GE Druck
Pressure measurement
for research & industry

Druck Limited
Fir Tree Lane
Groby
Leicester LE6 0FH
England
Tel: 0116 231 7100

Pressure Automated

Calibration Equipment

Calibration manual

K0450

Amendment Record

Iss No	Date	C/N No	Originator	Typed	Workflow No.	Amendments
1	21/04/10	N/A	Robert Lee	Robert Lee	144693	New document
2	12/10/10	25591	Robert Lee	Robert Lee	152835	Add section 2, PACE1000 details

Approvals

Engineering P BRADLEY		
Marketing M SINGLETON	Technical Communications R LEE	

Print Instructions

Page size 180 x 230 mm.

Note: this document is normally published electronically and shipped on UD-0001.

THIS HARDCOPY IS NOT TO BE USED AS CAMERA COPY.

GE
Measurement & Control Solutions

Pressure Automated Calibration Equipment

Calibration manual K0450

PACE5000

PACE6000

PACE Indicators

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.

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	Pressue 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

The equipment contains the following symbols to identify hazards.

CE

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, on the instrument, indicates do not throw-away in domestic bin, hazardous material, dispose correctly in accordance with local regulations.

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_20 @ 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_20 @ 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.

CONTENTS

Title	Page
CALIBRATION PROCEDURES for PACE CONTROLLERS	1-1
Introduction	1-1
Calibration Status	1-1
Preliminary Operations	1-1
Connecting the Calibrator	1-2
Calibration Check (All Ranges)	1-3
Calibration Adjustment	1-5
CALIBRATION PROCEDURES for PACE INDICATORS	2-1
Introduction	2-1
Calibration Status	2-1
Preliminary Operations	2-1
Connecting the Calibrator	2-2
Calibration Check (All Ranges)	2-3
Calibration Adjustment	2-5

intentionally left blank

1 Calibration Procedures for PACE Controllers

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.

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.*

Calibration Equipment

The original GE Calibration Certificate shows the measurement uncertainty of the original calibration standard.

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.

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”, fit blanking plugs to both positive and negative supply ports on the manifold.

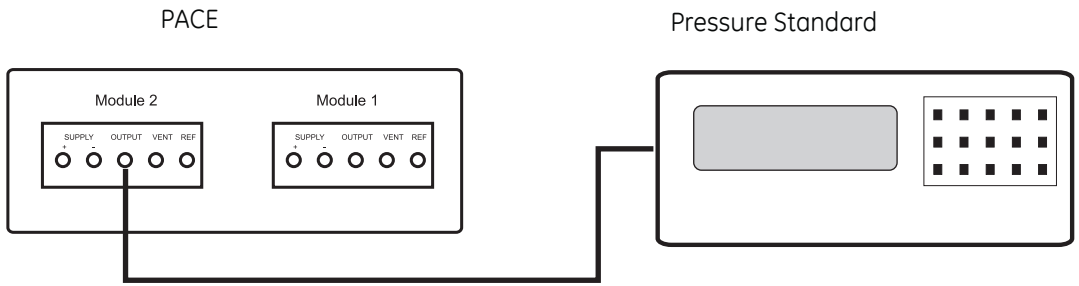
Make sure that before starting a calibration procedure both pressures on gauge measurements are equalised and stable.

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

Connecting the Calibrator

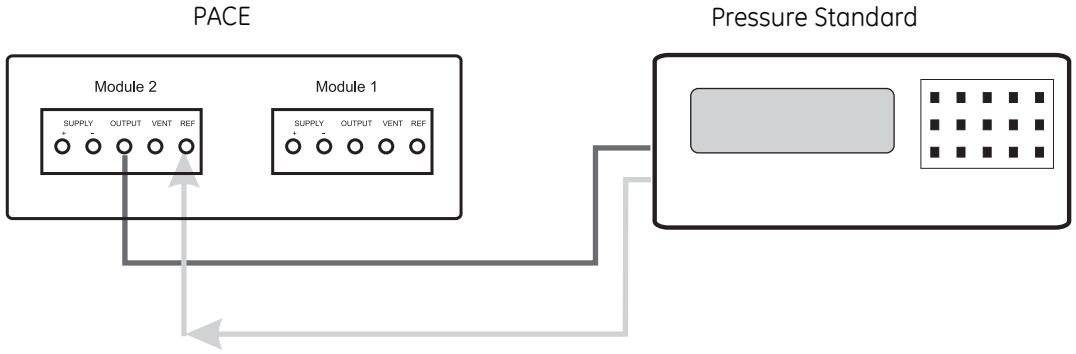
Connect the calibrator for each pressure range as follows:

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



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.



Absolute Range

Note

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

Calibration Check (All Ranges)

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.

Gauge ranges should be zeroed 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.

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.

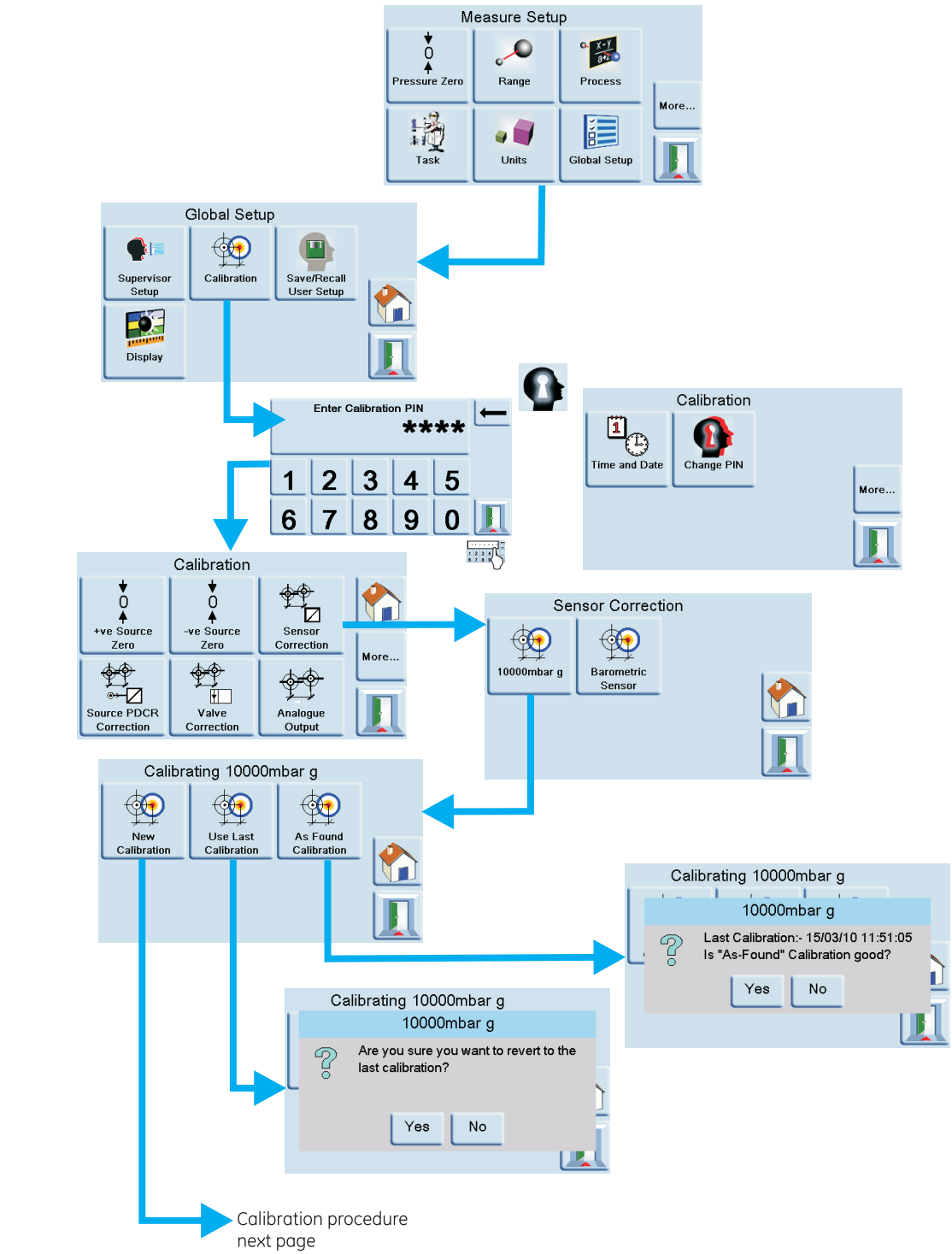
6 If the recorded difference exceeds the permissible deviation for the selected range, the calibrator requires a calibration adjustment for that range. Refer to sales data sheets SDS0001 and SDS0008 for permissable deviation.

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.


Measure Setup
Pressure Zero
Range
Process
More...
Task
Units
Global Setup
Global Setup
Supervisor Setup
Calibration
Save/Recall User Setup
Display
Enter Calibration PIN
****
1 2 3 4 5
6 7 8 9 0
Calibration
Time and Date
Change PIN
More...
Calibration
+ve Source Zero
-ve Source Zero
Sensor Correction
More...
Source PDCR Correction
Valve Correction
Analogue Output
Sensor Correction
10000mbar g
Barometric Sensor
Calibrating 10000mbar g
New Calibration
Use Last Calibration
As Found Calibration
Calibrating 10000mbar g
10000mbar g
Last Calibration:- 15/03/10 11:51:05
Is "As-Found" Calibration good?
Yes
No
Calibrating 10000mbar g
10000mbar g
Are you sure you want to revert to the last calibration?
Yes
No
Calibration procedure next page

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 must 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.

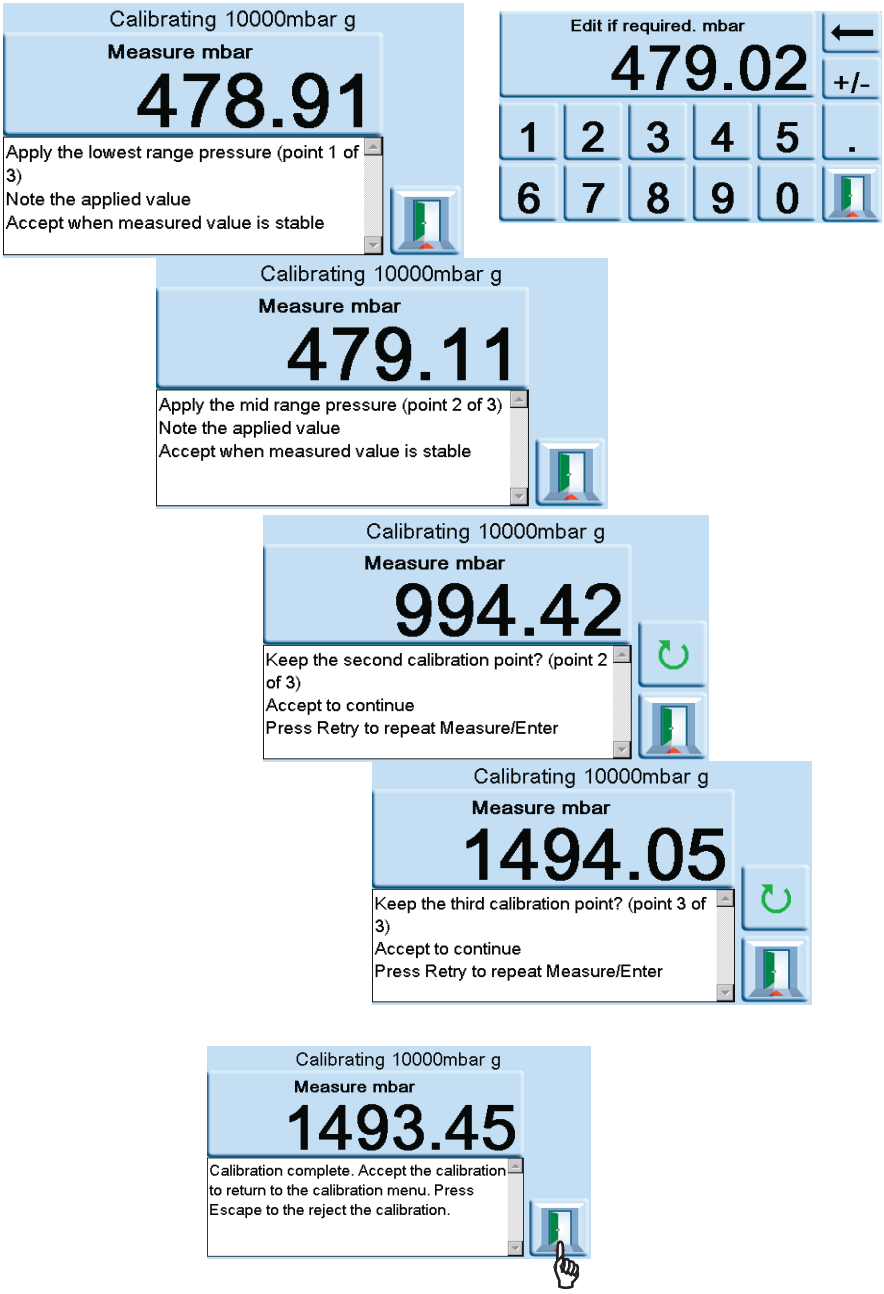
7 Select **Accept** to store the first value and the display goes to the next pressure value to be set.

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.


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 the reject the calibration.

2 Calibration Procedures for PACE Indicators

Introduction

The PACE indicator 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.

Calibration Status

Using the **Measured Pressure/Instrument Status** menu, the sensor calibration status of the indicator 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.*

Calibration Equipment

The original GE Calibration Certificate shows the measurement uncertainty of the original calibration standard.

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 Indicator user manual K0470.

Notes on calibration

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

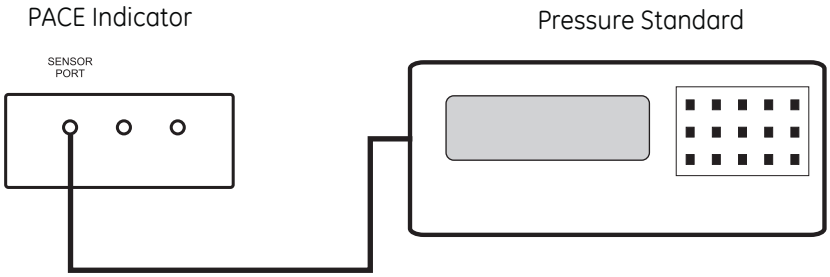
Make sure that before starting a calibration procedure both pressures on gauge measurements are equalised and stable.

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

Connecting the Indicator

Connect the indicator for each pressure range as follows:

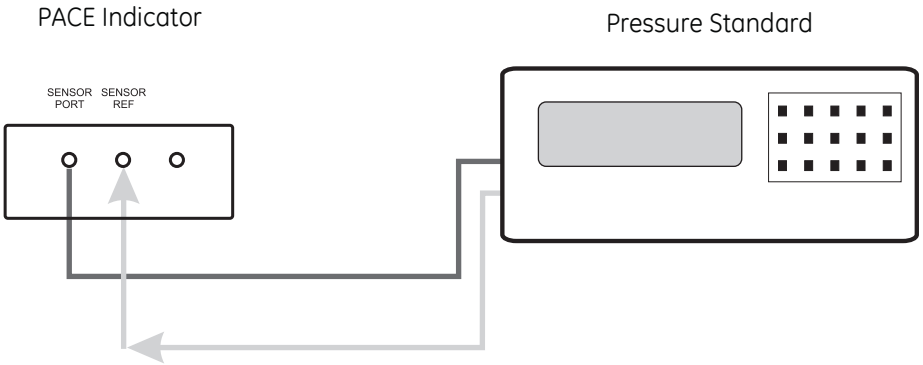
Connect the output of the pressure standard to the indicator port.



rear view

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.



rear view

indicator reference port open to atmosphere or to reference port of the pressure standard.

Absolute Range

Note

The indicator adds the barometric reading to a gauge range to produce an absolute range.

Calibration Check (All Ranges)

Procedure

Set the indicator to measure mode:

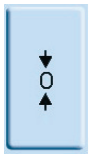
1 Connect calibration standard for the pressure range to be checked.

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.

Gauge ranges should be zeroed as follows:



1 Press **Measure Pressure/Zero** to zero the selected range or press the zero button on the screen.

2 On completion of the zero operation, the display shows Zero completed successfully.

3 Adjust calibration pressure to the first pressure value.

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.

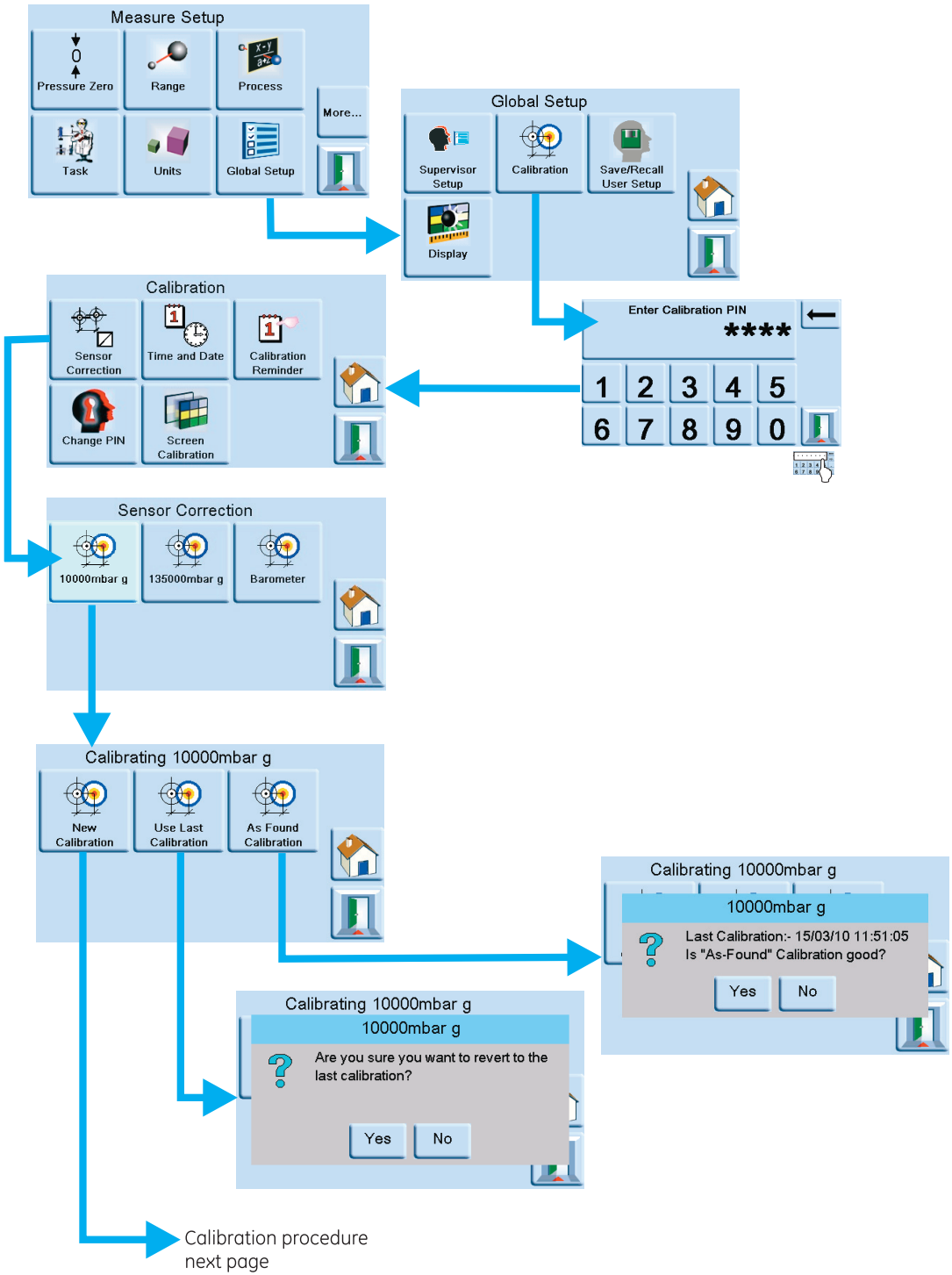
6 If the recorded difference exceeds the permissible deviation for the selected range, the indicator requires a calibration adjustment for that range. Refer to the sales data sheet for permissable deviation.

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 indicator.


Measure Setup
Pressure Zero
Range
Process
More...
Task
Units
Global Setup
Global Setup
Supervisor Setup
Calibration
Save/Recall User Setup
Display
Calibration
Sensor Correction
Time and Date
Calibration Reminder
Change PIN
Screen Calibration
Enter Calibration PIN
****
1 2 3 4 5
6 7 8 9 0
Sensor Correction
10000mbar g
135000mbar g
Barometer
Calibrating 10000mbar g
New Calibration
Use Last Calibration
As Found Calibration
Calibrating 10000mbar g
10000mbar g
Last Calibration:- 15/03/10 11:51:05
Is "As-Found" Calibration good?
Yes
No
Calibrating 10000mbar g
10000mbar g
Are you sure you want to revert to the last calibration?
Yes
No
Calibration procedure next page

Calibration Adjustment

To adjust a calibration range of the indicator, proceed as follows.

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

Note
The calibration adjustments must 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.

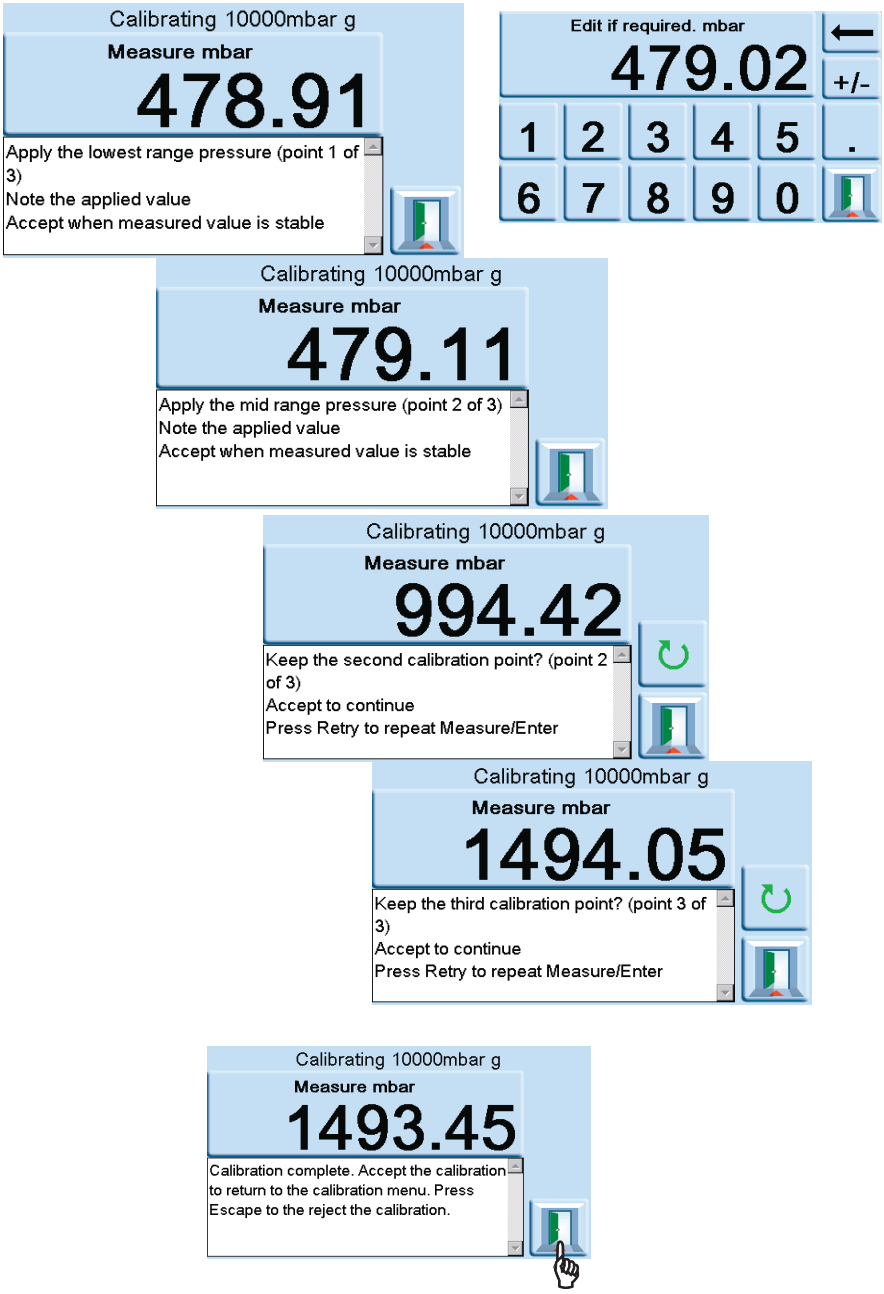
7 Select **Accept** to store the first value and the display goes to the next pressure value to be set.

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 indicator.


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 the reject the calibration.