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PACE

Pressure Automated Calibration Equipment

Calibration Manual

Druck.com

Contents

Introduction

This technical manual gives calibration instructions for the PACE Pressure Controllers and Indicators.

The features shown and described in this manual will not be available on some models.

For the full specification and user manual, refer to the Druck website:

https://druck.com

Safety

WARNING **Turn off the source pressure(s) and carefully release pressure from the pressure lines before disconnecting or connecting the pressure lines. Proceed with care.**

Only use equipment with the correct pressure rating.

Before applying pressure, examine all fittings and equipment for damage. Replace all fittings and equipment that have damage. Do not use any fittings and equipment that have damage. Do not apply more than the maximum working pressure of the instrument.

This equipment is not rated for oxygen use.

Do not use with media that has an oxygen concentration > 21 % or other strong oxidizing agents.

This product contains materials or fluids that may degrade or combust in the presence of strong oxidizing agents.

Do not apply pressure greater than the maximum safe working pressure.

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 shown, or it is possible that the protection given by the equipment will not work.

This publication contains operating and safety instructions that must be followed to make sure of 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.

This manual has user instructions and safety information for the PACE instruments. All personnel must be correctly trained and qualified before they use or do maintenance on the instruments. The customer must make sure this occurs.

Pressure

It is the responsibility of the calibration technician to apply pressures within the published pressure range and to only use external pressure equipment with correctly rated fittings and components.

Maintenance

This manual does not include maintenance details for the equipment. Refer to the separate User Manuals for maintenance details. See “Associated Publications” on page 3.

Technical Advice

Contact the manufacturer for technical advice.

Symbols

Symbol	Description
CE	This equipment meets the requirements of all relevant European safety directives. The equipment carries the CE mark.
UK CA	This equipment meets the requirements of all relevant UK Statutory Instruments. The equipment carries the UKCA mark.
	This symbol, on the equipment, indicates that the user must read the user manual.
	This symbol, on the instrument, indicates that the user must refer to the user manual. This symbol, in this manual, indicates a hazardous operation. Ce symbole, sur l'instrument, indique que l'utilisateur doit consulter le manuel d'utilisation. Ce symbole, dans le manuel, indique une situation dangereuse.
	This symbol warns the user of the danger of electric shock. Ce symbole alerte l'utilisateur sur le danger de choc électrique.
	Druck is an active participant in Europe's Waste Electrical and Electronic Equipment (WEEE) take-back initiative (directive 2012/19/EU). The equipment that you bought has required the extraction and use of natural resources for its production. It can contain hazardous substances that could impact health and the environment. In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems. Those systems will reuse or recycle most of the materials of your end life equipment in a sound way. The crossed-out wheeled bin symbol invites you to use those systems. If you need more information on the collection, reuse, and recycling systems, please contact your local or regional waste administration. Please visit the link below for take-back instructions and more information about this initiative.  **https://druck.com/weee**

Glossary

This manual uses these terms. Abbreviations are the same in the singular and plural.

Term	Description
bar	Unit of pressure
bara	bar - absolute
barg	bar - gauge
CM	Control Module
FS	Full Scale
ft	Foot
H_2O	Water
Hg	Mercury
in	Inch
kg	kilogram
m	Meter
mbar	millibar
Pa	Pascal
PACE	Pressure Automated Calibration Equipment
ppm	Parts per millon
psi	Pounds per square inch
REF	Reference
SCPI	Standard Commands for Programmable Instruments
°C	Degrees Celsius
°F	Degrees Fahrenheit
+VE	Pressure input

Associated Publications

This table lists the Druck publications referenced in this manual:

Publication	Title
K0467	PACE 1000 Quick Start and Safety Instructions
K0470	PACE 1000 and PACE Tallis User Manual
K0447	PACE 5000 / 6000 User Guide and Safety Instructions
K0443	PACE 5000 / 6000 Pressure Control Module User Manual
K0476	PACE Pressure Control Module User Guide and Safety Instructions
K0469	PACE Heritage Communications Manual
K0472	PACE Series SCPI Manual

1. Calibration Check

PACE controllers and indicators include a calibration function. To make sure the PACE is within specification, a calibration check must be done at chosen intervals. If the ‘as found’ calibration data of the PACE is not within the permitted deviation, do a calibration adjustment.

2. Calibration Status

The **Measured Pressure** or **Instrument Status** menu shows the calibration status of the instrument on the front panel screen. The **Calibration History** lists the dates of the stored calibration corrections.

Note: The Date and Time must be set correctly in the **Measured Pressure** or **Global Setup** or **Calibration** menu.

3. Calibration Equipment

The original Druck Calibration Certificate shows the measurement uncertainty of the original pressure calibration standard. For preservation of the uncertainty of the PACE calibration, checks and adjustments must be done using a calibrator uncertainty of less than or equal to the original pressure calibration standard. It is important when measuring the stability of a sensor (especially in Tallis units) that the unit is returned to the same calibration lab and ideally the same primary standard is used. This removes differences between standards from the drift calculation.

4. Preliminary Operations

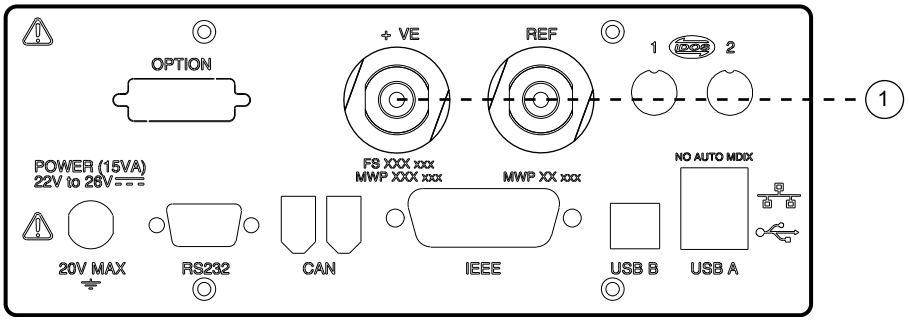
Review and understand the whole procedure before doing a calibration.

Before doing a calibration:

1. Energize the PACE and allow it to thermally stabilize for at least 2 hours in a thermally stable environment.
2. Do a Leak Test as detailed in PACE User Manual K0443 (PACE Control Module only).

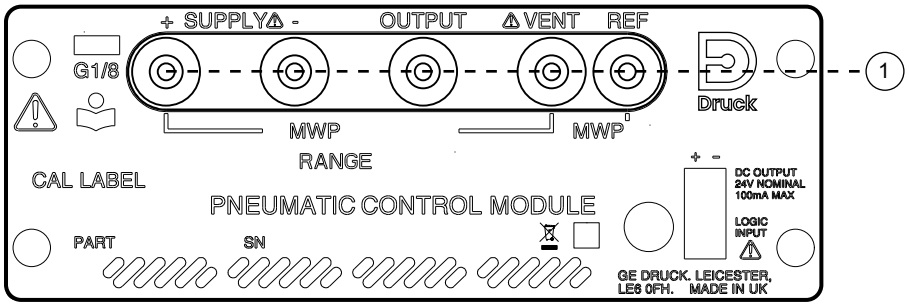
5. Notes on Calibration

The pressure calibration standard output port and the PACE reference level must be at the same level. See illustrations below for PACE reference level. If the pressure calibration standard is not at the PACE reference level, use height-corrected applied pressure.



1 Reference Level

Figure 1: PACE 1000 and PACE Tallis Reference Level



1 Reference Level

Figure 2: PACE Control Module Reference Level

Set the PACE units of pressure to one of the necessary units for calibration.

5.1 Pressure Connection Overview

WARNING Turn off the source pressure(s) and carefully open the pressure lines to atmosphere before disconnecting or connecting the pressure lines. Proceed with care.

Only use equipment with the correct pressure rating.

Before applying pressure, examine all fittings and equipment for damage. Replace all fittings and equipment that have damage. Do not use any fittings and equipment that have damage.

Do not apply more than the maximum working pressure of the instrument.

This equipment is not rated for oxygen use.

5.1.1 Pressure Adapters

Figure 3 shows the available range of PACE pressure adapters

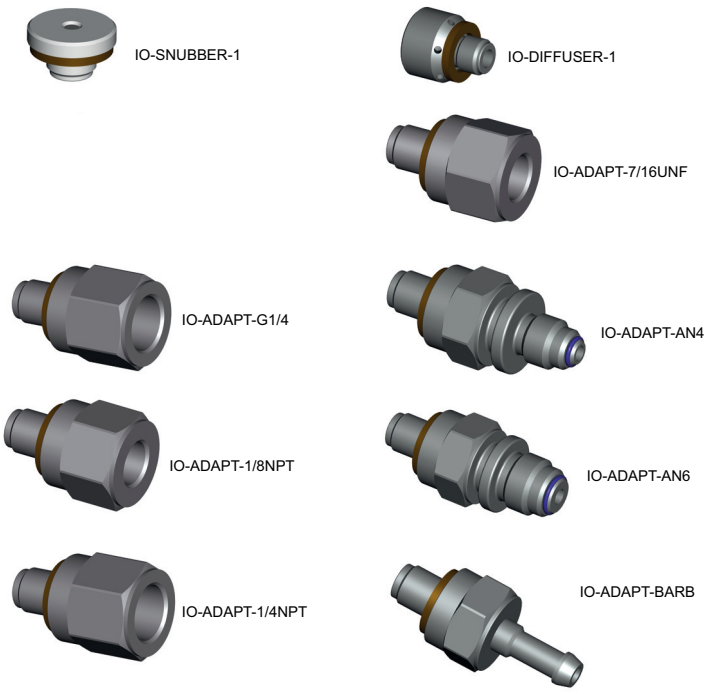


Figure 3: Pressure Adapters

Refer to Table 1 and the Datasheet for more information.

Table 1: Pressure Adapters and other Parts

Part	Details
IO-DIFF-KIT-LP	Differential connection kit low pressure
IO-SNUBBER-1	Restricter/Snubber
IO-DIFFUSER-1	Diffuser
IO-ADAPT-1/4NPT	ISO 228 G1/8 Male to 1/4 NPT Female.
IO-ADAPT-1/8NPT	ISO 228 G1/8 Male to 1/8 NPT Female.
IO-ADAPT-7/16UNF	ISO 228 G1/8 Male to 7/16-20 UNF Female.
IO-ADAPT-AN4	ISO 228 G1/8 Male to AN4 37° Male.
IO-ADAPT-AN6	ISO 228 G1/8 Male to AN6 37° Male.
IO-ADAPT-BARB	ISO 228 G1/8 Male to 1/4 Hose.
IO-ADAPT-G1/4	ISO 228 G1/8 Male to ISO 228 G1/4 Female.

5.1.2 Pressure Connection

WARNING Parallel threads must be used. Female thread type is parallel thread to ISO228/1 (DIN ISO228/1, JIS B0202) G1/8.

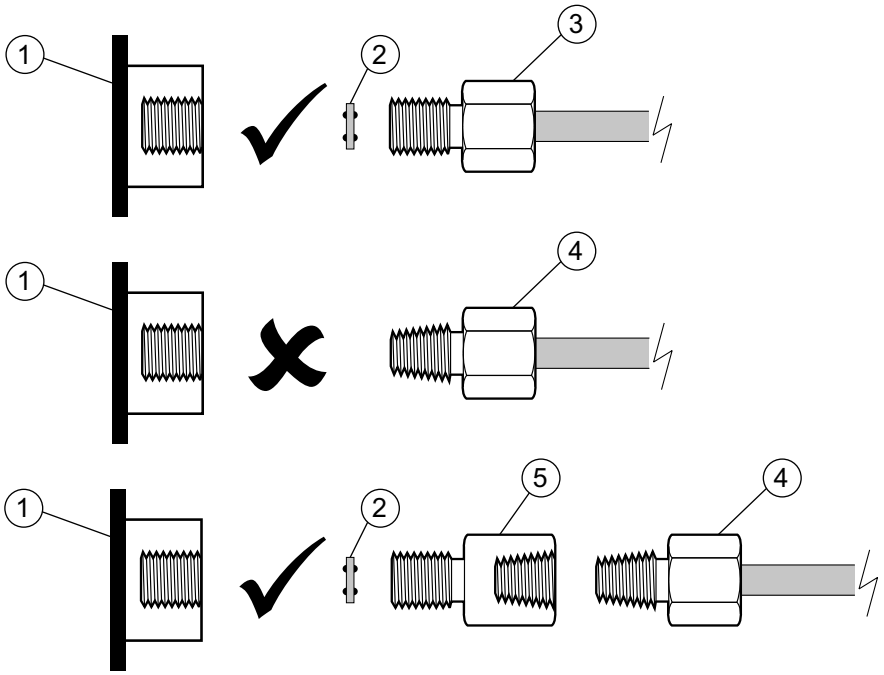
DO NOT CONNECT TAPERED THREADS DIRECTLY TO THE INDICATOR. Connect NPT tapered threads through a suitable pressure adapter.

The PACE has parallel thread pressure connectors. Use only the connector type shown in Table 2.

Table 2: PACE Pressure Connector Thread Specification

PACE Connector	Thread Specification
Supply +, Supply -, Output, Vent, Reference	ISO228/1 G1/8 Parallel Threads (DIN ISO228/1, JIS B0202)

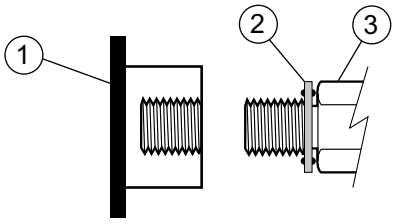
Refer to Figure 4 for connection to the PACE pressure connectors.



1 PACE pressure connector.
2 Bonded seal.
3 ISO228/1 G1/8 pressure connector.
4 NPT thread pressure connector.
5 Pressure adapter, see Section 5.1.1.

Figure 4: PACE Pressure Connection

For pressures less than 100 bar (1450 psi), see alternative sealing method in Figure 5.



1 PACE pressure connector.
2 Bonded seal.
3 ISO228/1 G1/8 pressure connector or adapter. For adapters, see Section 5.1.1.

Figure 5: Alternative Sealing Method for < 100 bar (1450 psi)

5.2 PACE Controller Connection for Output Sensor Calibration

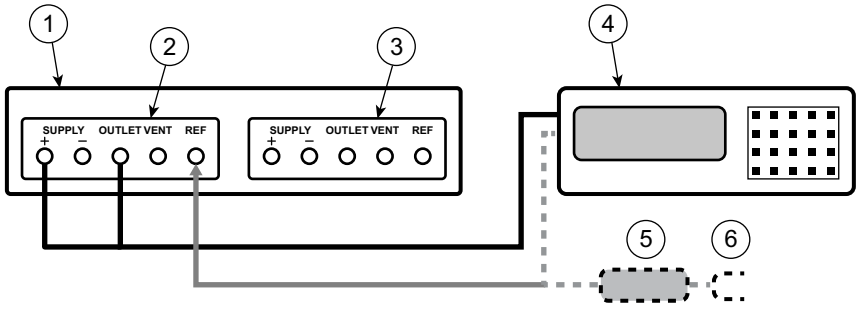
WARNING Except for the barometric sensor calibration, connect the SUPPLY + port to the OUTLET port when calibrating the PACE controller module. Failure to follow this procedure may result in the sudden uncontrolled release of trapped pressure.

INFORMATION For optimum performance, connect the PACE reference port to the pressure calibration standard with a snubber to atmosphere. This is not normally necessary for pressure ranges of 7 bar and above.

1. Connect the output of the pressure calibration standard to the PACE modules as shown in the diagrams.

   Note: For gauge sensor calibration, apply both positive **and** negative gauge pressures to the PACE outlet port.

2. For control module types CM0, 1 and 2, to attenuate changes in atmospheric pressure, or changes due to drafts, connect the PACE reference port to the pressure calibration standard reference port. Add a snubber (IO-SNUBBER-1) to the connecting pipe to prevent line pressure changes due to temperature changes.



1 PACE Pressure Controller (seen from rear).
2 Control Module 2.
3 Control Module 1.
4 Pressure calibration standard.
5 Snubber.
6 Atmosphere

Figure 6: Connections for Control Modules Type CM0, 1 and 2

3. For control module type CM3, connect only the module outlet and supply +ve to the calibration standard.

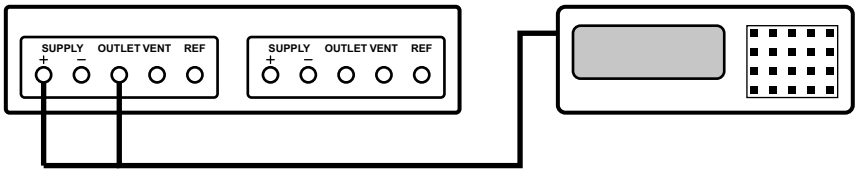
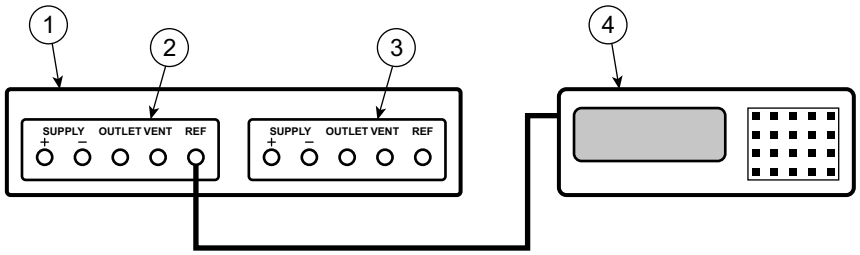


Figure 7: Connection for Control Module Type CM3

5.3 PACE Controller Connection for Barometric Sensor Calibration

1. Connect the output of the pressure calibration standard to the PACE module reference port.

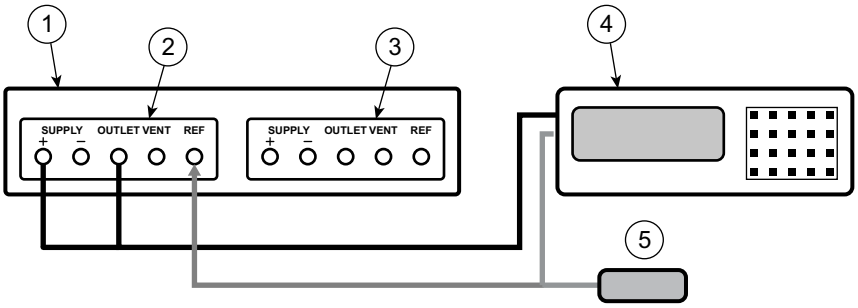
Note: You do not need to connect the Supply+ and Outlet port for this connection.



1 PACE Pressure Controller (seen from rear).
2 Control Module 2.
3 Control Module 1.
4 Pressure calibration standard.

Figure 8: Connection for Barometric Sensor Calibration

5.4 PACE Controller Connection for Low Pressure Calibration



1 PACE Pressure Controller (seen from rear).
2 Control Module 2.
3 Control Module 1.
4 Pressure calibration standard.
5 Low pressure differential connection kit (IO-DIFF-KIT-LP).

Figure 9: Connection for Low Pressure Measurement

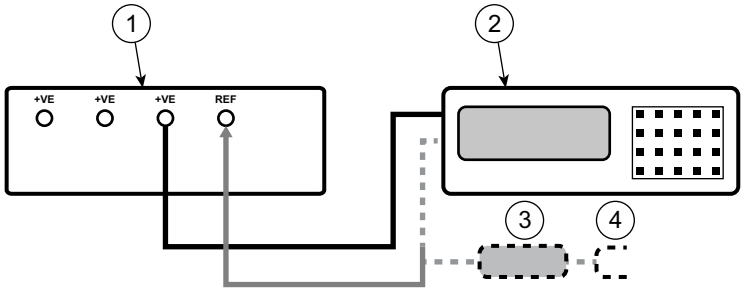
5.5 PACE Indicator Connection for Input Sensor Calibration

INFORMATION For optimum performance, connect the PACE reference port to the pressure calibration standard with a snubber to atmosphere. This is not normally necessary for pressure ranges of 7 bar and above.

1. Connect the output of the pressure calibration standard to the PACE input port.

   Note: For gauge sensor calibration, apply positive and negative gauge pressures to the PACE input port.

2. To attenuate changes in atmospheric pressure, or changes due to drafts, connect the PACE reference port to the pressure calibration standard reference port. If a reference connection is unavailable, fit snubber IO-SNUBBER-1 to the PACE reference port.



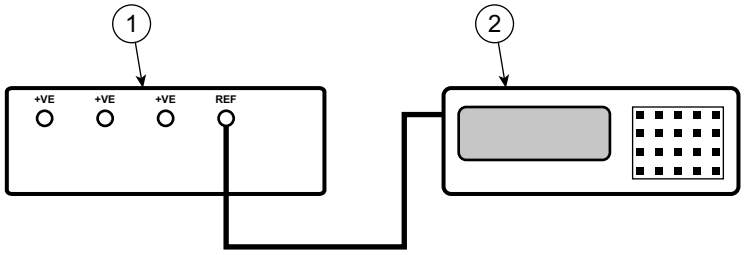
1 PACE Pressure Indicator (seen from rear).
2 Pressure calibration standard.
3 Snubber
4 Atmosphere.

Figure 10: Connection for Input Sensor Calibration

5.6 PACE Indicator Connection for Barometric Sensor Calibration

This connection also applies to PACE1000 units with IRS3 sensors and the PACE Tallis units fitted with a barometer.

1. Connect the output of the pressure calibration standard to the PACE reference port.

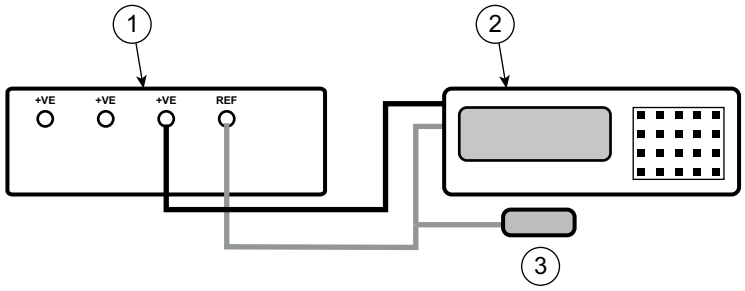


1 PACE Pressure Indicator (seen from rear). 2 Pressure calibration standard.

Figure 11: Connection for Barometric Sensor Calibration

5.7 PACE Indicator Connection for Low Pressure Calibration

Use this connection when there is no line pressure, for low pressure and low noise measurement in gauge or pseudo gauge mode.

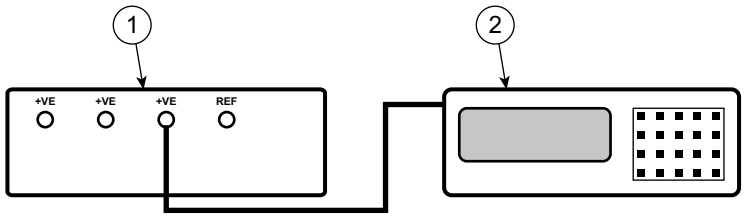


1 PACE Pressure Indicator (seen from rear).
2 Pressure calibration standard.
3 Low pressure differential connection kit (IO-DIFF-KIT-LP).

Figure 12: Connection for Low Pressure Measurement

5.8 PACE Indicator Connection for Absolute Pressures

This connection also applies to PACE1000 units with IRS3 sensors and the PACE Tallis units.



1 PACE Pressure Indicator (seen from rear). 2 Absolute Sensor or instrument.

Figure 13: Connection for Absolute Pressures

6. Calibration Check A - Control Modules

INFORMATION **This check is for Control Modules CM0, 1 and 2 (and CM3 up to and including 3.5 bar Absolute).**

Zero the gauge ranges (CM0, CM1, CM2) immediately before a calibration check.

For CM3 8 bar absolute ranges and above, zero the Reference Sensor. See the user manual.

Zeroing is not necessary for CM3 2 bar and 3.5 bar ranges.

Note: The PACE adds the barometric reading to a gauge range to produce a pseudo-absolute range (for CM2 and below). For CM3 the PACE subtracts the barometric reading from an absolute range to produce a pseudo-gauge range.

Note: Use the Calibration check mode, as this removes any additional pressure processing enabled by the user.

For PACE calibration menus, refer to Appendix A.

To check the calibration of PACE, proceed as follows:

1. Connect the PACE to the pressure calibration standard. See Section 5.
2. With the pressure calibration standard connected to the correct pressure port, on the PACE screen, select the measured pressure then **Range** to select the pressure range to be checked.
3. For gauge ranges (CM0, 1, 2), apply zero pressure to the UUT.
   a. Select the measured pressure then **Zero** to zero the selected gauge range.
   b. On completion of the zero operation, the display shows ‘Zero completed successfully’.
4. Select the measured pressure then **Global Setup** > **Calibration** and enter the Calibration PIN (4321).
5. Select **Sensor Correction**.
6. Select the pressure range to be checked or corrected.
7. Select the pressure sensor to be checked or corrected.
8. Select **Calibration Check**.
9. Adjust the applied calibration pressure to the first pressure value and wait until this pressure, displayed on PACE is stable to less than 5 ppm (0.0005%) for CM2 and below (aim for 1 ppm (0.0001%) on CM3). The standard deviation of the measured pressure is shown on the screen in the pressure units to help with measuring the deviation in pressure.
10. Compare the pressure value on the pressure calibration standard to the value shown on the PACE and record the difference.
11. Do steps (9) and (10) again for each calibration pressure.
12. If the recorded difference is more than the permitted deviation (Precision) for the selected range, it is necessary to do a calibration adjustment for that range on the calibrator. Refer to PACE Datasheet for permitted precision deviation and accuracy.

Note: If it has been less than 24 hours since calibration, the PACE specification equals the Datasheet precision specification with respect to the original pressure calibration standard. If it has been greater than 24 hours since calibration, the PACE specification is the Route-Sum-Squared (RSS) of the Datasheet precision and the long term stability specification with respect to the original pressure calibration standard.

13. If no adjustment has been done and the calibration check is within the precision limits, then the calibration date can be updated by selecting the **As Found** Calibration Icon.

14. Select the next pressure range for a calibration check.
15. After completing all calibration checks, adjust the pressure calibration standard to atmospheric pressure.
16. Disconnect the pressure calibration standard from the output.
17. If no further calibration is necessary, de-energize the PACE.

7. Calibration Adjustment A1 - Control Modules

INFORMATION **This adjustment is for Control Modules CM0, 1 and 2 up to and including 3.5 bar Absolute.**

For PACE calibration menus, refer to Appendix A.

To adjust the calibration of PACE:

1. Connect the PACE to the pressure calibration standard. See Section 5.

   Note: Calibration adjustments can be carried out in any order. Three calibration points are necessary for gauge sensors. Two calibration points are necessary for absolute sensors.
2. Select the measured pressure then **Global Setup > Calibration** and enter the Calibration **PIN (4321)**.
3. Select **Sensor Correction**.
4. Select the pressure range to be corrected.
5. Select the pressure sensor to be corrected.
6. Select **Calibration Adjustment**.
7. Adjust the applied calibration pressure to the first pressure value and wait until this pressure, shown on PACE, is stable to less than 5 ppm (0.0005%) for CM2 and below (aim for 1 ppm (0.0001%) on CM3). The standard deviation of the measured pressure is shown on the screen (σ) in the pressure units to aid with measuring the deviation in pressure.

Note: The display also shows throughout this procedure the message ‘Calibrating’ and the selected pressure range.

8. Use the on-screen keypad to enter the applied pressure, then select the entered value to save it.
9. The screen will now ask **‘keep calibration point?**’ select the shown pressure to keep the calibration used or select the undo icon to enter again the applied pressure.
10. Do steps (7) to (8) again for the next value.
11. Select **Repeat** to re-apply the same pressure and **Quit Calibration** to exit the calibration of this pressure range.
12. Do a calibration check to make sure this procedure worked. “Calibration Check A - Control Modules” on page 11.
13. After completing the calibration procedures, adjust the pressure calibration standard to atmospheric pressure. Slowly open the On/Off valve to release any trapped pressure in the SUPPLY+ port. Disconnect the pressure calibration standard from the PACE.
14. If no further calibration is necessary, de-energize the PACE.

8. Calibration Adjustment A2 - Control Modules

INFORMATION **This adjustment is for Control Modules CM3 and CM3-B at 8 bar absolute and above.**

CM3 and CM-3B control modules both have barometers that need calibration check and if required adjustment.

Note: Zeroing the Reference Sensor is not necessary for calibration adjustment as this is reset automatically during the adjustment process.

1. Do a calibration check (Section 6 steps (1) to (5) and (8) to (14)) on the Barometer first. If the recorded difference is more than the permitted deviation then the Barometer must be adjusted (see Section 7).
2. Do the steps in Section 7 Calibration Adjustment A1.

9. Calibration Check B - PACE Indicators

INFORMATION **This check is for PACE1000 and PACE Tallis.**

Zero the gauge ranges (PACE1000 IPS) immediately prior to a calibration check.

For PACE1000 and PACE Tallis 8 bar absolute ranges and above, zero the main sensor. See the user manual.

Zeroing is not necessary for PACE1000, PACE Tallis 2 bar and 3.5 bar absolute ranges.

Note: The PACE adds the barometric reading to a gauge range to produce a pseudo-absolute range. The PACE subtracts the barometric reading from an absolute range to produce a pseudo-gauge range.

Note: Use the Calibration check mode, as this removes any addition pressure processing enabled by the user.

For PACE calibration menus, refer to Appendix A.

To check the calibration of PACE:

1. Connect the PACE to the pressure calibration standard. See Section 5.
2. With the pressure calibration standard connected to the correct pressure port, select the measured pressure and select **Range** to select the pressure range to be checked.
3. For gauge ranges (IPS sensors), apply zero pressure to the UUT.
   a. Select the measured pressure then **Zero** to set the selected gauge range to zero.
   b. On completion of the zero operation, the display shows ‘Zero completed successfully’.
4. Select the measured pressure then **Global Setup** > **Calibration** and enter the Calibration PIN (4321).
5. Select **Sensor Correction**.
6. Select the pressure sensor to be checked or corrected.
7. Select **Calibration Check**.
8. Adjust the applied calibration pressure to the first pressure value and wait until this pressure, shown on PACE is stable to less than 5 ppm (0.0005%) for IPS sensors and below (aim for 1 ppm (0.0001%) on IRS3 and TRS3 (Tallis)). The standard deviation of the measured pressure is shown on the screen in the pressure units to help with measuring the deviation in pressure.
9. Compare the pressure value on the pressure calibration standard to the value shown on the PACE and record the difference.

10. Do steps (8) and (9) again for each pressure.
11. If the recorded difference is more than the permitted deviation (precision) for the selected range, a calibration adjustment for that range is necessary on the calibrator. Refer to the PACE Datasheet for permitted precision deviation and accuracy.

Note: If it has been less than 24 hours since calibration, the PACE specification equals the Datasheet precision specification with respect to the original pressure calibration standard. If it has been greater than 24 hours since calibration, the PACE specification is the Route-Sum-Squared (RSS) of the Datasheet precision and the long term stability specification with respect to the original pressure calibration standard.

12. If no adjustment has been done and the calibration check is within the precision limits, then the calibration date can be updated by selecting the 'As Found' calibration icon.
13. Select the next pressure range for a calibration check.
14. After completing all calibration checks, adjust the pressure calibration standard to atmospheric pressure.
15. Disconnect the pressure calibration standard from the output.
16. If no further calibration is necessary, de-energize the PACE.

10. Calibration Adjustment B1 - PACE Indicators

INFORMATION **This adjustment is for PACE1000 IPS. It is also for IRS and TRS (Tallis) up to and including 3.5 bar absolute.**

For PACE calibration menus, refer to Appendix A.

To adjust the calibration of PACE:

1. Connect the PACE to the pressure calibration standard. See Section 5.

Note: Calibration adjustments may be done in any order. Three calibration points are necessary for gauge sensors. Two calibration points are necessary for absolute sensors.

2. Select the measured pressure then **Global Setup** > **Calibration** and enter the Calibration PIN (4321).
3. Select **Sensor Correction**.
4. Select the pressure range to be corrected (PACE controllers only).
5. Select the pressure sensor to be corrected.
6. Select **Calibration Adjustment**.
7. Adjust the applied calibration pressure to the first pressure value and wait until this pressure, displayed on PACE, is stable to less than 5 ppm (0.0005%) for IPS sensors and below (aim for 1 ppm (0.0001%) on CM3). The standard deviation of the measured pressure is displayed on the screen in the pressure units to aid with measuring the deviation in pressure.

Note: The display also shows throughout this procedure the message **'Calibrating'** and the selected pressure range.

8. Use the on-screen keypad to enter the applied pressure, then select the entered value to save it.
9. The screen will now ask 'Keep calibration point?' select the displayed pressure to keep the calibration used or select the undo icon to renter the applied pressure.
10. Do steps (7) to (9) again for the next value.
11. Select **Repeat** to re-apply the same pressure and **Quit Calibration** to exit the calibration of this pressure range.

12. Do a calibration check to make sure this procedure worked. Refer to Section 6.
13. After completing the calibration procedures, adjust the pressure calibration standard to atmospheric pressure. Disconnect the pressure calibration standard from the PACE.
14. If no further calibration is necessary, de-energize the PACE.

11. Calibration Adjustment B2 - PACE Indicators

INFORMATION **This adjustment is for PACE1000 IRS3 and PACE Tallis TRS3 at 8 bar absolute and above.**

Note: Zeroing the Reference Sensor is not necessary for calibration adjustment as this is reset automatically during the adjustment process.

1. Do a calibration check (see “Calibration Check B - PACE Indicators” on page 13) on the Barometer first. If the recorded difference is more than the permitted deviation then the Barometer must be adjusted (see “Calibration Adjustment B1 - PACE Indicators” on page 14).
2. Do the steps in “Calibration Adjustment B1 - PACE Indicators” on page 14.

12. PACE Tallis Linearity Adjustment

INFORMATION **The linearity of the Tallis sensors does not usually need adjusting. This adjustment allows the linearity to be improved to an individual pressure standard within the range of -127 to +127 ppm of the sensor full scale. 11 adjustment points are available, which can be applied at any pressure over the range of the sensor and do not have to be equally-spaced. Pressure points must be applied in ascending order. We recommend that there is 1 point at the lowest and highest. Linearity correction is interpolated linearly between points. We recommend a minimum of 5 points. 11 points give optimal performance.**

1. Connect the PACE Tallis to the pressure calibration standard. Refer to Section 5.
2. Select the measured pressure, then **Global Setup** > **Calibration** and enter the Calibration PIN (4321).
3. Select **Sensor Correction**.
4. Select the pressure sensor to be corrected.
5. Select **Linearity Correction**.
6. Adjust the applied calibration pressure to the first pressure value and wait until this pressure, shown on the PACE, is stable (aim for 1 ppm (0.0001%)). The standard deviation of the measured pressure is shown on the screen (σ) in the pressure units to aid with measuring the deviation in pressure.

   Note: The display also shows throughout this procedure the message ‘Linearizing’ and the selected pressure range.
7. Select the pressure shown and use the on-screen keypad to enter the applied pressure, then select the value on the display to save it.
8. The display will now show ‘Keep calibration point?’. Select the pressure shown to keep the calibration pressure used or select the undo icon to re-enter the applied pressure.
9. Repeat steps (7) to (9) for the next value.
10. After entering three points the display will show a ‘tick’ icon. After completing the third pressure, complete the linearity adjustment by selecting the ‘tick’ icon, or do more adjustment points if necessary then select the tick icon to complete the linearity correction.

11. If necessary, select the **exit** icon to exit and reject the linearity correction.
12. Do a calibration check to make sure this procedure has worked. Refer to Section 6.

After completing the calibration procedures, adjust the pressure calibration standard to atmospheric pressure.

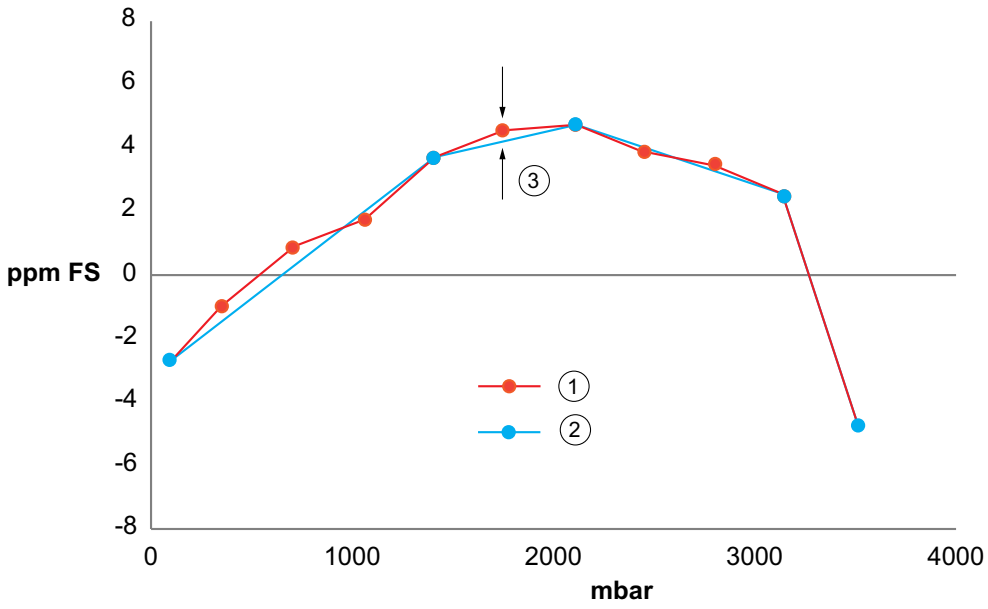
12.1 Selecting PACE Tallis Linearity Correction Points

When selecting linearity adjustment applied pressure points for PACE Tallis, the ‘as found’ linearity error must be evaluated. Try to apply the least amount of linearity points while reducing the residual error to below 1 ppm of the sensor full-scale (FS).

12.1.1 Method to Evaluate the Effect of the Linearity Correction

1. Plot the ‘as found’ errors (indicated pressure - applied pressure) across the full pressure range of the sensor.
2. Draw points onto the ‘as found’ error graph where there is a large change in the slope of the graph.
3. Draw straight lines between the points.
4. Examine the residual error. After the linearity correction, the residual error will be the difference between the straight lines and the ‘as found’ data. We strongly recommend that you use the minimum and maximum pressure points as 2 of the points. Use a minimum of 3 points and a maximum of 11 points.

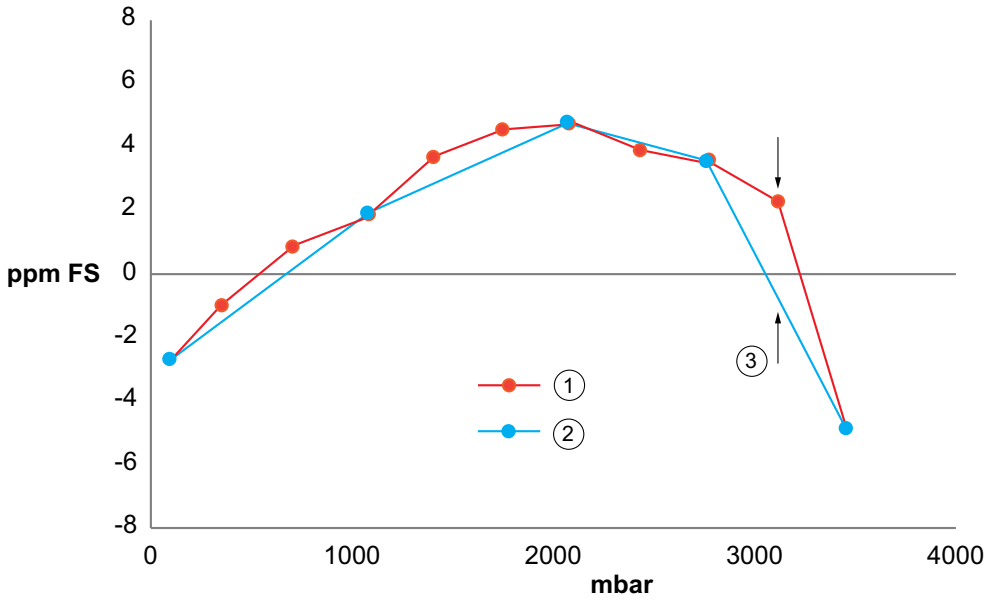
12.1.2 Example of Good Point Selection



1 ‘As Found’ Data
2 Points Selected
3 Small residual error <1 ppm

This example shows typical ‘as found’ data for a 3500 mbar sensor. The selected adjustment points in blue are at the larger changes in the slope. Residual error is the deviation for the straight lines drawn between them. The selected points give a residual error of less than 1 ppm of the full-scale of the sensor. The selected points were 70, 1400, 2100, 3145 and 3500 mbar.

12.1.3 Example of Bad Point Selection



1 'As Found' Data
2 Points Selected
3 Large residual error >1 ppm

This example shows the same 'as found' data but with bad selected points. The result is a large residual error.

13. Recommended Calibration Check Points

Barometric Variant	2 bara / 1 barg up to 21 bara / 20 barg
750 mbar	35 mbara / -965 mbarg
900 mbar	20% of full-scale pressure
950 mbar	40% of full-scale pressure
1050 mbar	60% of full-scale pressure
1150 mbar	80% of full-scale pressure
1050 mbar	100% of full-scale pressure
1000 mbar	80% of full-scale pressure
950 mbar	60% of full-scale pressure
900 mbar	40% of full-scale pressure
750 mbar	20% of full-scale pressure
-	35 mbara / -965 mbarg

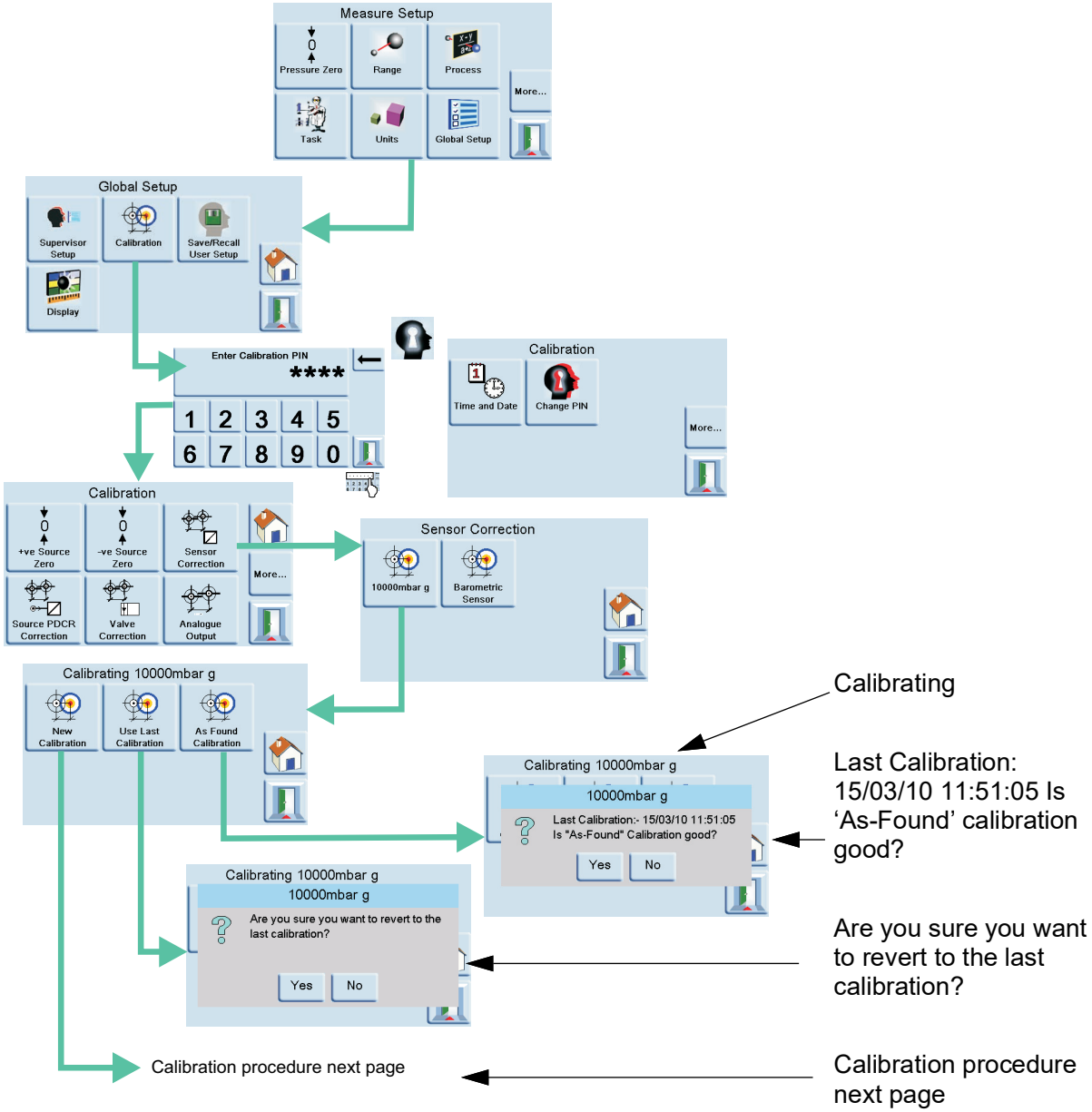
36 bara / 35 barg and Above	All Other Variants (700 mbarg and Below)
Atmospheric / 0 mbarg	0 mbarg
20% of full-scale pressure	-100% of full-scale pressure
40% of full-scale pressure	-80% of full-scale pressure
60% of full-scale pressure	-60% of full-scale pressure
80% of full-scale pressure	-40% of full-scale pressure
100% of full-scale pressure	-20% of full-scale pressure
80% of full-scale pressure	0 mbarg
60% of full-scale pressure	20% of full-scale pressure
40% of full-scale pressure	40% of full-scale pressure
20% of full-scale pressure	60% of full-scale pressure
Atmospheric / 0 mbarg	80% of full-scale pressure
-	100% of full-scale pressure
-	0 mbarg

14. Recommended Calibration Adjustment Pressures

Sensors	Pressures
IRS and TRS (absolute)	20% of the full-scale range of the sensor
	80% of the full-scale range of the sensor
IPS (gauge)	80% of the negative range
	0 pressure
	80% of the positive range.

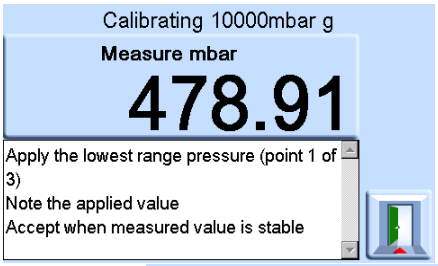
Appendix A. PACE Menus and Screens

A.1 PACE Controller Menus

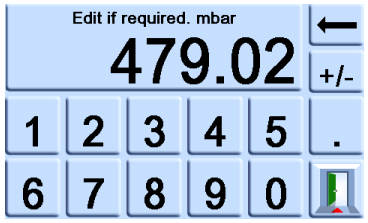


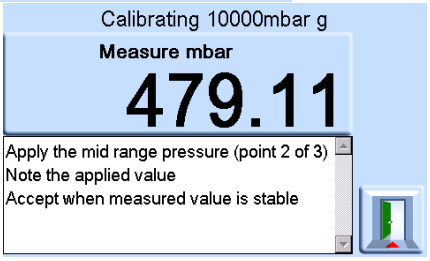
A.2 PACE Controller Screens

Calibrating

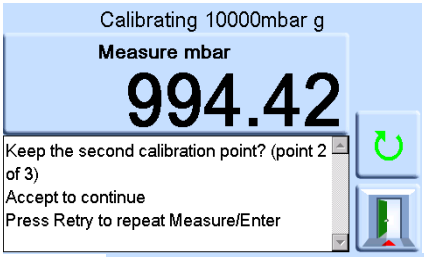


Apply the lowest range pressure (point 1 of 3)
Note the applied value
Accept when measured value is stable

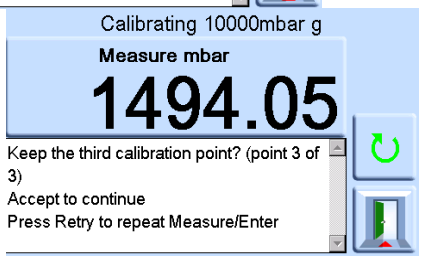




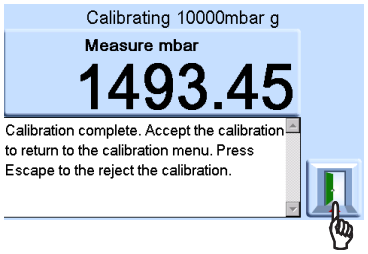
Apply the mid range pressure (point 2 of 3)
Note the applied value
Accept when measured value is stable



Keep the second calibration point? (point 2 of 3)
Accept to continue
Press retry to repeat Measure/Enter

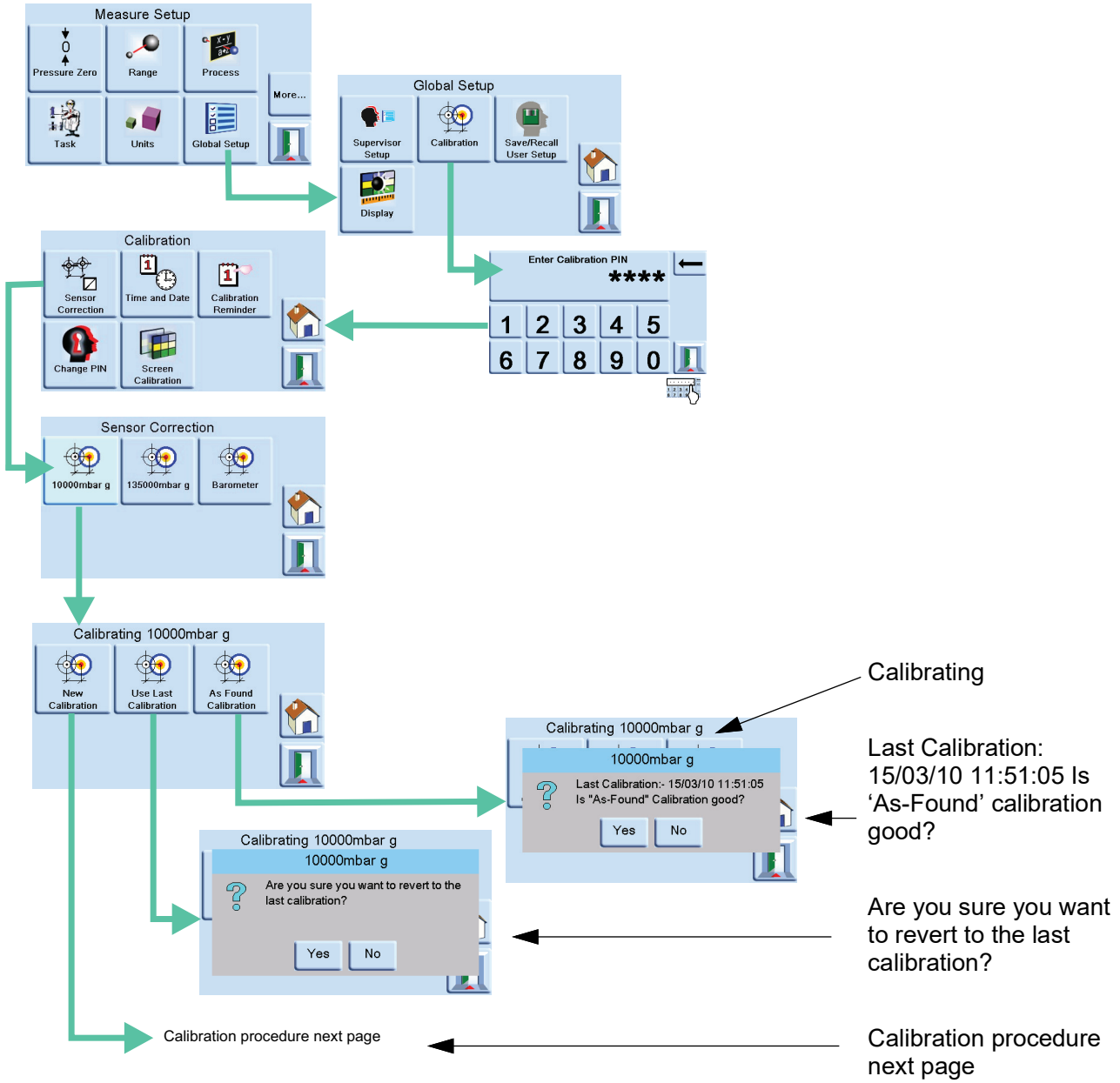


Keep the third calibration point? (point 3of 3)
Accept to continue
Press retry to repeat Measure/Enter



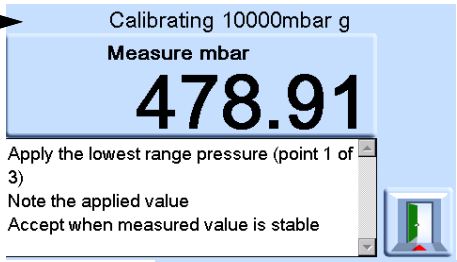
Calibration complete. Accept the calibration to return to the calibration menu. Press Escape to reject the calibration.

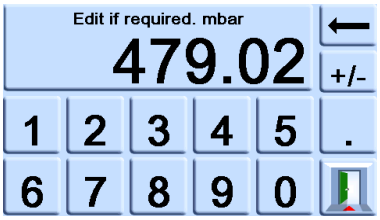
A.3 PACE Indicator Menus



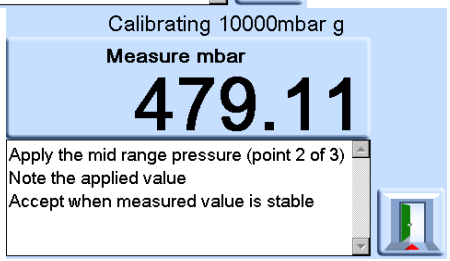
A.4 PACE Indicator Screens

Calibrating

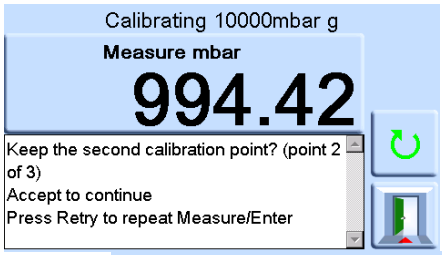




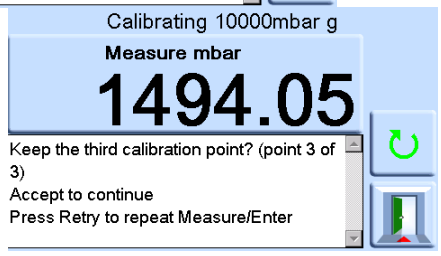
Apply the lowest range pressure (point 1 of 3)
Note the applied value
Accept when measured value is stable



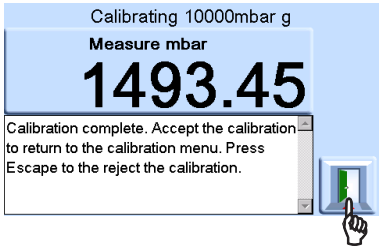
Apply the mid range pressure (point 2 of 3)
Note the applied value
Accept when measured value is stable



Keep the second calibration point? (point 2 of 3)
Accept to continue
Press Retry to repeat Measure/Enter



Keep the third calibration point? (point 3 of 3)
Accept to continue
Press Retry to repeat Measure/Enter



Calibration complete. accept the calibration to return to the calibration menu. Press Escape to reject the calibration.

Appendix B. Pressure Units and Conversion Factors

Pressure Units	Factor (hPa)	Pressure Units	Factor (hPa)
mbar	1.0	cmH_2O @ 20°C	0.978903642
bar	1000.0	mH_2O @ 20°C	97.8903642
Pa (N/m^2)	0.01	kg/m^2	0.0980665
hPa	1.0	kg/cm^2	980.665
kPa	10.0	torr	1.333223684
MPa	10000.0	atm	1013.25
mmHg @ 0°C	1.333223874	psi	68.94757293
cmHg @ 0°C	13.33223874	lb/ft^2	0.4788025898
mHg @ 0°C	1333.223874	inH_2O @ 4°C	2.4908891
inHg @ 0°C	33.86388640341	inH_2O @ 20°C	2.486413
mmH_2O @ 4°C	0.0980665	inH_2O @ 60°F	2.487641558
cmH_2O @ 4°C	0.980665	ftH_2O @ 4°C	29.8906692
mH_2O @ 4°C	98.0665	ftH_2O @ 20°C	29.836983
mmH_2O @ 20°C	0.097890364	ftH_2O @ 60°F	29.8516987

To convert from pressure VALUE 1 in pressure UNITS 1, to pressure VALUE 2 in pressure UNITS 2, calculate as follows:

VALUE 2 = VALUE 1 x (FACTOR 1/FACTOR 2)

Appendix B. Pressure Units and Conversion Factors

Office Locations

https://druck.com/contact

Services and Support Locations

https://druck.com/service