MODEL 6150

USER'S MANUAL

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Document Number: 9052

Date: Mar.11, 2011.

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REVISION HISTORY

Document No.	Release Date	Description
9052	10/10/2008	Model 6150 User's Manual
9052	03/11/2011	Model 6150 Rev B1 User's Manual

WARNING

THE 6150 USES LINE VOLTAGES FOR ITS OPERATION WHICH ARE POTENTIALLY DANGEROUS. IMPROPER OPERATION OF THIS EQUIPMENT MAY RESULT IN PERSONAL INJURY OR LOSS OF LIFE. HENCE THE EQUIPMENT DESCRIBED IN THIS MANUAL SHOULD BE OPERATED ONLY BY PERSONNEL TRAINED IN PROCEDURES THAT WILL ASSURE SAFETY TO THEMSELVES, TO OTHERS AND TO THE EQUIPMENT.

BEFORE PERFORMING ANY MAINTENANCE, TURN THE POWER OFF AND DISCONNECT THE POWER CORD FROM THE POWER SOURCE.

ALWAYS USE A 3-PIN GROUNDED OUTLET AS YOUR AC POWER SOURCE

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SECTION 1

INTRODUCTION

The 6150 Digital Air Data and Leak Tester is a high accuracy Pitot Static Tester which can be used for performing leak checks on the Pitot and Static systems of all aircraft. It can also be used to perform accuracy checks on altimeters, airspeed indicators, air data computers and other air data related equipment on-board aircraft. However, such accuracy checks must be limited only to aircraft that are not RVSM compliant. The 6150 is **NOT** RVSM compliant. However, the relatively high accuracy (see specifications) of the 6150 makes it suitable for use to perform **only** leak-checks even on RVSM compliant aircraft.

The 6150 has powerful built-in pumps for vacuum and pressure. Altitudes and Airspeeds can be simulated on the Static and Pitot outputs by using the metering valves provide on the unit. There is no maintenance required on the 6150, other than the annual calibration.

The top panel of the 6150 is shown in Figure 1. The different components on the top panel, indicated by numbers in Figure 1, are explained below.

1. Static output port

This #4-AN port is normally connected to the Static port of the aircraft. As an option, this port can also be fitted with a #6-AN fitting.

2. Pitot output port

This #4-AN port is normally connected to the Pitot port of the aircraft.

3. AC input connector

This 3-pin circular connector accepts AC input power for the unit. AC power between 90-260 VAC and 47-440 Hz is suitable for the unit. Nominal power consumption is 70 VA.

4. AC Fuse

The AC input power is fused with a 1 amp slow-blow, 20 mm fuse.

5. ON/OFF switch

This is used to turn power to the unit, ON or OFF.

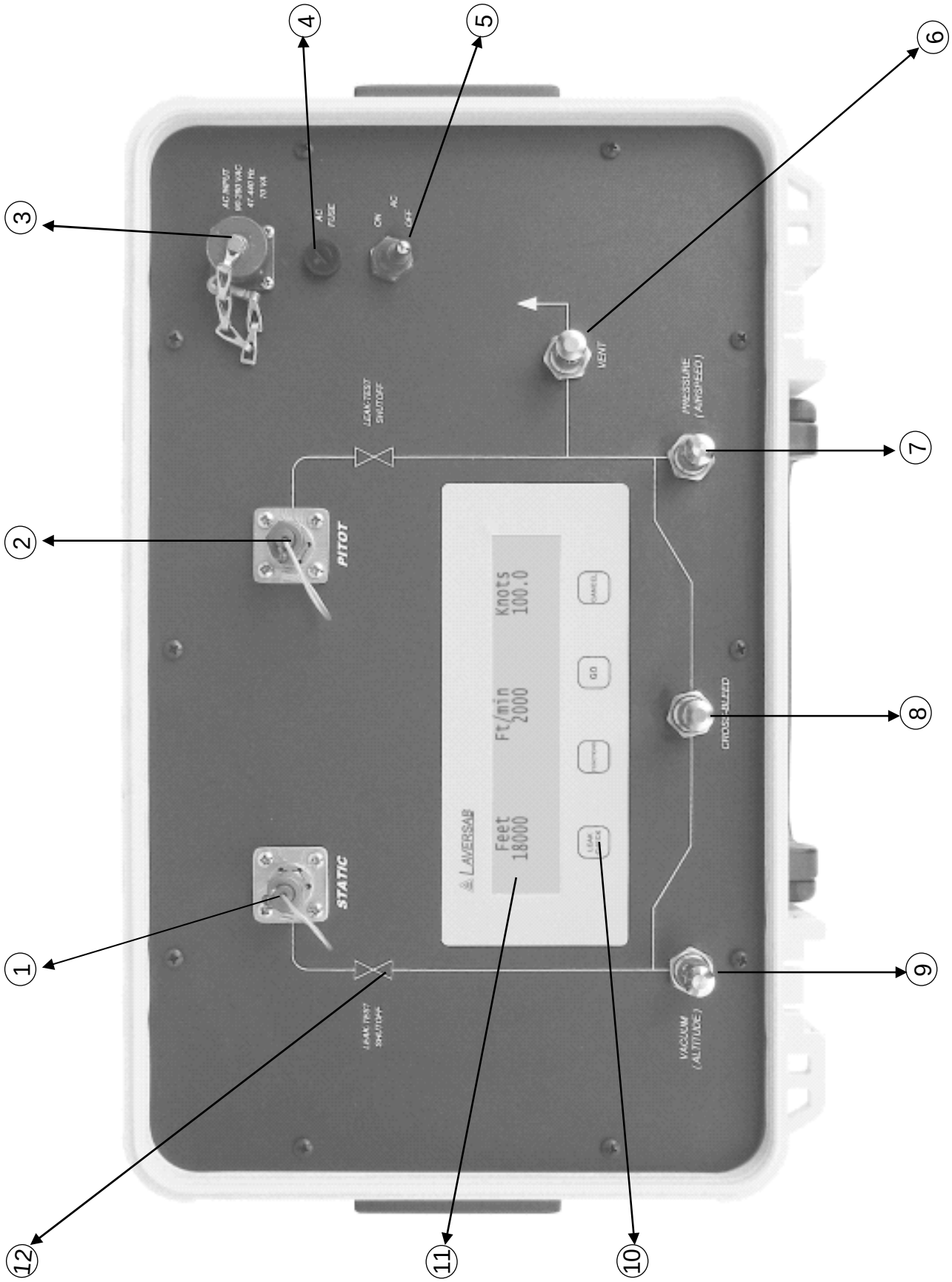

1
2
3
4
5
6
7
8
9
10
11
12
AC INPUT
AC FUSE
ON
AC
OFF
VENT
LEAK-TEST SHUTOFF
PRESSURE (AIRSPEED)
PITOT
STATIC
CROSS-BLEED
VACUUM (ALTITUDE)
LAVERSAB
Feet
18000
Ft/min
2000
Knots
100.0
CANCEL
GO
LEAK CHECK

Figure 1

6. VENT metering valve

This valve is used to vent-to-ambient, pressure or vacuum from the Pitot output. With the Cross-bleed valve open, the Vent valve can also vent-to-ambient, pressure or vacuum from the Static system.

CAUTION : This metering valve seals before it reaches its STOP. Do Not tighten at all past this STOP. Not even finger-tight. Any tightening past the STOP may cause permanent damage to the valve and it will constantly leak.

7. PRESSURE or AIRSPEED metering valve

This valve is used for increasing airspeed or pressure at the Pitot output. With the Cross-bleed valve open, it can also be used to create pressure on the Static port for altitudes below field elevation (like -1000 feet) .

CAUTION : This metering valve seals before it reaches its STOP. Do Not tighten at all past this STOP. Not even finger-tight. Any tightening past the STOP may cause permanent damage to the valve and it will constantly leak.

8. CROSS-BLEED valve

When this valve is open it equalizes pressure between the Pitot and Static outputs and provides Zero airspeed.. When this valve is closed it isolates the Pitot and Static outputs and allows the user to create a specific airspeed, either by opening the Vent valve or the Pressure valve.

CAUTION : This metering valve seals before it reaches its STOP. Do Not tighten at all past this STOP. Not even finger-tight. Any tightening past the STOP may cause permanent damage to the valve and it will constantly leak.

9. VACUUM or ALTITUDE valve

Opening this valve increases altitude or vacuum on the Static output. If the Cross-bleed valve is closed while altitude (vacuum) is increased on the Static output, this will cause airspeed to increase automatically on the Pitot output, even if the Vent valve is open, since the difference between Pitot pressure and Static pressure increases. If the Cross-bleed valve is open and the Vent valve and Pressure valve are closed, opening the Vacuum valve will increase altitude on the Static output but maintain close to Zero airspeed on the Pitot output.

CAUTION : This metering valve seals before it reaches its STOP. Do Not tighten at all past this STOP. Not even finger-tight. Any tightening past the STOP may cause permanent damage to the valve and it will constantly leak.

10. Keypad

There are four keys:

The LEAK CHECK key is used to enter the Leak-test mode, and also for some other functions.

The FUNCTIONS key is used to scroll through several functions (detailed later). It is also used for some other actions.

The GO key is used to execute certain commands or options.

The CANCEL key is used to cancel certain commands or functions. This key is also used to return to the Main Screen on the display.

11. Display

All indicators and readings are shown on this 40-character by 4-line LCD display. The display is backlit for easy viewing in all lighting conditions. The various screens shown on the display are explained in detailed in Section 2.

12. LEAK-TEST SHUTOFF solenoid-valves

There are two valves, one on the Static output and one on the Pitot output. During the Leak-test mode, both of these solenoid-valves are automatically closed to isolate the aircraft from the metering valves of the 6150. The 6150 can still monitor the altitude and airspeed on the Static and Pitot ports. However, once the solenoid-valves are closed, none of the metering valves will have any effect on the pressure (or vacuum) on the Static or Pitot outputs.

SECTION 2

FUNCTIONAL DETAILS

This section explains all the different screens and functions of the 6150.

2.1 Power On.

When power is turned ON to the 6150, the display shows the sign-on screen for 3 seconds. The pumps remain OFF. After the sign-on screen, the display shows the Limits and Leak-times screen.

2.2 Limits and Leak-times

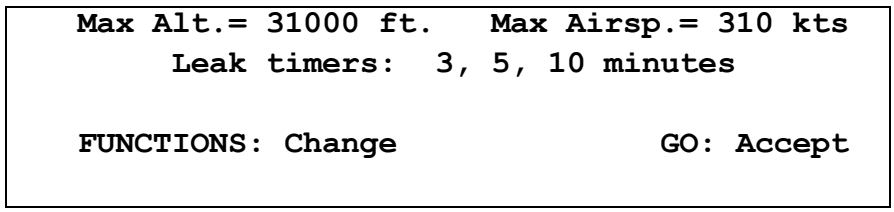
The Limits and Leak-times screen shows the current setting of the user-programmable value for the maximum altitude limit and maximum airspeed limit. It also shows the current setting for the three programmable leak time periods. This screen is displayed only after power-up.

The minimum altitude limit is always set at -1200 feet and cannot be changed. The minimum airspeed limit is set to -20 knots and cannot be changed.

The leak time periods are used in the leak test mode where the 6150 displays the altitude and airspeed at the end of the specified time period and also the accumulated leak in altitude and airspeed over that time period. For example, if the leak timers are set for 3, 5 and 10 minutes and the leak check was started at 10000 feet, then at the end of 3 minutes if the altitude was at 9500 feet then the accumulated leak over 3 minutes is 500 feet. So the 6150 would display the values 9500 and 500. The airspeed leak at the end of 3 minutes would be shown in the same manner. The process is repeated at the end of 5 minutes and 10 minutes also.

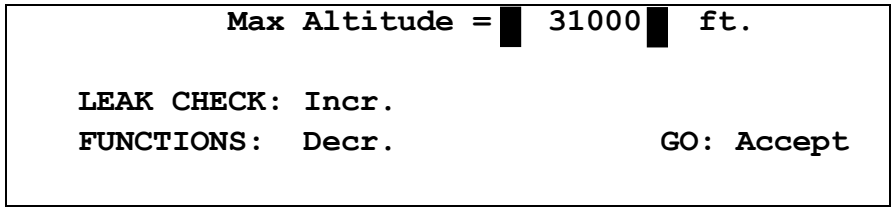
Please refer to the details on "Leak Check Screen", later in this section.

The Limits and Leak-times screen appears as below.



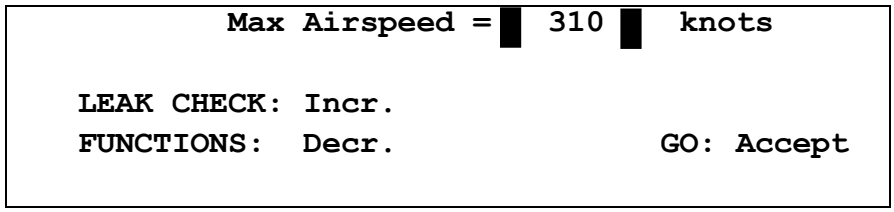
The screen shows that the maximum altitude limit is set to 31000 feet and the maximum airspeed limit is set to 310 knots. The leak timers are set for 3, 5 and 10 minute intervals.

To make changes to values, press the FUNCTIONS key. To accept the values as they appear, press GO. If the FUNCTIONS key is pressed to make a change, the next screen that appears is shown below.



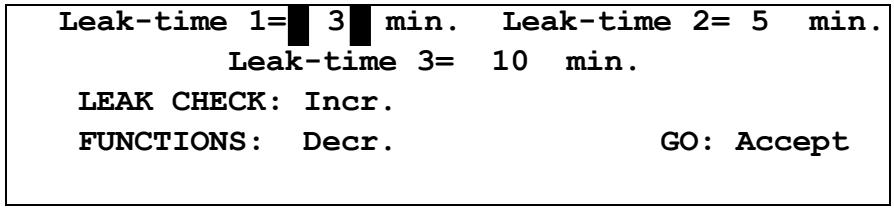
This screen allows the max altitude limit to be changed. Pressing LEAK CHECK increases the limit by 1000 feet.. Pressing FUNCTIONS decreases the value by 1000 feet. The maximum altitude limit can be changed in steps of 1000 feet, between a minimum value of 10,000 ft. and a maximum of 60,000 ft. It is recommended that the limit be set to a value that is at least 1000 feet higher than the maximum altitude that will normally be generated with the 6150 for the user's typical aircraft. For example, if the user will normally perform tests up to 30,000 ft. then the limit should be set at 31,000 ft..

Once the value of the limit is acceptable, pressing GO will accept the selected value and move to next screen shown below.



This screen allows the max airspeed limit to be changed, using the LEAK CHECK and FUNCTIONS keys, in increments of 10 knots. The limit can be changed between 100 knots and 500 knots. The limit should be set at least 10 knots above "normal-usage" airspeed, i.e. if the tester will normally be used up to 300 knots then the limit should be set to 310 knots.

Press GO to accept the value for max. airspeed. This will bring up the next screen shown below



This screen allows the user to select the value for leak-time 1. The value will increment or

decrement in steps of 1 minute. The minimum value for leak-time 1 is 1 minute and the maximum is 18 minutes. When GO is pressed, the displayed value is accepted and the screen changes as shown below:

```
Leak-time 1= 3  min.  Leak-time 2= 5 min.
         Leak-time 3=  10  min.
 LEAK CHECK: Incr.
 FUNCTIONS:  Decr.              GO: Accept
```

This screen allows the user to select the value for leak-time 2. The value will increment or decrement in steps of 1 minute. The minimum value for leak-time 2 is one minute higher than leak-time 1 and the maximum is 19 minutes. When GO is pressed, the displayed value is accepted and the screen changes as shown below:

```
Leak-time 1=  3  min.  Leak-time 2= 5  min.
         Leak-time 3= 10 min.
 LEAK CHECK: Incr.
 FUNCTIONS:  Decr.              GO: Accept
```

This screen allows the user to select the value for leak-time 3. The value will increment or decrement in steps of 1 minute. The minimum value for leak-time 3 is one minute higher than leak-time 2 and the maximum is 20 minutes. When GO is pressed, the displayed value is accepted and the screen changes as shown below:

```
 Max Alt.= 31000 ft.   Max Airsp.= 310 kts
      Leak timers:  3, 5, 10 minutes

 FUNCTIONS: Change              GO: Accept
```

Press GO to accept the changes. You will now exit the Limits and Leak-times screen and the next screen will appear as shown below.

2.3 Main Screen

Most of the operations to control and achieve specific altitudes and airspeeds will be done while in this screen, shown below:

```
     Feet          Ft/min.          knots
      425              0              6.5
          Press GO to start pumps
```

In this screen, (the values displayed on your screen will likely be different), 425 feet is the altitude being measured at the Static output of the 6150 and 6.5 knots is the airspeed being measured at the Pitot output. There is no change of altitude so the VSI is indicated as 0 ft/min.

Please note that any VSI values below 20 ft/min will be shown as 0 ft/min.

Pumps are normally off and can be started by pressing GO.

Under certain conditions the pumps will be turned OFF automatically (see section 2.3.7)

Before starting the pumps, please ensure that all 4 metering valves are closed.

Before starting the pumps, please connect the Pitot and Static outputs to the aircraft.

While in the Main Screen, the metering valves can be used to change the altitude at an appropriate VSI (Ft/min), and also the airspeed. The recommended method for using these metering valves is shown below. This method is the simplest way to achieve desired altitudes and airspeeds, without having to operate more than one metering valve at a time.

2.3.1 Changing airspeed while maintaining altitude at ambient (Ground).

Increase airspeed: Close all valves. Slowly open the Pressure (Airspeed) valve while watching the knots value increase. When the desired knots value is achieved, close the Pressure (Airspeed) valve.

Decrease airspeed: Close all valves. Slowly open the Vent valve until the desired airspeed is achieved, then close the Vent valve.. An airspeed between -15 knots and +15 knots is essentially equal to zero airspeed.

2.3.2 Changing Altitude while maintaining zero airspeed.

Keeping airspeed near zero while changing altitude is the ideal way to move from one altitude to another. **Please note that keeping airspeed near zero will NOT damage the airspeed indicator on the aircraft.**

Close all valves. Slowly open the Cross-bleed valve until airspeed is close to zero. Then open the Cross-bleed valve all the way and leave it open. This ensures that airspeed will always stay close to zero while altitude is increased or decreased.

Increase altitude: Slowly open the Vacuum valve while watching the VSI (Ft/min).

The displayed VSI value is heavily damped. Please allow a few seconds for the VSI value to stabilize after making any changes to the Vacuum valve.

Once a desired VSI is achieved, it will reduce very slowly, and it may not be necessary to

constantly make changes to the Vacuum valve. Slowly close the Vacuum valve as you approach the desired altitude.

Decrease altitude: Close the Vacuum valve completely, then slowly open the Vent valve while watching the VSI. This will allow you to achieve altitudes all the way down to Ground. If an altitude below Ground is desired (like -1000 ft.) then close the Vent valve and slowly open the Pressure valve while watching the VSI. To return to Ground altitude, close the Pressure valve and slowly open the Vent valve.

Note that during all these operations, the Cross-bleed valve is completely open and therefore, airspeed will be close to zero.

2.3.3 Changing Airspeed while maintaining an Altitude other than Ground

Increase airspeed: Close the Cross-bleed valve. Slowly open the Pressure valve (or the Vent valve) until the desired airspeed is achieved. The Vent valve will work only for airspeeds below ambient pressure.

Decrease airspeed: Close the Pressure valve (and Vent valve). Then slowly open the Cross-bleed valve until the desired airspeed is achieved. Notice that as the Cross-bleed valve is opened, the Altitude will also decrease. Watch the VSI as the Cross-bleed valve is opened.

2.3.4 Maintaining a positive Airspeed while changing Altitude.

This requires making constant changes to two valves simultaneously and is therefore NOT a recommended method. However if it is absolutely necessary to follow this method, please follow the steps below.

Increase altitude: First achieve the desired positive airspeed using the Pressure valve while keeping the other valves closed. Close the Pressure valve. Open the Vacuum valve slowly. As the altitude increases, the airspeed will also increase. Reduce the airspeed to the desired value by opening the Cross-bleed valve. You will need to constantly adjust the Vacuum and Cross-bleed valves to maintain the desired VSI and the desired positive airspeed. When the desired altitude is achieved, close both the Vacuum and Cross-bleed valves. The Cross-bleed valve should be closed before the Vacuum valve to maintain the desired positive airspeed.

Decrease altitude: First achieve the desired positive airspeed using the Pressure valve while keeping the other valves closed. Close the Pressure valve. Slowly open the Cross-bleed valve. This will cause the airspeed to decrease and the altitude also to decrease. Increase the airspeed to the desired value by opening the Pressure valve. You will need to constantly adjust the Pressure and Cross-bleed valves to maintain the desired VSI and the desired positive airspeed. When the desired altitude is achieved, close both the Pressure and Cross-bleed valves. The Cross-bleed valve should be closed before the Pressure valve to maintain the desired positive airspeed.

2.3.5 Checking for leaks in the Main Screen

When an altitude and airspeed have been achieved, it is possible to check for leaks without going into the Leak Test screen.

If the Cross-bleed valve is open and the other three valves are closed, the altitude value shown on the display will indicate the leak of both the Static and Pitot system combined.

Do NOT pinch-off either hose to the aircraft to try and isolate the leak between Pitot and Static sides. This could cause a large negative airspeed on the aircraft.

To isolate the Pitot and Static systems, close the Cross-bleed valve and open the Pressure (or Vent) valve to increase the airspeed to about 100 knots. Then, with all valves closed, the true Static leak will be shown on the displayed altitude value. However, it will still not be possible to determine the true Pitot leak since the displayed airspeed value will change depending on both the Static and Pitot leaks.

To determine the true Pitot leak while at an altitude other than Ground, keep all valves closed and a positive airspeed of approximately 100 knots. Then open the Vacuum valve slowly to hold the altitude steady at a fixed value. By doing this you are compensating for the Static leak. Now the displayed airspeed value will indicate the true Pitot leak.

Please note that if altitude is more than 500 feet above Ground and airspeed is around 100 knots, a Pitot leak will cause airspeed to INCREASE.

The ideal way to perform a Pitot leak check is while holding Static at Ground, as follows. Close all valves. Ensure that both Pitot and Static are at Ground by opening the Cross-bleed valve and then the Vent valve. Once Ground is achieved, close Cross-bleed and Vent valves. Slowly open the Pressure valve to achieve 100 knots. Close the Pressure valve. The true Pitot leak can be observed on the displayed airspeed value. In this situation, any leak Pitot leak will always cause airspeed to decrease.

2.3.6 Protection against Negative Airspeed

The 6150 has built-in protection against excessive negative airspeed. An internal relief-valve prevents the airspeed from going more negative than about -30 knots.

This relief-valve is active even when the 6150 is powered-off.

There are two conditions during the operation of the 6150 when the internal relief-valve will NOT protect against negative airspeed.

a. During Leak-Check Mode, the Leak Test Shutoff solenoids are closed. This prevents the relief-valve from providing the negative airspeed protection to the aircraft. **Therefore, in Leak-Check Mode, if the 6150 detects negative airspeed, it automatically trips out of Leak-Test Mode and opens the Leak Test Shutoff solenoids, thereby allowing the relief-valve to provide protection against excessive negative airspeed.**

b. During Calibration Mode, the Leak Test Shutoff solenoids are closed. This prevents the relief-valve from providing the negative airspeed protection. However, this protection is normally not required during Calibration Mode.

2.3.7 Warnings

While in the Main Screen, several warning messages are displayed to alert the user to existing or potential error conditions. These messages are automatically cleared when the error condition no longer exists. Warning messages are displayed for the following conditions.

a. Airspeed close to limit : Indicates that at the rate at which airspeed is being changed, it will exceed the limit within 10 seconds. Usually, slowing down the rate of change of airspeed will clear the message.

b. Airspeed is negative : Indicates that airspeed is more negative than -20 knots. Opening the Cross-bleed valve or the Pressure valve will usually make airspeed more positive.

c. Airspeed over limit : Indicates that airspeed is over the programmed limit.

Under this condition, the pumps will automatically be turned OFF.

If altitude is at Ground, reduce airspeed by opening the Vent valve. If altitude is above Ground, reduce airspeed by opening the Cross-bleed valve. After the airspeed is below the limit, close all valves and then turn ON the pumps

d. Altitude close to limit : Indicates that at the rate at which altitude is being changed, it will exceed the limit within 10 seconds. Usually, reducing the VSI will clear the message.

e. Altitude over limit : Indicates that altitude is either over the programmed max. limit or below -1200 feet.

Under this condition, the pumps will automatically be turned OFF.

To decrease altitude from a high value, open the Cross-bleed valve and then the Vent valve. To increase altitude from a negative value, open the Vent valve. If the airspeed starts going negative, open the Cross-bleed valve also. After the altitude is within limits, close all valves and then turn ON the pumps.

f. Any combination of the above 5 conditions will generate other warning messages.

A list of all the warning messages is shown below:

** Airspeed close to limit **
** Airspeed over limit **
** Airspeed is negative **

** Altitude close to limit **
** Altitude over limit **
** Alt and A/S close to limits **
** Alt and A/S over limits **
** A/S negative, Alt over limit **
** A/S negative, Alt close to limit **
** A/S over limit, Alt close to limit **
** Alt over limit, A/S close to limit **

2.4 Leak Check Mode

The Leak Check mode is used to perform an accurate timed leak-check of the Pitot and Static systems of the aircraft. During the Leak Check mode, both Pitot and Static systems are leak-checked simultaneously. Before entering the Leak Check mode, you must achieve the desired altitude and airspeed at which the leak check is to be performed. This is done using the metering valves while in the Main Screen (section 3 above).

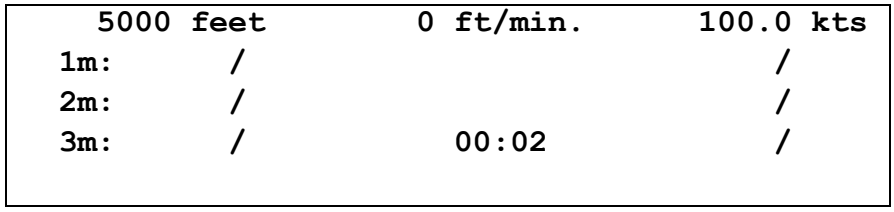
Once the desired altitude and airspeed have been achieved, enter the Leak Check mode by pressing the LEAK CHECK key. The Leak Test Shutoff solenoids will close. This will isolate the Pitot and Static outputs from the pumps and the metering valves.

In Leak Check mode the aircraft is not protected against negative airspeed. If a negative airspeed condition exists, the 6150 will automatically trip out of Leak Check mode to prevent excessive negative airspeed. See section 2.3.6 above.

Within 10 seconds of entering the Leak Check mode, the pumps will automatically turn OFF. At that point, all four metering valves should be closed.

You may exit out of Leak Check mode, back to the Main Screen, at any time by pressing the CANCEL key.

In Leak Check mode the display appears as below (actual values may be different)



The top line shows the actual measured values at the Static and Pitot outputs. These are updated every 0.25 seconds. Please note that any VSI values below 20 ft/min will be shown as 0 ft/min.

The center of the 4th line shows the elapsed time in minutes and seconds (mm:ss).

The start of the second, third and fourth lines show "1m:", "2m:" and "3m:" which indicates that the leak times have been programmed for 1, 2 and 3 minutes. For changing leak-time values please see Section 2.2.

At the end of 1 minute of elapsed time, the display appears as below:

```
  4995 feet          0 ft/min.          99.8 kts
1m: 4995 /   5                       99.8 / 0.2
2m:      /                                /
3m:      /             01:00              /
```

Line 2 now shows that at the end of 1 minute, the altitude was 4995 ft. and the amount of altitude leak over 1 minute was 5 feet. Also, the airspeed was 99.8 knots and the amount of airspeed leak over 1 minute was 0.2 knots.

Although line 1 will continue to update, line 2 will remain as shown.

At the end of 2 minutes of elapsed time, the display appears as below:

```
  4991 feet          0 ft/min.          99.6 kts
1m: 4995 /   5                       99.8 / 0.2
2m: 4991 /   9                       99.6 / 0.4
3m:      /             02:00              /
```

Line 3 now shows that at the end of 2 minutes, the altitude was 4991 ft. and the total amount of altitude leak over 2 minutes was 9 feet. Also, the airspeed was 99.6 knots and the total amount of airspeed leak over 2 minutes was 0.4 knots.

Although line 1 will continue to update, lines 2 and 3 will remain as shown.

At the end of 3 minutes of elapsed time, the display appears as below:

```
  4988 feet          0 ft/min.          99.5 kts
1m: 4995 /   5                       99.8 / 0.2
2m: 4991 /   9                       99.6 / 0.4
3m: 4988 /  12             03:00     99.5 / 0.5
```

Line 4 now shows that at the end of 3 minutes, the altitude was 4988 ft. and the total amount of altitude leak over 3 minutes was 12 feet. Also, the airspeed was 99.5 knots and the total amount of airspeed leak over 3 minutes was 0.5 knots.

Although line 1 and the timer will continue to update, lines 2, 3 and 4 will remain as

shown.

Once the timed leak has completed you should record all the displayed values before returning to the Main Screen by pressing CANCEL. The values shown on the display for the timed leaks are automatically recorded internally in the 6150 and may be retrieved later. Please see section 5.1 for more details.

When CANCEL is pressed to exit out of the Leak Check mode, the Leak Test Shutoff solenoids are opened and the Main Screen is displayed.

2.4.1 Warnings in Leak Check mode

While in the Leak Screen, several warning messages are displayed to alert the user to existing or potential error conditions. These messages are automatically cleared when the error condition no longer exists. Warning messages are similar to those displayed in the Main Screen. Please see Section 2.3.7 above.

There is one exception.

If airspeed goes more negative than -20 knots while in the Leak Check mode, the 6150 will automatically trip out of Leak Check mode and return to the Main Screen. The Leak Test Shutoff solenoids will be opened to allow the internal relief-valve to protect the aircraft against excessive negative airspeed. See section 2.3.6

When the 6150 trips out of Leak Check mode due to negative airspeed, the following message will appear on the Main Screen:

Leak-check cancelled due to negative A/S
Press GO to continue

When the GO key is pressed, normal operation in the Main Screen will continue.

2.5 Functions

From the Main Screen, pressing the FUNCTIONS key allows you to scroll through several functions. These are described below.

2.5.1 RECORDED Leak values

The first function shows the Leak values that were recorded during the last-executed Leak Check. **The leak values are stored even through a power-down.** If the last Leak Check that was performed was started at 5000 feet and 100.0 knots, and the leak values were exactly as shown in section 2.4 above, then the screen displayed will appear as shown below:

```
    5000 feet    ** RECORDED **     100.0 kts
```

```
1m: 4995 /   5                    99.8 / 0.2
2m: 4991 /   9                    99.6 / 0.4
3m: 4988 /  12                    99.5 / 0.5
```

This screen shows the starting values of the leak check on line 1 and the timed leak values on lines 2, 3 and 4.

Please note that this function will only show the **last-executed** Leak Check, even if it is incomplete.

Press CANCEL to return to the Main Screen. Press FUNCTIONS to scroll to the next function.

2.5.2 Calibration

The second function allows you to enter the Calibration mode. The following screen is displayed:

```
        Press GO for CALIBRATION mode


FUNCTIONS: next Fn.          CANCEL: exit
```

If GO is pressed then the next screen will ask for a password to enter Calibration mode. For more details on Calibration mode please refer to Section 4.

Press CANCEL to return to the Main Screen. Press FUNCTIONS to scroll to the next function.

2.5.3 Select Units of Feet and knots

The third function allows you to select the Static units of Feet and the Pitot units of knots. If these units are selected they will remain effective through a power-down. The following screen is displayed.

```
            Units = Feet & knots
      Press GO to select these units

FUNCTIONS: next Fn.          CANCEL: exit
```

If GO is pressed, the effective units will be Feet and knots.

Press CANCEL to return to the Main Screen. Press FUNCTIONS to scroll to the next function.

2.5.4 Select Units of Meters and kmph

The fourth function allows you to select the Static units of Meters and the Pitot units of kmph. If these units are selected they will remain effective through a power-down. The following screen is displayed.

```
          Units = Meters & kmph
      Press GO to select these units

FUNCTIONS: next Fn.          CANCEL: exit
```

If GO is pressed, the effective units will be Meters and kmph.

Press CANCEL to return to the Main Screen. Press FUNCTIONS to scroll to the next function.

2.5.5 Select Units of inHg.

The fifth function allows you to select the Static units of inHg (absolute) and the Pitot units of inHg (absolute). If these units are selected they will remain effective through a power-down. The following screen is displayed.

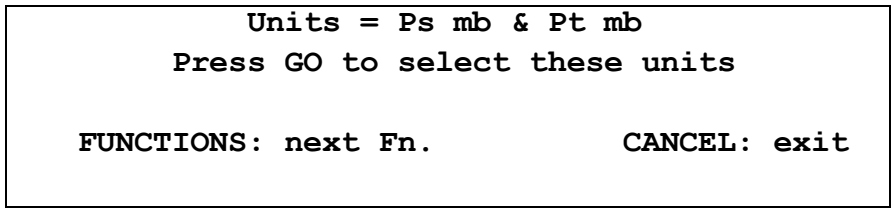
```
        Units = Ps inHg & Pt inHg
      Press GO to select these units

FUNCTIONS: next Fn.          CANCEL: exit
```

If GO is pressed, the effective units will be inHg (absolute) for both Static and Pitot.

Press CANCEL to return to the Main Screen. Press FUNCTIONS to scroll to the next function.

2.5.6 Select Units of mbar.

The sixth function allows you to select the Static units of mbar (absolute) and the Pitot units of mbar (absolute). If these units are selected they will remain effective through a power-down. The following screen is displayed.



If GO is pressed, the effective units will be mbar (absolute) for both Static and Pitot.

Press CANCEL to return to the Main Screen. Press FUNCTIONS to scroll to the next function. Since this is the last function, pressing FUNCTIONS returns you to the Main Screen.

SECTION 3

TYPICAL USE

This section outlines the typical method of using the 6150.

3.1 Setup

1. Turn ON the 6150.

2. Check the limits and leak times to see if they are acceptable. Change them if required using the steps outlined in Section 2.2. Once these values are acceptable, press GO. You are now in the Main Screen.

3. Close all four metering valves.

4. Connect the aircraft to the Pitot & Static outputs.

5. Press GO to turn ON the pumps.

3.2 Low-level leak checks

1. Increase the airspeed to about 100 knots using the Pressure valve. Perform a quick leak check to determine if the Pitot output is within acceptable leak limits. If a large leak exists, find and fix the leak before proceeding further.

2. Bring airspeed down close to zero by opening the Vent valve.

3. Close all valves. Open the Cross-bleed valve completely.

4. Slowly open the Vacuum valve to increase the altitude. Watch the VSI to ensure it does not exceed the maximum VSI of the aircraft. While altitude increases, airspeed will always be close to zero.

5. Achieve an altitude of about 3000 feet above Ground. Close the Vacuum valve (leave the cross-bleed valve open) and perform a quick leak check to determine if the Static output is within acceptable leak limits. Since the Cross-bleed valve is open, the Pitot system is connected to the Static system, but the Pitot system has already been leak-checked and made reasonably leak-tight in step 6 and should not contribute significantly to the Static leak.
Typically if the Static leak is less than 15 feet/min when the altitude is 3000 feet above Ground, it is an acceptable leak. If a larger leak exists, find and fix the leak before proceeding further.

6. Now that both Pitot and Static systems are reasonably leak-tight, you may proceed to either perform a high-altitude leak check or an accuracy check of the airspeed indicator and altimeter on the aircraft. If you need to perform an accuracy check, skip to Section 3.4.

3.3 High-altitude leak check

1. To perform a high-altitude leak check, make sure that airspeed is close to zero and the cross-bleed valve is open. Slowly open the Vacuum valve to increase altitude and VSI.

2. Once the desired altitude is achieved, close the Vacuum valve. Close the cross-bleed valve.

3. Slowly open the Vent valve to achieve the desired airspeed. When the airspeed is achieved, press the Leak Check key to start the timed Leak Check. You are now in the Leak Screen.

4. If a large leak is detected, CANCEL out of Leak mode immediately. Otherwise wait for the timed leaks to be completed, then CANCEL out of Leak mode.

5. The pumps will be turned OFF while in Leak mode. It is **not** necessary to turn the pumps ON to return to Ground.

6. Slowly open the cross-bleed valve to reduce airspeed. Watch the VSI as you do so. Once airspeed is close to zero, open the cross-bleed valve completely.

7. Slowly open the Vent valve while watching the VSI. Altitude will reduce. Once altitude is close to Ground level, open the Vent valve completely to ensure that the system is completely vented.

8. Turn OFF the 6150.

9. Disconnect from the aircraft.

10. Close all valves.

3.4 Airspeed accuracy check

Assuming you have come here from section 3.2 Step 6, the cross-bleed valve will be completely open and airspeed will be close to zero.

1. Open the Vent valve slowly to reduce the reduce the altitude. Watch the VSI.

2. Once the system is completely vented to Ground, close the cross-bleed valve and the Vent valve.

3. Slowly open the Pressure valve to increase the airspeed to the desired value. Once the desired value is achieved, note the reading on the aircraft's airspeed indicator.

4. Repeat step 3 for all the desired airspeed values to be checked.

5. When all airspeed checks are complete, close the Pressure valve and open the Vent valve to reduce airspeed to zero. If airspeed is not close to zero even when the Vent valve is fully open, slowly open the cross-bleed valve to bring airspeed down to between +15 and -15 knots.

6. If an altimeter accuracy check needs to be performed, skip to Section 3.5

7. Turn OFF the 6150.

8. Disconnect from the aircraft.

9. Close all valves.

3.5 Altimeter accuracy check

1. Slowly open the cross-bleed valve until airspeed is near zero. Once airspeed is near zero, open the cross-bleed completely.

2. Slowly open the Vent valve to reduce altitude until it is near Ground. Once the altitude is at Ground., close the Vent valve, but leave the cross-bleed valve wide open.

3. During the entire altimeter accuracy check, airspeed will be maintained close to zero and the cross-bleed valve will be left wide open. This will **not** damage the airspeed indicator on the aircraft.

4. Typically the first point in an altimeter check is at -1000 ft. To achieve this altitude, make sure the Vacuum valve and Vent valve are closed. Slowly open the Pressure valve watching the VSI is not excessive. When -1000 ft is achieved, close the Pressure valve and note the reading on the altimeter.

5. For the remaining altimeter test points, slowly open the Vacuum valve until the desired altitude is achieved. Watch the VSI. When the altitude is stable at the test point, note the reading on the altimeter, then proceed to the next test point.

6. If a high-altitude leak check needs to be performed at a specific altitude, refer to section 3.3.

7. After the highest altitude point has been checked, close the Vacuum valve. Slowly open the Vent valve to reduce altitude. Watch the VSI. Typically, there are two more tests points for hysteresis while altitude is being reduced. Stop at these points and note

altimeter readings.

8. Continue to open the Vent valve (while watching VSI) until the system is completely vented.

9. Turn OFF the 6150.

10. Disconnect from the aircraft

11. Close all valves.

SECTION 4

CALIBRATION

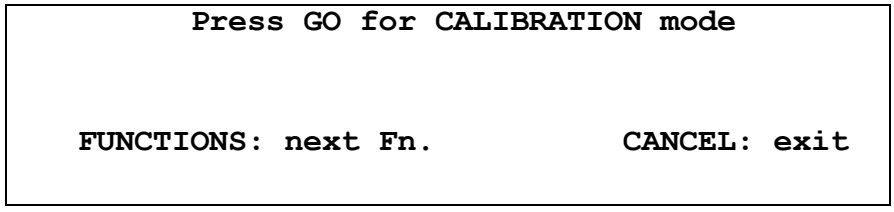
4.1 Equipment

The calibration procedure for the 6150 requires the following equipment:

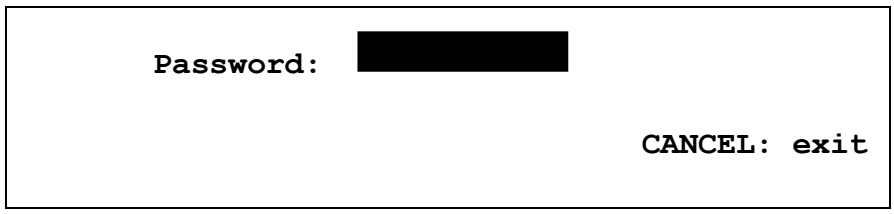
1. Pressure controller (Standard) with an accuracy of at least 0.004 inHg between 1 and 60 inHg absolute. The controller must be able to achieve pressures between 1.0 inHg (abs) and 60 inHg (abs).
2. Pressure supply of Dry Air or Nitrogen connected to Pressure controller
3 Vacuum pump connected to Pressure controller.

4.2 Calibration Procedure

From the main Screen, press the FUNCTIONS key two times. The following screen will be displayed.



Press GO to bring up the password screen shown below.



When the correct password is entered, the calibration mode is entered. The Leak Test Shutoff solenoids are closed and the following screen is displayed.

```
      Static (Ps)              Pitot (Pt)
      29.921  inHg             29.923  inHg
Step 1: Generate 1.000 inHg on Ps & Pt
outputs, then press GO   (CANCEL to exit)
```

Calibration is always done in units of inHg. The second line shows the actual measured values at the Static and Pitot ports.

Step 1.

1. Connect the Pressure Controller (Standard) to the Static and Pitot ports of the 6150.
2. Generate approximately 1.0 inHg on both outputs. Perform a leak check by putting the Standard into Measure or Leak mode. The leak should not exceed 0.015 inHg per minute. Proceed to the next step only if the leak is within tolerance.
3. Using the Standard, generate exactly 1.000 inHg on both outputs. Allow the pressure to be stable for 1 minute to eliminate any temperature effects.
4. Note the actual readings on the 6150. These will be noted as the "As Found" Vacuum values in the calibration report. (Figure 4.1)
5. Press GO on the 6150.

If the Generated value (on Standard) and Actual value (on 6150) differ by more than 1.0 inHg then an error message appears on lines 3 and 4, as shown below

```
      Static (Ps)              Pitot (Pt)
       2.125  inHg              2.127  inHg
ERROR:  Generated & Actual values differ
by more than 1.0 inHg. Press GO
```

This error indicates that either the Standard did not actually generate 1.000 inHg when GO was pressed in step 4 above or there is large difference in accuracy between the Standard and the 6150. Unless this discrepancy can be resolved, calibration cannot proceed further.

If there is no error, then the screen will change to the following:

```
      Static (Ps)              Pitot (Pt)
       1.003  inHg              1.004  inHg
Step 2:    Generate 32.000 inHg on Ps
output, then press GO   (CANCEL to exit)
```

Step 2.

1. Using the Standard, generate exactly 32.000 inHg on the Static output of the 6150. Allow the pressure to be stable for 1 minute to eliminate any temperature effects.
2. Note the actual Static value on the 6150. This will be noted as the "As Found" full-scale Static value in the calibration report (figure 4.1)
3. Press GO on the 6150.

If the Generated value (on Standard) and Actual value (on 6150) differ by more than 1.0 inHg then an error message appears on lines 3 and 4, as shown below

```
      Static (Ps)              Pitot (Pt)
      33.125  inHg             33.127  inHg
ERROR:  Generated & Actual values differ
by more than 1.0 inHg. Press GO
```

This error indicates that either the Standard did not actually generate 32.000 inHg when GO was pressed in step 4 above or there is large difference in accuracy between the Standard and the 6150. Unless this discrepancy can be resolved, calibration cannot proceed further.

If there is no error, then the screen will change to the following:

```
      Static (Ps)              Pitot (Pt)
      32.005  inHg            32.007  inHg
Step 3:    Generate 60.000 inHg on Pt
output, then press GO   (CANCEL to exit)
```

Step 3.

1. Ensure that the Standard will not create a pressure of more than 32.0 inHg on the Static output of the 6150 when the Pitot output is increased to 60.0 inHg. This can be done with an isolation valve between the Static and Pitot outputs of the 6150.

Warning: If the pressure on the Static output of the 6150 exceeds 33 inHg, it may cause severe damage to the Static transducer in the 6150.

2. Using the Standard, generate exactly 60.000 inHg on the Pitot output of the 6150. Allow the pressure to be stable for 1 minute to eliminate any temperature effects.
3. Note the actual Pitot value on the 6150. This will be noted as the "As Found" full-scale Pitot value in the calibration report (figure 4.1)
4. Press GO on the 6150.

If the Generated value (on Standard) and Actual value (on 6150) differ by more than 1.0

inHg then an error message appears on lines 3 and 4, as shown below

```
      Static (Ps)              Pitot (Pt)
      32.005  inHg             61.346  inHg
ERROR:  Generated & Actual values differ
by more than 1.0 inHg. Press GO
```

This error indicates that either the Standard did not actually generate 60.000 inHg when GO was pressed in step 4 above or there is large difference in accuracy between the Standard and the 6150. Unless this discrepancy can be resolved, calibration cannot proceed further.

If there is no error, then the screen will change to the following:

```
    Please record the following values
 Ps zero = 0.0032    Ps slope = 0.999975
 Pt zero = 0.0041    Pt slope = 0.999921
Press GO to Accept ;    CANCEL to Reject
```

The above screen indicates that the calibration is complete and awaiting "acceptance". The displayed values show the zero and slope corrections for Ps and Pt. These value should be recorded for future reference.

If the calibration appears to have been done **incorrectly**, press CANCEL to reject the calibration just performed. The calibration will be voided and the old calibration values will be maintained.

If the calibration was done correctly, the press GO to accept the new calibration. This will bring up the next screen:

```
      Static (Ps)              Pitot (Pt)
      32.000  inHg            60.000  inHg
Step 4:     Calibration complete. Perform
Verification then press CANCEL to exit.
```

Step 4.

The above screen indicates that the new calibration values are in effect. However, before exiting the calibration mode, it is important to perform a verification of the new calibration. This is typically done at 1.000 inHg and at 10%FS steps for each output.

1. Using the Standard, generate the following pressures on the Static output of the 6150 in units of inHg : 1.000, 3.200, 6.400, 9.600, 12.800, 16.000, 19.200, 22.400, 25.600, 28.800 and 32.000. Note the Static readings on the 6150 at each pressure. The noted readings will be entered in the Static verification section of the calibration report (Figure 4.1)

2. Using the Standard, generate the following pressures on the Pitot output of the 6150 in units of inHg : 1.000, 6.000, 12.000, 18.000, 24.000, 30.000, 36.000, 42.000, 48.000, 54.000 and 60.000. Note the Pitot readings on the 6150 at each pressure. The noted readings will be entered in the Pitot verification section of the calibration report (Figure 4.1)

3. If the difference between 6150 readings and Standard values does not exceed 0.006 inHg at any point, then the calibration is successful

4. Disconnect the Standard from the 6150. Leave both output ports open to ambient.

5. Press CANCEL to exit out of Calibration mode.

4.3 Calibration Report

A typical calibration report is shown in Figure 4.1. The values that are normally recorded from the 6150 during the calibration process are shown in bold italics.

Model: 6150 **Serial#:** 74678

Full scale: Ps: 32 inHg
Pt: 60 inHg

Last Calibrated date: 10/10/08

CALIBRATION RESULTS

STATIC PRESSURE (Ps):

TEST POINT	AS FOUND	AS LEFT	DEVIATION
	inHg	inHg	inHg
1. Vacuum	***1.003***	1.000	0.003
2. Fullscale	***32.005***	32.000	0.005

PITOT PRESSURE (Pt):

TEST POINT	AS FOUND	AS LEFT	DEVIATION
	inHg	inHg	inHg
1. Vacuum	***1.004***	1.000	0.004
2. Fullscale	***60.009***	60.000	0.009

VERIFICATION RESULTS

STATIC PRESSURE (Ps)		PITOT PRESSURE (Pt)	
APPLIED	**DISPLAYED**	**APPLIED**	**DISPLAYED**
inHg	inHg	inHg	inHg
1.000	***1.000***	1.000	***1.000***
3.200	***3.200***	6.000	***5.998***
6.400	***6.400***	12.000	***11.998***
9.600	***9.600***	18.000	***17.999***
12.800	***12.801***	24.000	***23.999***
16.000	***16.002***	30.000	***32.000***
19.200	***19.202***	36.000	***36.001***
22.400	***22.401***	42.000	***42.002***
25.600	***25.601***	48.000	48***.002***
28.800	***28.800***	54.000	***54.001***
32.000	***32.000***	60.000	***60.000***

Calibrated by: Date:

Figure 4.1 Sample calibration report

SECTION 5

MAINTENANCE

Scheduled maintenance of the 6150 includes calibration once a year. The calibration procedure is described in Section 4.

Apart from this there are no other scheduled maintenance requirements.

APPENDIX A

SPECIFICATIONS

Static Output

Pressure units

range:	1.0 to 32 inHg
resolution:	0.001 inHg
accuracy:	0.008 inHg

Altitude units

range:	-2000 ft. to 60,000 ft.
resolution:	1 foot
accuracy:	8 ft. @ 0 ft.
	24 ft. @ 35,000 ft.
	48 ft. @ 50,000 ft.

Climb units

range:	0 to 10,000 ft/min
resolution:	1 ft/min

Leak check

resolution	1 ft/min ; 0.001 inHg/min

Pitot Output

Pressure units

range:	1.0 to 60 inHg
resolution:	0.001 inHg
accuracy:	0.008 inHg

Airspeed units

range:	0 to 500 knots
resolution:	0.1 knots
accuracy:	2.0 knots @ 50 knots
	1.0 knots @ 100 knots
	0.5 knots @ 200 knots
	0.2 knots @ 500 knots

Leak check

resolution:	0.1 knot/min ; 0.001 inHg/min

Calibration Interval

One year

Power requirement

90-260 VAC, 47-440 Hz., 50 VA

Dimensions & weights

18″ x 12″ x 7″ / 18 lbs

.

Environmental specs:

Operating temp.	0^{o} to50^{o}C
Storage temp.	-40^{o} to 75^{o}C
Humidity:	5 to 95% non-condensing

APPENDIX B

REPAIR AND RETURN POLICIES

If it is determined that the product is defective, please call Laversab customer service department: (281) 325-8300 or fax (281) 325-8399 or e-mail customerservice@laversab.com for further assistance.

Before shipping any equipment to Laversab for repair, please call the customer service department at (281) 325-8300 or fax (281) 325-8399 or e-mail to customerservice@laversab.com . Please include a description of the problem that has been identified when returning defective equipment.

Ship equipment to :

LAVERSAB, INC.
505 Gillingham Ln..
Sugar Land, Texas 77478
U.S.A.

Note: Please pack the 6150 in a carton prior to shipping. Do not ship without proper packing. Warranty will be void if the 6150 is shipped without proper packing.