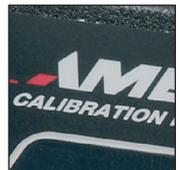
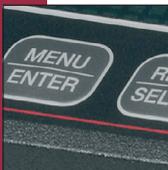


Reference Manual
Handheld Pressure Calibrator
JOFRA HPC400

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*...because calibration is
a matter of confidence*



HPC400

Reference Manual

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1. Introduction

The JOFRA HPC400 is an accurate, full function pressure calibrator. The calibrator includes the following features and functions:

- Large graphical LCD display. Intuitive menu system for easy operation of the large number of useful and handy functions and features.
- Switch test functionality uses a high speed pressure update rate for superior performance and repeatability.
- Current measurement, with or without 24 volt loop power.
- Voltage measurement capability.
- The JOFRA HPC400 is well suited for various applications including calibration of gauges, pressure switches, safety valves, and P/I transmitters.
- The HPC400 is available in three pressure ranges, 2, 7 or 20 bar compound. Please see pressure range/accuracy table for further details (Page 28).
- Vacuum is supported in all pressure ranges

Read this manual carefully before using the instrument and make sure that all safety instructions and warnings are observed.

1.1 Contacting AMETEK/JOFRA

US, Canada, Latin America
Europe, Africa, Middle East
Asia

AMETEK M&CT 1-800-527-9999
AMETEK Denmark A/S + 45 4816 8000
AMETEK Singapore Pte. Ltd.
At + 65 (64) 842 388

1.2 Standard Equipment

Inspect the unit carefully upon receipt. Save packing carton in case reshipment is necessary. If there appears to be any damage, equipment missing or if there are any questions about the unit, contact AMETEK.

Check to see if your calibrator is complete. It should include:

- HPC400 Calibrator
- Reference Manual
- Test Leads
- Pressure Fittings
- Calibration Certificate

1.3 Safety information

Symbols Used

The following table lists the International Electrical Symbols. Some or all of these symbols may be used on the instrument or in this manual.

Symbol	Description
	AC (Alternating Current)
	AC-DC
	Battery
	CE Complies with European Union Directives
	DC
	Double Insulated
	Electric Shock
	Fuse
	PE Ground
	Hot Surface (Burn Hazard)
	Read the User's Manual (Important Information)
	Off
	On
	Canadian Standards Association

The following definitions apply to the terms “Warning” and “Caution”.

- “Warning” identifies conditions and actions that may pose hazards to the user.
- “Caution” identifies conditions and actions that may damage the instrument being used.

Use the calibrator only as specified in this manual, otherwise injury and damage to the calibrator may occur.



To avoid possible electric shock or personal injury:

- Do not apply more than the rated voltage. See specifications for supported ranges.
- Follow all equipment safety procedures.
- Never touch the probe to a voltage source when the test leads are plugged into the current terminals.
- Do not use the calibrator if it is damaged. Before you use the calibrator, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.
- Select the proper function and range for your measurement.
- Make sure the battery cover is closed and latched before you operate the calibrator.
- Remove test leads from the calibrator before you open the battery door.
- Inspect the test leads for damaged insulation or exposed metal. Check test leads continuity. Replace damaged test leads before you use the calibrator.
- When using the probes, keep your fingers away from the probe contacts. Keep your fingers behind the finger guards on the probes.
- Connect the common test lead before you connect the live test lead. When you disconnect test leads, disconnect the live test lead first.
- Do not use the calibrator if it operates abnormally. Protection may be impaired. When in doubt, have the calibrator serviced.
- Do not operate the calibrator around explosive gas, vapor, or dust.
- When measuring pressure, make sure the process pressure line is shut off and depressurized before you connect it or disconnect it from the calibrator.
- Disconnect test leads before changing to another measure or source function.
- When servicing the calibrator, use only specified replacement parts.

- To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the battery indicator appears



Caution

To avoid possible damage to calibrator or to equipment under test:

- Use the proper jacks, function, and range for your measurement application.

2. Calibrator Interface

Figure 1 shows the location of the input and output connections on the calibrator, while Table 1 describes their use.

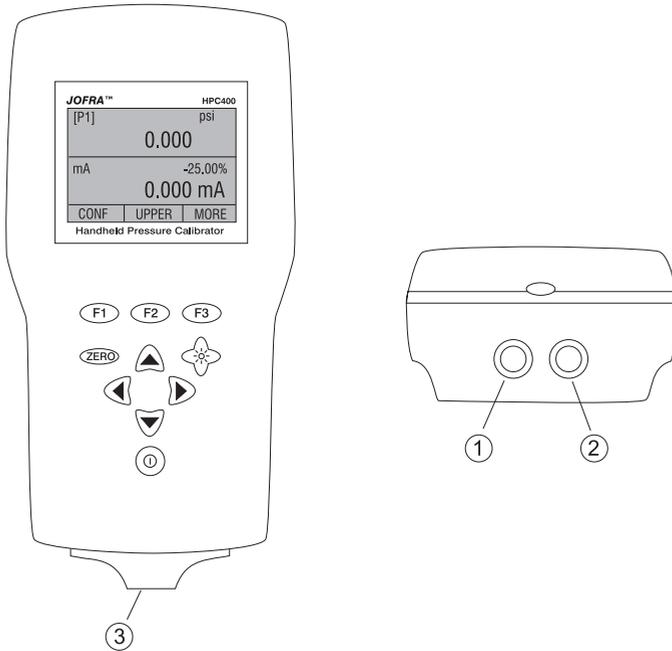


Figure 1. Input/Output Terminals

Table 1: Input and Output Terminals

No.	Name	Description
1, 2	Input Terminals	These terminals are used to measure current, voltage and a contact closure for switch test.
3	P1 Pressure Port	This is the connection for the internal sensor [P1]

Figure 2 shows the location of the keys on the calibrator. Table 2 lists the functions of each key.

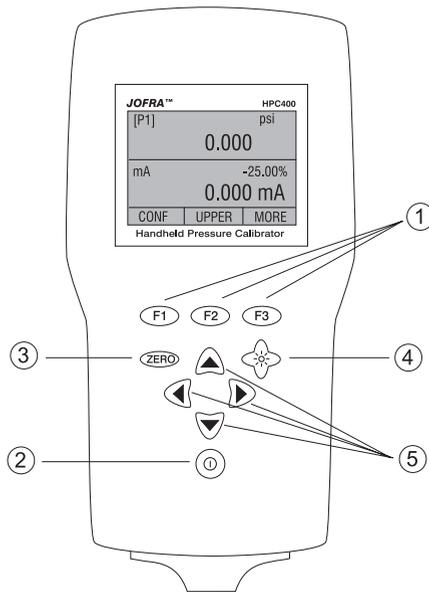


Figure 2. Keypad

Table 2. Key Functions

No.	Name	Function
1	Function Keys	These keys are used in various ways, primarily to configure the calibrator
2	ON/OFF Key	This key is used to turn the calibrator on and off
3	ZERO Key	This key is used to zero pressure measurements
4	Backlight Key	This key is used to turn the backlight on and off
5	Cursor Keys	This key is for setting user input values

Note: When the calibrator is turned on by pressing the ON/OFF key, it will go through a short startup self-check routine. During that routine, the display shows the current firmware revision level, auto shutdown status and the ranges of the internal pressure sensors. The calibrator requires a maximum of 5 minutes warm-up to rated accuracy. Large changes in ambient temperature may require a longer warm-up period. See section 2.3 for instructions on zeroing the pressure sensor displays. Pressure ranges should be zeroed each time the calibrator is started.

2.1 Calibrator Display

The Calibrator Display consists of two regions: The menu bar (No. 5 on Figure 3, located along the bottom of the screen) is used to access a menu system. The main display (No. 1 on Figure 3) consists of up to three process measurement sub-regions. These sub-regions will henceforth be referred to as the UPPER, MIDDLE and LOWER displays. Figure 3 shows the location of the different display fields while table 3 describes them.

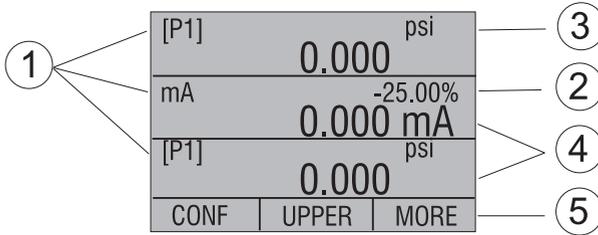


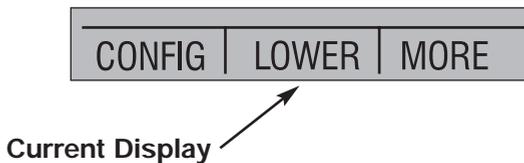
Figure 3. Display

Table 3: Display Functions

No.	Name	Description
1	Primary Parameters	Indicates what is being measured.
2	Span Indicator	Indicates the percent of the 4 to 20 mA span. (For mA and mA Loop functions only)
3	Pressure Units	Indicates one of 15 pressure units available for display.
4	Units	Indicates the unit of measure for the display.
5	Menu bar	Access to menu systems

2.1.1 Main Menu Functionality

There are three options on the Main Menu, CONFIG, {current display} and MORE. The Main Menu is home for the menu display.



2.1.1.1 Setting the Current Display

The current display is indicated by the center option on the Main Menu, pressing the F2 key will toggle the current display.

2.1.1.2 Setting Current Display Parameters

To set the parameters of the current display use the CONFIG option to get to the Display Configuration Menu.



Here the SELECT option will toggle through the choices for each parameter. The first parameter is MODE. Since voltage, current and switch test modes all use the same jacks, two of these functions cannot be used concurrently. The ability to select certain functions is limited based on what is already selected in another active display. The NEXT option is used to change to the second parameter. Only Pressure mode has a second parameter. Pressures can be read in 15 engineering units.

With a single display the following modes are available:

P[1] = Pressure on left side sensor.

P[1] ST = Switch Test with left side sensor.

mA = Milliamps measure without loop power.

mA LOOP = Milliamps measure with loop power.

VOLTS = Voltage Measure.

The following table shows which functions are available concurrently.

An X in a column indicates that the mode in the current display will not be available for selection if the mode in that row is in use in any other active display.

Table 4 Mode Concurrency

CURRENT DISPLAY							
OTHER DISPLAYS		P[1]	P[1] ST	mA	mA Loop	Volts	
	P[1]						
	P[1]ST		X	X	X	X	
	mA		X		X	X	
	mA Loop		X	X		X	
	Volts		X	X	X	X	

2.1.1.3 Accessing Other Menus

Use the MORE option on the Main Menu to access the other menu functions.

2.2 Using the Backlight

The backlight is controlled by the dedicated backlight key. It toggles on and off when the key is pressed; There is a user defined timer configuration settings for the backlight in the functions menu system (2.4.12)

2.3 Using the Zero Function

When the ZERO KEY is pressed, the calibrator will zero the current display if a pressure mode is selected, and the pressure is within the zero limit. The zero limits are within 5% of the full scale range of the selected sensor. If the display indicates "OL," the zero function will not operate."

When a sensor is selected on the current display and the ZERO KEY is pressed the calibrator subtracts the current reading from the output. The zero limits are within 5% of the full scale range of the selected sensor. If the display indicates "OL," the zero function will not operate.

2.4 Menu Controlled Functions

There are 10 'sub-main' menus that can be accessed through the MORE option of the Main Menu. A 'sub-main' menu contains three options. The first option is unique to the function. The second and third options of a 'sub-main' menu are always the same. The NEXT option leads to the next 'sub-main' menu and the DONE option returns to main window. For the last 'sub-main' menu the NEXT option wraps around to home. See Appendix X (pages 41 & 42) Menu Tree, for a detailed mapping of the menu structure.

A note on naming convention:



If a 'sub-main' menu has subordinate menus, it will henceforth be referred to as {function} Main Menu. E.g. the display contrast sub-main menu will be called the Contrast Main Menu. If not it will be called the {function} menu.

Menu Functions Overview

<i>2.4.01 MINMAX, min / max hold.....</i>	<i>Page 11</i>
<i>2.4.02 CONTRAST, display contrast adjustment.....</i>	<i>Page 12</i>
<i>2.4.03 LOCK CFG, instrument setup lock.....</i>	<i>Page 12</i>
<i>2.4.04 SETUPS, store or recall of setups.....</i>	<i>Page 12</i>
<i>2.4.05 AUTO OFF, setup of automatic off timer.....</i>	<i>Page 13</i>
<i>2.4.06 DISPLAY, setup numbers of display windows.....</i>	<i>Page 13</i>
<i>2.4.07 RESOLUTION, select display resolution.....</i>	<i>Page 14</i>
<i>2.4.08 LIGHT TIMER, setup of backlight timer.....</i>	<i>Page 15</i>
<i>2.4.09 HART, switches hart resistor on and off.....</i>	<i>Page 16</i>
<i>2.4.10 DAMP, normal or slow display update rate.....</i>	<i>Page 16</i>

2.4.01 MIN MAX hold

The JOFRA HPC400 Pressure Calibrators have a min/max feature for capturing the minimum and maximum values of any displayed parameter.

To use the MIN / Max storage function proceed as follows:

1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Press the NEXT button until MINMAX appears in the left text field, now press the F1 key to activate the Min / Max storage function.

MIN MAX	NEXT	DONE
---------	------	------

2. After the Min / Max have been activated, pressing the F1 key will toggle the display through the min/max values that are stored in the min/max registers. These readings are live so that the new min/max values will be recorded while in this mode. To reset the min/max registers simply press the clear key. These registers are also cleared at power-up, when pressure is zeroed or when the configuration is changed.

[P1]	psi	
-0.003		
mA	-25.00%	
4.000 mA		
MIN	CLEAR	DONE

[P1]	psi	
30.000		
mA	-25.00%	
20.001 mA		
MAX	CLEAR	DONE

The Min / Max mode is cancelled by pressing F3

2.4.02 Setting the Display Contrast

1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Press the NEXT button until CONTRAST appears in the left text field, now press the F1 key to activate the contrast adjustment function.
2. Use the cursor keys to adjust the display contrast to the desired level and then use the CONTRAST DONE option to return home.



2.4.03 Locking and Unlocking Configurations

When the LOCK CFG option is chosen the menu display returns home and the CONFIG option on the Main Menu indicates that it is locked. Also all menus are locked out with the exception of the %ERROR, LEAK TEST, MINMAX, SET Δ/Σ and CONTRAST menus and the Configuration Lock Menu. When the UNLOCK CFG option is chosen the configuration is unlocked and the menu display continues to the next sub-main menu.

To use the Locking function proceed as follows:

1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Press the NEXT button until LOCK CFG appears in the left text field. Now press the F1 key to activate the function. To reactivate the function use UNLOCK CFG in the same way.



2.4.04 Saving and Recalling Setups

The calibrator will automatically save the current set-up for recall at power-up. Additionally 5 set-ups can be accessed through the SETUPS menu.

To use the Locking function proceed as follows:

1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Press the NEXT button until SETUPS appears in the left text field. Now press the F1 key to enter the function.



2. Choose SAVE to save a set-up , RECALL to recall the set-up, or DONE to do nothing and return home.



If SAVE or RECALL is selected use the cursor keys to select the set-up location. Then use the save option to store the current set-up into the selected location or the recall option to recall the set-up stored in the selected location. The display menu will automatically go home.

SAVE SETUP 1		
--------------	--	--

RCL SETUP 1		
-------------	--	--

2.4.05 Setting AutoShut-off Parameters

The calibrator can be set to automatically shut-off after a selected number of minutes; this function can also be disabled.

To change parameters proceed as follows:

1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Press the NEXT button until AUTO OFF appears in the left text field. Now press the F1 key to enter the setup.
2. To set the auto shut off parameters select the AUTO OFF option on the Auto Shut Off Main Menu.

AUTO OFF		NEXT		DONE
----------	--	------	--	------

3. Use the cursor keys to select the number of minutes before the calibrator turns off or disable auto shut-off by scrolling all the way down to 0.

AUTO SHUTDOWN		ON
	15	
AUTO OFF DONE		

4. Use the AUTO OFF DONE option to set the parameters and return home. The auto shut off time is reset whenever a key is pressed.

2.4.06 Activating and Deactivating a Display

This is where the number of active measuring windows / channels are selected, 1, 2 or 3 windows can be selected, to give the optimal mix between text size, overview and amount of information.

To use the number of windows, pressed as follows:

1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Press the NEXT button until DISPLAY appears in the left text field. Now press the F1 key to enter the function.



2. The NEXT option can be used to select which display to act upon. The ON/OFF option turns the selected display on or off. The selected display and current on/off state are displayed in the lower display.



3. Use the DONE option to save the changes and return home. When a display is deactivated its configuration is retained. When the display is activated its configuration is checked against the configurations of the other currently active displays, if the configurations are in conflict the recalled display's configuration is modified to avoid the conflict. If all three displays are deactivated the LOWER display will come on automatically

2.4.07 Low resolution function.

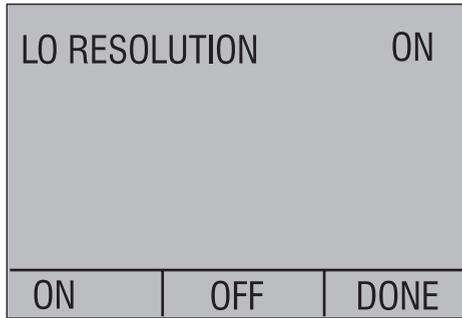
Due to the high accuracy of the JOFRA HPC400 the measured values are displayed with many digits, this might be an disadvantage in some cases, therefore the HPC has a low resolution function. The function takes away the last digit.

To turn the function on or off, proceed as follows:

1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Press the NEXT button until RESOLUTION appears in the left text field. Now press the F1 key to enter the function.



2. The select ON or OFF to turn the low resolution function on or off.



- Pressing DONE returns to main menu.

2.4.08 Setting display Light-off Parameters

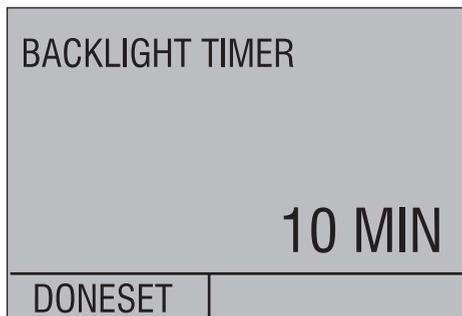
The calibrator will automatically shut-off the display back light after a selected number of minutes.

To change parameters proceed as follows:

- With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Press the NEXT button until LIGHT TIMER appears in the left text field. Now press the F1 key to enter the setup.



- Use the cursor up/down keys to select the number of minutes before the light turns off.



- When the desired time has been reached, press DONE SET to return to main menu.

2.4.09 Switching HART resistor on or off.

The calibrator has a built in 250 ohms serial "HART" resistor, to prevent communication errors on live HART networks, while calibrating 4-20 mA output from pressure transmitters. The resistor is switched into the loop, as a serial resistor.

To change switch in or out the HART resistor proceed as follows:

1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Press the NEXT button until HART appears in the left text field. Now press the F1 key to enter the setup.

HART RESISTOR		ON
ON	OFF	DONE

2. Switches the resistor on or off.
3. DONE returns to main menu.

2.4.10 Switching damping on or off.

To give a more stable reading on fluctuating readings, the HPC400 has a damping function. This function applies to internal sensors only. When damping is ON, the calibrator displays a running average reading of ten measurements. The calibrator takes approximately 3 readings per second.

To switch in or out damping proceed as follows:

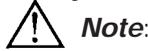
1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Press the NEXT button until DAMP appears in the left text field. Now press the F1 key to enter the setup.

DAMP		OFF
ON	OFF	DONE

2. Switches damping on or off.
3. DONE returns to main menu.

3. Measuring Pressure

To measure pressure, connect the calibrator using an appropriate fitting. Choose a pressure setting for the display being used. The calibrator is equipped with one or two internal sensors and many optional external sensors (JOFRA APMs) are available. Be sure to choose the sensor based on working pressures and accuracy.



Note:

Pressure sensors may be damaged and/or personnel injury may occur due to improper application of pressure. Please refer to the table of ranges and resolutions at the back of this manual for information on overpressure and burst pressure ratings. Vacuum should not be applied to any gauge pressure sensor. The calibrator display will indicate "OL" when an inappropriate pressure is applied. If "OL" is observed on any pressure display, the pressure should be reduced or vented immediately to prevent damage or possible personnel injury. "OL" is displayed when the pressure exceeds 120% of the nominal range of the sensor or when a vacuum in excess of 2 PSI is applied on gauge range sensors.

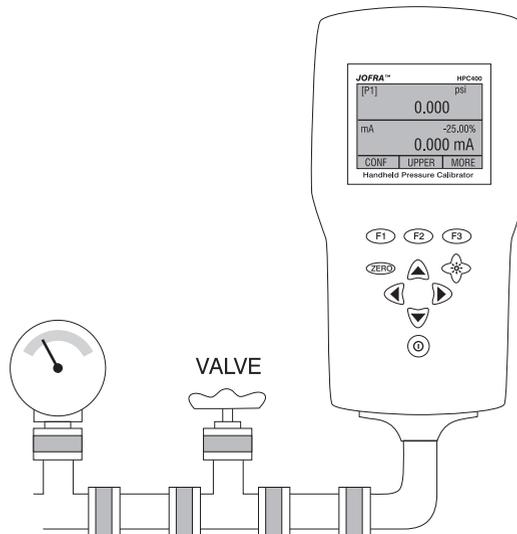


Figure 4

Use the (ZERO) key to zero the pressure sensor when vented to atmospheric pressure.

Important NOTE: To protect sensor integrity and prevent damage to the sensor, the calibrator will display OL [overload] when the applied pressure exceeds 120% of the full scale calibrated range of the sensor.

Important NOTE: To ensure accuracy of the calibrator it is critical to zero the calibrator before a device is calibrated.

3.1 Media Compatibility

The calibrator utilizes a media isolated sensor to prevent sensor contamination. Whenever possible clean, dry air is the media of choice. If that is not always possible, make sure that the media is compatible with Nickel Plated Brass and 316 Stainless Steel.

4. Measuring Current

To measure current use the input terminals on the top of the calibrator. Select the mA function on one of the displays. Current is measured in mA and percentage of range. The range on the calibrator is set to 0% at 4 mA and 100% at 20 mA.

Note: The display will indicate "OL" when the measured current exceeds the nominal range of current measurement (24 mA).

For example:

If the current measured is displayed as 75% then the mA value is 16 mA.

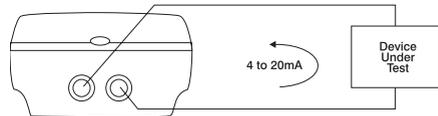
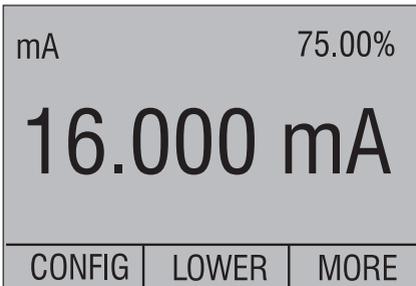


Figure 5

5. Measuring Voltage

To measure voltage use the input terminals on the top of the calibrator. Select the Volts function on one of the displays. The calibrator can measure up to 30V.

Note: The display will indicate "OL" when the measured voltage exceeds the nominal range of voltage measurement (30 V).

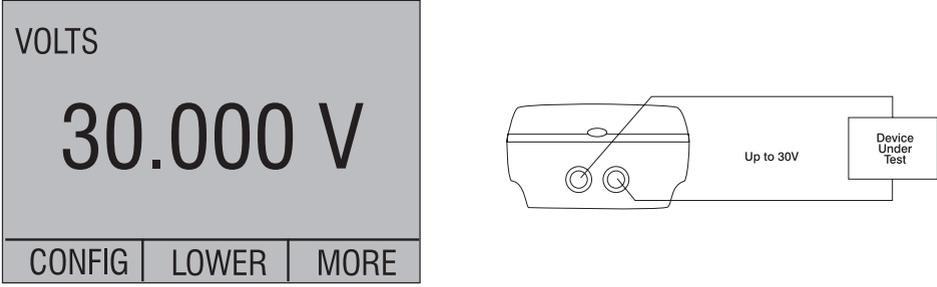


Figure 6

6. Performing a Pressure Switch Test

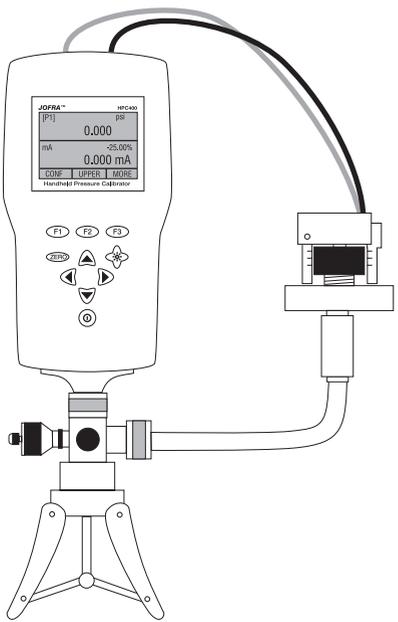
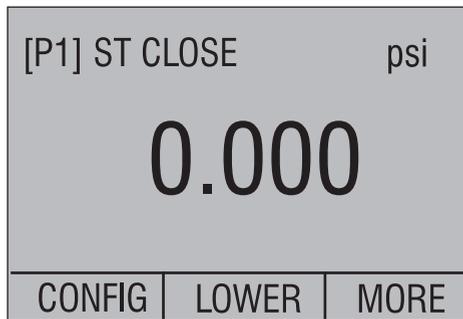


Figure 7

To perform a switch test, follow these steps:

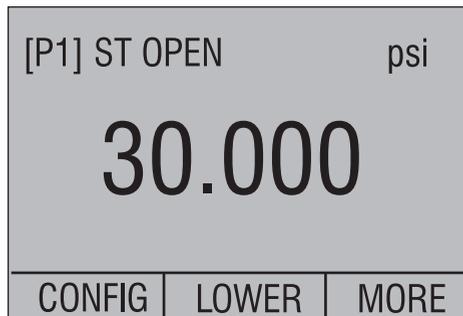
1. Change the setup to Setup 4 (default switch test).
Setup 4: The upper display is set to [P1] ST, all other displays are off.
2. Connect the calibrator to the switch using the pressure switch terminals. The polarity of the terminals does not matter. Then connect the pump to the calibrator and the pressure switch.
3. Make sure the vent on the pump is open. Zero the calibrator if necessary. Close the vent after zeroing the calibrator.
4. The top of the display will read "CLOSE".
5. Apply pressure with the pump slowly until the switch opens.

Important NOTE: In the switch test mode the display update rate is

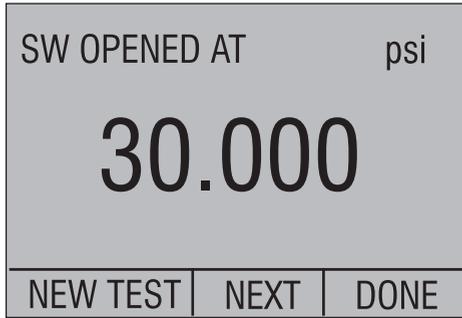


increased to help capture changing pressure inputs. Even with this enhanced sample rate pressurizing the device under test should be done slowly to ensure accurate readings.

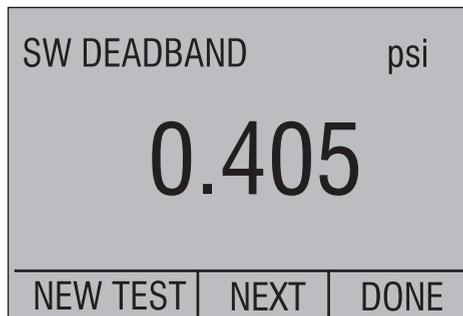
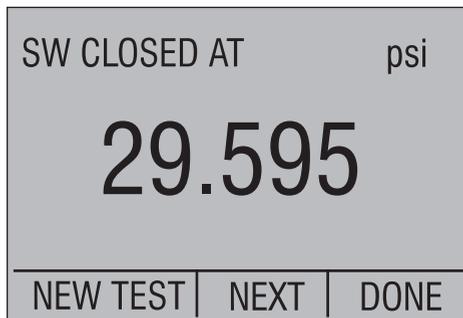
6. Once the switch is open, "OPEN" will be displayed, bleed the pump slowly until the pressure switch closes.
7. At the top of the display it will now read, "SW OPENED AT" and give you the pressure that the switch opened at.



8. Press the "NEXT" option to view when the switch closed, and the dead band.



9. Press the "NEW TEST" option to clear the data and perform another test.



10. Press the "DONE" option to end the test and return to the standard pressure setting.

Important NOTE: The following example uses a normally closed switch. The basic procedure is still the same for a normally open switch, the display will just read "OPEN" instead of "CLOSE".

Example:

[P1] ST will return to [P1].

7. Calibrating Transmitters

7.1 Using the mA Input Function

The mA input function allows the user to read back the 4-20 mA output from the device being calibrated. This can be done in one of two ways.

- 1) Passively - Where the device under test directly generates 4-20 mA and can be read by the calibrator.
- 2) Actively - Where the calibrator supplies 24 VDC loop power to the device under test to power the device while reading the resulting 4-20 mA signal.

[P1]	psi	
30.000		
mA	100.00%	
20.000 mA		
CONFIG	LOWER	MORE

[P1]	psi	
30.000		
mA LOOP	100.00%	
20.000 mA		
CONFIG	LOWER	MORE

7.2 Calibrating a Pressure-to-Current Transmitter

To calibrate a pressure-to-current transmitter (P/I), perform the following steps:

1. Connect the calibrator and the pump to the transmitter.
2. Apply pressure with the pump.
3. Measure the current output of the transmitter.
4. Ensure the reading is correct. If not, adjust the transmitter as necessary.

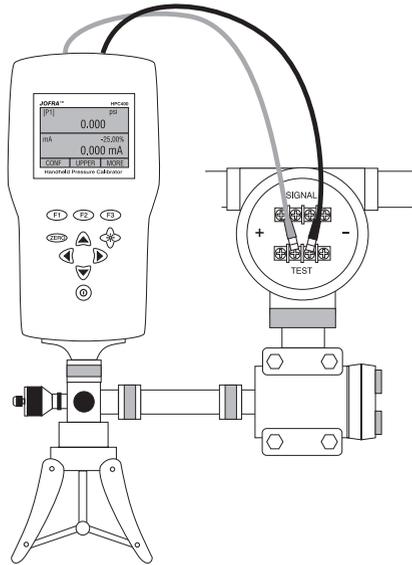


Figure 9.

8. Minimum and Maximum Storage Capability

The JOFRA HPC400 Pressure Calibrators have a min/max feature for capturing the minimum and maximum values of any displayed parameter.

The min/max function can be accessed by stepping through the menu options until "min/max" is shown on the display above the F1 key. At this time, pressing the F1 key will toggle the display through the min/max values that are stored in the min/max registers. These readings are live so that the new min/max values will be recorded while in this mode.

[P1]		psi
	-0.003	
mA		-25.00%
	4.000 mA	
MIN	CLEAR	DONE

[P1]		psi
	30.000	
mA		-25.00%
	20.001 mA	
MAX	CLEAR	DONE

To reset the min/max registers simply press the clear key. These registers are also cleared at power-up or when the configuration is changed.

9. Factory Setups

The Calibrator is loaded with five factory setups. These setups are shown below.

[P1]	30.000	psi
mA	20.000 mA	100.00%
CONFIG	UPPER	MORE

Setup 1: The upper display is set to [P1] mode and the middle is set to mA, lower is off.

[P1]	30.000	bar
mA	20.000 mA	100.00%
CONFIG	UPPER	MORE

Setup 2: The upper display is set to [P1] mode and the middle is set to mA, lower is off.

[P1]	10.000	psi
VOLTS	0.000	V
CONFIG	UPPER	MORE

Setup 3: The upper display is set to [P1] mode and the middle is set to [VOLTS], lower is off.

[P1]	10.000		bar
VOLTS	0.000		V
CONFIG	UPPER	MORE	

Setup 4: The upper display is set to [P1] mode and the middle is set to [VOLTS], lower is off.

[P1] ST CLOSE	0.000		psi
CONFIG	LOWER	MORE	

Setup 5: The lower display is set to [P1] switch test, the other displays are off.

10. Specifications (18 °C to 28 °C unless otherwise noted.)

General

Instrument Setup Recall	5; last used on power-up
Environmental Operating Temperature Storage Temperature Ingress Protection	-10 °C to +50 °C -20 °C to +60 °C IP54
Power Requirements Battery Battery Life	6.0 VDC Four (4) standard AA cells > 35 hours, typical usage
Physical Dimensions Weight	8.3" H x 3.9" W x 2.0" D (200.9 x 99.1 x 50.1 mm) 1 lb. 7 oz. (0.651 kg) with batteries installed
EMI/RFI Conformance	EN61326
Connectors/Ports	Pressure 1/8" BSP female
Included Accessories	
Item	HPC 400
1/8" male BSP to 1/4" female BSP	Standard
1/8" male BSP to 1/4" male NPT	Standard
1/8" sealed gasket 2 type washer	Standard
Read + Black test lead and clips	Standard
Hand strap w/clip	Standard
NIST traceable calibration certificate	Standard
User manual	Standard
RS232 cable	Option; for service only
Soft case	Option

Ranges

Compound:	-1 to 2 bar (-14 to 30 psi) -1 to 7 bar (-14 to 100 psi) -1 to 20 bar (-14 to 300 psi)
mA	0 to 24.000 mA
Volts	0 to 30.000 VDC
Engineering Units	psi, bar, mbar, kPa, MPa, kg/cm ² , mmH ₂ O @ 4°C, mmH ₂ O @ 20°C, cmH ₂ O @ 4°C, cmH ₂ O @ 20°C, inH ₂ O @ 4°C, inH ₂ O @ 20°C, inH ₂ O @ 60°F, mmHg @ 0°C, inHg @ 0°C

Accuracy 18°C to 28°C (unless otherwise noted)

Pressure	
All ranges	± 0.05% F.S.
Temperature Effect Add ± 0.005% F.S./°C outside 18°C to 28°C	
Electrical	
mA	± 0.015% of rdg ± 0.002mA
Volts	± 0.015% of rdg ± 0.002 VDC
Switch-Test	5 VDC (< 1mA)
Hart Resistor	250 ohm
Transmitter Supply	24 VDC ± 10%
Temperature Effect - Electrical Ranges Temperature Effect Add ± 0.001% F.S./°C outside 18°C to 28°C	

11. Maintenance

11.1 Replacing Batteries

Replace batteries as soon as the battery indicator turns on to avoid false measurements. If the batteries discharge too deeply the JOFRA HPC400 will automatically shut down to avoid battery leakage.

Note: Use only AA size alkaline batteries or optional rechargeable battery pack.

11.2 Cleaning the Unit

Warning

To avoid personal injury or damage to the calibrator, use only the specified replacement parts and do not allow water into the case.

Caution

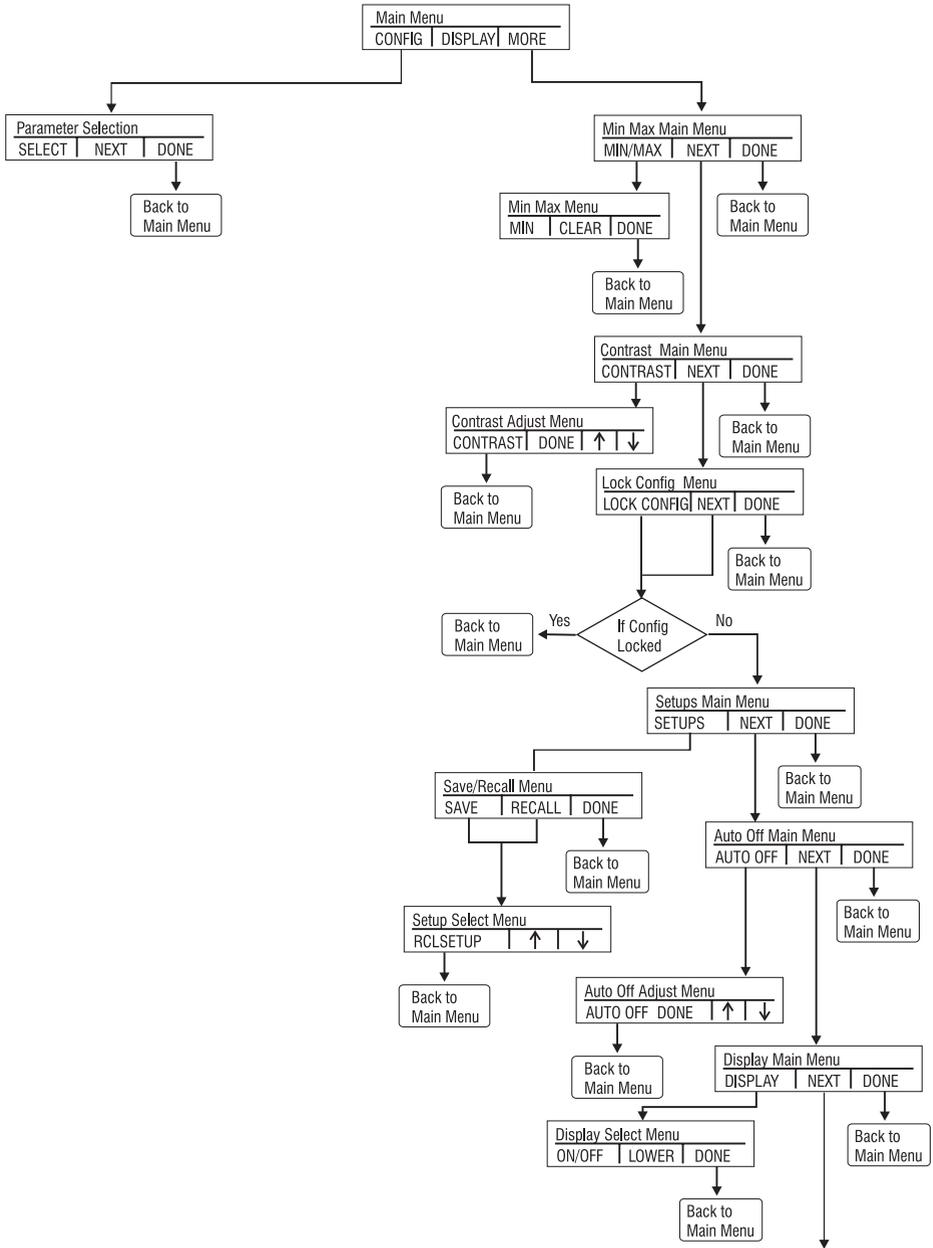
To avoid damaging the plastic lens and case, do not use solvents or abrasive cleansers. Clean the calibrator with a soft cloth dampened with water or water and mild soap.

11.3 Service Center Calibration or Repair

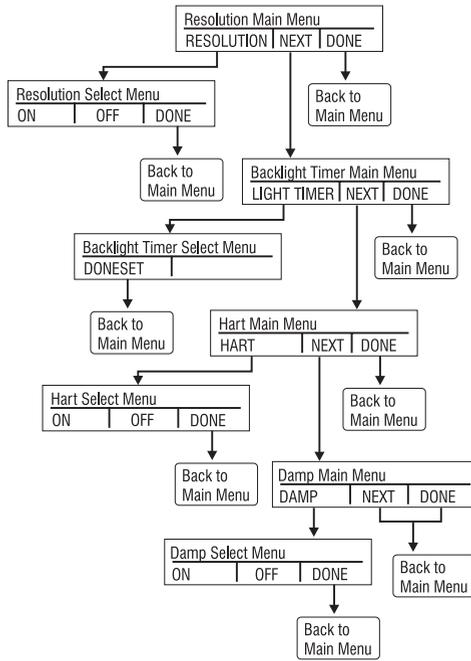
Only qualified service personnel should perform calibration, repairs, or servicing not covered in this manual. If the calibrator fails, check the batteries first, and replace them if needed.

Verify that the calibrator is being operated as explained in this manual. If the calibrator is faulty, send a description of the failure with the calibrator. Be sure to pack the calibrator securely, using the original shipping container if it is available.

Appendix X



continued on next page...



AMETEK JOFRA™ HPC400 Ranges and Resolutions

Range (Bar)		2	7	20
Burst Pressure (Bar)		20	70	133
Proof Pressure (Bar)		4	14	40
Static Pressure (Bar)		NA	NA	NA
Range (PSI)		30	100	300
Burst Pressure (PSI)		300	1000	2000
Proof Pressure (PSI)		60	200	600
Static Pressure (PSI)		NA	NA	NA
Psi	1	30.000	100.00	300.00
bar	0.06894757	2.0684	6.8947	20.684
mbar	68.94757	2068.4	6894.8	20684
kPa	6.894757	206.84	689.48	2068.4
MPa	0.00689476	0.2068	0.6894	2.0684
kg/cm ²	0.07030697	2.1092	7.0307	21.092
cmH ₂ O @ 4°C	70.3089	2109.3	7030.9	21093
cmH ₂ O @ 20°C	70.4336	2113.0	7043.4	21130
mmH ₂ O @ 4 °C	703.089	21093	70309	N/A
mmH ₂ O @ 20°C	704.336	21130	70434	N/A
inH ₂ O @ 4°C	27.68067	830.42	2768.1	8304.2
inH ₂ O @ 20°C	27.72977	831.89	2773.0	8318.9
inH ₂ O @ 60°F	27.70759	831.23	2770.8	8312.3
mmHg @ 0°C	51.71508	1551.5	5171.5	15515
inHg @ 0°C	2.03602	61.081	203.60	610.81

- Proof pressure - maximum allowable pressure without a shift in calibration
- Burst pressure - sensor damaged or destroyed; some risk of personnel injury



AMETEK Calibration Instruments

One of the world's leading manufacturers and developers of calibration instruments for temperature, pressure and process signals as well as for temperature sensors both from a commercial and a technological point of view.

JOFRA Temperature Instruments

Portable precision thermometers. Dry-block and liquid bath calibrators: 4 series, with more than 25 models and temperature ranges from -90° to 1205°C/-130° to 2200°F.

JOFRA Pressure Instruments

Convenient electronic systems ranging from -1 to 1000 bar - multiple choices of pressure ranges, pumps and accuracies, fully temperature-compensated for problem-free and accurate field use.

JOFRA Signal Instruments

Process signal measurement and simulation for easy control loop calibration and measurement tasks - from handheld field instruments to laboratory reference level bench top instruments.

JOFRA Marine Instruments

A complete range of calibration equipment for temperature, pressure and signal, approved for marine use.

FP Temperature Sensors

A complete range of temperature sensors for industrial and marine use.

M&G Pressure Testers

Pneumatic floating-ball or hydraulic piston dead weight testers with accuracies to 0.015% of reading.

M&G Pumps

Pressure generators from small pneumatic "bicycle" style pumps to hydraulic pumps generating up to 1,000 bar.

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