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PS-425

Pitot-Static/Air Data Tester



OPERATION AND MAINTENANCE MANUAL

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PRESTON PRESSURE LLC

PS-425

USER AND MAINTENANCE MANUAL

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WARRANTY AND LIABILITY STATEMENT

Preston Pressure LLC warrants its products against defects in workmanship and material under normal, intended use for a period of two years from the date of purchase. Valves are warranted for a period of 180 days.

Preston Pressure's limit of liability shall be to repair or replace the product at their discretion. Transportation shall be pre-paid to the Preston Pressure factory or authorized service facility. Preston Pressure shall not be liable for any consequential damage expense.

This warranty shall be void if the product has been repaired or altered in any way that adversely affects its performance or reliability. This warranty shall be void if the product has been subject to abuse, misuse, contamination, negligence, accident, shipping damage, or improper operation.

Preston Pressure reserves the right, at its own discretion, to make changes in materials, designs, finish, or specifications, without obligation to install or incorporate such changes in products previously manufactured.

This warranty shall, at Preston Pressure's option, become void if the ownership is changed, unless the prior owner or proposed owner obtains written approval of continuation of coverage prior to the change of ownership.

Preston Pressure reserves the right to revise this manual and to make changes to content from time to time in the content thereof, without obligation to notify any person of such revision.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CHAPTER 1

GENERAL INFORMATION

Description of the PS-425 Pitot-Static Test Box

The PS-425 Air Data, pitot-static test box is a digital display tester used to test aircraft altimeters, airspeed indicators, pitot-static systems, and other vacuum and low-pressure devices. This test box incorporates transducer sensor technology that is largely immune to the failures and costly repairs associated with analog instruments.

The PS-425 incorporates a digital instrument model TST-621-35. Altitude is displayed in feet, with increments of 2 and 5 feet. Airspeed is displayed in knots. Vertical speed is indicated in feet per minute.

The PS-425 is powered by 8 D-size batteries or an external power adapter. The vacuum and pressure sources are derived from independent manual pumps, and each pump has its own reservoir, thus eliminating the complexity and maintenance of an additional pressure/vacuum selector valve. The tester can simulate pressure and vacuum suitable for up to 35K ft and 500 Knots.

PS-425 SPECIFICATIONS

Digital Altimeter:

Display Range : -1000 to 35,000 feet

Vacuum Pump Range: -1000 to 35,000 feet

Resolution: from -1,000 to 30,000 feet resolution is in 2-foot increments
from 30,000 to 35,000 feet resolution is in 5-foot increments

Sensor Accuracy: approximately 0.03 %

Temperature range: 32 degrees F to 120 degrees F (0 C to 50 C)

Altitude units: Feet

Digital Airspeed:

Range: 18 – 500 Knots

Resolution: 1 Knot

Sensor Accuracy: 0.03%

Temperature range: 32 degrees F to 120 degrees F (0 C to 50 C)

Physical Dimensions: 10.5”D X 14.25”L X 10”H (27x35x25 cm)

Weight: approximately 17.5 lbs (8 Kg)

Power Source:

External: 12 VDC (from a 110/220 VAC adaptor or other source)

Internal: 12 VDC (from internal batteries)

Current draw: 100 mA with backlight on, 10 with backlight off

Other Features:

Leak test feature: 2 minutes, selectable down to 30 seconds (longer test periods available upon request)

VSI (vertical speed indicator) : Limited to 9,999 ft/minute

Note: The PS-425 does NOT have the precision required to test RVSM altimeter systems.

FRONT PANEL LAYOUT



Front Panel Description

The **UNITS** button is used to toggle between the two primary display modes. Upon powering up, the display indicates altitude in feet and airspeed in knots. Pressing the UNITS button will switch the display to indicate altitude in feet and vertical speed per minute in feet. Pressing the UNITS button again will toggle back to the original display.

The **LEAK CHECK** will begin a 120 second timer, and the display will also show the gain or loss of altitude or airspeed experienced during the displayed time period.

If the Leak Check button is pressed while in the altitude/airspeed mode, the leak check will enter the airspeed leak test mode.

If the Leak Check button is pressed while in the altitude/VSI mode, the leak check will enter the altitude leak test mode.

If the operator wishes to select a different length of testing time, the Leak Check button may be pressed repeatedly, which will cause a reduction in the timer counter in 30-second increments. The timer will not toggle above 120 seconds nor under 30 seconds. Once the time is selected, press the Units button to start the timer.

The **EXIT** button is used to exit out of the leak check mode.

The **LIGHT** button will toggle the display backlight ON or OFF.

Altitude - The altitude is measured based on a reference point of 29.92 (sea level). This is pre-set at calibration and cannot be changed by the operator. The altitude is displayed in increments of 2 feet up to 30,000 feet, and 5 feet at altitudes above 30,000 feet.

Airspeed – The airspeed is calculated based on the pressure differential between the static sensor and the pressure sensor. The two sensors are identical but independent. A pressure difference between the two sensors will not cause damage, even if they are at a high vacuum on one sensor and a high pressure on the other. (Either sensor may be damaged if its pressure exceeds 20 psi.)

If the pitot pressure is lower than the static pressure, the airspeed reading will show **“InverseP”**. **An inverted pressure situation will not damage the TST-621 instrument, but it may damage instruments in the aircraft!**

If the airspeed exceeds 500 knots, or if the altitude range exceeds 40,000 feet, the airspeed display will indicate “ ---- ”. This condition will not damage the TST-621 instrument, but the display serves to indicate that the pressure differential has exceeded the altitude or airspeed calculations.

CHAPTER 2

THEORY

The PS-425 test box consists of one manual vacuum pump, one manual pressure pump, reservoirs for the pressure and vacuum, and a digital display for indicating altitude and airspeed.

- **Pneumatic Theory**

Metering valves allow the operator to control the rate of flow of the air from the pressure or vacuum sources, exiting out through the vacuum and pressure ports. The vent valves allow for metering the produced vacuum or pressure back into the atmosphere. One crossbleed valve permits the operator to isolate the pressure and vacuum sides, or to allow the balancing of pressures, or even to reverse the normal “flow” of pressure.

The two round gauges allow the operator to monitor the level of pressure or vacuum that is stored in the tester’s reservoirs.

When the operator wishes to simulate an altitude, the Crossbleed, Vacuum, and Vacuum Vent valves are gently closed. The vacuum cylinder is pumped until sufficient vacuum is in the reservoir, as indicated on the Vacuum Reservoir Gauge. How much vacuum will be needed depends on the desired altitude, and is also affected by how long the tubing and lines are between the test box and the altimeter. **The vacuum and pressure reservoir gauges serve only as general references of reservoir vacuum and pressure; they are not used in the actual calibration of any instrumentation, and do not require calibration.** Once sufficient vacuum is obtained in the reservoir, the Vacuum Valve is gently opened to allow air to be suctioned into the system through the vacuum port. Once sufficient altitude simulation is obtained, the Vacuum Valve is gently closed. Reduction in altitude is accomplished by gently opening the Vacuum Vent Valve, and allowing atmospheric air pressure to enter into the lines.

If the operator needs to go to an altitude below atmospheric pressure, pressure must be introduced into the pressure reservoir. Opening the Crossbleed Valve will enable pressure to flow from the pressure reservoir to the altimeter. Open the Crossbleed valve, and then the Pressure valve to pressurize the vacuum side.

Similarly, when airspeed is to be simulated, the Crossbleed, Pressure and Pressure Vent valves will first be closed, until the operator establishes a pressure build-up in the pressure reservoir by pumping the pressure cylinder. Then the Pressure Valve will be gently opened, allowing air pressure to flow through the pressure port to the airspeed indicator. To reduce pressure, the Pressure Vent valve is opened to leak the air pressure into the atmosphere.

CHAPTER 3

OPERATION

- **Preliminary Information**

Prior to using the PS-425 tester, the user should become familiar with the unit by reading this manual and operating the tester independently of any other attached devices.

For greater accuracy, the indicator should be powered on for 15 minutes before use.

The test procedures described in this manual are general in nature, for reference use only. The operator may substitute these procedures with others, as applicable to the tests to be performed, or according to other specific documentation.

Error codes display as follows:

- The display will blink if altitude exceeds 35,200 feet, or if sensor temperature is below 32F or 0C, or above 122F or 50C. Beyond these limits the accuracy should not be trusted.
- Altitude displays “High Alt” if it exceeds 40,000 feet.
- “InverseP” will be indicated on the airspeed side if the static pressure exceeds the pitot pressure by more than approximately 0.1 mbar. Due to its independent pressure and static sensors, no damage will occur to the tester due to inverse pressure. However, damage could occur to any system attached to the tester, therefore the warning is to alert the user of the condition.
- “Over Pressure” will be indicated on the airspeed side if the pressure exceeds the equivalent of 500 knots. Due to independent pressure and static sensors, no damage will occur to the tester due to this condition. However, damage could occur to any system attached to the tester, therefore the warning is to alert the user of the condition.

Be very gentle with the precision metering valves. Do not close these valves with unnecessary force, or internal damage to valve seating will occur.

- **Pre-Testing**

Pre-test the static system of the PS-425 test box according to the following steps:

1. Ensure the PS-425 is not connected to any external hoses or devices.
2. Close the Vacuum Control, Vacuum Vent, Crossbleed, Pressure Control, and Pressure Vent valves.
3. Turn on the power, and then actuate the Vacuum Pump until the Vacuum Reservoir gauge reads approximately -15 inHG.

4. Gently open the Vacuum Control valve to make the Altimeter section climb. This climb may be done rapidly without damage to the sensor.
5. When the Altimeter reads at least 18,000 feet, gently close the Vacuum Control valve.
6. Wait for about 60 seconds for internal pressures to stabilize. Then perform a leak check.
7. The leak check function will activate and begin to monitor the leak rate. Verify that the PS-425 does not leak exceeding 100 feet per minute. Write down the leak rate for future reference. (Subtract this value from the total leak rate when testing the aircraft, to arrive at the aircraft's leak rate.)
8. Gently open the Vacuum Vent valve to bring the test box back to ground (ambient) pressure.

Pre-test the pressure system of the PS-425 test box according to the following steps:

1. Turn on the power to the PS-425.
2. Ensure the PS-425 is not connected to any external hoses or devices.
3. Close the Vacuum Control, Vacuum Vent, Pressure Control, Crossbleed valve, and Pressure Vent valves.
4. Actuate the Pressure Pump until the Pressure Reservoir gauge reads approximately 15 PSI.
5. Gently open the Pressure Control valve to make the Airspeed section climb. This climb may be done rapidly without damage to the sensor.
6. When the Airspeed reads at least 300 knots, gently close the Pressure Control valve.
7. Wait for about 30 seconds for internal pressures to stabilize. Activate the leak check function to monitor the leak rate. Verify that the PS-425 does not leak exceeding 2 knots per minute. Write down the leak rate for future reference. (Subtract this value from the total leak rate when testing the aircraft, to arrive at the aircraft's leak rate.)
8. Gently open the Pressure Vent valve to bring the test box back to ground (ambient) pressure.

Testing Aircraft Pitot System Only

1. Turn on the power to the PS-425.
2. Connect the Pressure Port to the aircraft Pitot system.
3. Close Pressure Control, Pressure Vent, and Crossbleed valves. Open Vacuum vent valve.
4. Actuate the Pressure Pump until the Pressure Reservoir indicates 15 PSI or more.
5. Gently open Pressure Control valve until desired speed(s) are achieved.
6. Compare the airspeed of the PS-425 box to the airspeed indicated in the aircraft.
7. Go to approximately 75% of the maximum airspeed of aircraft indicator (or the speed specified by the manufacturer). Close the Pressure Control valve and after allowing a few seconds for stabilization, perform a leak check. The pitot system

should not leak more than two knots per second, plus the leakage previously noted in the pressure system pre-test.

8. Gently open the Pressure Vent valve to return the pitot pressure to ambient pressure.

Testing of Aircraft Static System

Note: If the previous pitot system test indicated an excessive leak, do not proceed until that leak is repaired. Damage to aircraft airspeed indicator could result.

1. Turn on the power to the PS-425.
2. Connect the Vacuum Port to the aircraft static port, and the Pressure Port to the aircraft pitot port. Set the aircraft altimeter to 29.92 inHg.
3. Close Vacuum Control, Vacuum Vent, Pressure Control, and Pressure Vent valves. Open Crossbleed valve.
4. Actuate the Vacuum Pump until a desired level of vacuum is seen on the Vacuum Reservoir gauge (generally -15 to -20 inHG). Actuate the Pressure Pump until the Pressure Reservoir indicates 15 PSI or more.
5. Gently open the Vacuum Control valve to cause the altitude to climb.
6. **DO NOT** exceed the climb rate of the aircraft VSI indicator, or the airspeed indicator limits. The VSI is a very delicate instrument.
7. Climb to the desired altitude(s) per the test to be performed.
8. Close the Vacuum Control valve, and after allowing a few seconds for stabilization, compare the aircraft altimeter with the test box.
9. When at the appropriate altitude (generally 18,000 feet) perform a leak check. If the static system shows leakage, be careful to not exceed the VSI rate. Be prepared to open the Vacuum Control valve if needed, to prevent excessive VSI indication.
10. Gently open the **Pressure Vent** valve to return the system pressure to ambient pressure. Do not exceed the VSI or airspeed indicator limits.

Note: if an altitude lower than ambient pressure is desired, do steps 1-4 above. Gently open the Pressure Control valve to pressurize the system, thereby causing the altimeter to decrease in altitude. Open the Vacuum Vent valve to return to ambient pressure.

Testing the Aircraft Pitot and Static systems simultaneously

Note: First ensure pitot system does not leak by performing Pitot system test on page 14.

1. Turn on the power to the PS-425.
2. Connect the Vacuum Port to the aircraft static port, and the Pressure Port to the aircraft pitot port. Set the aircraft altimeter to 29.92 inHg (1013.3 mB).
3. Close Vacuum Control, Vacuum Vent, Pressure Control, and Pressure Vent valves. Open Crossbleed valve.

4. Actuate the Vacuum Pump until a desired level of vacuum is seen on the Vacuum Reservoir gauge (generally -15 to -20 inHG). Actuate the Pressure Pump until the Pressure Reservoir indicates 15 PSI or more.
5. Gently open the Vacuum Control valve to cause the altitude to climb.
6. **DO NOT** exceed the climb rate of the aircraft VSI indicator, or the airspeed indicator limits. The VSI is a very delicate instrument.
7. Climb to the desired altitude(s) per the test to be performed.
8. Close the Vacuum Control valve, and after allowing a few seconds for stabilization, compare the aircraft altimeter with the test box.
9. When at the appropriate altitude (generally 18,000 feet) perform a leak check. If the static system shows leakage, be careful to not exceed the VSI rate. Be prepared to open the Vacuum Control valve if needed, to prevent excessive VSI indication.
10. To display an airspeed, close Crossbleed valve and gently open Pressure valve until desired airspeed is indicated. Close Pressure valve.
11. To return system to ambient pressure, ensure Crossbleed valve is open. Then gently open the **Pressure Vent** valve to return the system pressure to ambient pressure. Do not exceed the VSI or airspeed indicator limits.

Note: if an altitude lower than ambient pressure is desired, do steps 1-4 above. Gently open the Pressure Control valve to pressurize the system, thereby causing the altimeter to decrease in altitude. Open the Vacuum Vent valve to return to ambient pressure.

CHAPTER 4

CALIBRATION PROCEDURES

The recommended calibration interval for the PS-425 is one year. If at any time during regular use the unit becomes unreliable or out of correct operating calibration, it must be repaired and/or re-calibrated before continuing its use.

The PS-425 is easy to calibrate. There are 4 set points used in the calibration of the altimeter. This enables the altimeter to have a greater degree of accuracy, allowing it to self-correct to the nearest calibrated set point.

The calibration factors are stored in the microcontroller's EEPROM memory and does not need battery back-up. The calibration will not be lost when power is removed.

Altimeter Calibration Procedures

1. Apply power to the PS-425 and allow a warm up for a *minimum* of 15 minutes.
2. Connect a known altitude pressure standard to the Static and Pitot ports, (both ports connected together, sensing the same pressure).
3. Press the Exit and Leak Check buttons simultaneously. The display will change to:

Cal? No Yes

4. Press the Leak Check button to proceed with calibration, or press the Exit button to exit out of the calibration mode without any changes being made.
5. At this point the display will read:

**Goto
0 Feet**

This is to notify the technician that the current calibration point is 0 feet (29.92 inHg). To select a different calibration point, press the backlight button (the button will not activate the light while in Cal mode).

There are 4 calibration points: 0, 10,000, 20,000, 30,000. When the desired calibration point is displayed, press the Units button.

The first calibration point display will read:

P *Altitude* (in feet)
In ↑ *xxx* ↓

The letter P indicates that the sensor being calibrated in this step is the Pitot sensor.

(Where *Altitude* is the sensed altitude in feet, and *xxx* is the current calibration value.)

Write down the calibration value so it can be re-set if needed!

The word “**In**” is displayed above the Units button. Press the Units button when ready to input the selected correction value.

6. Go to a pressure that corresponds to the selected calibration point (referenced from 29.92 inHg), as read from a pressure standard. When the altitude is stable for approximately 30 seconds, note the altitude displayed on the PS-425 display in calibration mode.

If the displayed altitude is lower than the standard, press the Exit button as needed to incrementally raise the altitude to be equivalent to the standard.

If the displayed altitude is higher than the standard, press the Leak Check button as needed to incrementally lower the altitude to be equivalent to the standard.

As the altitude is adjusted, note that the displayed correction factor also changes, and the change is in increments smaller than the altitude. Use this to fine-tune the altitude as close as you can to the standard.

When the PS-425 altitude matches the standard as close as possible, wait another 30 seconds to ensure that the internal mathematical filtering corrections have been done. If satisfied with the results, press the Units button to Input the selected correction, and the display will automatically proceed to the next calibration level.

7. Repeat the procedure in step 7 at each requested altitude: 10000, 20000 and 30000 feet as needed.

8. After the last calibration point has been entered, the display will briefly read “**Storing**” and then re-start. There is no need to re-cycle power.

9. While bringing the PS-425 back down to ground level pressure, test each calibration point as specified in the chart. Enter the corrected value at each point. (The correction chart may be photocopied, cut out, and fixed to the test box for handy reference.)

Helpful Notes: When the display is indicating “Go To *XX* Feet”, pressing the Light button will cycle through the various calibration points of 0, 10,000, 20,000 feet, etc. After 30,000 feet it will exit the calibration mode. This is handy for use in those cases when only one range is in need of calibration. Note, however, that the PS-425 unit’s pressure must be within less than 2,500 feet of the selected range in order to save the new value. This eliminates accidentally saving a value when in an incorrect pressure range.

Note: Allowable error tolerances are as follows:

Altitude	+/-Error	Altitude	+/-Error
-1000	5	14000	25
0	5	16000	27
500	5	18000	30
1000	5	20000	32
1500	6	22000	35
2000	7	25000	38
3000	7	30000	45
4000	8	35000	51
6000	10		
8000	15		
10000	20		
12000	22		

PS-425 S/N

FOR TEST ALTITUDE	DISPLAY ALTITUDE	FOR TEST ALTITUDE	DISPLAY ALTITUDE
- 1000		10000	
0		12000	
500		14000	
1000		16000	
1500		18000	
2000		20000	
3000		22000	
4000		25000	
6000		30000	
8000		35000	

Cal Date:

Expires:

Original Calibration Correction Values
(for reference during calibration):

Calibration Point Correction value

0 Ft

10,000 Ft

20,000 Ft

30,000 Ft

Airspeed Calibration Procedures

1. Perform the altimeter calibration described in the previous section. The pitot sensor is calibrated in this process, along with the static sensor.

2. When a satisfactory altitude calibration is obtained, go through each test point in the following chart, and enter the corrected value at each point. (The correction chart may be photocopied, cut out, and fixed to the test box for handy reference.)

Note: if the airspeed calibration needs additional adjustment after being calibrated in the altitude calibration procedures, the adjustment can be done by entering the calibration process described in steps 1-6 of the previous section. Then adjust only the P sensor up or down to increase or decrease the calibration point. Unplug the unit, and power up again. Repeat as needed to achieve the desired correction.

TEST AIRSPEED	DISPLAY AIRSPEED	TEST AIRSPEED	DISPLAY AIRSPEED
40 Kts		250 Kts	
60 Kts		275 Kts	
80 Kts		300 Kts	
100 Kts		325 Kts	
120 Kts		350 Kts	
140 Kts		375 Kts	
160 Kts		400 Kts	
180 Kts		425 Kts	
200 Kts		450 Kts	
225 Kts		500 Kts	

Calibrated by: _____ Date: _____
 Next Calibration Due Date: _____

CHAPTER 5

MAINTENANCE REPAIRS AND TROUBLESHOOTING

Note: Refer to the Theory of Operation section as a reference on how the various systems function.

Annual Maintenance

The following annual maintenance is recommended:

1. Check color of beads in air reservoir/dryer. Change if pink. The dryer is a common in-line dryer used in small air compressor systems. A new dryer can be purchased from Preston Pressure, or an internet search for “mini inline desiccant air dryer” may lead to an alternate source.
3. Verify batteries are fresh. Avoid old batteries that may leak and corrode the battery contacts.
4. Verify vacuum reservoir tank is mounted tightly.
5. Verify pump cylinders are tight.
6. Verify switches and valves on front panel are mounted tightly.
8. Test for leaks.
9. Perform calibration checks, and re-calibrate if necessary.

- **Troubleshooting**

Refer to the following chart of symptoms, causes, and repair comments:

SYMPTOMS	POSSIBLE CAUSES	COMMENTARY
Display shows garbage or freezes at the beginning display.	Microcontroller had a power brown-out or there is a low voltage condition.	1. Turn off unit for 15 seconds before powering up again. 2. Re-cycle power switch. If problem occurs frequently, it may be caused by a corroded switch. Also check battery contacts.
Display never finishes initializing	1. Tester is being operated in conditions that are	1. Operate the tester in a warmer environment.

	<p>excessively cold.</p> <p>2. Low battery</p> <p>3. If occurring on airspeed side, it is not receiving static pressure from vacuum sensor.</p>	
Unit will not vacuum up to 35,000 feet	<p>1. Leak in internal hoses or plumbing connectors</p> <p>2. Cylinder pump is weak or inoperative</p>	<p>1. Troubleshoot plumbing to find leak(s)</p> <p>2. Replace defective cylinder</p>

CHAPTER 6

SHIPPING AND STORAGE

Shipping Instructions

- Partially open all valves
- Ensure power switch is off
- Package the test box inside another box, with at least 2 inches of packing material around the tester
- Tester is not likely to be damaged with ground shipping if packaged properly

Storage Instructions

- Partially open all valves
- Place lid on tester
- Store the test set in a controlled environment
- If storage is to exceed 1 year, remove batteries from unit