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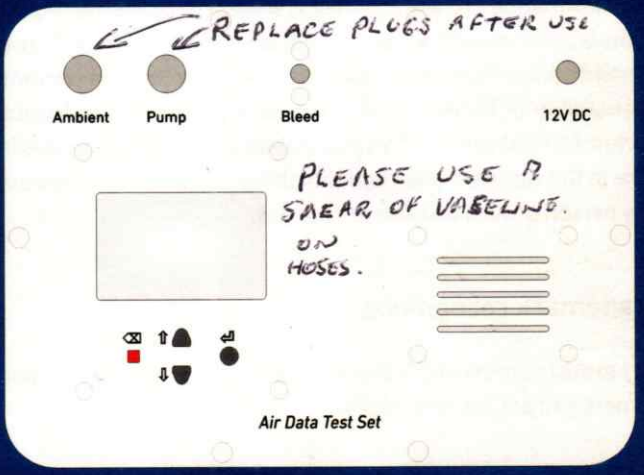
SADTS
Sport Air Data Test Set



User Manual

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Version history

Version	Date	Changes
0.5a	20191105	Initial draft
0.6a	20191218	Draft updates

Contents

Introduction

1.1 Purpose

SADTS is designed to provide a test capability of air data instruments for sport aircraft such as gliders and recreational powered aircraft. Such tests may be routinely required to be performed during annual maintenance inspections and instrumentation refit.

The device is simple to operate and the built-in suite of tests enables operators to perform tests according to airworthiness standards, in a systematic and consistent way.

Usability features have been designed-in to reduce the level of training, skill and currency required to perform the tests.

Note: SADTS is designed for moderate speed VFR-operation aircraft.

The drift rate of the pressure sensors is not sufficiently low for SADTS to be used to test altitude encoders in transponders.

SADTS has not been designed for high speed aircraft where compressibility effects are significant.

Airspeed indicators for very slow aircraft (slower than 30 kn) require pressure sensor accuracy higher than that offered by SADTS.

1.2 Functional description

SADTS employs digital measurement and control to automate the air data tests as much as possible. A microcontroller drives a peristaltic pump via a stepper motor, based on measurements from pressure sensors, to provide vacuum or positive pressure to the device under test (DUT). This means a single pump connection to the aircraft systems and instruments is used.

A second pressure sensor is used to provide the ambient (or ground static) pressure whilst testing is underway. Some tests use absolute pressure, whilst others use pressure differentials between the two sensors.

The pump control uses an adaptive control based on monitoring of the pressurisation process, such that the rate of change of pressure is regulated to specified test limits.

A variety of test types are offered:

Active hold tests These tests drive the DUT to a set pressure and then maintain it during the check duration, compensating for small leaks that may be present. Typically, the operator is required to physically check the DUT reads within some tolerance of the internal measured value.

Leak tests These tests drive the DUT to a set pressure and then halt the pump during the check duration. Typically, the operator is required to physically check the DUT reads within some tolerance of the internal measured value; or to confirm the leak rate during the check duration is within a specified tolerance.

The operator is provided with on-screen instructions to guide the proper and safe conduct of the test.

1.3 General precautions

Operators of the test equipment should be familiar with the contents of this manual.

⚠ **Attention:** Incorrect use of the test equipment can permanently damage connected aircraft instruments. Ensure test equipment is operated in accordance with this manual and care is taken at all times the equipment is connected to aircraft instruments.

⚠ **Attention:** Do not shorten hoses connected to instruments, as shorter hoses may result in the system internal volume being lower than the minimum allowable volume and cause the pressure regulation system to overshoot.

⚠ **Attention:** Do not leave device unattended while the Pump hose is connected to instruments or airframe, as gauge pressure can change over extended periods due to atmospheric changes, which can result in negative gauge pressure being applied to ASIs.

1.4 Models

K168A2C1V1 Pre-production prototype

K168A2C2V2 Added backlight to display, audio indicator

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System Overview

2.1 System diagram

Show process system diagram

- 12 V DC input
- Pump (peristaltic, stepper motor driven)
- 2x Absolute digital pressure sensors
- Microcontroller with Bluetooth
- Graphical display, keys, audio indicator
- O-ring sealed locking ports
- Vent for cooling, intake and exhaust
- Bleed valve
- Intake filter

2.2 Package contents

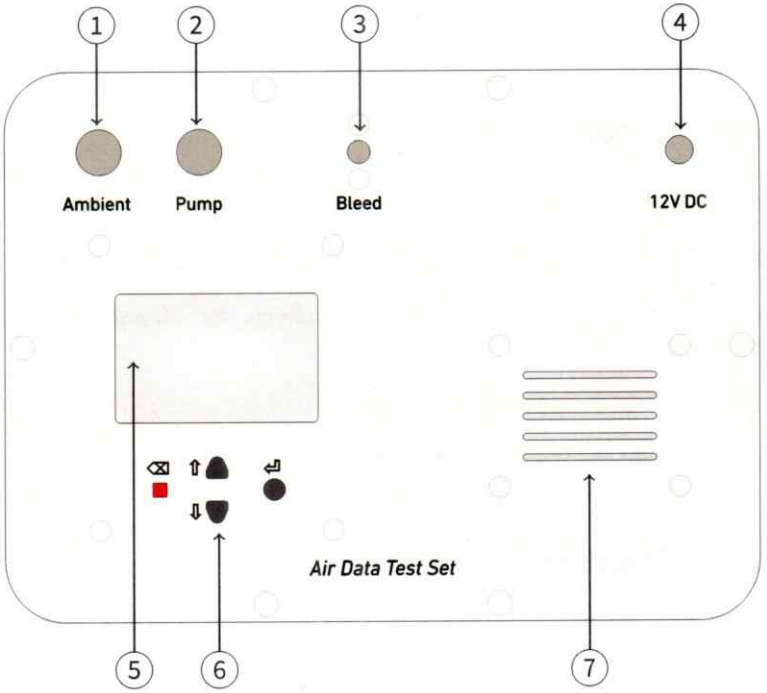
The standard SADTS package contains the following items:

- SADTS device in case
- User manual
- 12 V DC power supply from domestic AC mains
- 12 V battery terminals to DC jack adaptor
- Pump hose: silicone tube 100 cm length 4×6 mm, with quick release plug fitting
- Calibration and self-test hose assembly: two silicone tubes 20 cm length 4×6 mm, each with quick release plug fitting; mutually connected via 5 mm T-connector to silicone tube 60 cm length 4×6 mm
- 5 mm hose stopper
- 5 mm inline hose connector

Accessories:

- Test chamber
- Static port adaptor
- Port dust covers
- Hose plug dust covers

2.3 Control panel



1. Port connector, ambient pressure
2. Port connector, pump
3. Bleed valve
4. Power input jack
5. Display with backlight, audio indicator
6. Keys
7. Vent

Operating Instructions

3.1 General

Keep case closed when not in use.

Keep front panel, ports and hoses free of dust and contamination.

Inspect equipment and hoses and check for cleanliness and integrity prior to use.

Only operate device on level surface.

Do not cover the vent grille during operation.

3.2 Powering the unit

Two options are available for powering the test unit:

- 12V DC power adaptor connected to AC mains
- DC battery, maximum 15V (Sealed Lead-Acid or lithium iron phosphate)

Use of a DC battery requires a lead with spade connectors to the DC barrel jack.

Prior to powering on the device, ensure hoses are disconnected.

When the power supply is connected via the DC jack, the system initialises and then drives the pump to equalise the pressure across the two ports.

Attention: Do not disconnect the power while the pump is operating as rapid deceleration can result in damage to the pump. Always pause or cancel any running test and wait for the pump to halt before disconnecting power.

3.3 Ports

Two quick-release ports are provided:

Ambient This port is typically left open and internally connects to a pressure sensor.

Pump This port is typically connected to the device under test.

During testing, instructions are displayed as to which ports shall be connected.

Note: The Ambient port is only connected for self-test and calibration purposes.

O-rings on the hose plugs are used to maintain an airtight seal with the port.

Both ports have a cylindrical body with a spring loaded catch with tab.

To connect a hose to a quick-release port

Push the hose plug into the port; the locking tab will extend and click.

To disconnect a hose from a quick-release port

Push the locking tab towards the port body; the port will click and the plug is then free to be withdrawn.

Attention: Connecting or disconnecting the Pump port to the airframe or aircraft instruments without using the bleed valve can cause sharp pressure changes which may result in damage to instruments.

Always use the bleed valve when connecting or disconnecting the Pump port to an airframe or aircraft instrument.

3.4 Bleed valve

The bleed valve enables the pump hose ambient pressure to be maintained whilst connecting and disconnecting a hose to the Pump port.

Note: If a test is aborted and the system is not powered, gradually open the bleed valve to allow the pump side hose to equalise pressure to ambient before disconnecting the device under test.

To open the bleed valve

Turn the knob anticlockwise 5 times.

To close the bleed valve

Turn the knob fully clockwise until tight.

3.5 Hoses

Hoses are used in various configurations depending on the operating mode:

Testing: Hose is connected from pump port to device under test.

Calibration slave: Hose is connected from Pump port to Ambient port and reference pressure source via a 'T' connector.

Self-test, leakage: Hose is connected from Pump port to Ambient port.

Self-test, range: Hose is connected from Pump port to stopper.

Hoses connect to the ports via supplied plugs.

⚠ **Attention:** Do not disconnect the hose from the Pump port when the system is pressurised. Simply disconnecting the hose will result in a rapid equalisation of pressure, which can damage any instrument attached at the time. Always wait until automatic equalisation, or manual equalisation via the bleed valve, is complete prior to disconnecting the hose.

To connect the pump hose to the device under test

1. Plug the hose into the pump port as required
2. Open the bleed valve
3. Connect the hose to the device under test
4. Close the bleed valve

To disconnect the pump hose from the device under test

If the system is equalised:

1. Open the bleed valve
2. Connect the hose to the device under test
3. Close the bleed valve
4. Unplug the hose from the pump port if no longer required

If a test is being performed, first cancel/abort the test so an equalisation is performed, prior to disconnecting the hose.

If the port is pressurised and the device is not powered, use the bleed valve (Section 3.4) to manually equalise pressure prior to disconnecting the hose.

3.6 Conducting tests

Prior to conducting any tests on an airframe or instrument, first check the maximum altitude and indicated airspeed limits and testing regime are appropriate for the device under test. See Section 6 for details.

Prior to conducting any tests on an airframe, it is recommended to survey the aircraft so that the pneumatic plumbing between ports and instruments are understood and to ensure proper hookup of the tester can be performed.

Note: For maximum accuracy, do not operate in high winds.

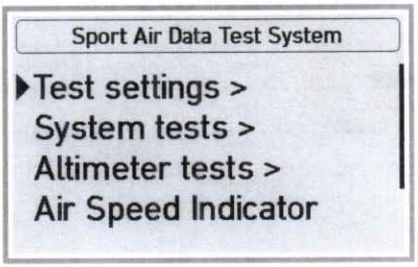
Do not allow hoses to become kinked.

Do not disturb hoses during tests.

Operate device at same height as instruments under test.

3.7 Menu system

Accessing the various functions of the device is performed by navigating through a menu system.



● ⏎	Select item at cursor
■ ⌫	Return from menu
▲ ⇧	Move cursor up
▼ ⇩	Move cursor down

The title display shows the name of the active menu. The path in the menu system is also displayed if the active menu is a sub-menu (for example 'Parent > Child').

▶ Menu cursor

> In menu labels, the item contains a sub-menu. Selecting the item opens the corresponding sub-menu.

Where the number of items in a menu is larger than one page, a bar is drawn on the right side of the screen to indicate the position of the cursor in the list.

3.8 Main menu

The main menu has the following items:

Running Tests

A common framework is used for all pre-programmed tests as well as manual tests.

4.1 Test framework

Each test proceeds through several states to ensure proper setup and completion.

Start ..... Section 4.5
Describe test to operator, ask confirmation to proceed

Prepare ..... Section 4.6
Instruct operator to configure instruments, aircraft and test set

Test ..... Section 4.2
One or more test stages

Equalise ..... Section 4.12
Returns pressure at Pump port to ambient pressure at a controlled rate

Restore ..... Section 4.7
Instruct operator to restore instruments and aircraft to their normal operating state

When a test consists of multiple stages, each stage must pass for the test result to be positive.

4.2 Testing stages

Each test stage proceeds through three states:

Run ..... Section 4.8
Activates pump, drives pressure at Pump port to set point

Settle ..... Section 4.10
Waits for hold time for system to stabilise before commencing check period

Check ..... Section 4.11
Instructs operator to check measurements

In addition to these states, the system can optionally be in two special states:

Pause ..... Section 4.9
Operator can interrupt and resume a running test

Error ..... Section 4.13
An error was detected during a running test

4.3 Test properties

Each type of test specifies a series of properties according to the test specification:

Mode: Specifies the metric used by the test: gauge altitude, absolute altitude, indicated airspeed, gauge pressure, absolute pressure, barometric scale.

Hold: Whether pump is active or passive during check period

Duration: Specifies the testing period.

Rate: Maximum and target rate of change of metric.

Set point: For each test stage, specifies the value of the target metric.

Tolerance: Specifies the allowable observed measurement error

(for active hold tests), or leak rate (difference in measured metric from start to end of the test period, for passive tests).

Test specifications are described further in Section 5.

4.4 Displays in tests

The title display shows the current test name. Where the test belongs to a family of tests, the family name is also displayed (for example 'Altimeter > Scale').

▬ A progress bar appears in the bottom of the display during active tests, and fills to right as the test pressure is approached, and clears from the left during the settle wait time.

▤ An animated pump state indicator appears in the left of the title display when the pump is active. When the pump drives flow into the device under test, the lines of this symbol become compacted; when the pump evacuates flow from the device under test, the lines of the symbol spread out.

3/20 Where tests comprise a sequence of sub-tests, an indicator appears in the right of the title display to indicate progress; in this example the test is currently at stage 3 of 20.

Numerical displays

The following terminology is used in tests to indicate the state of the device under test relative to the commanded pressure.

Current Current measured value of test metric

Set point Set point (command value) of test metric

Test Δ Difference of current measured value from value at start of *Settle* phase

± Allowable tolerance of test metric

Units are displayed on the right of the screen.

Alternative numerical display pages

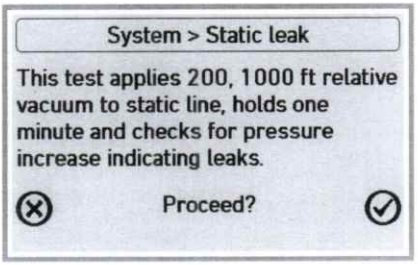
Prior to the hold phase, the main display during tests can be changed using the cursor keys.

Main: Current measured value; set point value

Rate: Current metric rate; target metric rate

Advanced: Gain (pump steps per Pa); pump speed in Hz

4.5 Start state

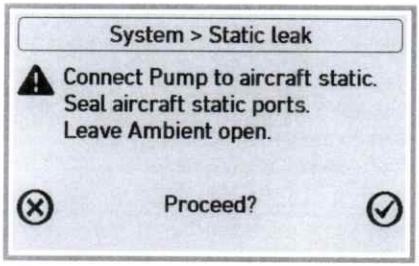


● ⏎ ⊘ Proceed to prepare test

■ ⌫ ⊗ Cancel

This page summarises the test stages to be performed and testing methodology, and waits for an acknowledgement that the operator wishes to proceed; otherwise the test is cancelled.

4.6 Prepare state



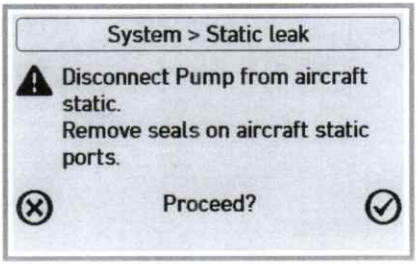
● ⏎ ⊘ Proceed to run test

■ ⌫ ⊗ Cancel

This page provides recommended configuration of the aircraft and instruments under test and waits for an acknowledgement that the operator has completed this configuration before proceeding with the test. If the aircraft and instruments cannot be safely configured for the test, the operator should cancel the test.

Note: The instructions presented are general recommendations; specific aircraft or testing scenarios may require different procedures to configure the aircraft or instruments for testing.

4.7 Restore state



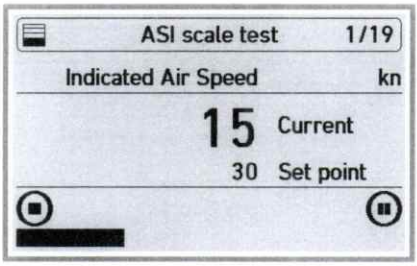
● ⏎ ⊘ Finish test

■ ⌫ ⊗ Cancel

Following testing, instructions are presented to the operator to reconfigure the aircraft and instruments to their normal operating state, typically reversing the work performed in the *Prepare* state.

Note: The instructions presented are general recommendations; specific aircraft or testing scenarios may require different procedures to restore the aircraft to an operational state.

4.8 Run state

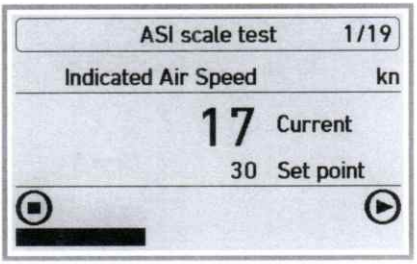


⏎	⏸	Stop pump and pause test
⌫	⏹	Cancel test, then equalise
⇧		Cycle up through alternative displays
⇩		Cycle down through alternative displays

Alternative numerical display pages are described in Section 4.4.

In the *Run* state, the pump is controlled to drive the pump side pressure to satisfy the set point conditions.

4.9 Pause state



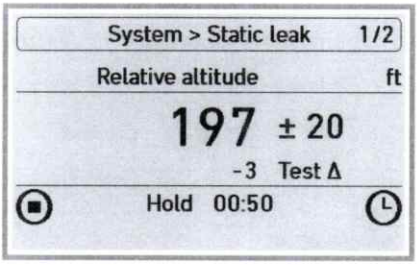
● ⏎ ⏵	Resume test or equalising
■ ⌫ ⏹	Cancel test, then equalise
▲ ⇧	Cycle up through alternative displays
▼ ⇩	Cycle down through alternative displays

Alternative numerical display pages are described in Section 4.4.

Pausing a running test may be performed if the operator needs to temporarily suspend the test while performing some other duty.

When a test or equalisation is paused, the pump is halted.

4.10 Settle state

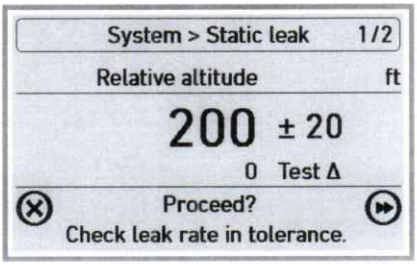


■⌫ ⊙ Cancel test, then equalise

In this state, the pump is deactivated if the test type is passive, or if active hold, the pump will be active to maintain the set point.

Because the *Settle* state is timed as required by the test regime, this state cannot be paused.

4.11 Check state



● ⏎ ⏩ Proceed to next test stage

■ ⌫ ⊗ Cancel test, then equalise

The *Check* state is used to mark the end of the test. The operator is instructed to determine whether the device under test satisfied the conditions of the test. This can take two forms based on the type of test:

Active tests: The test is successful if the instrument reading is within the specified tolerance.

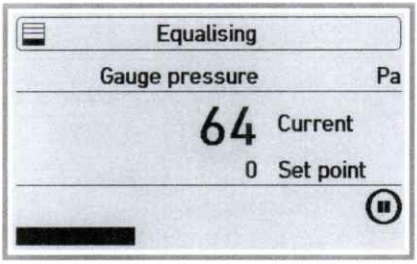
Passive tests: The test is successful if the change in metric during the settle period is within the specified tolerance. Usually this is for leak tests.

Note: During the *Check* state, the operator should record the test performed and the result of the test.

Some tests require the operator to observe the instrument under test during the *Settle* state.

The pump is halted during the *Check* state.

4.12 Equalise state



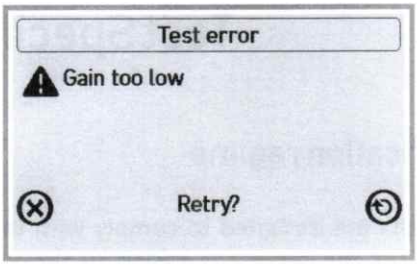
⏎ ⏸	Stop pump and pause
⇧	Cycle up through alternative displays
⇩	Cycle down through alternative displays

Alternative numerical display pages are described in Section 4.4.

Equalisation is performed at the end of each test or when tests are cancelled to return the pump side pressure to ambient conditions.

The *Equalise* state is functionally similar to the *Run* state, but with a set point for zero gauge pressure. Consequently, regardless of the type of test selected, measurements are expressed in terms of pressure (Pa).

4.13 Error messages



● ⏎ ⟲ Retry operation

■ ⌫ ⊗ Cancel test, then equalise

Errors require operator intervention. When an error is raised, the current running test or equalisation state is paused and the pump is halted.

Potential error messages include:

Pressure sensor fault A hardware fault has been detected. Return SADTS to manufacturer for servicing.

Gain too low Indicates the pump is unable to drive the pressure at a practical rate, which may indicate presence of a major leak in the device under test, or a test volume that exceeds the maximum specifications listed in Section 9.

Gain too high Indicates that the sensitivity of the pressure to pump rotation is too high; typically this is caused by a test volume that is lower than the minimum specifications listed in Section 9.

No progress Pressure is fluctuating such that the test is not expected to be completed in reasonable time.

Pressure too slow Rate of change of pressure is too low for the test to be completed in reasonable time.

Test Specifications

5.1 Specification regime

Programmed tests are designed to comply with the requirements and procedures of the regime specified in the Standard setting described in Section 6.8.

Note: It is recommended to refer to the current issued test regime documentation to ensure that tests are carried out in accordance with the specification, and at the required testing intervals.

5.2 Pressure rates

While the pump is driving the pump side pressure to the set point, the control system regulates the pump speed to keep the rate of change of the metric to a target value. As the set point is approached, the rate is gradually reduced to prevent overshoot.

Rates with altitude metric

Fast: 16 000 ft per minute when the altitude error is greater than 3000 ft, otherwise 3000 ft per minute.

Medium: 3000 ft per minute.

Slow: 750 ft per minute.

Rates with airspeed metric

Fast: 3 kn/s.

Medium: 2 kn/s.

Rates with pressure metric

The same rates are used as altitude metric.

5.3 System tests

System tests are used to test the airframe static and pitot systems for leaks. Both system tests consist of two stages, the first stage having a a small pressure difference set point to enable rapid determination of a major leak without having to proceed to the second stage, which is the proper specified test.

At the end of each test stage, any pressure change should be compared with the permitted variance. If the pressure change exceeds the tolerance, then a leak has been detected and the source of the leak must be found and rectified before re-testing.

Note: Leaks in the static or pitot system, if minor, might not prevent ASI and Altimeter tests from being successfully carried out.

Static leak test

This test applies 200 and 1000 ft relative vacuum to static line, settles 1 minute and checks for pressure increase indicating leaks.

Mode	*Hold*	*Duration*	*Rate*
Gauge alt	Passive	60 s	Medium

Set point (ft)	*Tolerance* (ft)	
	CAO 100.5	GFA
200	20	20
1000	100	100

The static system should be tested in-situ, complete with all instruments connected to it. Ideally, this will be accomplished by connecting to a static port. All other static ports should be sealed for the duration of testing. The test will cause both the ASI and altimeter to rise as vacuum is applied.

A positive finding is obtained when the relative altitude measurement, observed at the end of the settle period, changes less than the tolerance for each test stage.

A negative finding indicates a leak is present and must be found and rectified before re-testing.

Pitot leak test

This test applies 60 and 120 kn relative pressure to pitot line, settles 10 seconds and checks for pressure drops indicating leaks.

Mode	*Hold*	*Duration*	*Rate*
Gauge speed	Passive	10 s	Fast

Set point (kn)	*Tolerance* (kn)	
	CAO 100.5	GFA
60	2	2
120	2	2

The test system should be connected direct to the pitot, ensuring the aircraft static ports are not sealed or blocked in any way. The test will cause both the ASI to rise as pitot pressure is applied.

A positive finding is obtained when the indicated airspeed measurement, observed at the end of the settle period, changes less than the tolerance for each test stage.

A negative finding indicates a leak is present and must be found and rectified before re-testing.

⚠ **Attention:** Failure to protect ASI(s) from high static vacuum or negative gauge pressure may result in damage to the instrument.

The bleed valve should always be used when connecting and disconnecting the Pump hose to the ASI pitot port or to an ASI instrument directly.

5.4 Altimeter tests

If altimeter tests are carried out through the aircraft static system, it is recommended that the pitot system should be connected via a T adaptor to the static system for the duration of the tests.

Alternatively, the ASI(s) can be disconnected from the static system and the exposed static line hoses sealed. This results in an incomplete test for the static system as the static system is not strictly in the normal operating state.

As an alternative to in-situ testing, each altimeter can be tested individually via their own static port independent of the aircraft static system.

Note: Major leaks in the altimeter detected during System Static Leak testing may require subsequent tests of the altimeter to be performed using a test chamber.

Altimeter scale

This test applies a increasing vacuum to the altimeter static, settles at set altitudes and waits for operator visual checks. Following ascending the altitude scale, two set points at 50% and 40% of the maximum altitude are tested, and a further test is performed after returning to ambient static pressure.

Mode	*Hold*	*Duration*	*Rate*	*Note*
Absolute alt	Active	60 s	Fast	Ascending
Absolute alt	Active	300 s	Fast	Descending

Set point (ft)	*Tolerance* (ft)	
	CAO 100.5	GFA
−1000	20	100
0	20	100
500	20	100
1000	20	100
1500	25	100
2000	30	100
3000	30	100
4000	35	120
6000	40	180
8000	60	240
10 000	80	300
12 000	90	360
14 000	100	420
16 000	110	480
18 000	120	540
20 000	130	600
22 000	140	660
25 000	155	750
30 000	180	900
35 000	205	1050
ambient	30	100

The maximum altitude for the test is set in the Settings (Section 6.4).

The tolerance at the 50% and 40% maximum altitude set points are set as per the ascending tolerance.

Connect Pump directly to altimeter static port. Leave Ambient port open. Set altimeter scale to 1013 hPa.

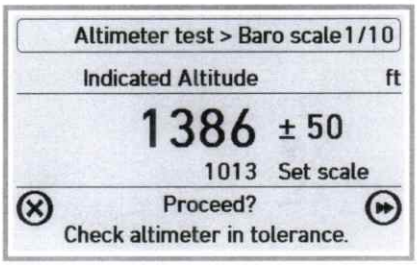
A positive finding is obtained when the altimeter indicates values within the tolerance of the current measurement, observed at the end of the settle period, for each test stage.

Altimeter barometric scale

This test applies steady atmospheric pressure to the altimeter, waits for operator to check effect of scale adjustments.

This test is passive: the pump is halted during all test stages.

Set point (hPa)	*Tolerance* (ft) CAO 100.5	GFA
952	25	50
965	25	50
982	25	50
999	25	50
1013	25	50
1033	25	50
1046	25	50
1049	25	50



For each set point, the operator adjusts the altimeter's barometric scale to the commanded "Set scale" value, and compares the altimeter reading to the measured value on the instrument.

Because the altimeter may have a scale error and scale errors have higher tolerance than the barometric scale test tolerance, it is necessary to subtract any scale error from the instrument's reading at each test stage. The first test stage is at 1013 hPa, so at this stage calculate the and record the offset error from the difference

between the measured value displayed and the altimeter's value. In subsequent stages, subtract the offset error from the displayed value when determining whether the altimeter is within tolerance.

A positive finding is obtained when the altimeter (adjusted for scale offset) indicates values within the tolerance of the current measurement, observed at the end of the settle period, for each test stage.

Connect Pump directly to altimeter static port. Leave Ambient port open.

Altimeter case leak

This test applies a 18 000 ft vacuum to the altimeter static, settles and waits for operator visual checks.

Mode	*Hold*	*Duration*	*Rate*
Absolute alt	Passive	60 s	Fast

Set point (ft)	*Tolerance* (ft)	
	CAO 100.5	GFA
18 000	100	100

Connect Pump directly to altimeter static port. Leave Ambient port open.

Note: In order to rapidly check whether an altimeter has a case leak, prior to performing this test, it is recommended to execute the Static leak test with the altimeter first.

A positive finding is obtained when the relative altitude measurement, observed at the end of the settle period, changes less than the tolerance.

Note: It may be necessary to perform the case leak test with the altimeter in a test chamber.

Altimeter vibration

This test applies a increasing vacuum to the altimeter static, settles at set altitudes and waits for operator visual checks.

Mode	*Hold*	*Duration*	*Rate*
Absolute alt	Active	2 s	Slow

Set point (ft)	*Tolerance* (ft)	
	CAO 100.5	GFA
1000	70	70
2000	70	70
3000	70	70
5000	70	70
10 000	80	80
15 000	90	90
20 000	100	100
25 000	120	120
30 000	140	140
35 000	160	160

The maximum altitude for the test is set in the Settings (Section 6.4).

Connect Pump directly to altimeter static port. Leave Ambient port open. Set altimeter scale to 1013 hPa.

A positive finding is obtained when the altimeter reading, after vibration, changes less than the tolerance, for each stage.

Vibration should be induced using a light tapping of the instrument panel adjacent to the altimeter if the altimeter does not have an integral vibrator.

5.5 Air Speed Indicator

This test applies a increasing gauge pressure to the ASI pitot, settles and waits for operator visual checks. Following this sequence, the test reverses the sequence, reducing gauge pressure, again holding and waiting for operator visual checks.

Mode	*Hold*	*Duration*	*Rate*
Gauge speed	Passive	10 s	Medium

Set point (kn)	*Tolerance* (kn)	
	CAO 100.5	GFA
30	4	4
⋮		
Maximum IAS	4	4
⋮		
30	4	4

Test stages occur in 10 kn increments and at the maximum indicated airspeed. The maximum indicated airspeed for the test is set in the Settings (Section 6.5).

It is recommended to perform a Zero pressure command (Section 7.3) prior to performing ASI tests.

⚠ **Attention:** Failure to protect ASI(s) from high static vacuum or negative gauge pressure may result in damage to the instrument.

The bleed valve should always be used when connecting and disconnecting the Pump hose to the ASI pitot port or to an ASI instrument directly.

5.6 Self-test

Vacuum range and Pitot range tests are used to make sure the pump is capable of providing the required pressures to conduct the tests. Providing the pump is functioning correctly, only a leak or extreme system capacity will prevent testing to the limits specified in Section 9.

Leakage

This test applies relative pressure to Pump and Ambient, settles and checks for pressure change indicating leaks in the instrument tester's ports, hoses and internal plumbing.

Mode	*Hold*	*Duration*	*Rate*
Gauge alt*	Passive	60 s	Medium

Set point (ft)	*Tolerance* (Pa)
−2000	100
2000	100

This test requires the two ports to be connected together and the system then runs to test at two pressures.

* The set points are gauge pressures relative to ambient conditions at the start of test.

In the event of a negative result, first check all fittings and hoses for integrity, as this is the most likely cause of a leak.

Vacuum range

This tests that the pump can supply a vacuum to the maximum altitude specified in the Settings (Section 6.4).

Mode	*Hold*	*Duration*	*Rate*
Absolute alt	Active	60 s	Fast

Set point (ft)	*Tolerance* (ft)
Maximum altitude	10

Connect the Pump port to the standard hose to a stopper.

A negative result may be indicative of system leaks or may indicate the pump peristaltic tubing is worn and needs replacement.

Pitot range

This tests that the pump can supply a relative increased pressure to the maximum indicated airspeed specified in the Settings (Section 6.5).

Mode	*Hold*	*Duration*	*Rate*
Gauge speed	Active	10 s	Medium

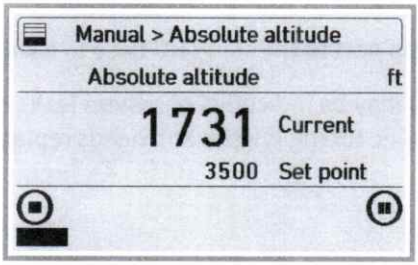
Set point (kn)	*Tolerance* (kn)
Maximum IAS	2

Connect the Pump port to the standard hose to a stopper.

5.7 Manual tests

Manual tests allow the operator to specify set points manually, in order to provide a mechanism to perform tests that vary from the programmed sequences built into SADTS.

Their operation differs from normal programmed tests in that there are no stages or tolerances defined and the operator uses the keys to adjust the set point, after which the controller immediately drives the pump pressure to achieve the target value.



⇧ Increase set point value

⇩ Decrease set point value

⌫ ⊗ Cancel test, then equalise

In order to not drive the pump continuously, the manual tests have a short settle time which on expiry halts the pump. Upon adjusting the set point or proceeding to the next test, the pump is activated again.

Five types of manual test are available:

Absolute altitude Drives the pump pressure to that corresponding to a set ISA altitude.

Relative altitude Drives the pump pressure to that corresponding to a set ISA altitude above the ambient ISA altitude.

Indicated airspeed Drives the pump pressure to yield a set indicated airspeed.

Absolute pressure Drives the pump pressure to an absolute value.

Gauge pressure Drives the pump pressure to a value relative to ambient.

Manual absolute altitude test

This mode applies absolute altitude pressure for an operator controlled set point.

Mode	*Hold*	*Duration*	*Rate*
Absolute alt	Active	30 s	Fast

Adjustments are in 500 ft increments. Permissible values are in the range −1000 ft to the maximum altitude in the Settings (Section 6.4).

Manual relative altitude test

This mode applies relative altitude pressure for an operator controlled set point.

Mode	*Hold*	*Duration*	*Rate*
Gauge alt	Active	30 s	Medium

Adjustments are in 100 ft increments. Permissible values are in the range −2500 ft to 2500 ft.

Manual indicated airspeed test

This mode applies indicated airspeed for an operator controlled set point.

Mode	*Hold*	*Duration*	*Rate*
Gauge speed	Active	30 s	Medium

Adjustments are in 10 kn increments. Permissible values are in the range 30 knots to the maximum airspeed in the Settings (Section 6.5).

Manual absolute pressure test

This mode applies absolute pressure for an operator controlled set point.

Mode	*Hold*	*Duration*	*Rate*
Absolute pressure	Active	30 s	Fast

Adjustments are in 1000 Pa increments. Permissible values are in the range 25 000 Pa to 120 000 Pa.

Manual gauge pressure test

This mode applies gauge pressure for an operator controlled set point.

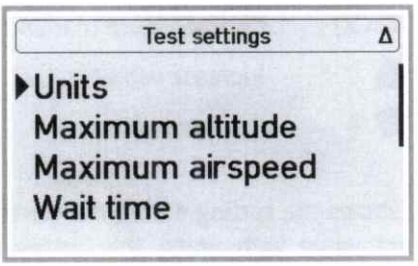
Mode	*Hold*	*Duration*	*Rate*
Gauge pressure	Active	30 s	Medium

Adjustments are in 50 Pa increments. Permissible values are in the range −20 000 Pa to 20 000 Pa.

Settings

The Test Settings menu permits all settings related to testing to be viewed and adjusted if required.

6.1 Test Settings menu

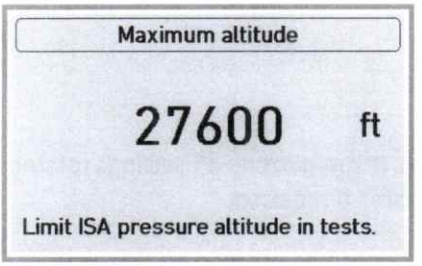


⏎	Edit item at cursor
⌫	Return to Main menu
⇧	Move cursor up
⇩	Move cursor down

The menu displays a list of settings which are described below, and a Save option. Δ indicates that settings have been changed since last save.

After adjusting a setting, select Save to store the new settings in non-volatile memory.

6.2 Settings editor



● ⏎	Apply; return to menu
■ ⌫	Cancel; return to menu
▲ ⇧	Increase value
▼ ⇩	Decrease value

The title display shows the setting name; the centre of the display shows the current value with units; the bottom of the display describes the setting.

6.3 Units

Unit system for altitude and airspeed.

The unit systems available are:

Metric Metres for height; km/h for indicated airspeed; m/s for climb rate

Imperial Feet for height; kn for indicated airspeed; feet per minute for climb rate

The default value is Imperial.

6.4 Maximum altitude

Limit ISA pressure altitude in tests.

This should be set to the lower of the design maximum for the instrument being tested and the test regime requirements.

Permissible values are in the range of 18 000 ft to 35 000 ft. The default value is 24 000 ft.

6.5 Maximum airspeed

Limit indicated airspeed in tests.

This should be set to the lower of the design maximum for the instrument being tested and the test regime requirements. For example, if the test regime requires a maximum of at least 140 kn but the ASI can read 160, then select 140, however, if the ASI can only read 130 kn, then 130 should be selected to avoid damaging the instrument.

Permissible values are in the range of 120 kn to 250 kn. The default value is 120 kn.

6.6 Wait time

Wait time after changing pressure.

Wait time specifies how long the pump stays active after arriving at the pressure set point, to enable temperatures to stabilise (temperature changes resulting from pumping induce fluctuations in actual pressure). Whilst testing, the test settle period commences once the wait time has expired.

Permissible values are in the range of 5 s to 20 s. The default value is 10 s.

6.7 Hold skip

When enabled, allows skipping of settle period during tests by pressing the ● ⏎ key for several seconds during the test period.

The default value is false.

6.8 Standard

Standards regime of test sequences. This setting determines, for each type of test, the set points and the permitted tolerances.

Available regimes are:

CAO 100.5 Corresponds to Civil Aviation Safety Authority (Australia) *Civil Aviation Order 100.5 (General requirements in respect of maintenance of Australian aircraft)*

GFA Corresponds to Gliding Federation of Australia tests according to GFA *Basic Sailplane Engineering PART 3 v24*.

The default value is GFA.

6.9 Volume click

Volume of user interface key press.

Permissible values are in the range of 0 to 8. The default value is 4.

6.10 Volume alerts

Volume of notification sounds.

Permissible values are in the range of 0 to 8. The default value is 6.

7

Service Modes

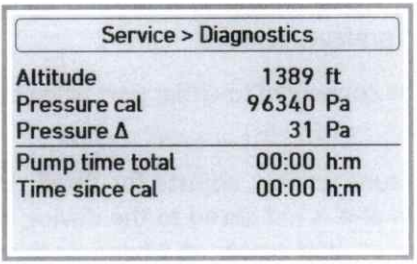
Service modes and functions are available from the Service menu.

7.1 Service menu

The Service menu has the following items:

Certain administration functions are only available in the Service menu when the device has been placed in administration mode:

7.2 Diagnostics



● ⏎ Return to Service menu

■ ⌫ Return to Service menu

The display contains the following items:

Altitude	Current system altitude (ISA)
Pressure cal	Calibrated ambient port pressure
Pressure Δ	Pressure difference between the Pump and Ambient pressure sensors
Pump time total	Total run time of the pump
Time since cal	Run time of the pump since last calibration

Note: If there is a significant difference (more than 10 Pa) in pressure between the pump and ambient ports when they are both disconnected, the Zero Pressure command (Section 7.3) should be used to maximise ASI test accuracy.

7.3 Zero pressure

This resets the pressure difference measured between the pump and ambient port pressure sensors.

No hose should be connected to either port when this command is selected.

Zeroing the pressure sensors adjusts for small drift in pressure sensor calibration and is not saved to the device; consequently it should be performed after power-up whenever the system is to be used for ASI tests.

7.4 Self-test menu

The Self-test menu has the following items:

Leakage Initiate leakage test.

Vacuum range Initiate vacuum range test.

Pitot range Initiate pitot range test.

These tests are described in Section 5.6.

7.5 About

● ⏎ Return to Service menu

■ ⌫ Return to Service menu

This displays a splash page which provides details of the model number, serial number, the firmware version installed as well as the current calibration status.

7.6 Calibration menu

This is only available when the system is in administration mode. See Section 8.2 for notes about calibration procedures.

The Calibration menu has the following items:

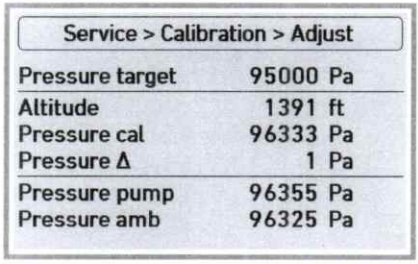
Adjust Enters Calibration editor ..... Section 7.7

Save Commits changed calibration data to non-volatile memory.

Reset Clears calibration values.

Δ indicates calibration has been adjusted; select Save to store.

7.7 Calibration editor



⇧	Adjust pressure upwards
⇩	Adjust pressure downwards
⌫	Return to Calibration menu

The display contains the following items:

Pressure target The pressure of the calibration set point nearest to the measured pressure. Ideally, the reference pressure should match this value during calibration.

Altitude The calibrated ISA altitude measured by SADTS.

Pressure cal The calibrated absolute pressure measured by SADTS.

Pressure Δ The difference in calibrated pressures between the Ambient and Pump side. Adjusting the calibration drives this value towards zero.

Pressure pump The uncalibrated Pump side absolute pressure.

Pressure amb The uncalibrated Ambient side absolute pressure.

7.8 Restart

This restarts the unit in non-administration mode.

7.9 OTA update

Prepares the device to accept firmware update Over the Air (OTA) via Bluetooth.

Note: Firmware updates do not reset the calibration; however firmware updates may reset other settings to default values.

Maintenance

8.1 Cleaning and care

Clean exterior of case with a cloth dampened with water.

Clean front panel with a dry microfiber cloth.

Do not leave device, fittings or hoses exposed to sunlight for extended periods of time.

Store fittings and hoses in a clean environment, such as a zip-lock bag.

8.2 Calibration

Calibration period

The test equipment requires calibration every two years. Calibration is programmed directly into the system.

Both internal pressure sensors use an independent 18 point calibration scheme and applies linear interpolation between points.

Calibration procedure

A traceable pressure standard capable of generating absolute pressures within the range of 25 000 Pa and 110 000 Pa is connected to both the Pump and Ambient side ports of the SADTS device via a

T adaptor. The SADTS device being calibrated is then entered into calibration adjustment mode (Section 7.7).

At each of a series of reference pressures, use the cursor keys to adjust the displayed calibrated pressure to match the reference pressure to within 5 Pa of the reference value. Once the sequence is complete, select Save from the Calibration menu (Section 7.6).

Calibration should be performed at 18 points as follows:

Pressure Absolute (Pa)	Altitude ISA (ft)
110 000	−2291
105 000	−989
100 000	364
95 000	1773
90 000	3243
85 000	4781
80 000	6394
75 000	8091
70 000	9882
65 000	11 780
60 000	13 800
55 000	15 962
50 000	18 289
45 000	20 812
40 000	23 574
35 000	26 631
30 000	30 065
25 000	33 999

Following calibration, apply a label to the SADTS case indicating the date of calibration and the traceable pressure standard used.

Calibration validity

The calibration chart will state the date of calibration as well as an instrument calibration code. This code MUST match that displayed when the system is powered on, or when accessing the status screen. A discrepancy means that the calibration data is no longer valid. In this event, do not use the system until it has been re-calibrated.

8.3 Servicing

Replacement of parts are required according to conditions in the following table:

Item	*Condition*	*Manufacturer part*
External items		
Hose	Damaged, stretched	Silicone tubing 4×6 mm
Plug O-ring seal	Worn or damaged	CPC 730800
Plug fitting	Damaged	CPC PMC2203
Plug caps	Missing	CPC PMC32
Port dust plugs	Missing	CPC PMC31
Items requiring opening case		
Peristaltic tube	Every 200 hours of pump operation	TBD
Port fitting	When damaged	CPC MC1602
Inlet filter	When blocked	Air Logic F-950-25 B85

Case fasteners require a Torx T10 driver. Other than as listed above, there are no user serviceable parts.

Technical Specifications

Power supply	
Voltage	12 V DC nominal 15 V DC maximum
Current	3 A (supply rating) 1.5 A (peak, pump active) 20 mA (pump inactive)
Connector	2.1×5.5 mm jack Center positive
Environmental limits in operation	
Ambient pressure	952 hPa to 1049 hPa
Relative humidity*	60 %
Temperature	0 °C to 40 °C
Device under test	
Internal volume*	500 ml
Pump hose	Silicone tubing 4×6 mm 80 cm minimum length
Pump performance	
Maximum absolute vacuum	25 000 Pa
Maximum pressure	130 000 Pa
Maximum flow rate	0.5 ml/s
Pressure sensors	
Maximum absolute vacuum	1000 Pa
Maximum pressure	130 000 Pa
Accuracy, 30 000 Pa to 110 000 Pa	< 250 Pa (uncalibrated)
Drift rate	TBD
Long term stability	-100 Pa/yr

* Preliminary specifications