

GE  
Digital Solutions

## Pressure Automated Calibration Equipment

Calibration manual - K0450 Revision B

### PACE5000



### PACE6000



### PACE1000



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## Introduction

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

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

## Safety

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.

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.

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

## Pressure

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

## Toxic Materials

There are no known toxic materials used in construction of this equipment.

## Maintenance

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

## Technical Advice

For technical advice contact the manufacturer.

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

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## Abbreviations

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

abs	Absolute
a.c.	Alternating current
ALT	Altitude
BSP	British pipe thread
CAS	Calculated airspeed
CSK	Countersunk
d.c.	Direct current
DPI	Digital Pressure Instrument
e.g.	For example
etc.	And so on
Fig.	Figure
ft	Foot
g	Gauge
Hg	Mercury
HTS	High tensile steel
Hz	Hertz
IAS	Indicated airspeed
i.e.	That is
IEC	International Electrotechnical Commission
IEEE 488	Institute of Electrical and Electronic Engineers standard 488 data
in	Inch
kg	Kilogram
kts/kn	knot
LCD	Liquid crystal display
m	Metre
mA	Milliampere
max	Maximum
mbar	Millibar
min	Minute or minimum
mm	Millimetre
mV	Millivolts
MWP	Maximum working pressure
No.	Number
NPT	National Pipe Thread
PACE	Pressure Automated Calibration Equipment
Para.	Paragraph
PDCR	Pressure transducer
PED	Pressure Equipment Directive
psi	Pounds per square inch
PTX	Pressure transmitter
ROC	Rate of Climb
RS232	Serial communications data standard
RtCAS	Rate of calculated airspeed

RtMach	Rate of Mach
SCPI	Standard Commands for Programmable Instruments
UUT	Unit under test
V	Volts
VFC	Volts-free contact
+ve	Positive
-ve	Negative
°C	Degrees Celsius

### Associated Publications

- K0447 PACE5000/6000 User Guide and Safety Instructions
- K0467 PACE1000 Indicator User Guide and Safety Instructions
- K0443 PACE5000/6000 Controller User Manual
- K0470 PACE1000 Indicator User Manual
- K0476 Pressure Control Module User Guide and Safety Instructions
- K0472 SCPI Communications Manual
- K0469 Heritage Communications Manual - Instrument Emulation

### Symbols



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



This symbol, on the equipment, indicates that the user should read the user manual.



This symbol, on the equipment, indicates a warning and that the user should refer to the user manual.

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.



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:

- Our customer service department: [www.gemeasurement.com](http://www.gemeasurement.com)
- Your local government office.



#### **WARNINGS**

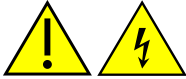
**TURN OFF THE SOURCE PRESSURE(S) AND CAREFULLY VENT THE PRESSURE LINES BEFORE DISCONNECTING OR CONNECTING THE PRESSURE LINES. PROCEED WITH CARE.**

**ONLY USE EQUIPMENT WITH THE CORRECT PRESSURE RATING.**

**BEFORE APPLYING PRESSURE, EXAMINE ALL FITTINGS AND EQUIPMENT FOR DAMAGE. REPLACE ALL DAMAGED FITTINGS AND EQUIPMENT. DO NOT USE ANY DAMAGED FITTINGS AND EQUIPMENT.**

**DO NOT EXCEED THE MAXIMUM WORKING PRESSURE OF THE INSTRUMENT.**

**THIS EQUIPMENT IS NOT RATED FOR OXYGEN USE.**



**THE GROUND LEAD OF THE INSTRUMENT MUST BE CONNECTED TO THE AC SUPPLY PROTECTIVE SAFETY GROUND.**

**ISOLATE THE POWER SUPPLY BEFORE MAKING ANY ELECTRICAL CONNECTIONS TO THE REAR PANEL.**

Pressure Units and Conversion Factors

Pressure units	Factor (hPa)	Pressure units	Factor (hPa)
mbar	1.0	cmH <sub>2</sub> O @ 20°C	0.978903642
bar	1000.0	mH <sub>2</sub> O @ 20°C	97.8903642
Pa (N/m <sup>2</sup> )	0.01	kg/m <sup>2</sup>	0.0980665
hPa	1.0	kg/cm <sup>2</sup>	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 <sup>2</sup>	0.4788025898
mHg @ 0°C	1333.223874	inH <sub>2</sub> O @ 4°C	2.4908891
inHg @ 0°C	33.86388640341	inH <sub>2</sub> O @ 20°C	2.486413
mmH <sub>2</sub> O @ 4°C	0.0980665	inH <sub>2</sub> O @ 60°F	2.487641558
cmH <sub>2</sub> O @ 4°C	0.980665	ftH <sub>2</sub> O @ 4°C	29.8906692
mH <sub>2</sub> O @ 4°C	98.0665	ftH <sub>2</sub> O @ 20°C	29.836983
mmH <sub>2</sub> O @ 20°C	0.097890364	ftH <sub>2</sub> O @ 60°F	29.8516987

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 PACE instrument contains selectable pressure units and user defined units. Use the conversion factors to calculate a user defined unit from the table above. Refer to the data sheets for the list of selectable pressure units.

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## 1 Introduction

The PACE controller incorporates a calibration facility; for the PACE to stay accurate, a calibration check should be carried out at chosen intervals. If the accuracy of the PACE is not within the permissible deviation, carry out a calibration adjustment.

## 2 Calibration Status

Using the **Measured Pressure/Instrument Status** menu, the calibration status of the calibrator can be displayed on the front panel screen. The status menu includes **Calibration History** which gives a list of dates of the stored calibration corrections.

**Note:** *The Date and Time must be set correctly using the **Measured Pressure/Global Set-up/Calibration** menu.*

## 3 Calibration Equipment

The original GE Calibration Certificate shows the measurement uncertainty of the original calibration standard. To preserve uncertainty of the PACE calibration, checks and adjustments must be performed using a calibrator uncertainty of less than or equal to the original calibration standard.

## 4 Preliminary Operations

Review and become familiar with the whole procedure before beginning a calibration process. Allow at least one hour for the PACE to thermally stabilize in a thermally stable environment after switching on and before calibration.

Before starting a calibration procedure:

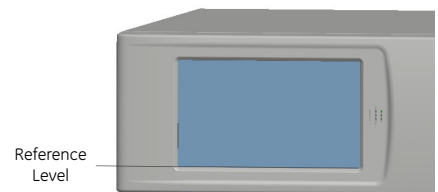
Carry out a leak test as detailed in PACE user manual K0443.

## 5 Notes on Calibration

The pressure standard output port and the reference level must be at the correct level or use height-corrected applied pressure.

To prevent applied calibration pressure “back feed” in PACE controllers, fit blanking plugs to both positive and negative supply ports on the manifold.

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



## 5.1 PACE Controller Connection



### WARNING

**ON COMPLETION OF CALIBRATION, OPEN THE ON/OFF VALVE TO VENT TRAPPED PRESSURE FROM THE SUPPLY + PORT TO ATMOSPHERE.**

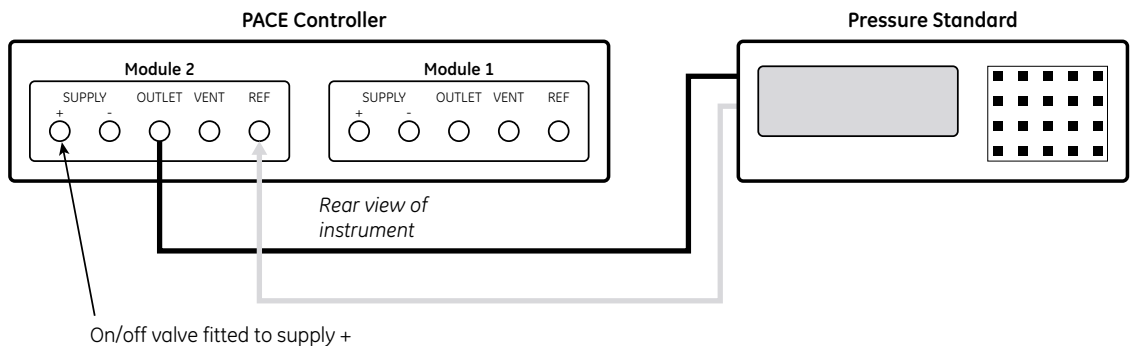
Connect the calibrator for each pressure range as follows:

Connect the output of the pressure standard to the PACE module output port.

Fit an on/off valve to the supply + input of the PACE controller. Leave the other side of the valve open to atmosphere. Turn the valve to the closed position.

### Gauge Reference

If the pressure standard has a reference connection, then connect this to the PACE reference port on the module manifold. Otherwise the calibrator reference port should be open to atmosphere.



**Note:** Module 2 reference port open to atmosphere or to reference port of the pressure standard.

**Note:** Optimum performance is achieved by connecting the PACE reference port to the pressure standard.

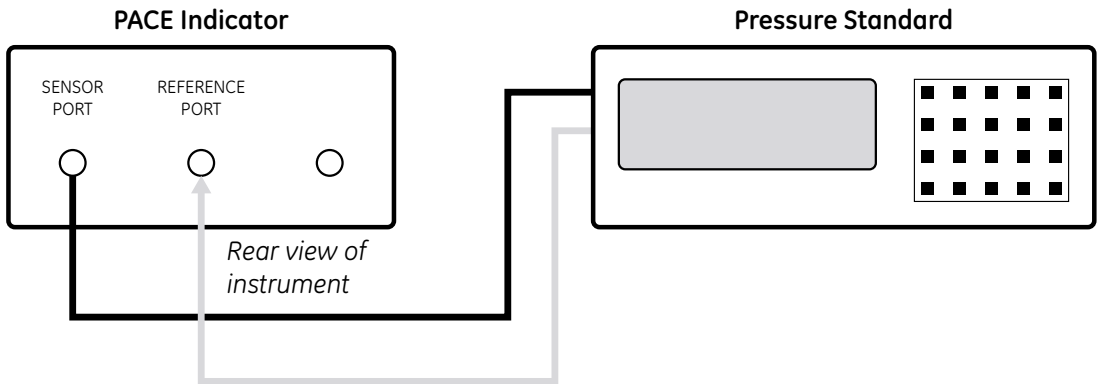
## 5.2 PACE Indicator Connection

Connect the indicator for each pressure range as follows:

Connect the output of the pressure standard to the indicator port.

### Gauge Reference

If the pressure standard has a reference connection, then connect this to the indicator reference port. Otherwise the indicator reference port should be open to atmosphere.



**Note:** Indicator reference port open to atmosphere or to reference port of the pressure standard.

**Note:** Optimum performance is achieved by connecting the PACE reference port to the pressure standard.

---

## 6 Calibration Check (All Ranges)

**Note:** The PACE adds the barometric reading to a gauge range to produce an absolute range.

### 6.1 Procedure

Set the calibrator to measure mode:

- 1 Connect calibration standard for the pressure range to be checked.
- 2 Press **Task** and select **Basic**.
- 3 With the pressure standard connected to the correct pressure port, select **Measured Pressure** and press **Range** to select the gauge pressure range to be checked.
- 4 Barometric pressure can be displayed in the status area.
- 5 Set maximum displayed resolution.

Gauge ranges should be zeroed immediately prior to a calibration check, as follows:

- 1 Press **Measured Pressure/Zero** to zero the selected range.
- 2 On completion of the zero operation, the display shows Zero completed successfully.
- 3 Adjust calibration pressure to the first pressure value and wait until this pressure, as displayed on PACE, is stable to less than 10ppm (0.001%). Display filtering may be required.
- 4 Compare the pressure value on the calibration standard to the value displayed and record the difference.
- 5 Repeat (3) and (5) for each pressure, as prompted by the PACE.
- 6 If the recorded difference exceeds the permissible deviation for the selected range, the calibrator requires a calibration adjustment for that range. Refer to PACE sales data sheets for permissible precision deviation. Precision specification is used if less than 24 hours since adjustment using the same calibration equipment. If greater than 24 hours, then the PACE specification is the sum of precision and long term stability.
- 7 Select the next pressure range for a calibration check.
- 8 After completing all calibration checks, adjust calibration standard to atmospheric pressure.
- 9 Disconnect calibration standard from the output.

If no further calibration is required, switch off the PACE.

## 7 Calibration Adjustment

To adjust a calibration range of the calibrator, proceed as follows:

- 1 Connect the calibrator for the range to be adjusted, as detailed in Calibration Check.

**Note:** *The calibration adjustments may be carried out in any order.*

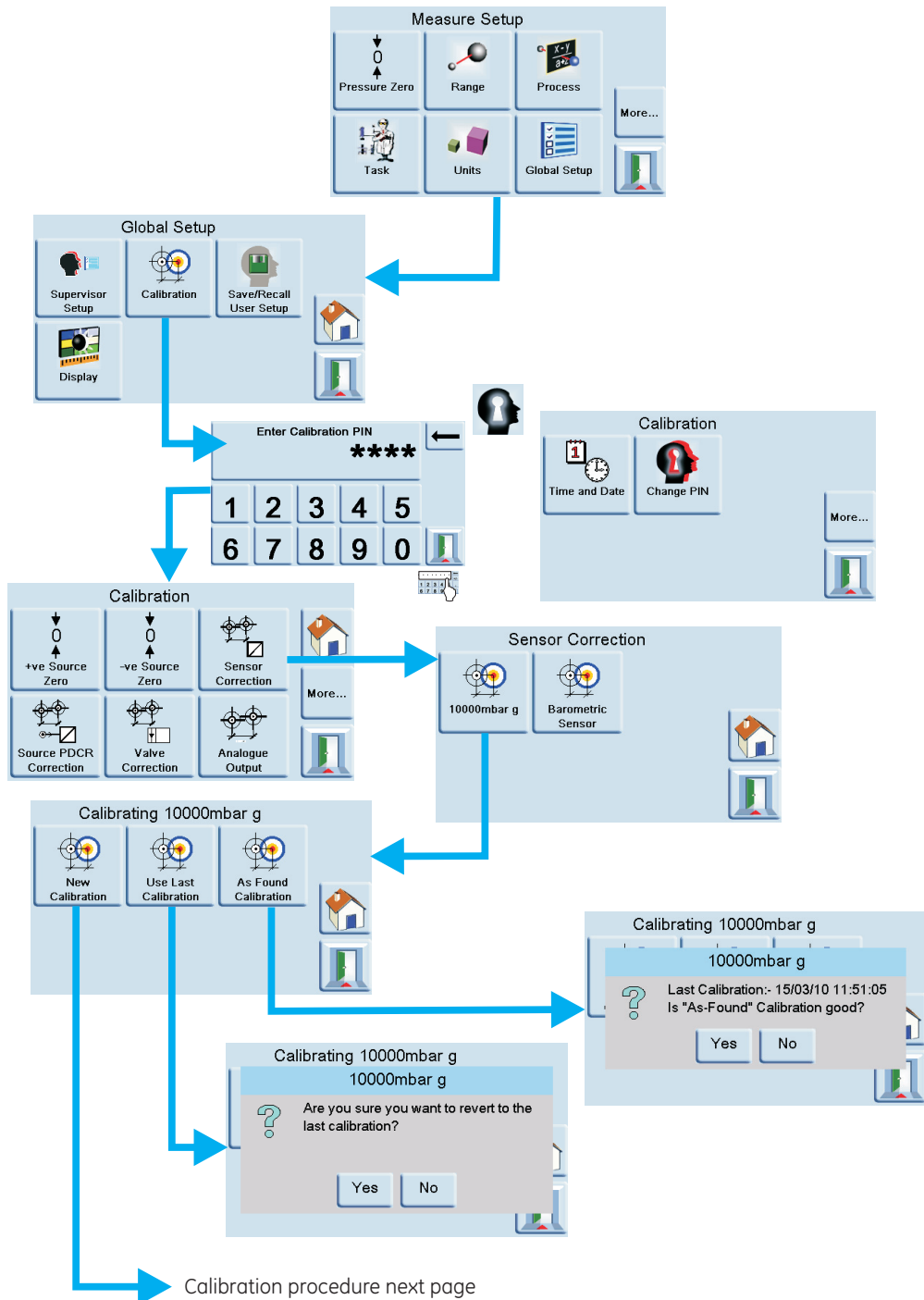
- 2 Select **Measured Pressure/Global Set-up/Calibration**, enter the Calibration **PIN (4321)**.
- 3 Select **Sensor Correction**.
- 4 Select the pressure range to be corrected.
- 5 Select **New Calibration**.
- 6 The display shows the first value to be set on the pressure standard and to press **OK** when the applied pressure is stable. Use the numeric keys to enter the precise applied pressure.

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

- 7 Select **Accept** to store the first value and the display goes to the next pressure value to be set.
- 8 Select **Repeat** to re-apply the same pressure and **Quit Calibration** to exit the calibration of this pressure range.
- 9 Repeat steps (5) to (7) for the next value.
- 10 Carry out a calibration check to verify this procedure.
- 11 After completing the calibration procedures, adjust the calibration standard to atmospheric pressure. Disconnect calibration standard from the PACE.

# Appendix A PACE Menus and Screens

## A.1 PACE Controller Menus




A.2 PACE Controller Screens

Calibrating 10000mbar g

Measure mbar

**478.91**

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




Edit if required. mbar

**479.02**

←

+/-


1	2	3	4	5	.
6	7	8	9	0	

Calibrating 10000mbar g

Measure mbar

**479.11**

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





Calibrating 10000mbar g

Measure mbar

**994.42**

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







Calibrating 10000mbar g

Measure mbar

**1494.05**

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






Calibrating 10000mbar g

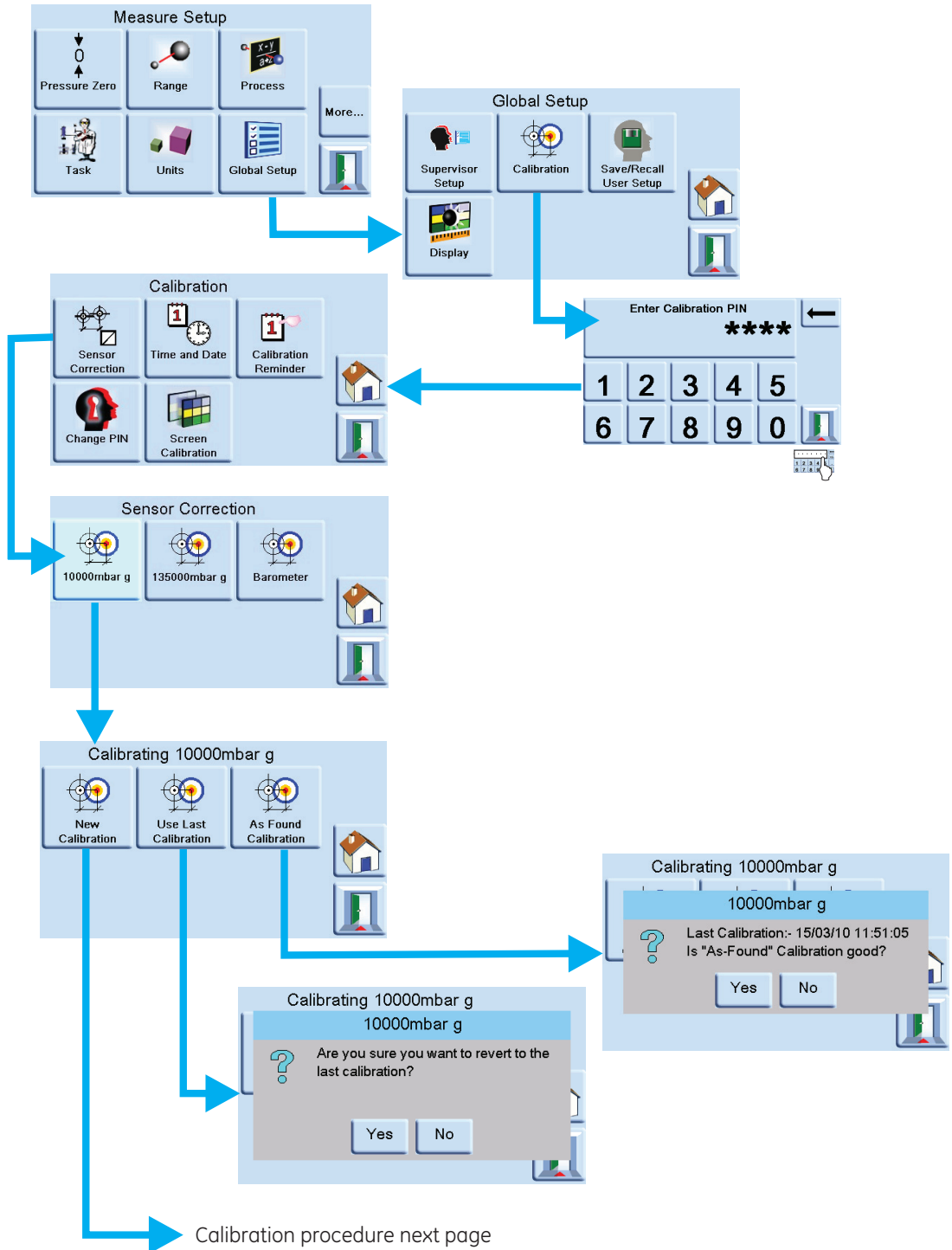
Measure mbar

**1493.45**

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 10000mbar g

Measure mbar

**478.91**

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




Edit if required. mbar

**479.02**

←

+/-


1	2	3	4	5	.
6	7	8	9	0	

Calibrating 10000mbar g

Measure mbar

**479.11**

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





Calibrating 10000mbar g

Measure mbar

**994.42**

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







Calibrating 10000mbar g

Measure mbar

**1494.05**

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






Calibrating 10000mbar g

Measure mbar

**1493.45**

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









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