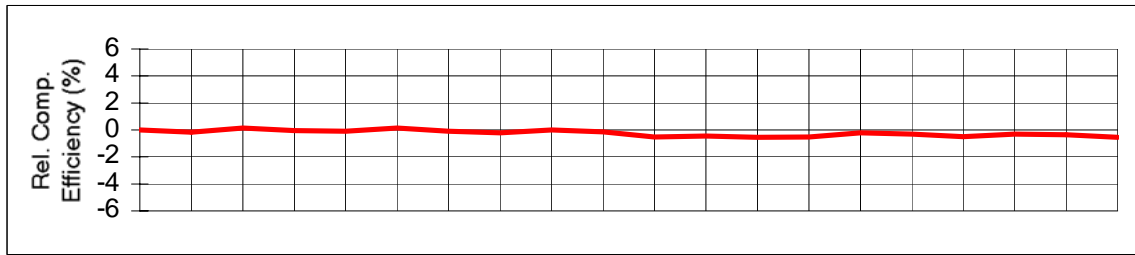
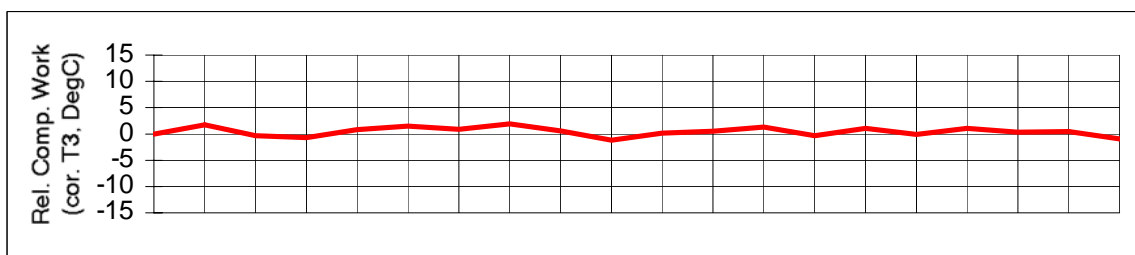
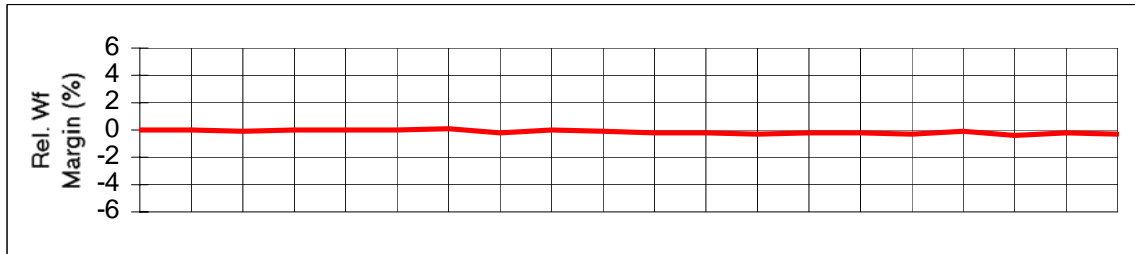
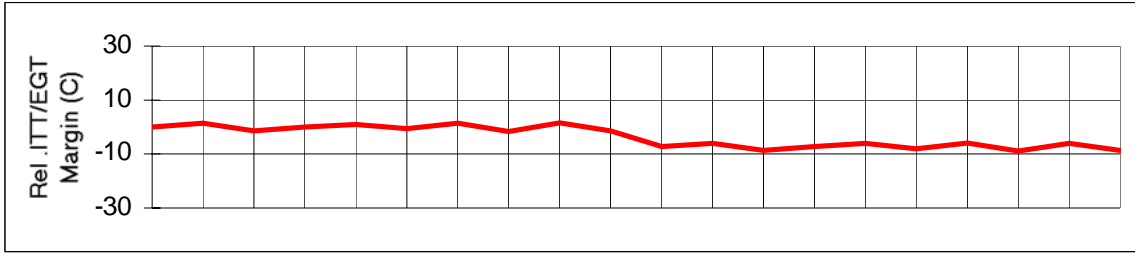


Figure 17. Indicated Airspeed 10 Knots Too High

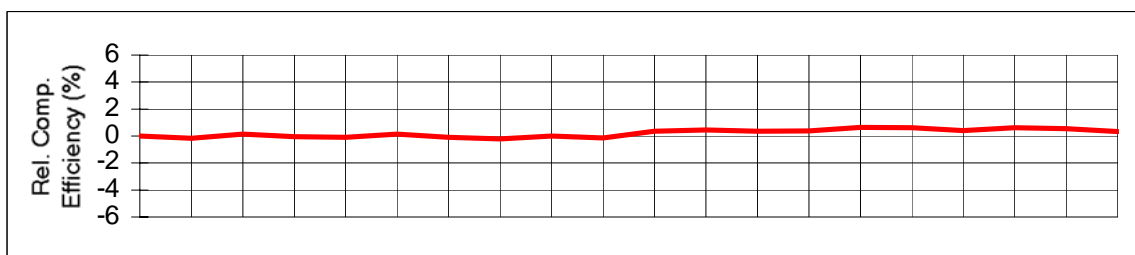
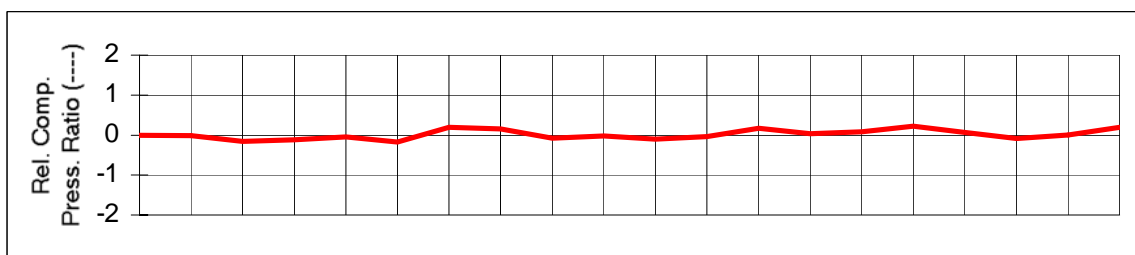
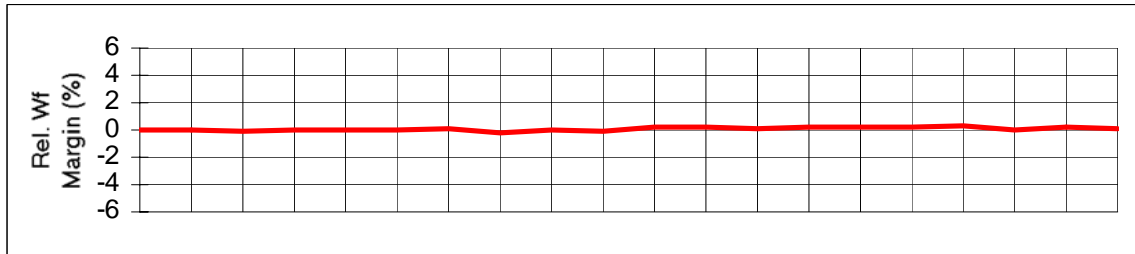
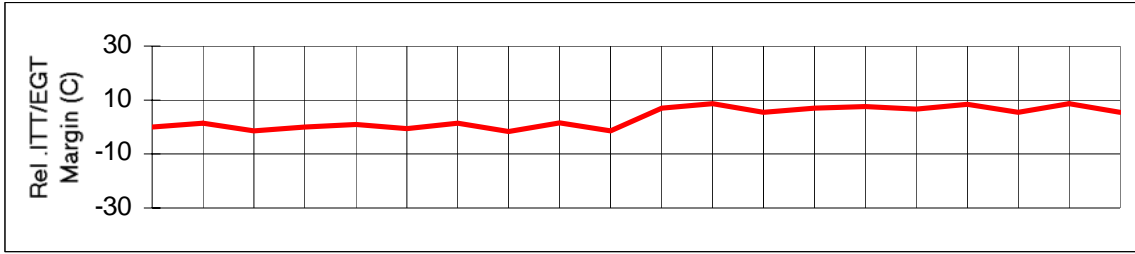


Figure 18. Indicated Airspeed 10 Knots Too Low

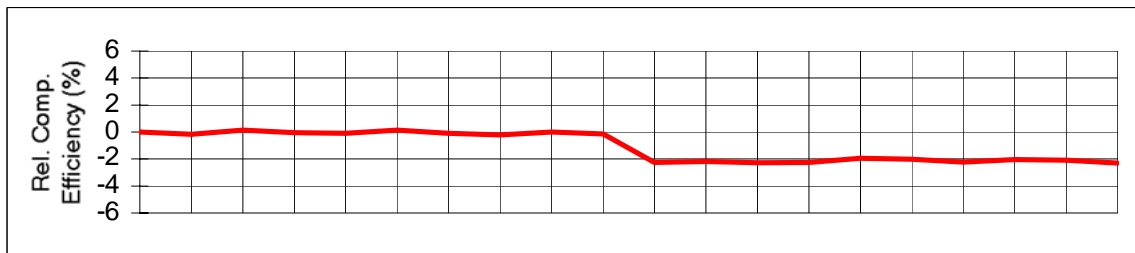
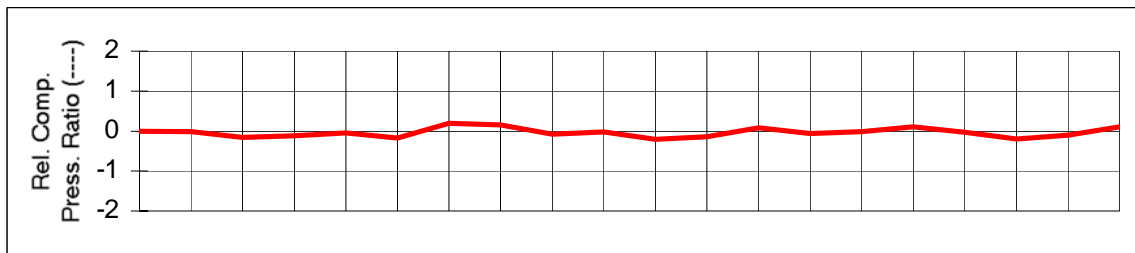
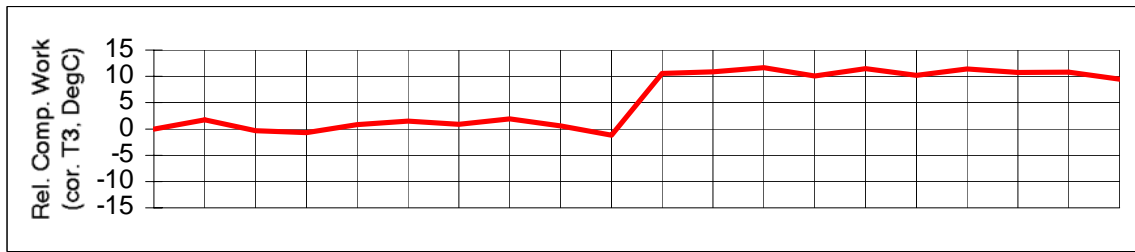
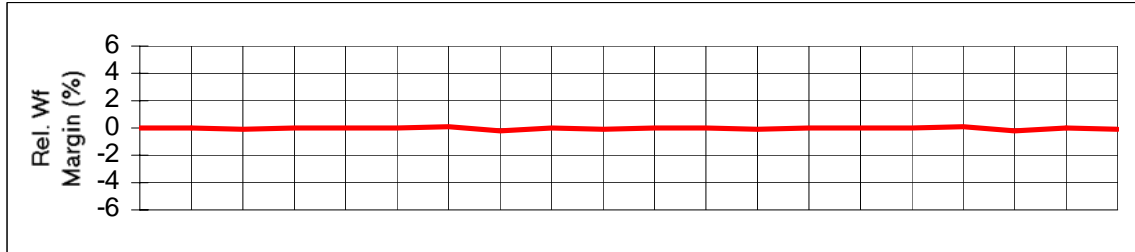
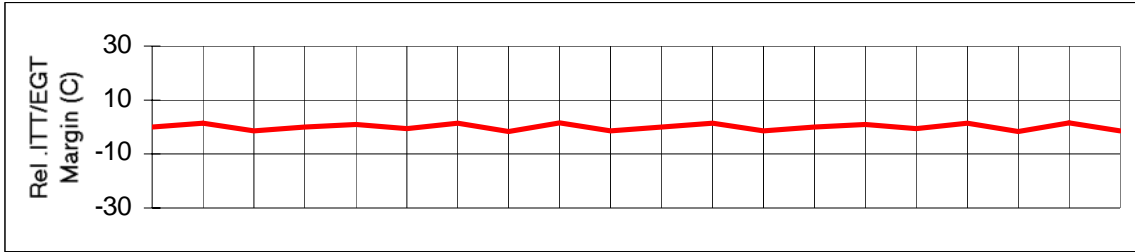


Figure 19. Compressor Discharge Temperature (T3) 10°C Too High

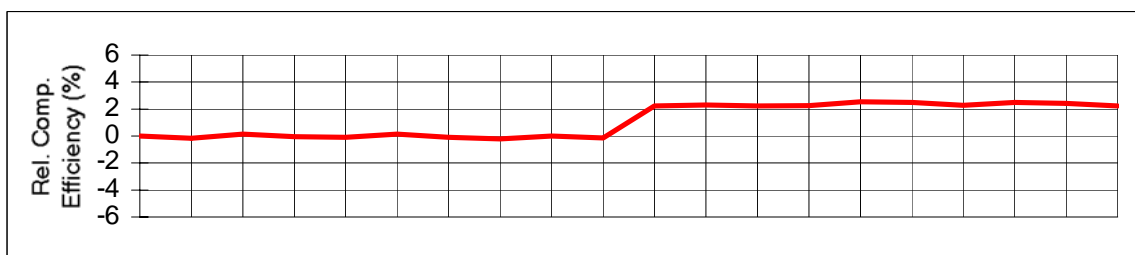
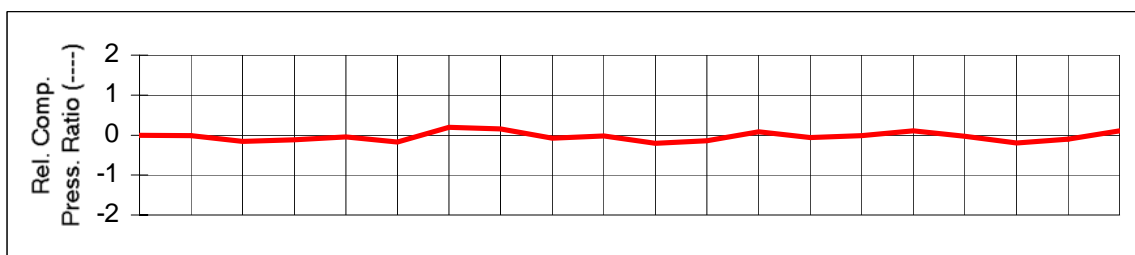
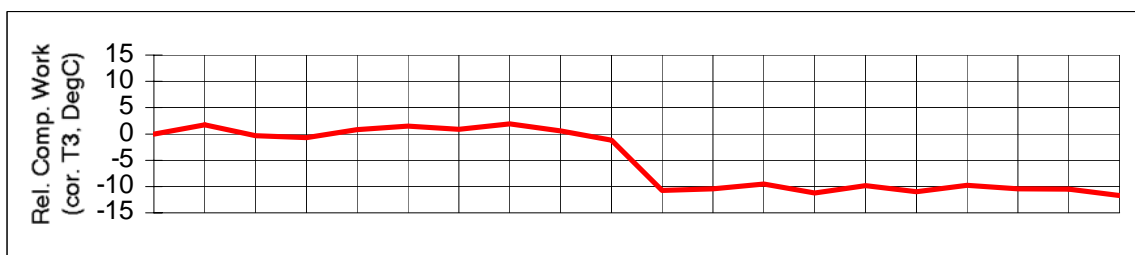
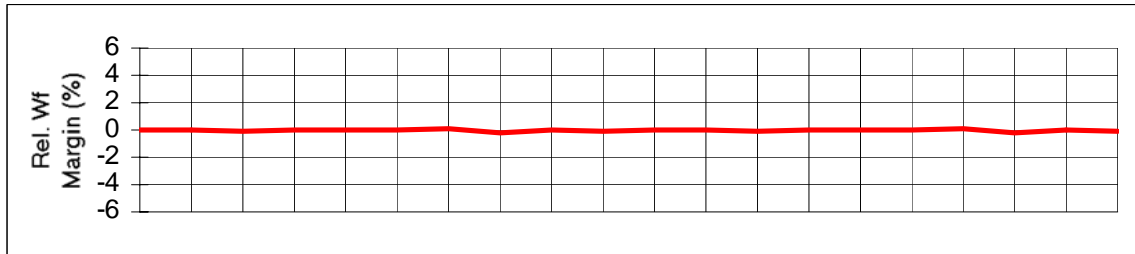
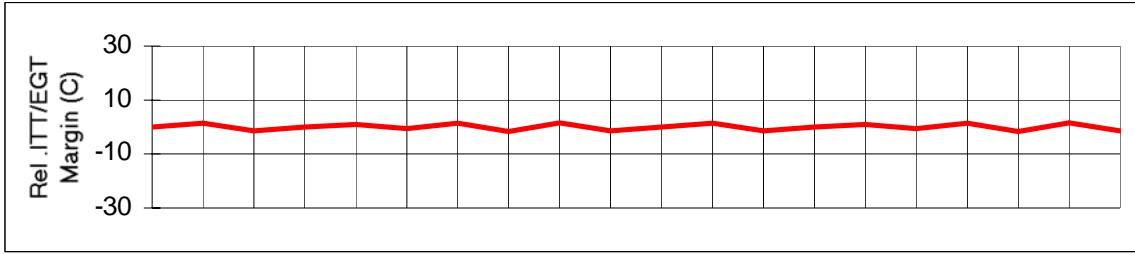


Figure 20. Compressor Discharge Temperature (T3) 10°C Too Low

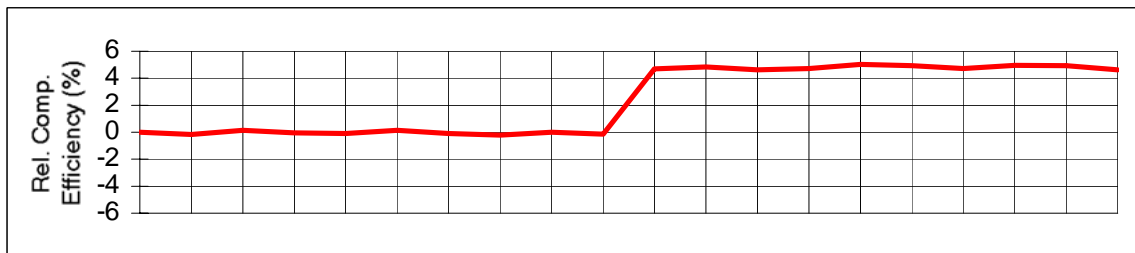
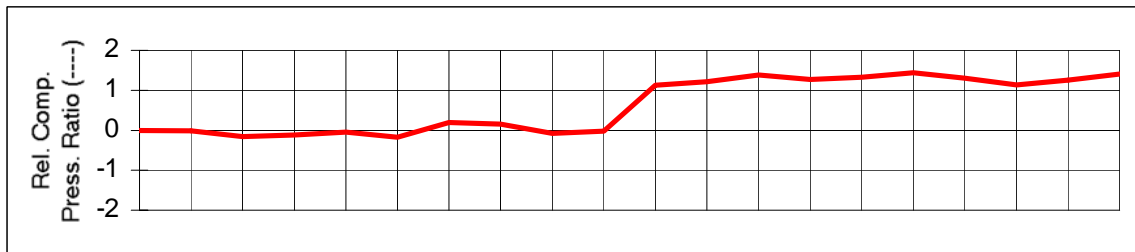
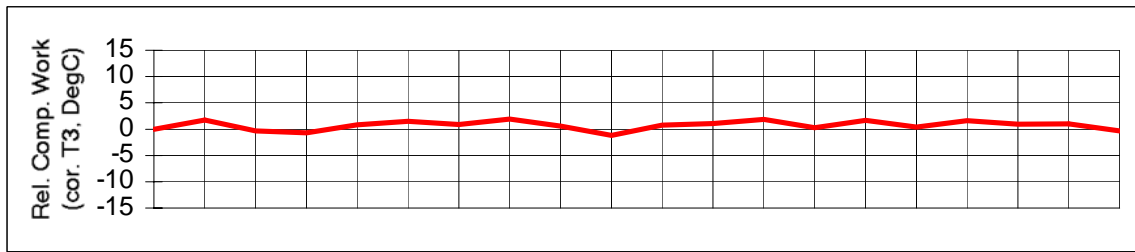
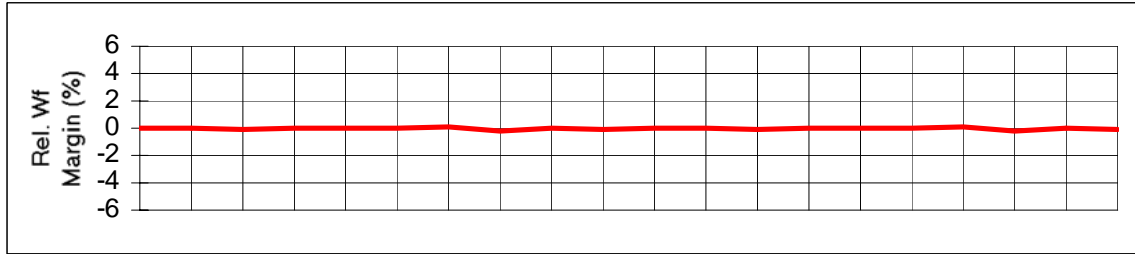


Figure 21. Compressor Discharge Pressure (P3) 10 psi Too High

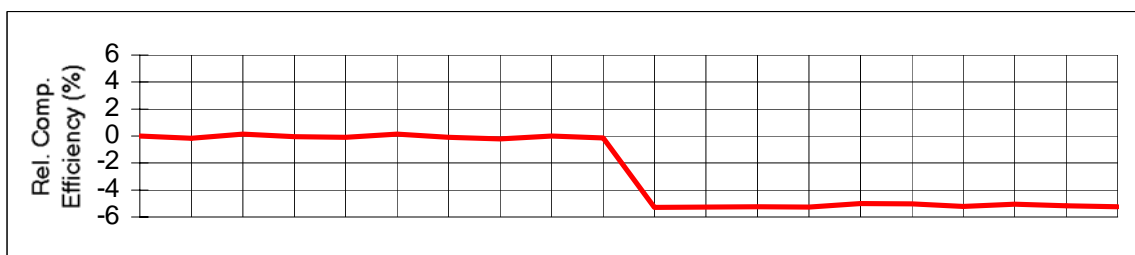
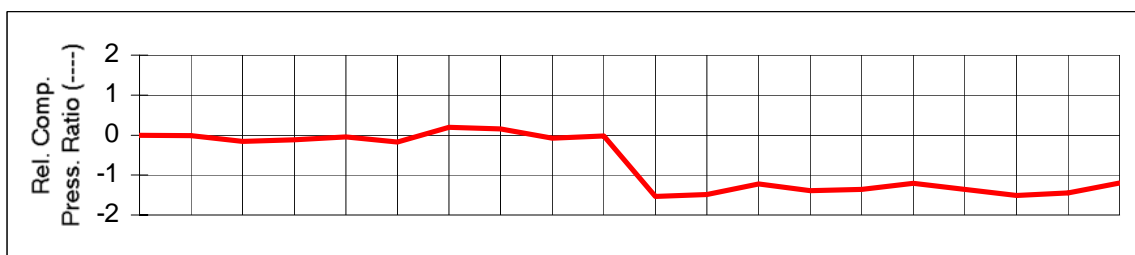
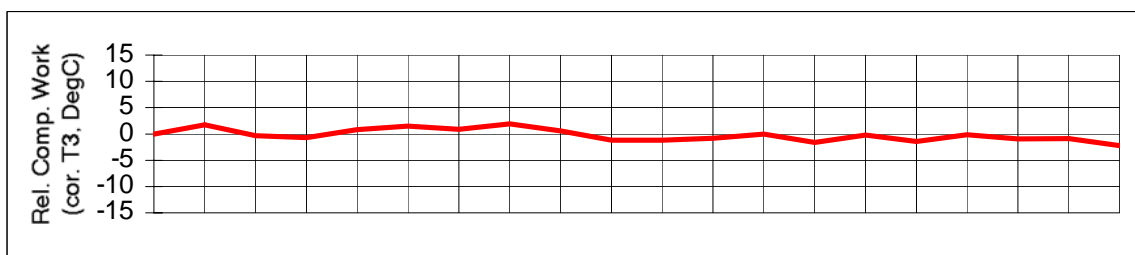
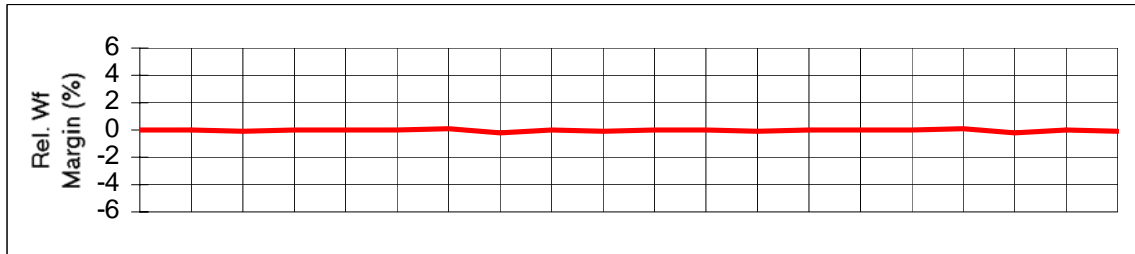
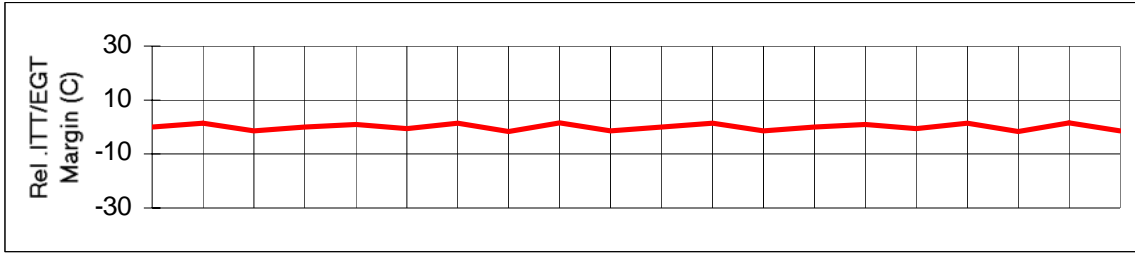


Figure 22. Compressor Discharge Pressure (P3) 10 psi Too Low

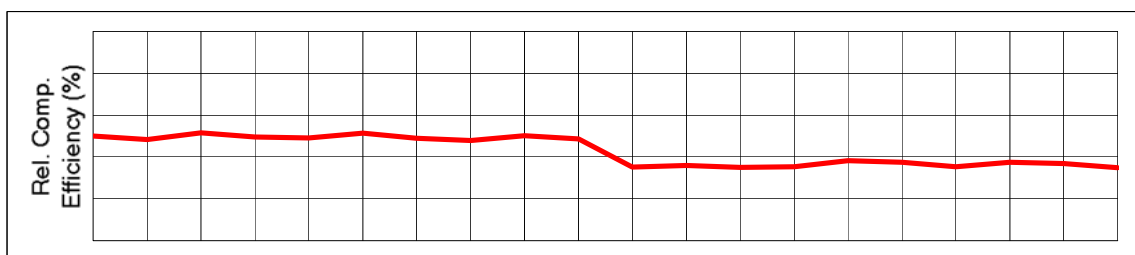
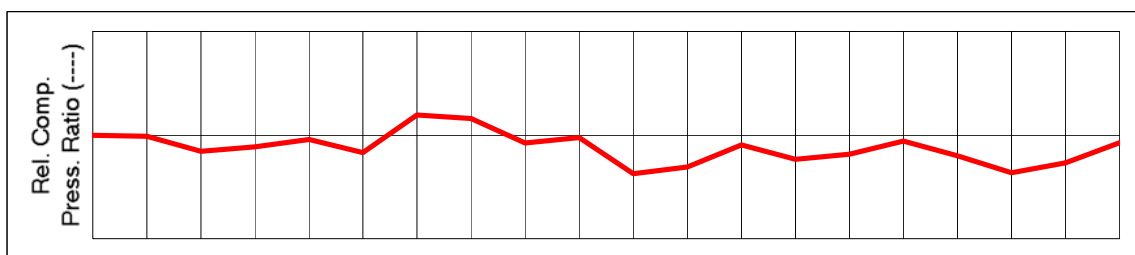
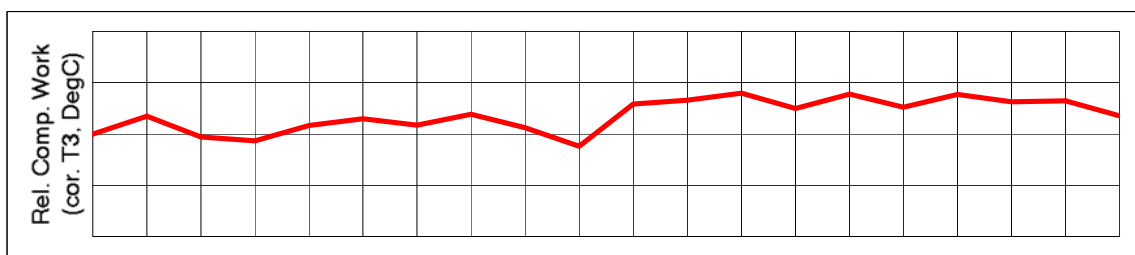
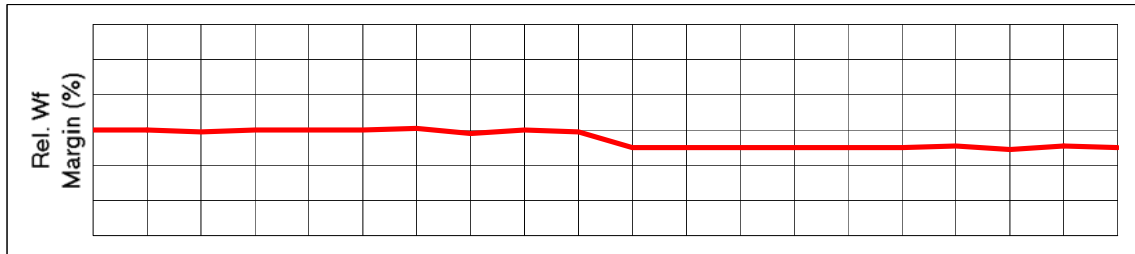
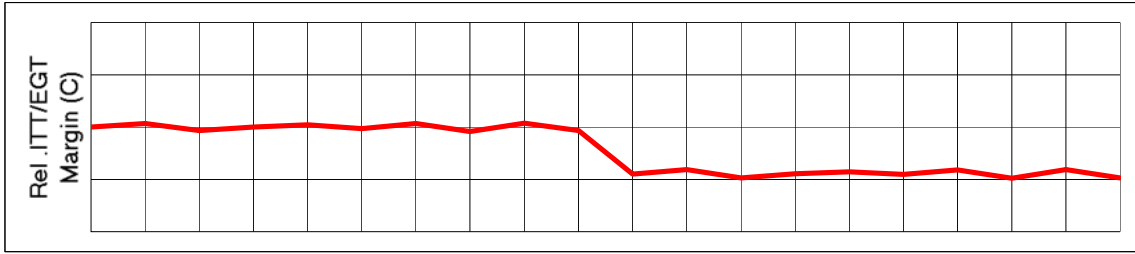
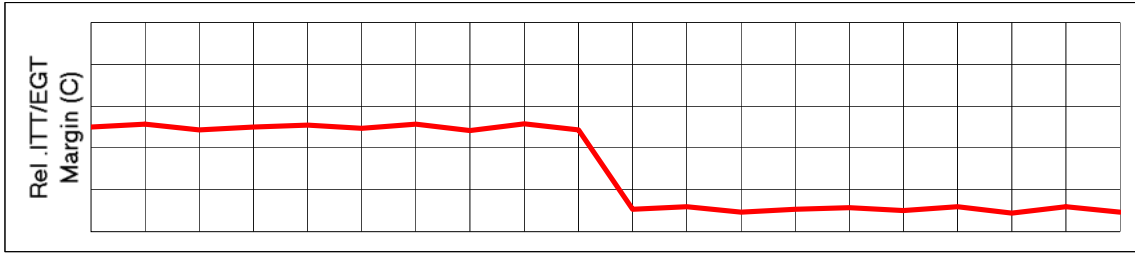


Figure 23. Deterioration Due to Reduced Compressor Performance



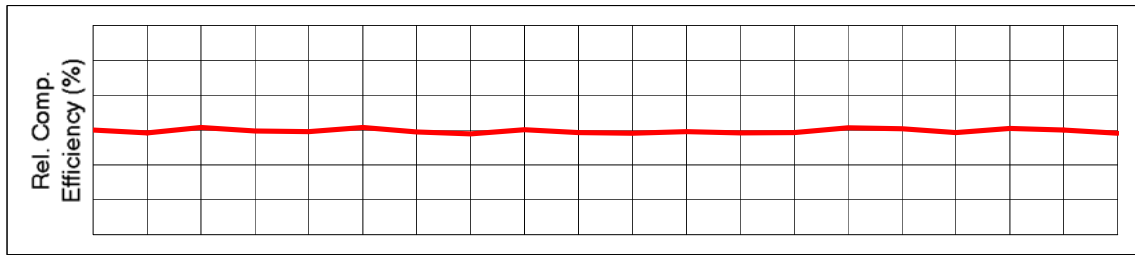
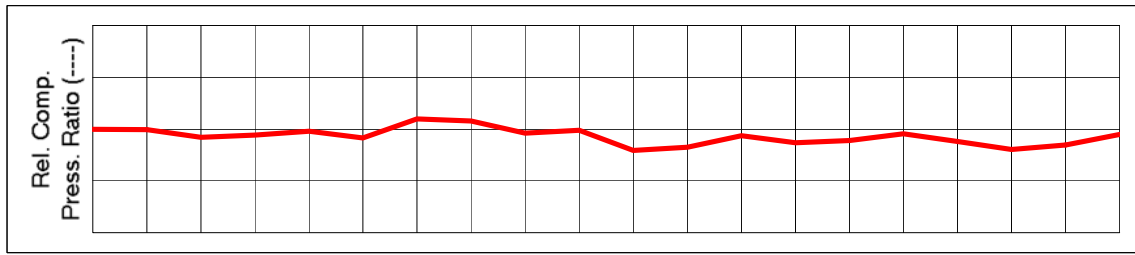
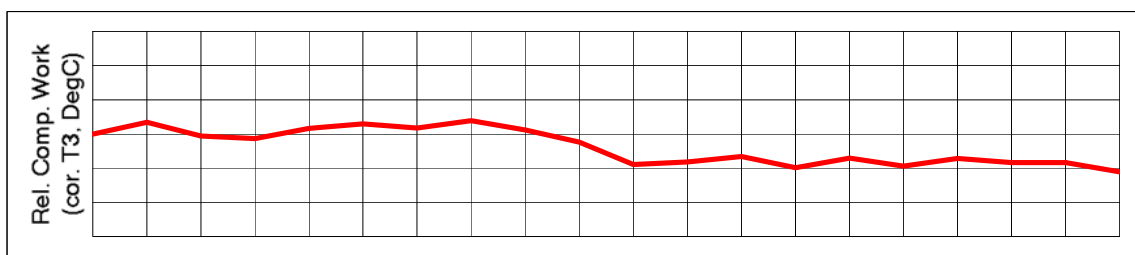
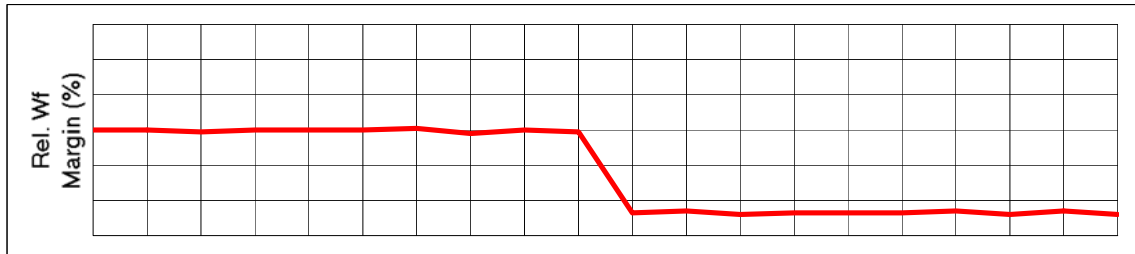
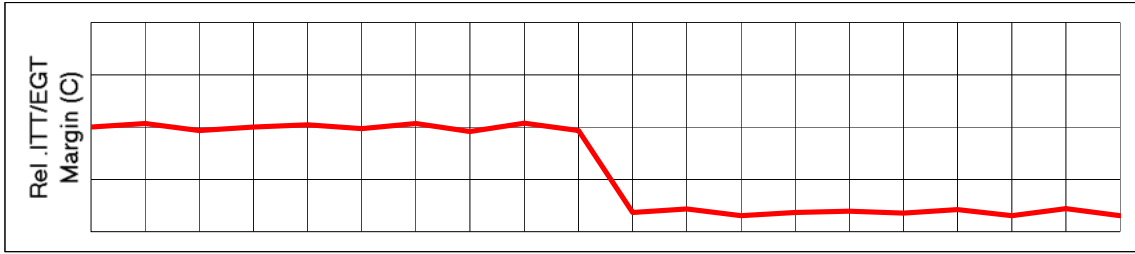


Figure 25. Perceived Deterioration Due to an Overboard Bleed Leak

12 Maintaining Databases

If you discover errors in your Trend Plus+ data or if you want to save storage space by deleting references to obsolete equipment or ex-employees, you will need to use the database maintenance features offered by the database views (windows).

You may use database viewers to maintain the following database tables:

- Aircraft
- Engine
- Pilot
- Station
- Technician
- Maintenance item
- Flight trend data
- Ground trend data
- Maintenance history

12.1 Procedures

Choose **Databases** from the menu bar, then choose the database you are interested in from the Database Menu. A new window containing a view of the database table will appear on the screen.

To add a record to the database, press [Insert]. The record's data entry dialog box will appear.

To edit a record already in the database, use the cursor bar to highlight the row you are interested in, and press [Enter] to bring up its dialog box for editing.

To delete a record from the database, use the cursor bar to highlight the row, then press [Delete]. You will be asked if you are sure before the record is deleted.

12.2 Maintaining the engine database

When you edit an engine record, Trend Plus+ will scan the engine's trend data, looking for inconsistencies. If any are found, Trend Plus+ will correct the trend data to agree with the engine record. For example, if you change an engine's Max Compensation or Max Compensation Date, Trend Plus+ will search the flight and ground data databases, update all records since the entered Max Compensation Date, and recompute performance calculations.

When you delete an engine record, if it is linked to an aircraft in the database, the link will be removed. Then, the engine record and all trend data belonging to that engine will be deleted.

13 Utilities

13.1 Reduce trend data

After entering flight or ground data on the Input Menu, select **Utilities | Reduce Trend Data** to perform trend calculations on the new data. You will need to do this before printing trend graphs or reports.

13.2 Change/remove engine

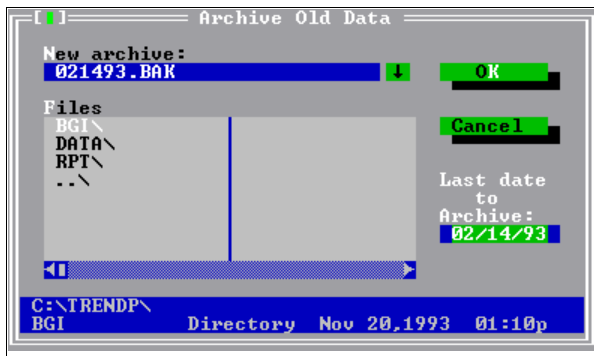
What do you do if you have entered several sets of data for an aircraft, only to learn that the engine was swapped out days ago? **Utilities | Change/Remove Engine** allows you to correct the database by telling Trend Plus+ which engine was removed, which engine was added, and when the change occurred. Trend Plus+ will make the necessary changes, and automatically apply the trend data you entered to the correct engine.

Because this will move trend data in the database, it is vital that you enter the correct date that the change occurred.

13.3 Archive old data

You can reduce the size of your database by archiving data that is sufficiently out of date. The archive process will copy trend data to an archive file, which you can backup in case you ever need to recall it, and will remove the archived data from your online database.

When you choose **Utilities | Archive Old Data**, you will be presented with the following dialog:



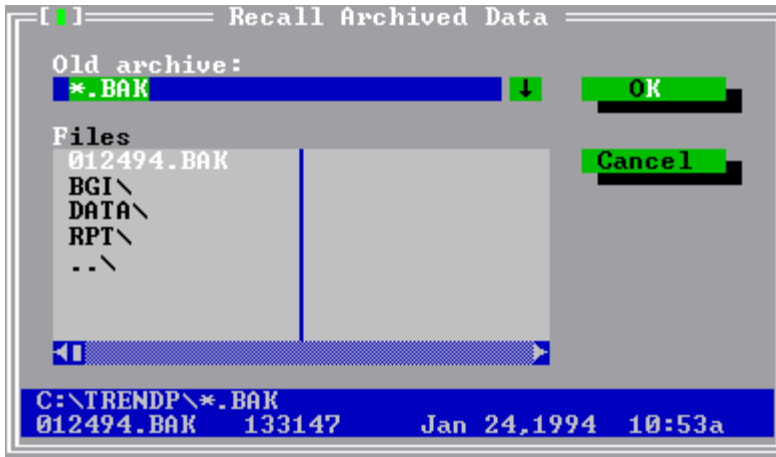
The “last date to archive” defaults to one year ago. You can change that date to suit your need; the archive file name will default to the numeric representation of the archive date, followed by the “.BAK” extension. (The date form will be “MMDDYY” or “DDMMYY,” depending on your system date format.)

When you press the OK button, the archive file will be created. This process may take a while to complete.

Note that the archive procedure only records engines and their accompanying trend data.

13.4 Recall archived data

If you need to read archived data back in to the system, choose **Utilities | Recall Archived Data**, and select the archive file you want to read back in.



When you press the OK button, the engine and trend data will be read back in from the archive file. The archive file does not preserve links to aircraft: If an archived engine still exists in the current database, but is attached to a different aircraft than when it was archived, Trend Plus+ will not move it from its current aircraft. If an archived engine does not exist in the current database, it will be read back in, but will not be connected to any aircraft in the database.

13.5 Backup databases

Choose **Utilities | Backup Databases** to copy the entire Trend Plus+ database system to a backup floppy disk.



Other than being compressed to reduce the number of floppy disks needed to backup a database, no special processing is done during the backup.

If you already backup your hard disk with a tape backup system or through other adequate means, this should be sufficient to protect your Trend Plus+ data. However, if you do not already backup your hard disk regularly, Honeywell strongly recommends that you use this backup procedure regularly.

13.6 Restore databases

Choose **Utilities | Restore Databases** to read an entire Trend Plus+ database back from a backup diskette.

Note: The old database will be restored exactly as it was in when backed up, and will completely overwrite any current Trend Plus+ database.



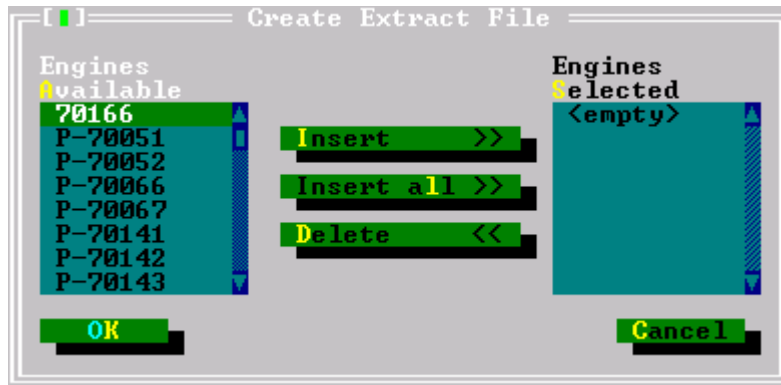
While backups should be made frequently, databases should only be restored if the database on your hard disk has been destroyed or corrupted through accident or hardware failure.

13.7 Rebuild index files

Occasionally the databases used by Trend Plus+ may become corrupted. This occurs after program crashes. If you receive database related error messages, you should use the **Utilities | Rebuild Index Files** menu option to rebuild your database. If this does not work, you need to contact ACES Systems to have your database repaired.

13.8 Create modem extract

Choose **Utilities | Create Modem Extract** to create an archive file suitable for modem transmission or other transfer.



The resulting archive file, named EXTRACT.BAK, will only contain information about the engines in the *Engines Selected* list box. Use the Insert, Insert all, and Delete buttons, or the [Insert] and [Delete] keys to move engines between the *Engines Available* and *Engines Selected* list boxes.

The extracted data will not be removed from your current database, and the person receiving the archive file can read it in without harming the data currently in his database.

This is the preferred method of transferring trend data between installations using Trend Plus+. It is much safer than physically copying database files or using the backup and restore procedures. However, it only records engines and their accompanying trend data.

13.9 Program setup

Items on this menu are discussed in the section entitled **Configuring Trend Plus+**.

14 Keystroke Reference

14.1 Popup menu keys

[Home]	Move to first menu item
[End]	Move to last menu item
[Up arrow]	Move to previous menu item
[Down arrow]	Move to next menu item
[Left arrow]	Change to different popup menu
[Right arrow]	Change to different popup menu
[Enter]	Select highlighted menu item
Letter key	Select menu item with that highlighted letter

14.2 Field editing keys

[Home]	Move to beginning of field
[End]	Move to end of field
[Right arrow]	Move right one character
[Left arrow]	Move left one character
[Insert]	Toggle insert/overtyping mode
[Delete]	Delete any highlighted text, or character under cursor
[Backspace]	Delete any highlighted text, or character to left of cursor
[Ctrl-Backspace]	Clear field

14.3 Report viewer keys

[Home]	Move to leftmost column
[End]	Move to rightmost column
[Right arrow]	Move right one column
[Left arrow]	Move left one column
[Page up]	Move up one screen
[Page down]	Move down one screen
[Ctrl-Page up]	Move to first record
[Ctrl-Page down]	Move to final record
[Alt-P]	Print database
[Alt-S]	Save database to a new text file
[Alt-O]	Change the sort order
[Alt-V]	Change the view (hide/show columns)

14.4 Database view keys

[Home]	Move to leftmost column
[End]	Move to rightmost column
[Right arrow]	Move right one column
[Left arrow]	Move left one column
[Page up]	Move up one screen

[Page down]	Move down one screen
[Ctrl-Page up]	Move to first record
[Ctrl-Page down]	Move to final record
[Insert]	Add a new record
[Delete]	Delete current record
[Enter]	Edit current record
[Alt-P]	<u>P</u> rint database
[Alt-S]	<u>S</u> ave database to a new text file
[Alt-O]	Change the sort <u>o</u> rder
[Alt-V]	Change the <u>v</u> iew (hide/show columns)

14.5 IEC import data viewer

[Home]	Move to leftmost column
[End]	Move to rightmost column
[Right arrow]	Move right one column
[Left arrow]	Move left one column
[Page up]	Move up one screen
[Page down]	Move down one screen
[Ctrl-Page up]	Move to first record
[Ctrl-Page down]	Move to final record
[Insert]	Add a new record
[Delete]	Delete current record
[Enter]	Edit current record
[Alt-S]	<u>S</u> ave database to a new text file
[Alt-V]	Change the <u>v</u> iew (hide/show columns)
[Alt-T]	Store IEC import data
[Alt-C]	<u>C</u> ancel IEC import

15 Menu Reference

15.1 File menu

<u>C</u> hange Database....	Change to a database stored in a different directory
<u>S</u> ave As...	Copy data in active window to a new file
<u>P</u> rint	Print data in active window
<u>P</u> rint <u>S</u> etup...	Configure printer
<u>E</u> xit	Exit Trend Plus+
<u>A</u> bout...	Show copyright/version information

15.2 Input menu

<u>F</u> light Data...	Enter new flight data
<u>G</u> round Data...	Enter new ground run data
<u>A</u> utomatic <u>I</u> EC Data...	Load data from IEC floppy disk file
<u>M</u> aintenance <u>A</u> ctivities...	Record data about maintenance performed

15.3 Add info menu

<u>A</u> ircraft...	Enter data into aircraft database
<u>E</u> ngine...	Enter data into engine database
<u>P</u> ilot...	Enter data into pilot database
<u>S</u> tation...	Enter data into station database
<u>T</u> echnician...	Enter data into technician database
<u>M</u> aintenance <u>i</u> tem...	Enter data into maintenance item database

15.4 Databases menu

<u>A</u> ircraft	View/modify aircraft database
<u>E</u> ngine	View/modify engine database
<u>P</u> ilot	View/modify pilot database
<u>S</u> tation	View/modify station database
<u>T</u> echnician	View/modify technician database
<u>M</u> aintenance <u>I</u> tem	View/modify maintenance item database
<u>F</u> light <u>T</u> rend <u>D</u> ata...	View/modify flight trend database
<u>G</u> round <u>T</u> rend <u>D</u> ata...	View/modify ground trend database
<u>M</u> aintenance <u>H</u> istory...	View/modify maintenance history database

15.5 Reports menu

<u>T</u> rend <u>P</u> lots...	Graph trend data
<u>B</u> atch <u>T</u> rend <u>P</u> lots	View/Print a group of engines trend graphs
<u>F</u> leet <u>P</u> erformance <u>R</u> anking...	View/print performance ranking report
<u>F</u> leet <u>P</u> erformance <u>G</u> raphic...	View/print performance ranking graph
<u>F</u> leet <u>D</u> istribution <u>G</u> raphic...	View/print distribution graph
<u>F</u> leet <u>U</u> sage...	View/print fleet usage report
<u>G</u> round <u>R</u> un <u>S</u> tatus...	View/print ground run status report

15.6 Utilities menu

<u>R</u> educe Trend Data	Transfer input data to trend databases
C <u>h</u> ange/Remove <u>E</u> ngine	Update aircraft to change engine
<u>A</u> rchive Old Data...	Transfer old data to archive file
R <u>e</u> call Archived Data...	Transfer archived data back into databases
<u>B</u> ackup Databases	Backup all databases to floppy diskette
R <u>e</u> store Databases	Replace databases with backup from floppy
R <u>e</u> build <u>I</u> ndex Files	Recreate database index files from data
C <u>r</u> eate Modem <u>E</u> xtract...	Create archive file suitable for telephone distribution
<u>P</u> rogram Setup	(See below)

15.7 Program setup menu

<u>D</u> ate Format...	Set system date format
<u>I</u> EC Import Filter...	Define filter to restrict data during IEC Import
<u>G</u> round Data Form...	Select which fields appear on Ground Data Entry form
<u>F</u> light Data Form...	(See below)

15.7.1 Flight data form menu

<u>F</u> ormat..	Select which fields appear on Flight Data Entry form
Data Entry <u>O</u> rd <u>e</u> r	Set tab order for Flight Data Entry form

Applicable Engines Appendix

At the time of the 2.5 release, Trend Plus+ is designed for use only with the engines listed below. Please refer to the latest Service Information Letter for an updated list of applicable engines.

Aircraft Model	Engine Model	100% Power
CASA 212-100	TPE331-5-252C	715
CASA 212-200	TPE331-10R-501C/511C	900
	TPE331-10R-502C/512C	^^
CASA 212-400	TPE331-12JR-701C	925
Cessna Conquest 441	TPE331-8-401S through 406S	635
	TPE331-10N-5XXS	^^
Commander 690 Series	TPE331-5-251K	700
	TPE331-5-252K	^^
	TPE331-5-254K	^^
	TPE331-5-255K	^^
Commander 695 Series	TPE331-10-501K/511K	715
Dornier 228-100	TPE331-5/5B-252D	715
	TPE331-10P-511D	
	TPE331-10T-511D	
Dornier 228-200	TPE331-5A/AB-252D	776
	TPE331-10GP-511D	^^
	TPE331-10GT-511D	^^
IAI S-2 Tracker	TPE331-15AW-801T	1650
Jetstream 3100	TPE331-10UG-513H/514H	900
	TPE331-10UGR-513H/514H	^^
Jetstream 3200	TPE331-12UAR-701H through 708H	1020
	TPE331-12UHR-701H through 708H	^^
Jetstream 4100	TPE331-14GR/HR-801H/802H	1500
	TPE331-14GR/HR-803H/804H	^^
	TPE331-14GR/HR-805H	1650
	TPE331-14GR/HR 900 Series	1500
	TPE331-14GR/HR 900 Series	1650
Marsh S2T/CDF	TPE331-14GR-801Z	1650
Merlin III/IIIA	TPE331-3U-304G	840
Merlin IIIB/C	TPE331-10U-501G/511G	900
	TPE331-10U-502G/512G	^^
	TPE331-10U-503G/513G	^^
Merlin IV C	TPE331-11U-601G/611G	1000
	TPE331-11U-602G/612G	^^
Metro I/II/IIA	TPE331-3U-304G	840
	TPE331-10UA-501G/511G	^^
Metro III	TPE331-11U-601G/611G	1000
	TPE331-11U-602G/612G	^^
	TPE331-12UAR-701G	^^
	TPE331-12UHR-701G	^^
Metro 23	TPE331-12UAR-701G	1000
	TPE331-12UHR-701G	^^
Mitsubishi MU-2B P-Model	TPE331-5-252M	665
Mitsubishi MU-2B J/K/M-Models	TPE331-6.251M	665
Mitsubishi Marquise	TPE331-10-501M	715

Sample Forms Appendix

The following pages contain sample forms which you may find helpful as design guides. If you wish, you may photocopy them for use with Trend Plus+.

Engine Information

Engine serial number: _____
Installed on aircraft: _____
Wing position: _____
Date installed: _____
Station: _____
TAT @ install: _____
TSN @ install: _____
TSO/CAM @ install: _____
Date of last HSI: _____
Date of last overhaul/CAM: _____
Indicated compensation: _____ °C Date: _____
Max compensation (DSC): _____ °C Date: _____

Engine (-14) Information

Engine serial number: _____
Installed on aircraft: _____
Wing position: _____
Date installed: _____
Station: _____
Date of last HSI: _____
Date of last CAM: _____
TSN @ last CAM: _____
Max compensation (DSC): _____
Max compensation date: _____

Ground Run Data

Date:	_____	Pressure Altitude:	_____
A/C Reg. Number:	_____	Indicated Compensation:	_____
Wing Position:	_____	Bleed Setting:	_____
Engine Serial Number:	_____	Anti-Ice:	<input type="checkbox"/> On <input type="checkbox"/> Off
Technician:	_____	Total Airframe Time:	_____
Station:	_____		
Outside Air Temp:	_____		

	Point 1	Point 2	Point 3	Point 4
Prop RPM:	_____	_____	_____	_____
Torque:	_____	_____	_____	_____
Fuel Flow:	_____	_____	_____	_____
EGT/ITT:	_____	_____	_____	_____
EGT - SRL Off:	_____	_____	_____	_____

Note: Run point 1 to Flight Manual target torque. If target torque cannot be reached, run to redline.

Drop EGT by 10 °C for each successive point.

Ground Run Data

Date:	_____	Pressure Altitude:	_____
A/C Reg. Number:	_____	Indicated Compensation:	_____
Wing Position:	_____	Bleed Setting:	_____
Engine Serial Number:	_____	Anti-Ice:	<input type="checkbox"/> On <input type="checkbox"/> Off
Technician:	_____	Total Airframe Time:	_____
Station:	_____		
Outside Air Temp:	_____		

	Point 1	Point 2	Point 3	Point 4
Prop RPM:	_____	_____	_____	_____
Torque:	_____	_____	_____	_____
Fuel Flow:	_____	_____	_____	_____
EGT/ITT:	_____	_____	_____	_____
EGT - SRL Off:	_____	_____	_____	_____

Note: Run point 1 to Flight Manual target torque. If target torque cannot be reached, run to redline.

Drop EGT by 10 °C for each successive point.

Flight Data

Flight Log Number: _____	Total Airframe Time: _____	HH
A/C Reg. Number: _____	Outside Air Temp: _____	<input type="checkbox"/> °C <input type="checkbox"/> °F
Date of Flight: _____	Pressure Altitude: _____	feet
Pilot: _____	Indicated Air Speed: _____	knots

	LHE - Pos 1	RHE - Pos 2	
Torque:	_____	_____	<input type="checkbox"/> % <input type="checkbox"/> ft-lbs
Prop RPM:	_____	_____	%
EGT/ITT:	_____	_____	<input type="checkbox"/> °C <input type="checkbox"/> °F
Fuel Flow:	_____	_____	pph
Oil Temp:	_____	_____	<input type="checkbox"/> °C <input type="checkbox"/> °F
Oil Pressure:	_____	_____	psi
Oil Added:	_____	_____	quarts
Bleed Setting:	_____	_____	
Anti-Ice:	<input type="checkbox"/> On <input type="checkbox"/> Off	<input type="checkbox"/> On <input type="checkbox"/> Off	

Flight Data

Flight Log Number: _____	Total Airframe Time: _____	HH
A/C Reg. Number: _____	Outside Air Temp: _____	<input type="checkbox"/> °C <input type="checkbox"/> °F
Date of Flight: _____	Pressure Altitude: _____	feet
Pilot: _____	Indicated Air Speed: _____	knots

	LHE - Pos 1	RHE - Pos 2	
Torque:	_____	_____	<input type="checkbox"/> % <input type="checkbox"/> ft-lbs
Prop RPM:	_____	_____	%
EGT/ITT:	_____	_____	<input type="checkbox"/> °C <input type="checkbox"/> °F
Fuel Flow:	_____	_____	pph
Oil Temp:	_____	_____	<input type="checkbox"/> °C <input type="checkbox"/> °F
Oil Pressure:	_____	_____	psi
Oil Added:	_____	_____	quarts
Bleed Setting:	_____	_____	
Anti-Ice:	<input type="checkbox"/> On <input type="checkbox"/> Off	<input type="checkbox"/> On <input type="checkbox"/> Off	

Error Message Appendix

Below is a list of the error messages you may encounter when using Trend Plus+. Some of these messages will be followed by explanatory text. If you receive a message for which the explanation asks you to call technical support, please see the **Troubleshooting Index** for information on what to do before calling, and to get technical support telephone numbers.

“???????” is not a valid time!

“???????” is not a valid date!

If you are sure you entered a valid date, check your system date format under Utilities | Program Setup | Miscellaneous.

Backup failed! Could not execute PKZIP backup program. (Internal error code ##.) Please check your Trend Plus+ manual.

Honeywell has a license to distribute PKZIP, the world-famous shareware file compression program, with Trend Plus+. The Trend Plus+ installation program will copy PKZIP.EXE and PKUNZIP.EXE into the same directory as TRENDP.EXE.

Internal error code 4: Too many open files. You need to increase the FILES= value in your CONFIG.SYS file. See your DOS manual.

Internal error code 6: Cannot locate command interpreter. Make sure your COMSPEC variable is correctly set to the full path of your DOS command interpreter.

Internal error code 10: The disk drive on which you have installed Trend Plus+ does not have enough free space to allow Trend Plus+ to save its state and execute a subprogram. You need to free up disk space and try again.

If you have received an internal error code not listed here, please write the error down and call for technical support.

Backup failed! PKZIP returned error code ##. Please check your Trend Plus+ manual.

Error code 1: PKZIP could not create a file. Check that your diskette is not write-protected, and if your computer is attached to a network, assure that you have write privileges in the Trend Plus+ directory.

Error code 4-11: Insufficient memory. If you receive this message, write down what you were doing, and what programs were running besides Trend Plus+. Then call for technical support.

Error code 14: The disk drive on which you have installed Trend Plus+ does not have enough free space to create files used for backup. You need to free up disk space and try again.

Error code 15: PKZIP could not open a file for writing. Check that your diskette is not write-protected.

Error code 26: Your DOS version is earlier than 3.0. DOS 3.0 or later must be installed in order for the backup procedure to work properly.

Error code 27: Your selected backup device is not a standard floppy drive. The backup procedure is only designed to work with standard 5¼ or 3½ inch diskette drives.

If you have received an internal error code not listed here, please write the error down and call for technical support.

Cannot create file. Use another name.

You have elected to create a new file, but entered the name of a file that already exists.

Cannot open IECDATAN.???**Cannot reduce ground data without co-processor.**

Your computer does not have a math coprocessor chip installed; Trend Plus+ requires one.

**Critical disk error on drive d:
Data integrity error on drive d:**

You may have a faulty diskette, or a problem with your disk subsystem.

Data reduction requires a co-processor.

Your computer does not have a math coprocessor chip installed; Trend Plus+ requires one.

Device access error.**Disk is not ready in drive d:**

The drive door may be open, or the disk not inserted completely.

Disk is write-protected in drive d:

Check the diskette's write-protect tab.

Engine ????? is installed in that position.

You tried to move an engine to an aircraft that already had an engine in that position.

Engine Serial number ????? already in database.

The engine has already been entered.

Engine to install is currently installed.**Error opening IEC database.**

Trend Plus+ could not create the new database table for importing IEC data. You may be out of disk space. If you are on a network, verify that you have Create privilege in the Trend Plus+ data directory.

Graph error -1: (BGI) graphics not installed (use initgraph).

Call for technical support if you receive this error.

Graph error -2: Graphics hardware not detected.

You are using display hardware that Trend Plus+ could not identify. Trend Plus+ requires a VGA-compatible display subsystem.

Graph error -3: Device driver file not found.**Graph error -4: Invalid device driver file.**

Files may be missing from the directory named BGI, which is located in your Trend Plus+ directory. (Usually C:\TRENDP\BGI.)

If you have an environment variable named BGI, it must contain the path to the BGI subdirectory. Set the environment variable correctly, and try again.

Graph error -5: Not enough memory to load driver.**Graph error -6: Out of memory in scan fill.****Graph error -7: Out of memory in flood fill.**

See the "Out of memory" error message.

Graph error -8: Font file not found.

See the "Graph error -3: Device driver not found" error message.

Graph error -9: Not enough memory to load font.

See the “Out of memory” error message.

Graph error -10: Invalid graphics mode for selected driver.**Graph error -11: Graphics error.****Graph error -12: Graphics I/O error.****Graph error -13: Invalid font file.**

See the “Graph error -3: Device driver not found” error message.

Graph error -14: Invalid font number.**Graph error -15: Invalid device number.****Graph error -18: Invalid version number.****Graph error 0x80##: I/O port error ## (device not online?).**

Check that your printer is online and ready.

Check that your printer is setup correctly in **File | Print Setup**.

Check that your computer is connected to the printer correctly.

Graph error 0x8100: Error opening work file.

If you are on a network, assure that you have file creation and write privileges in the Trend Plus+ directory.

Graph error 0x8200: Error writing work file (disk full?).

The disk on which Trend Plus+ is installed may not have enough free space to process the requested plot. Free up disk space and try again.

Graph error 0x8300: Error reading work file.**Graph error 0x8400: User ESCAPE.****Graph error 0x8500: Insufficient memory for this mode.**

If you have multiple windows open on the screen, close as many as you can and try to print your plot again. If you get this message again, try choosing to **File | Printer Setup**, and, if you have selected better or best print quality, select good print quality instead. Then to print your plot again.

Graph error 0x8600: Postscript prologue not found.

See the “Graph error -3: Device driver not found” error message.

Ground data entry requires co-processor.

Your computer does not have a math coprocessor chip installed; Trend Plus+ requires one.

Hardware failure on drive d:**Help topic not found.**

This message can only occur because of an internal program error. Call for technical support.

Invalid directory.

You have specified a directory that does not exist or cannot be created.

Invalid drive or directory.

You have specified a disk drive letter that does not exist, or a directory that does not exist or cannot be created.

Invalid file name.

You have specified a file name that does not conform to DOS file name limitations. See your DOS manual to learn appropriate DOS file naming conventions.

Item already exists!

Needed file is locked or missing.

A disk error occurred because Trend Plus+ could not open a file.

If your computer is on a network, this error usually occurs when someone else is already using Trend Plus+; the current version of Trend Plus+ does not allow multiple concurrent users.

No aircraft available.

No data imported.

No engines available.

No engines to report.

No Engines with data to rank.

No IECDATAN.??? files available.

No records to process.

No trend data available.

Not enough memory for this operation.

Not enough memory.

Out of memory.

Your computer does not contain enough memory for Trend Plus+ to complete the selected task.

Each open window takes some memory; database and report viewers require a lot of memory. If you have multiple windows open, close as many as you can, then retry the task that ran out of memory.

Consult your DOS manual for memory optimization techniques.

Printer out of paper

Problem creating Fleet Ranking.

Problem creating Fleet Usage Report.

Problem creating Ground Run Status Report.

Problem creating KEYFILE.INP data file.

Problem creating REDUCE.INP data file.

Problem executing REDUCE.EXE.

Problem opening engine database.

Problem opening REDUCE.OUT

Problem opening trend database (primary).

Problem opening trend database (secondary).

Problem parsing REDUCE.OUT

Problem storing data results.

Problem writing KEYFILE.INP.

Problem writing to REDUCE.INP data file.

Read fault on drive d:

You may have a bad diskette, or your disk drive or drive controller may not be working properly.

REDUCE.EXE failed with an error.

**Restore failed! Could not execute PKUNZIP restore program. (Internal error code ##.)
Please check your TrendPlus+ manual.**

See the message "Backup failed! Could not execute PKZIP backup program. (Internal error code ##.) Please check your Trend Plus+ manual."

Restore failed! PKUNZIP returned error code ##. Please check your TrendPlus+ manual.

Error code 4-8 and 20: Insufficient memory. If you receive this message, write down what you were doing, and what programs were running besides Trend Plus+. Then call for technical support.

Error code 9: The diskette in the restore disk drive does not contain a Trend Plus+ backup file.

Error code 11: The diskette in the restore disk drive contains an empty Trend Plus+ backup file. No files were in the data directory when it was backed up.

Error code 50: The disk drive on which you have installed Trend Plus+ does not have enough free space to restore your Trend Plus+ backup. You need to free up disk space and try again.

If you have received an internal error code not listed here, please write the error down and call for technical support.

Sector not found on drive d:

Seek error on drive d:

Your drive or drive controller may not be working properly.

Tail number already exists.

The aircraft has already been entered into the database.

The date must be after ##/##/##!
The date must be before ##/##/##!
The number in this field must be greater than ####!
The number in this field must be greater than or equal to ####!
The number in this field must be less than ####!
The number in this field must be less than or equal to ####!
This field must be completely filled!
This field must contain a number!
This field must contain a number!
This field must contain at least 1 character!

You have typed invalid data into a dialog box data entry field.

Too many files.

A **File | Open** or **File | Save As** dialog box is being displayed, and there are too many files in the current directory to be displayed in the dialogs' file list box. You will not be able to select a file name from the list box, but if you know the file name you want, you can still type it in manually.

Unable to open help file.

The Trend Plus+ help file may be missing.

Unknown media type in drive d:

Write fault on drive d:

You may have a bad diskette, or your disk drive or drive controller may not be working properly.

You do not have enough free memory to run this program. Consult your DOS manual for memory optimization.

Your free memory space is limited; some functions will be disabled. Consult your DOS manual for memory optimization.

You have too little "low memory" (also known as "DOS memory") available. The actual amount is shown as the "largest executable program size" if you run the DOS CHKDSK program.

This problem can occur no matter how many megabytes of RAM are installed in your computer. The low memory may be taken up by DOS shells, Windows, or drivers.

Troubleshooting Appendix

If you have mechanical difficulties with your Honeywell Engine

Honeywell supplies technical and maintenance help for their engines. Please contact your Honeywell Field Service Engineer.

A directory of Field Service Engineers can be found on the web:

- Go to <https://www.e-engines.honeywell.com/>
- On the menu at the top of the screen, click on “Services & Support”.
- Click on “ES&S Service Center Brochure” to download the list.
- You will need to have a copy of Adobe Reader installed on your computer in order to view the list. If you do not have Adobe Reader, you can go to www.adobe.com to get a free copy.

You can also identify your field service engineer by:

- Calling 800-601-3099 within the U.S.
- Calling 602-365-3099 from outside the U.S.
- Sending a FAX to 602-365-3343.

If you have technical difficulties with Trend Plus+

ACES Systems supplies technical assistance help for the Trend Plus+ software package. Before calling support, it is vital that you have answers ready for all the questions on the Software Problem Report, so you can give your ACES contact the right information they will need to diagnose your problem. Permission is granted to photocopy the following Software Problem/Suggestion Report for the purpose of getting technical support for your registered copy of Trend Plus+.

