

GE  
Sensing

# Druck ADTS 2XX Air Data Test Set

Calibration Manual K0425



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## Introduction

Ü This technical manual provides calibration instructions for the Air Data Test System.

## Scope

Ü This technical manual contains the calibration instructions for the calibration technician of this equipment.

## Safety

Ü The manufacturer has designed this equipment to be safe when operated using the procedures detailed in this manual. Do not use this equipment for any other purpose than that stated.

Ü This publication contains operating and safety instructions that must be followed to ensure safe operation and to maintain the equipment in a safe condition. The safety instructions are either warnings or cautions issued to protect the user and the equipment from injury or damage.

Ü Use qualified\* calibration technicians and good engineering practice for all procedures in this publication.

## Pressure

Ü Do not apply pressure greater than the maximum safe working pressure to the equipment.

## Toxic Materials

Ü There are no known toxic materials used in this equipment.

## Maintenance

Ü The equipment must be maintained using the manufacturer's procedures and should be carried out by authorized service agents or the manufacturer's service departments.

## Technical Advice

Ü For technical advice contact the manufacturer or subsidiary.

\* A qualified calibration technician must have the necessary technical knowledge, documentation, special test equipment and tools to carry out calibration work on this equipment.



This equipment meets the requirements of all relevant European safety directives. The equipment carries the CE mark.



This symbol, on the instrument, indicates that the user should refer to the user manual. This symbol, in this manual, indicates a hazardous operation.



Do not dispose of this product as household waste. Use an approved organisation that collects and/or recycles waste electrical and electronic equipment. For more information, contact one of these:

- Ü our customer service department (contact us at [www.gesensing.com](http://www.gesensing.com))
- Ü your local government office

## Approved Service Agents

For a list of approved service agents visit our website: [www.gesensing.com](http://www.gesensing.com)

**TABLE OF CONTENTS**

Preliminary pages .....	i
Introduction .....	i
Scope .....	i
Approved Service Agents .....	ii
Table of contents (this table) .....	iii
List of Tables .....	iii
ATEX Certified Advanced Hand Terminal .....	iv
Abbreviations .....	v
Glossary .....	vi
Pressure units and conversion factors .....	viii

Section	Title	page
---------	-------	------

**1 INTRODUCTION**

1.1 Calibration Description .....	2
1.2 Preliminary Operations .....	3
1.3 PIN Protection .....	3

**2 INSTALLATION**

2.1 Calibration Checks of Static Channels Ps1 and Ps2 .....	4
2.2 Calibration Checks of the Pitot Channel .....	5
2.3 Sensor Calibration of the Pitot and Static Channels .....	6
2.4 Completion of Sensor Calibration .....	8

**LIST OF TABLES**

Table	Title	page
-------	-------	------

1-1 Calibration Requirements .....	1
1-2 Equipment Requirements .....	2
2-1 Static Channel Calibration Pressures .....	4
2-2 Pitot Channel Calibration Pressures .....	5
2-3 Pitot and Static Channel Calibration Points .....	7

## ATEX CERTIFIED ADVANCED HAND TERMINAL

### CONDITIONS OF USE

The ATEX certified Advanced Hand Terminal can be used in zone 2\* hazardous areas in accordance with the ATEX certification document and schedule.

### Marking detail:

Refer to Advanced Hand Terminal User Manual K0418 and the label on the Advanced Hand Terminal.

### SPECIAL CONDITION OF USE

- The power supplies must be isolated when connecting the advanced hand terminal in the hazardous area.
- The advanced hand terminal must not be disconnected when energized in the hazardous area.
- The advanced hand terminal is a non-serviceable component. If the advanced hand terminal becomes unserviceable it can only be replaced by another ATEX compliant hand terminal.

### Note:

*The advanced hand terminal must only be used with the cable assembly supplied and marked "DO NOT SEPARATE WHILST ENERGISED IN HAZARDOUS AREA"*

\* Zone 2 hazardous area definition, see User Manual K0417 or User Manual K0451.

## Abbreviations

The following abbreviations are used in this manual; the abbreviations are the same in the singular and plural.

A	Ampere
abs	Absolute
ADTS	Air Data Test System
AHT	Advanced hand terminal
ALT	Altitude
Alt1	Altitude static channel 1
Alt2	Altitude static channel 2
e.g.	For example
etc.	And so on
°C	Degrees Celsius
°F	Degrees Fahrenheit
i.e.	That is
max	Maximum
mbar	Millibar
min	Minute or minimum
mm	Millimetre
No.	Number
PIN	Personal identification number
Ps	Static pressure
Ps1	Static channel 1
Ps2	Static channel 2
Pt	Total pressure (Pitot)
Qc	Differential pressure Ps1-Pt
QFE	Local atmospheric pressure
QNH	Barometric pressure at sea level
RTC	Real time clock
+ve	Positive
-ve	Negative

## Glossary

### Terminology

The terminology used in this manual is specific and individual interpretation must not be introduced.

The terms are defined as follows:

- Adjust: To bring to a more satisfactory state; to manipulate controls, levers, linkages, etc. to return equipment from an out-of-tolerance condition to an in-tolerance condition.
- Align: To bring into line; to line up; to bring into precise adjustment, correct relative position or coincidence.
- Assemble: To fit and secure together the several parts of; to make or form by combining parts.
- Calibrate: To determine accuracy, deviation or variation by special measurement or by comparison with a standard.
- Check: Make a comparison of a measure of time, pressure, temperature, resistance, dimension or other quality with a known figure for that measurement.
- Disconnect: To detach the connection between; to separate keyed or matched equipment parts.
- Dismantle: To take apart to the level of the next smaller unit or down to all removable parts.
- Examine: To perform a critical visual observation or check for specific conditions; to test the condition of.
- Fit: Correctly attach one item to another.
- Inspect: Review the work carried out by Specialists to ensure it has been performed satisfactorily.
- Install: To perform operations necessary to properly fit an equipment unit into the next larger assembly or system.
- Maintain: To hold or keep in any particular state or condition especially in a state of efficiency or validity.
- Operate: Make sure that an item or system functions correctly as far as possible without the use of test equipment or reference to measurement.
- Readjust: To adjust again; to move back to a specified condition; to bring back to an in-tolerance condition.
- Reconnect: To rejoin or refasten that which has been separated.
- Refit: Fit an item which has previously been removed.

## Glossary (contd)

- Remove: To perform operations necessary to take an equipment unit out of the next larger assembly or system. To take off or eliminate. To take or move away.
- Repair: To restore damaged, worn out or malfunctioning equipment to a serviceable, usable or operable condition.
- Replace: Remove an item and fit a new or a serviced item.
- Reset: To put back into a desired position, adjustment or condition.
- Service: To perform such operations as cleaning, lubricating and replenishing to prepare for use.
- Test: Ascertain by using the appropriate test equipment that a component or system functions correctly.

## Pressure Units and Conversion Factors

Pressure unit	Factor (Pascals)	Pressure unit	Factor (Pascals)
bar	100000	lbf/ft <sup>2</sup>	47.8803
lbf/in <sup>2</sup> (psi)	6894.76	inHg	3386.39
mH <sub>2</sub> O	9806.65	inH <sub>2</sub> O [1]	249.089
mbar	100	ftH <sub>2</sub> O [1]	2989.07
kgf/cm <sup>2</sup>	98066.5	atm	101325.0
kgf/m <sup>2</sup>	9.80665	pdl/ft <sup>2</sup>	1.48816
mmHg	133.322	dyn/cm <sup>2</sup>	0.1
cmHg	1333.22	hbar	10000000
mHg	133322.0	tonf/ft <sup>2</sup> (UK)	107252.0
mm/H <sub>2</sub> O [1]	9.80665	tonf/in <sup>2</sup> (UK)	15444300
cm/H <sub>2</sub> O [1]	98.0665	inH <sub>2</sub> O (USA) [2]	248.64135
N/m <sup>2</sup>	1	ftH <sub>2</sub> O (USA) [2]	2983.6983
hPa	100	kP/mm <sup>2</sup>	9806650
kPa	1000	kP/cm <sup>2</sup>	98066.5
MPa	1000000	kP/m <sup>2</sup>	9.80665
torr	133.322		

**TABLE OF PRESSURE UNITS AND CONVERSION FACTORS**

### Unit Conversion

To convert FROM pressure VALUE 1 in pressure UNITS 1

TO pressure VALUE 2 in pressure UNITS 2, calculate as follows:

$$\text{VALUE 2} = \text{VALUE 1} \times \frac{\text{FACTOR 1}}{\text{FACTOR 2}}$$

### **Note:**

The conversion factor for pressure units referenced [1] are calculated for a water temperature of 4°C. Pressure units referenced [2] are calculated for a water temperature of 68°F these units are normally used in the USA.

## 1 INTRODUCTION

- The ADTS 2XX incorporates a calibration facility that operates through an enable switch, located on the front panel under a calibration protection label. For the system to stay accurate, a calibration check should be carried out at chosen intervals. If the accuracy of the system is not within the specification, carry out a calibration adjustment.

### Calibration process

- The maintain calibration menu contains the PIN protected calibration adjustment functions:
  - Sensor calibration
  - Valve calibration (not accessible)
- This manual describes the sensor calibration. An additional PIN protects the valve calibration, as this procedure must only be carried out at the repair depot.

**TABLE 1-1 CALIBRATION REQUIREMENTS**

Test instrument characteristics (1)	Performance specifications (2)	Test method (3)
Pneumatic pressure	Range: 35 mbar to 3000 mbar absolute  Accuracy: ± 0.01% of reading	Compared against pressure standard.

**TABLE 1-2 EQUIPMENT REQUIREMENTS**

Equipment	Minimum use specifications	Calibration equipment	Sub-item
Pressure standard	Range: 35 mbar to 3000 mbar absolute  Accuracy: ± 0.01% of reading Uncertainty better than 50 ppm. Traceable to national standards.	RUSKA 2468 primary pitot static tester	-

## 1.1 Calibration Description

- **Calibration Check**

This procedure checks the calibration accuracy without adjusting it. It may be used either to see if the system requires a calibration or to verify performance following a calibration adjustment.

- **Calibration Adjustment**

The procedure applies known pressures to the air data test system and then entering the exact applied pressure using the hand-terminal or front panel touch screen. After all calibration points have been entered, the air data test system automatically calculates the necessary offset (zero) and slope (span) corrections.

The date of this procedure is logged and stored during this procedure.

## 1.2 Preliminary Operations

- Review and become familiar with the whole procedure before beginning calibration process.
- Allow at least one hour for the air data test system to thermally stabilize after switching on and before performing any calibration routines.
- Before starting a calibration procedure carry out a leak test, see section 2.
- To enable calibration adjustment, remove the calibration label and set the switch to calibrate (switch latched above the front panel level).
- All three output ports of the air data test system can be connected together and a common pressure applied by the pressure standard. The expansion ports in the lid provides a useful method of connection.
- Use the units of pressure measurement of millibar in the following procedures.
- Calibration adjustments and calibration check must be carried out with the pressure standard at the same level as the air data test system.

## 1.3 PIN Protection

The ADTS 2XX contains two protected menus, the operating limits and the maintain calibration menu.

The factory set PIN codes are sent to the supervisor in a separate envelope.

### IMPORTANT NOTE

Change these codes for authorised access. Unauthorised access to these two menus can make this system inaccurate and could, in control mode, cause excessive rates of pressure change.

## 2 CALIBRATION

### 2.1 Calibration Check of Static Channels Ps1 and Ps2

- Before starting this procedure carry out a leak test.
  - Set the unit to Leak/Measure mode, set operating limits to MAX and disable Auto Leak, refer to the User manual for further details.
  - Connect the pressure standard to static channels Ps1 and Ps2.
- (1) Make sure that the calibration switch is set to disable.
- (2) Adjust calibration pressure to the first pressure value in Table 2-1.
- (3) Compare the pressure value on the calibration standard to the value displayed and record the difference.
- (4) Repeat (2) and (3) for pressure No. 2 to 9 in Table 2-1.
- (5) If the recorded difference exceeds the allowable tolerance (\*) carry out a calibration adjustment.
- (6) Adjust calibration standard to atmospheric pressure. Disconnect calibration standard from the channels Ps1 and Ps2.
- (7) If there is no further calibration or testing required, switch off the unit.

TABLE 2-1 STATIC CHANNEL CALIBRATION PRESSURES

Pressure No.	Pressure mbar	Tolerance* mbar
1	34.98	±0.10
2	71.72	±0.10
3	178.74	±0.10
4	314.85	±0.10
5	465.63	±0.10
6	696.82	±0.10
7	843.07	±0.10
8	1013.25	±0.10
9	1355	±0.10

\* The tolerance quoted in this table may need to be adjusted to allow for measurement uncertainties of the calibration standard in use. The limits stated relate to the published, minimum specification for the equipment entering service. Acceptance limits may vary at the user's discretion for specific applications.

## 2.2 Calibration Check of the Pitot Channel

- Before starting this procedure carry out a leak test.
  - Set the unit to Leak/Measure mode, set operating limits to MAX and disable Auto Leak, refer to the User manual for further details.
  - Connect the pressure standard to pitot channel Pt.
- (1) Connect calibration standard to the pitot output.
  - (2) Set the calibration pressure to the first pressure value in Table 2-2.
  - (3) Compare the pressure value on the calibration standard to the value displayed and record the difference.
  - (4) Repeat (2) and (3) for pressure No. 2 to 7 in Table 2-2.
  - (5) If the recorded difference exceeds the allowable tolerance (\*) repeat steps (2) to (4). If, on the second calibration check, the recorded difference exceeds the allowable tolerance (\*) carry out a calibration adjustment.
  - (6) The display goes back to the channel select menu, select another channel for calibration checking or exit the calibration menu.
  - (7) Set the calibration standard to atmospheric pressure. Disconnect calibration standard from the pitot output.
  - (8) If there is no further calibration or testing required, switch off the unit.

**TABLE 2-2 PITOT CHANNEL CALIBRATION PRESSURES**

Pressure No.	Pressure mbar	Tolerance* mbar
1	35	±0.35
2	500	±0.35
3	1000	±0.35
4	1500	±0.35
5	2000	±0.35
6	2500	±0.35
7	3000	±0.35

\* The tolerance quoted in this table may need to be adjusted to allow for measurement uncertainties of the calibration standard in use. The limits stated relate to the published, minimum specification for the equipment entering service. Acceptance limits may vary at the user's discretion for specific applications.

## 2.3 Sensor Calibration of the Pitot and Static Channels

- Before starting this procedure carry out a calibration check of all channels.
- Set the unit to Leak/Measure mode, set operating limits to MAX and disable Auto Leak, refer to the User manual for further details.
- Set the calibration switch to enable (switch latched above the front panel level).

**Note:** Pressure values other than those stated in Table 2-3 can be used within the ranges of Ps1, Ps2 and Pt. A minimum of two calibration points must be used.

### Procedure

- To perform a calibration, select **SETUP** and **Calibrate Sensors**:

CALIBRATE SENSORS																			
LAST CALIBRATED [25/07/2006]																			
Ps1	1000.88 mbar		Current Zero Offset and Span	New Calculated Zero Offset and Span															
			0.23 mbar	0.00 mbar															
	Enter Ps1 Reference		-0.038 %	0.000%															
Ps2	1000.96 mbar		-0.41 mbar	0.00 mbar															
			0.040 %	0.000%															
Pt	1000.93 mbar		-0.82 mbar	0.00 mbar															
			0.001 %	0.000%															
<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>7</td><td>8</td><td>9</td><td>0</td><td>.</td></tr> <tr> <td>4</td><td>5</td><td>6</td><td>000</td><td>CLR</td></tr> <tr> <td>1</td><td>2</td><td>3</td><td colspan="2">ENTER</td></tr> </table>					7	8	9	0	.	4	5	6	000	CLR	1	2	3	ENTER	
7	8	9	0	.															
4	5	6	000	CLR															
1	2	3	ENTER																
No. of Points Entered PS1 = 0 PS2 = 0 PT = 0																			
Accept Ps1 Cal. Accept Ps2 Cal. Accept Pt Cal. Cancel All Points Back																			

- Adjust the pressure standard and apply pressure No. 1 in Table 2-3, allow the displayed reading to stabilize.
- Press, Enter Pt reference and, using the numeric keys, set the value of pressure No. 1. The screen shows the number of points entered Pt = 1.

CALIBRATE SENSORS																			
LAST CALIBRATED [25/07/2006]																			
Ps1	404.36 mbar		Current Zero Offset and Span	New Calculated Zero Offset and Span															
			0.23 mbar	0.00 mbar															
	Enter Ps1 Reference		-0.038 %	0.000%															
Ps2	400.17 mbar		-0.41 mbar	0.00 mbar															
			0.040 %	0.000%															
Pt	50.02 mbar		-0.82 mbar	0.00 mbar															
			0.001 %	0.000%															
Enter PT Reference <input type="text" value="50"/> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>7</td><td>8</td><td>9</td><td>0</td><td>.</td></tr> <tr> <td>4</td><td>5</td><td>6</td><td>000</td><td>CLR</td></tr> <tr> <td>1</td><td>2</td><td>3</td><td colspan="2">ENTER</td></tr> </table>					7	8	9	0	.	4	5	6	000	CLR	1	2	3	ENTER	
7	8	9	0	.															
4	5	6	000	CLR															
1	2	3	ENTER																
No. of Points Entered PS1 = 0 PS2 = 0 PT = 1																			
Accept Ps1 Cal. Accept Ps2 Cal. Accept Pt Cal. Cancel All Points Back																			

- (4) Adjust the pressure standard and apply pressure No. 2 in Table 2-3, allow the displayed reading to stabilize. The display shows the number of points entered Pt = 2 and the current zero offset and span values and the new calculated zero offset and span values. The screen also changes with the **Accept Pt Cal** highlighted.

**Note:** This is the minimum number of calibration points and in only one channel. Pressing Accept Pt Cal stores the new calculated zero offset and span values for Pt channel, the other channels - Ps1 and Ps2 keep the original (current) values.

CALIBRATE SENSORS																			
LAST CALIBRATED [25/07/2006]																			
Ps1	404.54 mbar		Current Zero Offset and Span	New Calculated Zero Offset and Span															
	Enter PS1 Reference		0.29 mbar -0.038 %	0.00 mbar 0.000%															
Ps2	400.37 mbar		-0.41 mbar 0.040 %	0.00 mbar 0.000%															
Pt	1355.13 mbar		-0.82 mbar 0.001 %	-0.84 mbar -0.000%															
Enter PT Reference 1355																			
<table border="1" style="width: 100px; margin-left: auto; margin-right: auto;"> <tr><td>7</td><td>8</td><td>9</td><td>0</td><td>.</td></tr> <tr><td>4</td><td>5</td><td>6</td><td>000</td><td>CLR</td></tr> <tr><td>1</td><td>2</td><td>3</td><td colspan="2">ENTER</td></tr> </table>					7	8	9	0	.	4	5	6	000	CLR	1	2	3	ENTER	
7	8	9	0	.															
4	5	6	000	CLR															
1	2	3	ENTER																
No. of Points Entered PS1 = 0 PS2 = 0 PT = 2																			
Accept Ps1 Cal. Accept Ps2 Cal. <b>Accept Pt Cal.</b> Cancel All Points Back																			

- (5) Continue applying calibration points to each channel as described above. The screen changes with the **Accept Ps1 Cal** and **Accept Ps2 Cal** highlighted.

**Note:** Pressing Accept for any channel overwrites the existing calibration data.

When the new values are acceptable press **Accept Cal**.

- (6) When complete, press **Back** to return to SETUP ADTS SYSTEM PARAMETERS.

**TABLE 2-3 PITOT AND STATIC CHANNEL CALIBRATION POINTS**

Pressure	Ps1 and Ps2 calibration points mbar	Pt calibration points mbar
1	35	35
2	600	600
3	1355	1355
4	-	3000

## 2.4 Completion of Sensor Calibration

- After completion of all calibration adjustment procedures, carry out the following:
  - (1) Set the calibration switch to disable (latched below the front panel level).
  - (2) Make sure the calibration standard and the unit are at atmospheric pressure. Disconnect the calibration standard from the unit.
  - (3) Fit a new calibration label over the calibration switch.