

# *Operator's Manual*

*Model 370*

*Digital Pressure Gage*

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# Introduction

Congratulations, and thank you for purchasing a SETRA Model 370 high accuracy Digital Pressure Gage. Its ease of operation and durable construction will provide years of reliable service. While the gage is easy to operate, it is advisable to read this guide carefully before use. It is designed to help you take full advantage of the functions and performance of the gage.

This guide is divided into five major sections:

Section One explains installation and power requirements for the Model 370.

Section Two provides a summary of the various keys, functions, displays and messages you will encounter when using this pressure gage.

Section Three explains in detail the basic functions and uses of this gage in pressure measurement.

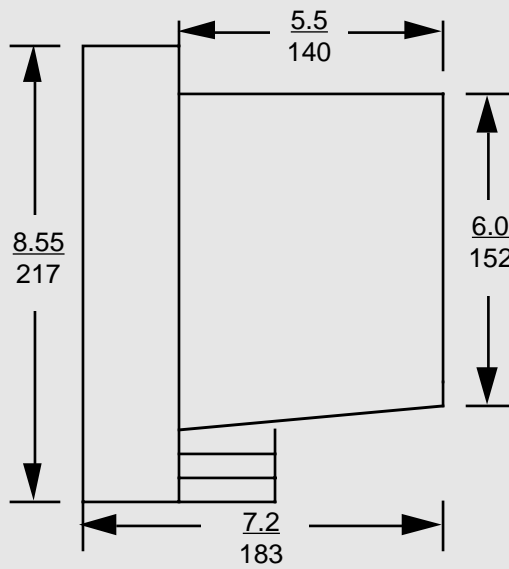
Section Four describes some advanced pressure measurement features available in the Model 370.

Section Five provides detailed instructions for the correct measurement of altitude for Model 370's with absolute or barometric pressure sensors.

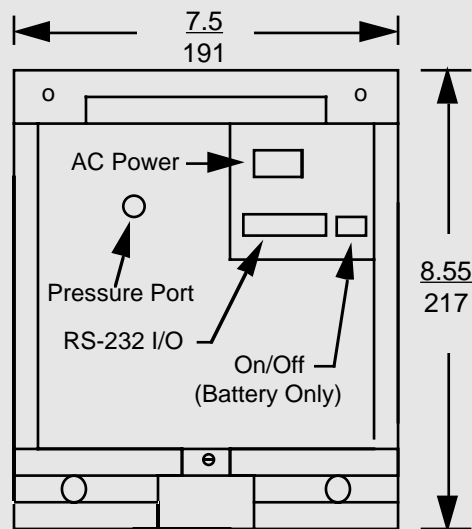
The Appendices include calibration and setup information, and instructions for interfacing the gage with computers and other equipment. Also provided are specifications, lists of accessories, and a warranty statement.

# OUTLINE DRAWING

## Side View



## Rear View



## **Section One**

### **INSTALLING THE MODEL 370**

The Setra Digital Pressure Gage, Model 370, is a highly accurate pressure measurement system utilizing the patented SETRACERAM sensor, advanced micro-computer based electronics, and sophisticated firmware, resulting in a 0.02% FS system accuracy.

The unusual ergonomic design of the Model 370 allows it to be used as a bench top instrument (with keypad and display at the proper angle for viewing), as a portable device with a built in carry handle, or as a rack mount instrument with the optional 19" rack mount kit.

#### ***SETUP***

Connect the pressure gage to an AC outlet by inserting one end of the provided power cord into the back of the gage, and the other end of the cord to the AC outlet. The gage will operate at any voltage from 100 to 240 VAC, 50 or 60 Hz. Once you have plugged your gage into a live outlet, it is automatically on.

The gage uses very little power, and may be left connected permanently.

If you have the optional battery, refer to Appendix IV concerning battery power and automatic recharging.

#### ***DISPLAY TEST***

When your gage is first powered on, it automatically performs a display test, showing all possible display segments. This test lasts approximately six seconds. The gage next displays "HELLO" and performs self-diagnostics to ensure proper operation. The gage then counts down to zero, and is ready for use.

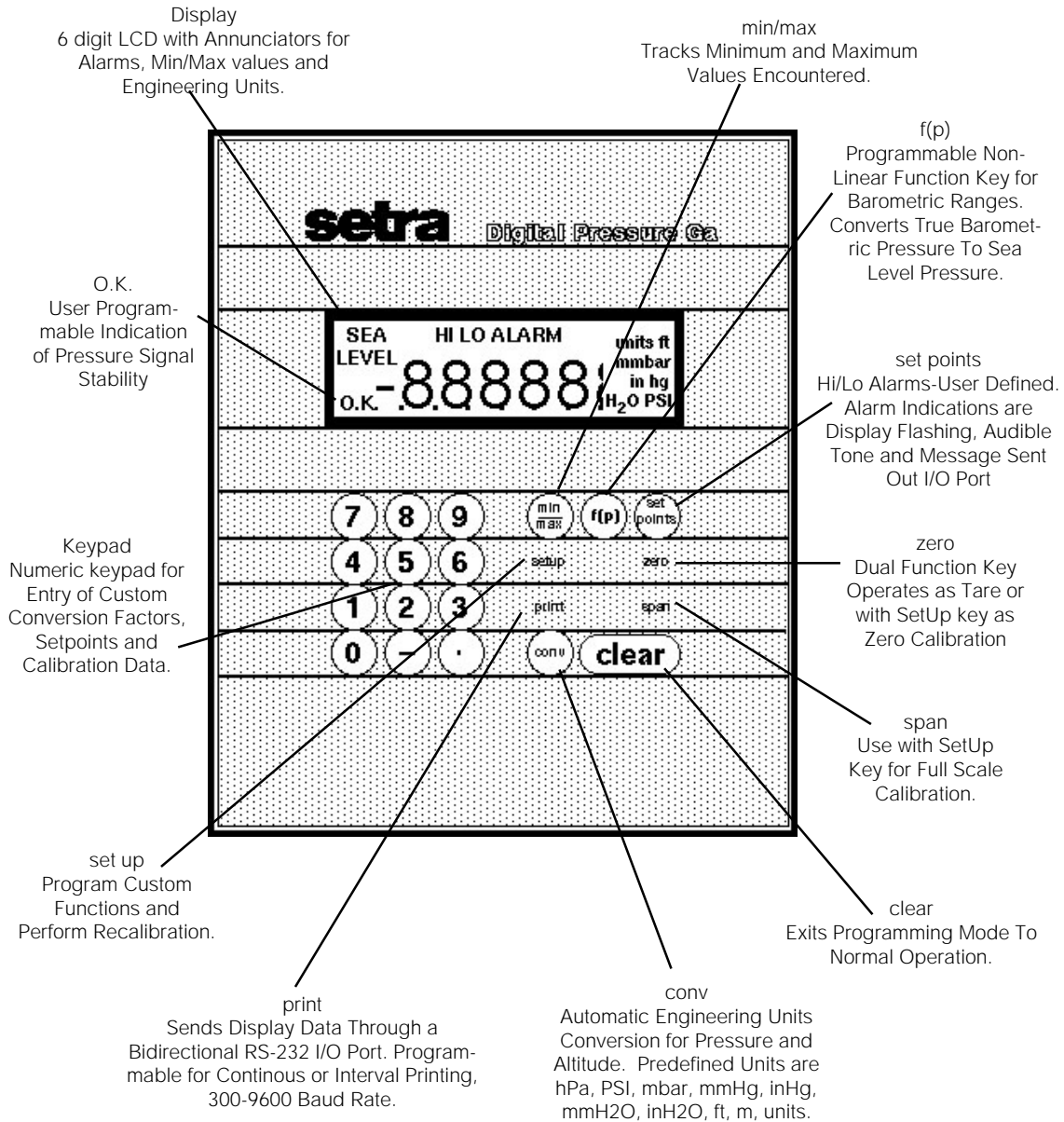
#### ***PRESSURE CONNECTIONS***

The Model 370 provides a standard 1/8 NPT female pipe thread pressure port with filter, for connection to a variety of available fittings. The pressure gage is rated for clean dry gas (nonconductive/noncorrosive).

The Proof Pressure of the Model 370 (the maximum pressure which can be applied without disturbing the calibration of the gage) is 150% of the full scale pressure. To ensure that the pressure applied to the gage does not exceed the proof pressure, properly rated relief valves should be installed in any system this gage is connected to.

That's all there is to installation. It is important that you read this User's Guide thoroughly to ensure proper use of the gage. The summary of Functions in the next Section serves as a handy reference.

# Portability and Accuracy Right Where You Need It



## Section Two SUMMARY OF FUNCTIONS

### 2.1 KEYBOARD FUNCTIONS

- print** Send information to a printer or other peripheral.
- conv** Convert engineering units being displayed.
- set points** Display HI and Lo Alarm setpoints.
- zero** Enter relative or absolute tare value.
- min max** Display minimum and maximum value encountered.
- clear** Clear the number or key sequence being entered or displayed.
- f(p)** Convert true pressure to SEA-LEVEL pressure (absolute pressure).
  
- setup print** Send status summary to a printer or other peripheral.
- setup set points** Change Hi and Lo Alarm setpoints.
- setup min max** Enter MIN/MAX tracking mode.
- min max** Exit MIN/MAX tracking mode.
- setup zero** Perform ZERO calibration procedure.
- setup span** Perform SPAN calibration procedure.
  
- clear** Clear the display, turn off MIN/MAX, clear the tare value, convert to display the units the gage was calibrated in.

## **2.2 DISPLAY SYMBOLS**

|                 |   |
|-----------------|---|
| <b>OK</b>       | The readings are within the user defined stability requirement. |
| <b>hPa</b>      | The reading shown is given in hectopascals.                     |
| <b>PSI</b>      | The reading shown is given in pounds per square inch.           |
| <b>inHg</b>     | The reading shown is given in inches of mercury.                |
| <b>mbar</b>     | The reading shown is given in millibars.                        |
| <b>mmHg</b>     | The reading shown is given in millimeters of mercury.           |
| <b>inH2O</b>    | The reading shown is given in inches of water.                  |
| <b>mmH2O</b>    | The reading shown is given in millimeters of water.             |
| <b>ft</b>       | The reading shown is given in feet of altitude.                 |
| <b>m</b>        | The reading shown is given in meters of altitude.               |
| <b>SEALEVEL</b> | The reading shown is corrected to sea level.                    |
| <b>units</b>    | The reading shown is given in user-defined pressure units.      |
| <b>HI ALARM</b> | The reading shown exceeds the HI setpoint.                      |
| <b>LO ALARM</b> | The reading shown exceeds the LO setpoint.                      |
| <b>HI</b>       | The reading shown is the maximum value encountered.             |
| <b>LO</b>       | The reading shown is the minimum value encountered.             |

### **2.3 DISPLAY MESSAGES**

- UnAbLE**        The gage is unable to execute the requested function in its current configuration. Clear the display and continue.
- OFLO**            The display is over-ranged because excess pressure is applied or because the user-defined conversion exceeds the number of digits available in the display.
- FLASHING  
DISPLAY**        The pressure applied exceeds the rated range of the sensor.
- BUSY**            The gage is acquiring a stable reading.

Other messages which are displayed in the course of using the various functions of the Model 370 are explained in the sections of the manual concerning those functions.

## Section Three

### DIGITAL PRESSURE GAGE FUNCTIONS

#### **3.1 ENTERING A NUMBER OR FUNCTION**

To enter a number or function, simply press the key or keys which correspond to the numbers or functions you wish to enter.

#### **3.2 CLEARING A NUMBER OR FUNCTION**

To clear a function or number you have begun to enter, press the **CLEAR** key. This automatically returns the gage to display mode, without affecting any other functions which may be in use.

To reset the Model 370 to its power up condition, press "-", then **CLEAR**. This clears the zero/tare value, shuts off MIN/MAX, and converts back to the original engineering units. All of these functions are described in later sections of this guide.

#### **3.3 IF YOU MAKE A MISTAKE**

If you mis-enter a number or enter a number or function the gage cannot accept, the display will read "UnAbLE". Press **CLEAR** to resume normal display, and re-enter the number or function.

### **3.4 CONVERTING ENGINEERING UNITS**

The Model 370 will measure pressure in any engineering units, including six built-in pressure conversions, two built-in altitude conversions, and a user definable conversion.

To convert from one unit to another, simply press the **CONV** key repeatedly until the units you want are in the display. The order of units is as follows: hPa - PSI - mbar - mmHg - inHg - mmH2O - inH2O - ft - m - units. To return directly to the units the gage was calibrated in, press "-" then **CONV**.

See Section 4.1 for instructions on the use of user-defined units ("units"), or Section 5 for displaying altitude.

### **3.5 TRACKING MIN AND MAX VALUES**

To use the Model 370 to track the minimum and maximum pressures applied to the sensor, enter the tracking mode by pressing **SETUP**, then **MIN/MAX**.

To examine the values stored, press **MIN/MAX**. The gage will display "HI" and the maximum value encountered for about three seconds, then will display "LO" and the minimum value encountered for about three seconds, and then will revert to normal display.

To shut off the min/max tracking mode, press "-", then **MIN/MAX**.

If the **MIN/MAX** key is pressed without having first entered the MIN/MAX tracking mode as described above, the display will read "UnAbLE". Press **CLEAR** and then follow the above procedure.

### **3.6 SETTING AND USING ALARM SETPOINTS**

The Model 370 has an alarm capability which will indicate when the pressure applied has exceeded a high or a low setpoint. The annunciators are an audible tone, a display message of "HI ALARM", and a message sent through the communications port.

To examine the current value of the setpoints, press **SETPOINTS**. The gage will display "HI ALARM" and the high setpoint for about three seconds, then will display "LO ALARM" and the low setpoint for about three seconds, and then will revert to normal display.

To enter new setpoints, convert to the engineering units you wish to use, and decide what values you will enter in the following procedure. Entering a value which is too high or too low will cause the display to read "UnAbLE". If this happens, press **CLEAR** to resume normal display mode.

1. Press **SETUP**, then **SETPOINTS**. The display will show "HI ALARM" and the current high setpoint.
2. Now you can enter a new high setpoint by entering a number. To keep the current setpoint without changing it, proceed to the next step without entering a new number.
3. Press **SETUP**. The Model 370 will accept the number in the display as the high setpoint, and immediately show "LO ALARM" and the low setpoint.
4. Enter a new low setpoint, or to keep the current low setpoint, proceed to the next step without entering a number.
5. Press **SETUP**. The number in the display will be accepted as the low setpoint, and the gage will revert to its normal display.

The factory setting for the high setpoint is 105% of the pressure range, and the low setpoint is 5% below the pressure range. To effectively disable the alarm setpoints, reset them to these values using the above procedure for entering setpoints.

### **3.7 USING THE TARE AND ZERO FUNCTION**

The TARE function on the Model 370 gives you a way of setting the displayed reading to zero or of subtracting a specified offset so that you can monitor changes in pressure relative to a known starting point. This is done by creating a tare value which will be subtracted before each updated reading is displayed.

To set the display to zero, press **ZERO**. The gage will save the reading in the display as the tare value, and will subtract that value from every subsequent reading before displaying it.

To subtract an offset from the display, enter the amount of the offset and press **ZERO**.

To add an offset to the display, press "-", then enter the amount of the offset and press **ZERO**.

To restore the normal display, press "-", then press **ZERO**. The gage will set the tare value to zero and resume displaying pressure in whatever engineering units are selected.

If you enter a number which will result in a reading requiring more digits than are available in the display, the display will show "OFLO". Press **CLEAR** to resume normal display.

### **3.8 PRINTING INFORMATION**

Your Setra Digital Pressure Gage is designed to print information when connected to the optional Setra Model 240P printer, using the following procedure:

1. Set the printer up as described in its' manual.
2. Connect the RS-232 cable from the printer to the Model 370.
3. Make sure the printers on-line light is on.
4. Press **PRINT** to send the reading in the Model 370 display to the printer.

NOTE: When using a printer other than the Setra 240P, set the baud rate of the gage to match that of the printer (see Appendix I).

To interpret the meaning of the symbols printed, see Appendix III - "RS-232 Serial Data Communications".

### **3.9 REPETITIVE PRINTING**

It is sometimes desirable to record pressure measurements at fixed intervals of time. To print at fixed intervals, follow this procedure:

1. Connect a printer as outlined in Section 3.8.
2. Enter the number of seconds between readings.
3. Press **PRINT**. The gage will print out a reading at the specified interval.
4. To cancel repetitive printing, press "-" then **PRINT**.

To interpret the meaning of the symbols printed, see Appendix III - "RS-232C Serial Data Communications."

Most printers, including the Setra 240P, are equipped with a buffer which allows them to receive information at high speed from the gage, and print it at the slower speed of the printer.

Using repetitive print mode with a printer which is not equipped with a buffer may cause a "Q-OFLO" message to be printed, indicating that the printer cannot accept information at the rate it is being sent. There are three solutions to this problem; either make the repetitive print interval longer, use a printer equipped with a buffer, or set the communications baud rate on both the gage and the printer as slow as possible (300 baud, for instance).

### **3.10 PRINTING SYSTEM STATUS**

To get a summary of the condition of all active functions, press **SETUP**, then press **PRINT**. A sequence of information will be printed indicating the range of the gage and the status of any functions which are currently in use, as shown in this example.

#### STATUS

|           |             |
|-----------|-------------|
| ELEV:     | 256 FT      |
| MAX:      | 14.4193 PSI |
| MIN:      | 14.5188 PSI |
| HI ALARM: | 15.8000 PSI |
| LO ALARM: | 11.0000 PSI |
| ZERO:     | 1.0000 PSI  |
| UNIT:     | 689.47 PSI  |

The actual messages will vary depending on which functions are in use.

### **3.11 INTERFACING WITH A COMPUTER**

Your Setra Digital Pressure Gage is designed to interface with a wide variety of computers. If your gage is connected to a computer, you can transmit information to the computer using the simple procedure given for "Printing Information."

For more advanced and versatile print functions, see Appendix III - "RS-232 Serial Data Communications."

## Section Four

# ADVANCED PRESSURE GAGE FUNCTIONS

### 4.1 **USER DEFINED ENGINEERING UNITS**

The Setra Digital Pressure Gage has several built-in engineering units conversions which are accessed simply by pressing **CONV**. If you want to display pressure in units other than those provided, use the following procedure.

Units can be directly changed by entering a factor (number to multiply by) or a divisor (number to divide by) and will be indicated in the display by "units".

1. Calculate the ratio you wish to enter. If your ratio is in the form of PSI per "UNITS", inHg per "UNITS", mbar per "UNITS", etc., you will enter a divisor. Proceed with steps 2 through 5.
2. Press **CONV** until the display reads in the known units from which you wish to convert.
3. If you are entering a divisor, press "-". If you are entering a factor, proceed to step 4.
4. Enter the conversion ratio.
5. Press **CONV**. The gage is now displaying pressure in the unit specified by the conversion ratio, and the "units" symbol.

The conversion ratio will be saved and used for the user-definable engineering units until you enter a new ratio, even if the power is shut off and turned back on.

To convert back to the built-in engineering units, press "-", then **CONV**.

When you execute this function through the RS-232 port instead of the keyboard, you can specify the symbol for the engineering units which will be reported through the port in response to the **PRINT** command.

1. If the ratio is a divisor, transmit the minus symbol, "-". If you are entering a factor, proceed to step 2.

2. the conversion ratio;
3. the command **U**, for CONVERT UNITS;
4. any combination of 5 alphanumeric characters, including spaces, to identify the engineering units.

For example, if the transducer is currently reporting in PSI and the desired units are grams per square centimeter the ratio is 70.307g/cm<sup>2</sup> per psi (a multiplier. Transmit:

70307Ug/cm<sup>2</sup>

the 370 will now report in g/cm<sup>2</sup> to an interrogation. The conversion ratio will be saved and used for the user definable engineering units until a new ratio is entered, even if the power is shut off and turned back on.

#### 4.2 DIGITAL ALTIMETER SETTING INDICATOR

The Model 370 may be used to display corrected sea-level pressure by "reducing" true barometric pressure at a known elevation to what the pressure would be at sea-level at the same latitude and longitude.

This function is only available on gages with barometric or absolute pressure sensors.

Before using the "SEA LEVEL" correction mode, you must first determine and enter the station elevation, which is the altitude above sea level at which the gage is installed.

1. Press **CONV** until the gage is displaying pressure units (make sure it is not displaying in "ft" or "meters").
2. Press "-", then **Clear** to make sure the tare/zero registers are empty.
3. Press **SETUP**, then press **f(p)**. The display will read "CAL FP".
4. Enter the station elevation and press **SETUP**. The display will read "units ft".
5. Press **CONV** to select the units of elevation, either "ft" or "meters".
6. Press **SETUP**. The gage will accept the station elevation and display "SEA LEVEL" corrected pressure.

Once you have entered that station elevation, you can switch quickly and easily from true barometric pressure to corrected sea level pressure and back by pressing **f(p)**.

The terms "Station Elevation" and "Reduction of Pressure" have very specific meanings in the jargon of Altimeter Setting Indicators and the actual calculations performed by the Model 370 are fairly complex. For further details, consult: "Smithsonian Meteorological Tables, Vol. 114", NACA Report #1235, or contact a Setra Applications Engineer.

NOTE: When the **f(p)** key is pressed in order to begin displaying pressure corrected to sea level, the zero/tare value described in Section 3.7 is cleared automatically to assure that absolute sea level pressure is displayed.

## Section Five

### DISPLAYING ALTITUDE

The Model 370 Digital Pressure Gage can be used to display a variety of altitude measurements. It may be used as an altimeter calibrator, a standard altimeter, a true corrected altimeter (self corrected or remote), or as a relative altimeter. It may be used to indicate small relative changes in altitude through the use of the zero/tare function.

This function is only available on gages having absolute or barometric pressure sensors.

#### **5.1 ALTIMETER CALIBRATOR, STANDARD ALTIMETER**

To indicate standard altitude with the Model 370, follow this procedure.

1. Clear the zero/tare register by pressing "-" then **ZERO**.
2. If the display is in "SEA LEVEL" press **f(p)** so that it is not in seal level mode.
3. Press **CONV** until the display is in "feet" or "meters".

The gage is now displaying altitude as a function of the Standard Atmosphere Curve. For a copy of the data which describes the Standard Atmosphere, consult: NACA Report 1235, or "Smithsonian Meteorological Tables, Vol. 114".

Note: This display of standard altitude will not coincide with the actual elevation. See the next section, "Displaying True Altitude" in this guide.

## 5.2 **DISPLAYING TRUE ALTITUDE**

The Model 370 can function as an altimeter displaying true altitude by correcting the above Standard Atmosphere conversion for the local barometric pressure. This correction can be setup two ways.

If you are starting at a known station elevation, use the following procedure:

1. Press **CONV** until the gage is displaying pressure units (make sure not to select "ft" or "meters").
2. Press **SETUP**, then press the **f(p)** key. The display will read "CAL FP".
3. Enter the station elevation and press **SETUP**. The display will read "units ft".
4. Press **CONV** to select the desired units of elevation, either "ft" or "meters".
5. Press **SETUP**. The gage will accept the station elevation and display "SEA LEVEL" corrected pressure (as in Section 4.2).
6. Press the **ZERO** key. The display indicates the difference between the current pressure and the sea level pressure.
7. Press the **CONV** key until the desired altitude units (ft or meters) appear in the display. The display will now indicate the true altitude above sea level.
8. The gage is now functioning as a corrected altimeter, and will indicate true altitude as it is moved from one location to another.

**CAUTION:** In any true altimetry application, the accuracy of the measurement is dependent on the quality of the correction made for local barometric pressure.

Barometric pressure changes often, and so then reading will drift over time as the sea level corrected pressure drifts. To recalibrate the true altimeter, repeat the above procedure at a known starting elevation often.

If you are not at a known elevation, the gage may be used in true altimeter mode by obtaining an Altimeter Setting Indication (sea level corrected pressure) from a local airport or weather station, and following this procedure:

1. Press the **CONV** key until the engineering units of the known sea level pressure appears in the display.
2. Enter the known seal level pressure and press **ZERO**. The difference between the sea level pressure and the current pressure is displayed.
3. Press **CONV** until the desired altitude units of measure are displayed.
4. The gage is now functioning as a corrected altimeter, and will display true altitude as it is moved from one location to another.

**CAUTION:** In any true altimetry application, the accuracy of the measurement is dependent on the quality of the correction made for local barometric pressure.

Distance from the reporting station and elapsed time from the measurement will greatly affect the accuracy of the altitude measurement as barometric pressure changes. Repeat the above procedure as often as new ASI data is available.

### **5.3 MEASURING RELATIVE ALTITUDE**

To measure relative altitude in either Standard or True Altimeter Mode, a reference altitude may be established by setting the displayed reading to zero, or by offsetting it by a specified amount entered as a tare value.

1. Use one of the above procedures to display either Standard or True Altitude.
2. To set the displayed reading to zero, press **ZERO**.
3. To subtract an offset from the display, enter the amount of the offset and press **ZERO**.
4. To add an offset to the display, press "-", then enter the amount of the offset and press **ZERO**.
5. The gage is now displaying altitude relative to the reference point, and will indicate changes in altitude as it is moved from one location to another.

**CAUTION:** In any true altimetry application, the accuracy of the measurement is dependent on the quality of the correction made for local barometric pressure.

Barometric pressure changes often, and so the reading will drift with time as the sea level corrected pressure drifts. To compensate for this effect, repeat the above procedures often.

## Appendix I

### SETUP FUNCTIONS

#### I.1 **FORMATTING BAUD RATE**

The Setra Digital Pressure Gage is capable of interfacing with a wide variety of computers or other devices through the RS-232 serial communications port. Devices which are connected this way must be set up to communicate at the same rate of speed.

To change the baud rate of the gage (the rate at which the gage sends information out through the port) so it agrees with that of the device connected to it, use the following procedure.

1. Press **CONV** until the gage is displaying pressure units (make sure it is not displaying in "ft" or "meters").
2. Press the "-" key.
3. Enter "5555". This is the baud rate access code.
4. Press **SETUP**. The display will read "CAL br".
5. Enter the baud rate. Choose either 300, 600, 1200, 1800, 2400, 3600, 4800 or 9600.
6. Press **SETUP**.

The baud rate is factory set to 2400. If you change the baud rate and wish the gage to retain the new rate after power is removed and restored, repeat steps 2-6 a second time.

## ***I.2 DISABLING THE BEEPER***

The gage emits a tone to verify the entry of a number or function. To disable the tone for silent operation, use the following procedure:

1. Press **CONV** until the gage is displaying pressure units (make sure it is not displaying in "ft" or "meters").
2. Press the "-" key.
3. Enter "9999". This is the beeper access code.
4. Press **SETUP**. The beeper is disabled.

To reactivate the beeper, repeat Steps 2-4.

## ***I.3 STABILITY INDICATOR***

The "OK" symbol is an indication of the stability of the pressure being applied to the sensor. "OK" is displayed whenever the pressure is changing by less than the Stability Indicator Limit from the last display update to the next.

The Stability Indicator Limit may be used when the Model 370 is serving as a Secondary Pressure Standard, to ensure that calibration pressures being applied to another device are accurate and stable within a given amount. For example, to indicate whether a pressure of 15 PSI is stable to within  $\pm 1$  PSI, the Stability Indicator Limit would be set to .1 PSI.

To change the Stability Indicator Limit, use the following procedure:

1. Press **CONV** until the gage is displaying pressure units (make sure it is not displaying in "ft" or "meters").
2. Press **CONV** until the gage is displaying the desired engineering units.
3. Press the "-" key.
4. Enter "1111". This is the Stability Indicator access code.
5. Press **SETUP**. The display will read "CAL Sb"
6. Enter the stability requirement in the specified engineering units and press **SETUP**. The gage will return to normal display, using the newly entered stability requirement as the criterion for displaying the "OK" symbol.

The stability requirement will remain in place until it is modified again, even if the power is removed and restored to the gage.

#### ***I.4 OMITTING ENGINEERING UNITS***

Some applications may require frequent switching from one engineering unit to another. The Model 370 can be setup to omit one or more of the built-in engineering units to reduce the number of times **CONV** must be pressed to get from one unit of measure to the next.

1. Press **CONV** until the gage is displaying pressure units (make sure it is not displaying in "ft" or "meters").
2. Press the "-" key.
3. Enter "2222". This is the Engineering Units access code.
4. Press **SETUP**. The display will read "CAL U".
5. Press **SETUP**. The display will read "1 or 0 units".
6. Enter "1" if you wish to include "units" (the user definable unit of measure) or "0" if you wish to omit it.
7. Press **SETUP**. The display will read "1 or 0 hPA".
8. Enter "1" if you wish to include "hPa" or "0" if you do not.
9. Press **SETUP**.
10. Repeat steps 6 & 7 until all units have been selected or omitted.

If is necessary for at least one pressure unit to be used. If no units of measure are selected, the gage will display "UnAbLE". Press **CLEAR** and start over.

#### ***I.5 SOFTWARE REVISION NUMBER***

To check the software revision number, use this procedure:

1. Press **CONV** until the gage is displaying pressure units (make sure it is not displaying in "ft" or "meters").
2. Press the "-" key.
3. Enter "7777" and press **SETUP**.
4. The display will read "rEF" and the revision reference number of the system software. Press **CLEAR** to restore normal display mode.

## ***1.6 SELF DIAGNOSTICS***

The Model 370 has a built-in self diagnostic procedure. This procedure prompts an operator to verify that the gage is fully operational, (but does not verify proper calibration), by checking the keyboard, the keyboard decoder, the display, and a checksum test on internal memory.

1. Press **CONV** until the gage is displaying pressure units (make sure it is not displaying in "ft" or "meters").
2. Press the "-" key.
3. Enter "8888". This is the Diagnostic access code.
4. Press **SETUP**. The display will read "d-noS".
5. Press **SETUP**. The display should read "do CLr".
6. Press **CLEAR**. The display should read "do CON".
7. Press **CONV**. The display should read "do FP".
8. Press **F(p)**. The display should read "do 3".
9. Press "3". The display should read "do 4".
10. Press "4". The display should read "do 8".
11. Press "8". The display should read "bUSY".
12. Wait until the display reads "PASS".
13. Press **SETUP**. All segments of the display should be lit.
14. Press **SETUP** and wait a few seconds. The gage should perform its power-up internal self test and return to normal display mode.

In the unlikely event that an error message appears, repeat the test procedure to determine that the proper key was pressed for each prompt. To restart the test procedure after an error message has been displayed, power to the gage must be turned off and back on. If the last diagnostics routine performed was not completed successfully, the gage will automatically return to the "d-noS" prompt, and the above procedure should be executed starting at Step 5.

If a problem persists, contact a Setra Applications Engineer for assistance.

## Appendix II

### CALIBRATION

The zero and span of the Model 370 Digital Pressure Gage may be calibrated using the following procedures. A high accuracy primary pressure standard is recommended as the calibration source, since the high accuracy of the Model 370 will be adversely affected if the calibration pressure is not of equal or greater accuracy.

The calibration procedure will require the same pressures, in the same engineering units (usually PSI), as were originally calibrated at the factory.

During calibration, note that the gage will display a prompt message, not the actual pressure applied, and cannot be used to monitor the pressure input during the calibration procedure.

#### **II.1 ZERO CALIBRATION**

1. Make certain the gage is in a stable temperature environment for several hours before calibration.
2. Press **SETUP**, then press **ZERO**. The display will read "APPLY" and the pressure required for zero calibration.
3. Apply the indicated pressure from a high accuracy standard.
4. Press **SETUP**. The gage will take data, adjust its zero calibration, and return to normal display mode.

If the new zero data is too far from the factory calibration, the gage will display "UnAbLE". Verify the applied pressure. If it is correct, contact a Setra Applications Engineer for assistance.

## **II.2 SPAN CALIBRATION**

To perform the span calibration on the Model 370, it is necessary to apply both the zero and the full scale pressures, as in the following procedure:

1. Make certain the gage is in a stable temperature environment for several hours before calibration.
2. Press **SETUP**, then press **SPAN**. The display will read "APPLY" and the pressure required for *zero* calibration.
3. Apply the indicated pressure from a high accuracy standard.
4. Press **SETUP**. The display will read "APPLY" and the pressure required for *full scale* calibration.
5. Apply the indicated pressure from a high accuracy standard.
6. Press **SETUP**. The gage will take data, adjust its' zero and span calibrations, and return to normal display mode.

If the new zero and full scale data is too far from the factory calibration, the gage will display "UnAbLE". Verify the applied pressures. If they are correct, contact a Setra Applications Engineer for assistance.

## **Appendix III**

### **RS-232 SERIAL DATA COMMUNICATIONS**

The Setra Model 370 Digital Pressure Gage is equipped with a bidirectional RS-232 interface which allows communications between the gage and other devices which are also equipped with an RS-232 interface.

This section provides detailed technical information showing how to operate the Model 370 remotely from a computer.

To perform printing operations to a serial printer, Section 3.7 "Printing Information" and Appendix I.2 "Formatting Baud Rate" provide the necessary information.

#### ***III.1 INTERFACING THE MODEL 370 TO A COMPUTER***

The bidirectional serial interface allows the gage to transmit information to a printer, computer, or terminal. It also allows the computer or terminal to send commands to the gage, duplicating the functions of the front keypad.

Any computer or terminal with an RS-232 serial port can be connected to the gage. The baud rates of the gage and the computer must be set identically. (see Appendix I.2 - "Formatting Baud Rate").

### III.2 SENDING COMMANDS TO THE GAGE

All the functions of the Model 370 may be executed by sending the appropriate command from the computer to the gage. The commands are standard alphabetic characters which correspond to keys on the front keypad of the gage. The table below also lists the ASCII and hexadecimal values of the codes for those interested in more technical programming.

| FUNCTION  | CODE | ASCII | HEX  | FUNCTION | CODE | ASCII | HEX  |
|-----------|------|-------|------|----------|------|-------|------|
| Setup     | S    | 83    | \$53 | 0        | 0    | 48    | \$30 |
| Clear     | C    | 67    | \$43 | 1        | 1    | 49    | \$31 |
| Conv      | U    | 85    | \$55 | 2        | 2    | 50    | \$32 |
| Min/Max   | M    | 77    | \$4D | 3        | 3    | 51    | \$33 |
| F(p)      | B    | 66    | \$42 | 4        | 4    | 52    | \$34 |
| Setpoints | A    | 65    | \$41 | 5        | 5    | 53    | \$35 |
| Zero      | Z    | 90    | \$5A | 6        | 6    | 54    | \$36 |
| Span      | F    | 70    | \$46 | 7        | 7    | 55    | \$37 |
| Print     | P    | 80    | \$50 | 8        | 8    | 56    | \$38 |
| —         | —    | 45    | \$2D | 9        | 9    | 57    | \$39 |
| .         | .    | 46    | \$2E |          |      |       |      |
| Verify    | V    | 86    | \$56 |          |      |       |      |

To execute a command, send the appropriate character code from the terminal or computer to the pressure gage.

For example, to interrogate the gage for a pressure reading, send from a terminal (or create a computer program which will send) the letter "P" through a serial port to the gage. The gage will receive the "P" and execute the print function. That is, it will transmit the reading in the display through its serial port back to the computer or terminal.

It is not necessary to transmit a carriage return or line feed character to the gage after a command character.

### III.3 RECEIVING DATA FROM THE GAGE

There are several types of messages which the gage may send in response to the various commands.

The immediate response to the **PRINT** command interrogation is the most common message. It is a string of characters consisting of the reading on the display and other information.

The format of that string of characters is shown below:

```
-----  
+ 1 2 3 . 4 5 6 units  A  OK SEA LEVEL cr lf  
-                               G  
                               T  
-----
```

The first character is the sign, next are 7 digits (including the decimal point) followed by a blank space. Next are six characters, including some spaces, which signify the engineering units, followed by another space, the symbol indicating (A)bsolute, (G)auge, or (T)ared pressure, and another space. This is optionally followed by the OK symbol (if the OK symbol on the display is on), and optionally followed by SEA LEVEL if in sea level correction mode. The string is ended with a carriage return and line feed character.

Other potential messages are "UnAbLE", "SET-UP", and "CAL" appearing in response to the various functions and situations described in other sections of this guide. See Section 3.10 for an example of the system status message sent in response to **SETUP PRINT**.

#### **III.4 IMMEDIATE AND REPETITIVE PRINT MODES**

Two print modes are available on the Model 370, as discussed in Sections 3.8 and 3.9.

The immediate print interrogation, used in the example above, is the preferred method of getting pressure data to a computer program.

The repetitive print mode is intended for sending data to a printer or data logger at a time interval which is user definable (Section 3.9).

#### **III.5 VERIFY FUNCTION**

To identify the Setra Digital Pressure Gage when it is connected remotely to a computer, send the command character "V" (for verify). The gage will respond with a message like the one shown below .

SETRA DIGITAL PRESSURE GAGE MODEL 370  
11.0000 TO 16.0000 PSI A

#### **III.6 STATUS AFTER POWER IS APPLIED**

The Setra Digital Pressure Gage has an internal nonvolatile memory for storing certain status and calibration information. This memory is not erased when power is removed from the unit. All setup functions (such as baud rate and alarm setpoints) and user conversion factors are stored in the memory, so that once they are setup, they do not need to be setup again unless you wish to change the configuration.

Some of the functions default to "not in use" when the power is turned on; MIN/MAX tracking will be off, the zero/tare value will be zero, and the f(p) function will be off.

During the first thirty seconds of operation, the gage will execute an internal self-diagnostic procedure. When the gage is ready for use, it will transmit the "Verify" message shown above.

### III.7 RS-232 INTERFACE HARDWARE

The RS-232 Communication Standard describes in detail the requirements and conventions of RS-232.

For most applications, the information given here is sufficient to solve any problems.

The Setra Digital Pressure Gage implements the majority of the RS-232 communications standard, but does not provide handshaking lines (such as busy, DSR, or DTR).

The four lines which must be connected are diagrammed below, along with the pin layout of the female connector on the back of the gage.

|    |   |       |     |                        |
|----|---|-------|-----|------------------------|
| 13 | 7 | 3 2 1 | PIN | DESC.                  |
| ○  | ○ | ○     | 1   | Protective ground      |
| ○  | ○ | ○     | 2   | Input to gage (RXD)    |
| ○  | ○ | ○     | 3   | Output from gage (TXD) |
| 25 |   | 14    | 7   | Signal ground          |

The Model 370 serial interface is a DCE (Data Communications Equipment) type, with a standard female DB25S pin connector. This means that it receives data on pin 2 and sends data on pin 3. This is in contrast to DTE (Data Transmission Equipment) which receives data on pin 3 and sends data on pin 2. The RS-232 standard describes communications between DTE and DCE devices.

Since many computers have serial ports configured as DTE, the Model 370 conveniently plugs directly into the standard serial port on most computers, using a standard RS-232 "straight-through" cable available from SETRA, or from any computer hardware vendor.

Some devices, including some printers and computers, will be equipped with DCE interfaces like that in the Model 370. To connect the Model 370 to these devices, a "null modem" cable is required. This is simply a cable which connects pin 2 and 3 of the Model 370 to pin 3 and 2 of the other device respectively by crossing them in the cable. This kind of cable is also available from SETRA, or from any computer hardware vendor.

The maximum recommended cable length is 15 meters.

The RS-232 data format used by the Model 370 is :

- 8 bits
- 1 start bit
- 1 stop bit
- no parity.

For more information, consult RS Standard RS-232, or contact a SETRA Applications Engineer.

## **Appendix IV ACCESSORIES AND OPTIONS**

### ***IV.1 BATTERY / RECHARGER OPTION***

The Model 370 Digital Pressure Gage can be operated as a portable instrument with the battery/recharger option. The battery option is designed to allow a standard 8 hour workshift, followed by a 16 hour recharge cycle.

The battery option is a rechargeable 12 VDC Nicad battery, and an automatic internal battery charger which functions whenever the gage is plugged into an AC outlet. Also included in the battery option are an on/off switch and the required internal wiring.

#### ***OPERATION***

The battery is shipped from the factory in a low charge condition. Before use, plug the gage into AC power for 16-24 hours to allow a complete charge of the battery to take place.

The high capacity Nicad batteries are rated for more than 1,000 charge/discharge cycles. As with any Nicad, the life and performance of the battery pack can be extended by following the suggested usage guidelines, that is, allow the battery to run and discharge for 8 continuous hours before recharging it for a minimum of 16 hours.

The battery is automatically trickle charged whenever AC power is present. There is no danger of overcharging the battery so no other precautions are necessary.

Setra also offers replacement or spare battery packs and an external recharger for applications where battery operation is desired for longer than 8 hours. A battery pack may be externally charged and then placed in the gage.

#### ***REPLACING THE BATTERY PACK***

1. Disconnect the AC power cord.
2. Place the gage face down on a clean flat surface.
3. Remove the 3 screws which hold the back cover in place and remove the cover.
4. Do not remove any other screws, opening the sensor cavity will affect calibration.
5. The battery is the block with the yellow plastic cover. Unplug its' cord from the receptacle in the housing.
6. Remove the battery by lifting up and back (the battery is "L" shaped).
7. Replace the new battery by reversing the above steps.

#### ***IV.2 IN CASE OF DIFFICULTY***

If a problem persists which cannot be solved by reading the appropriate sections of this manual, contact a SETRA Applications Engineer for assistance at the toll free number: 1-800-257-3872

#### ***IV.3 OPTIONS***

1. Internal rechargeable battery pack.
2. 19 inch rack mount kit.

# Models 370 Specifications

## Pressure Ranges

| Type of Pressure | Pressure Range     | Readout or Report | Altitude Range <sup>1</sup> |
|------------------|--------------------|-------------------|-----------------------------|
| Barometric       | 600 to 1100 hPa/mb | 600.00 to 1100.00 | -1000 to 13,800 ft.         |
|                  | 800 to 1100 hPa/mb | 800.00 to 1100.00 | -1000 to 6,400 ft.          |
| Absolute         | 0 to 10 psia       | 10.0000           | 10,300 to 100,000 ft.       |
|                  | 0 to 20 psia       | 20.0000           | -1000 to 100,000 ft.        |
|                  | 0 to 50 psia       | 50.0000           | -1000 to 100,000 ft.        |
|                  | 0 to 100 psia      | 100.0000          | -1000 to 100,000 ft.        |

Proof Pressure: 150% of full scale pressure range

Pressure Media: Clean dry air or other gases (non-condensable)

## Performance Data

|                                    |  |
|------------------------------------|--|
| Accuracy <sup>2</sup>              | $\pm 0.02\% \text{ FS}^3$ at 70°F (21°C) |
| Non-Linearity                      | $\pm 0.012\% \text{ FS}$ (End Point)     |
| Hysteresis                         | 0.010% FS                                |
| Non-Repeatability                  | 0.010% FS                                |
| <u>Thermal Effects<sup>4</sup></u> |  |
| Compensated Range °F (°C)          | +32 to +110 (0 to +45)                   |
| Zero Shift %FS/100°F (°C)          | 0.002 (0.004)                            |
| Span Shift %FS/100°F (°C)          | 0.001 (0.002)                            |
| Altitude Resolution                | 1 ft. (4 ft. for 100 psi range)          |
| Stability                          | 0.005% FS, 24 hours                      |
|                                    | 0.02% FS, 30 days                        |
|                                    | 0.05% FS, 1 year                         |

## Operating Power

Model 370 110/220 VAC (-10% to +20%), 50/60 Hz, optional 12 VDC internal rechargeable battery pack (approx. 8 hours between charges). Approximately 4 watts power consumption.

- Notes:**
- Altitude is calculated using a polynomial expression, which is derived from the standard atmosphere curve, and corrected to sea level by the methods outlined in "Smithsonian Meteorological Tables, Vol. 114". Ranges greater than 20 psia not recommended for altimeter certification.
  - RSS of Non-Linearity, Non-Repeatability and Hysteresis.
  - FS = 300 hPa/mb for 800-1100 hPa/mb range; 500 hPa/mb for 600-1100 hPa/mb range.
  - Unit calibrated at 70°F. Maximum thermal error is computed from this datum.

## Output Data

### Model 370

|                |   |
|----------------|---|
| Display        | 6 digit Liquid Crystal Display (LCD) with annunciators for pressure/altitude engineering units ( <b>PSI, mbar, hPa, mmHg, in.Hg, mmH<sub>2</sub>O, in.H<sub>2</sub>O, ft, m, units</b> ), <b>HI/LO ALARM</b> , pressure signal stability ( <b>O.K.</b> ) and barometric pressure corrected to sea level ( <b>SEA LEVEL</b> ). |
| Digital Output | Bidirectional RS-232 interface. All display data can be transmitted on the interface (Model 370) and all keyboard functions and commands can be duplicated using a remote terminal or keyboard.   |

## **Appendix V WARRANTY INFORMATION**

### ***V.1 LIMITED WARRANTY - PRESSURE PRODUCTS***

SETRA warrants its products to the original consumer purchaser against defects in materials and workmanship for a period of one year from the date of sale by SETRA, as shown in its shipping documents, subject to the following terms and conditions:

Without charge, SETRA will repair or replace products found to be defective in materials or workmanship within the warranty period provided that:

- a) the product has not been subject to abuse, neglect, accident, incorrect wiring not our own, improper installation or servicing, or use in violation of instructions furnished by SETRA;
- b) as to any prior defects in materials or workmanship covered by this warranty, the product has not been repaired or altered by anyone except SETRA or its authorized service agencies;
- c) the serial number or date code has not been removed, defaced or otherwise changed.
- d) examination discloses, in the judgement of SETRA, a defect in materials or workmanship which developed under normal installation, use and service;
- e) SETRA is notified in advance and approves the return, and the products return, and the products returned to SETRA transportation prepaid.

Setra does not assume the costs of removal and/or installation of the product or any other incidental costs which may arise as the result of any defect in materials or workmanship nor will SETRA be liable for consequential damages.

This warranty is in lieu of all other express warranties. Any warranty implied by law, including warranties of merchantability or fitness, is in effect only for the duration of the express warranties set forth above. No representative or person is authorized to give any other warranty or to assume for SETRA any other liability in connection with the sale of its products. SETRA will not be liable for any consequential damages resulting from the use or installation of its products.

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