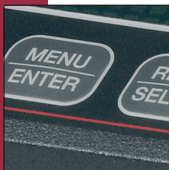


User Manual
Handheld Pressure Calibrator
JOFRA HPC600

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



JOFRA HPC600
Reference Manual

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1. Introduction

JOFRA HPC600 combines 5 units into a single portable calibrator. HPC600 contains; pressure indicator, calibration pump, mA loop tester (measure/source), voltmeter and finally a high accuracy thermometer.

The JOFRA HPC600 is designed to be a simple to use yet very versatile pressure calibrator. Its internal pressure sensor combined with an innovative electrically powered pump along with inputs for mA, voltage, switch contacts and an RTD probe allow the HPC600 to calibrate virtually any pressure device. An external pressure module option allows an even wider range of pressure calibration options including absolute and differential.

1.1 Contacting AMETEK/JOFRA

US, Canada, Latin America	AMETEK M&CT 1-800-527-9999
Europe, Africa, Middle East	AMETEK Denmark A/S + 45 4816 8000
Asia	AMETEK Singapore Pte. Ltd. At + 65 (64) 842 388

1.2 Standard Equipment

Check to see if your calibrator is complete. It should include: JOFRA HPC600 Calibrator, instruction manual, test leads, calibration hose kit with fittings, carrying case, calibration certificate with data.

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

Symbol	Description
	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.

Warning

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 pressure module.
- 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 or sourcing application.

2. Calibrator Interface

Figure 1 shows the location of the pressure controls, connection port and electrical inputs.

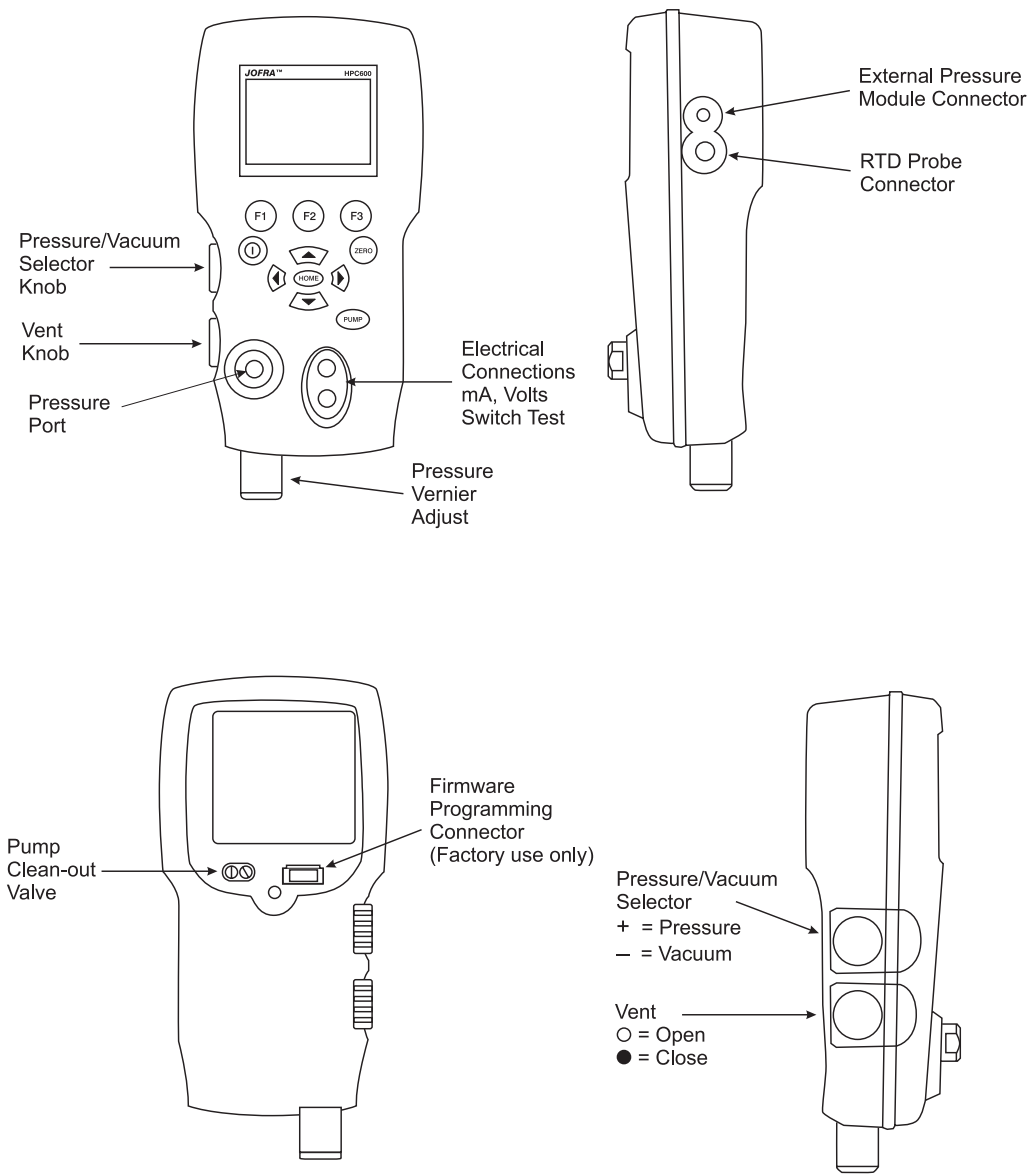


Figure 1

Figures 2A and 2B show the location of the keys. Table 2 describes the function of each key.

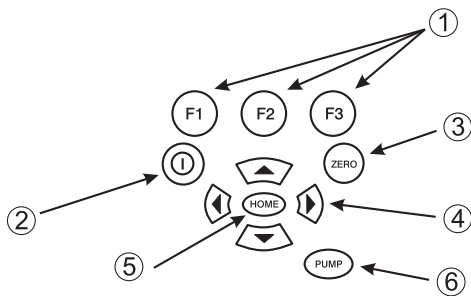


Figure 2A
Keypad

Table 2 Key Functions

No.	Name	Description
1	Function Keys	These are soft keys used 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	Arrow Keys	Used to control mA source/sim. and to set pump and % error limits
5	Home Key	Return to main menu screen
6	Pump Key	Push to run pump (Electric pump version)

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 range of the internal pressure sensor. 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 (located along the bottom of the screen) is used to access a menu system. The main display (the rest) 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.

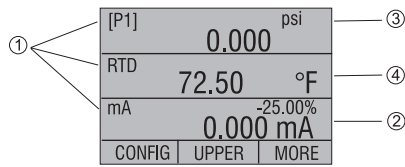


Figure 3
Display

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.

2.1.1 Top Level Menu Functionality

There are three options for this menu: MENU, {Active Display}, and LIGHT. The Top Level Menu is home for the menu display.



2.1.1.1 Using the MENU Option

The MENU option is the gateway to the rest of the menu system.

2.1.1.2 Using the Active Display Option

The active display is indicated by the center option on the Top Level Menu. It is used to select the display to which the ZERO key will apply.

2.1.1.3 Using the LIGHT OPTION

The backlight can be toggled on and off using this key.

2.1.2 Main Menu Functionality

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



2.1.2.1 Setting the Active Display

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

2.1.2.2 Setting Active Display Parameters

To set the parameters of the active 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 display. The NEXT option is used to change to the second parameter. Only RTD and Pressure modes have a second parameter, RTDs can be read in Celsius or Fahrenheit and Pressures can be read in 15 engineering units.

With a single display the following modes are available:

P[1] = Pressure internal sensor.

[EXT] = Pressure with external pressure module.

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

[EXT] ST = Switch Test with external pressure module.

Note: mA functions are only available on the Lower Display.

mA MEASURE = Milliamps measure without loop power.

mA MEAS/24V = Milliamps measure with loop power.

mA SOURCE = Milliamps source.

mA SIM-2W = Milliamps simulate using an external supply from the UUT.

VOLTS = Voltage Measure.

RTD = RTD Temperature Measurement (if a probe is connected).

The following table shows which functions are available concurrently.

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

Table 4 Mode Concurrency

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

X = Not a valid combination

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 LIGHT softkey on the main menu on the models with electric pump and a dedicated backlight key for manual pump units. It toggles on and off when the key is pressed; this is one of the few functions that cannot be controlled by the serial interface. There is a user defined timer configuration setting for the backlight in the function menus.

2.3 Using the Zero Function

When the ZERO KEY is pressed, the calibrator will zero the **active 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." **Note:** The ZERO KEY is only used for pressure.

2.3.1 Internal Sensor and Pressure Module (non-absolute)

When a sensor or module is selected on the active display and the ZERO KEY is pressed the calibrator subtracts the current reading from the output. The zero limits are within 10% of the full scale range of the selected sensor. If the display indicates "OL," the zero function will not operate.

2.3.2 Absolute Internal Sensor or Absolute Pressure Module

When an absolute pressure sensor is selected on the current display and the ZERO KEY is pressed the calibrator displays the current barometric pressure on the lower display. At this point the user has two options. With the port open (vented) to atmosphere, and with access to a high accuracy barometric reference, the user can utilize the cursor keys to adjust the current value to the barometric reference pressure and store it in the calibrator using the SET key. The second option is to use the RESET key to return the barometric offset to the factory setting. After pressing either the SET or RESET key the user will be prompted to either confirm or cancel their selection.

PRESSURE REFERENCE	
14.469	
RESET	SET

CONFIRM	CANCEL
---------	--------

2.4 Other Menu Controlled Functions

There are '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 home. For the last 'sub-main' menu the NEXT option wraps around to home. See Appendix X 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.

2.4.01 %ERROR, on line calculation of sensors error %	Page 10
2.4.02 LEAK TEST, automatic leak test timer function	Page 12
2.4.03 MINMAX, min / max hold	Page 14
2.4.04 CONTRAST, display contrast adjustment	Page 15
2.4.05 LOCK CFG, instrument setup lock	Page 15
2.4.06 SETUPS, store or recall of setups	Page 15
2.4.07 AUTO OFF, setup of automatic off timer	Page 16
2.4.08 DISPLAY, setup numbers of display windows	Page 16
2.4.09 PROBE TYPE, Setup of temperature sensor type	Page 17
2.4.10 DAMP, normal or slow display update rate	Page 18
2.4.11 HART, switches hart resistor on and off	Page 18
2.4.12 RESOLUTION, select display resolution	Page 18
2.4.13 PUMP, setup of electrical pump	Page 19

2.4.01 %ERROR calculation

The calibrator features a function which can calculate pressure vs. milliamp error as a percentage of the 4 to 20 mA loop span. The percent error mode uses all 3 screens and has a unique menu structure. It simultaneously displays pressure, mA and error percent.

To use the %ERROR function proceed as follows:

1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Now press the F1 key to activate the %ERROR option.
2. Press the F1 key to select the CONFIG option.
3. The first option is setting the Port, use the select option to scroll through the port choices, when finished select the NEXT option.

% ERROR PORT		[P1]
SELECT	NEXT	DONE

4. LOOP POWER can be toggled on/off, select NEXT when done.

LOOP POWER		OFF
ON	OFF	NEXT

5. Use SELECT to toggle through the UNIT options, and select NEXT to move on.

SET UNIT		psi
SELECT	NEXT	DONE

6. Use the cursor keys to set the 100% point of the desired pressure range, select DONE SET when finished.

SET 100% BELOW	psi
30.000	
DONE SET	

- Again, use the cursor keys to set 0% point and select DONE SET when finished and the %ERROR mode will be ready to use.

SET 0% BELOW	psi
0.000	
DONE SET	

Note: The 0% and 100% point will be saved in non-volatile memory until they are changed again by the user for the internal sensors and external pressure modules. When using an external module the 0% and 100% are set to low and full scale of the module until the user changes it, or if it was previously saved.

EXIT leaves the %ERROR mode

[P1]	psi
0.00	
mA	0.00%
4.000 mA	
% ERROR	0.00 %
CONFIG	EXIT

2.4.02 LEAK TEST

The calibrator features a leak test function which calculate leak rate. The timer can be set from 5 to 120 seconds, regardless of the set time the leak rate is calculated in leak per minute. The function gives a good and repeatable expression for the leak of a pressure system. This feature might be used before calibration to document / indicate leak rate.

To use the leak rate function 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 LEAK TEST appears in the left text field. Now press the F1 key to activate the leak test option.
- Press the F2 key to select the CONFIG option.

3. The first option is setting the Port, use the select option to scroll through the port choices, when finished select the NEXT option.

LEAKTEST PORT [P1]		
SELECT	NEXT	DONE

4. Use SELECT to toggle through the UNIT options, and select NEXT to move on.

SET UNIT psi		
SELECT	NEXT	DONE

5. Use cursor keys to set test time, and press DONE SET to confirm.

SET TIMER	
60 S	
DONE SET	

Note: The units and time will be saved in non-volatile memory until they are changed again by the user. They may be used at the next leak test without having to do the configuration each time.

6. To start leak test press F1 button, the time is counted down, and the Initial, Final and calculated leak rate in pressure per minute is shown.

INITIAL		5.00	psi
FINAL		4.95	psi
[P1] LEAKRATE		0.05	/M
RESET	CONFIG	EXIT	

EXIT leaves the leak rate function.

2.4.03 MIN MAX hold

The JOFRA HPC600 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 has 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]		-0.003	psi
mA		-25.00%	
		4.000	mA
MIN	CLEAR	DONE	

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

The Min / Max mode is cancelled by pressing F3

2.4.04 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.



2.4.05 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, 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.



2.4.06 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 Set-up 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.



2.4.07 Setting AutoShut-off Parameters

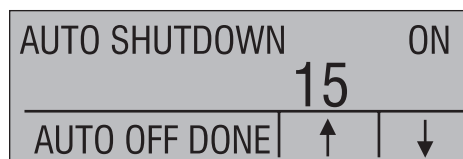
The calibrator can be set to automatically shut-off after a selected number of minutes; this function can also be disabled.

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.



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.



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.

2.4.08 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, 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 DISPLAY appears in the left text field. Now press the F1 key to enter the function.

DISPLAY	NEXT	DONE
---------	------	------

- 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.

MIDDLE		ON
ON/OFF	MIDDLE	DONE

- 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.

2.4.09 Setting the RTD probe type

The JOFRA HPC600 has a built in high accuracy RTD thermometer, it works with an RTD sensor (optional).

To select type of temperature sensor 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 PROBE TYPE appears in the left text field. Now press the F1 key to enter the function.

PROBE TYPE	NEXT	DONE
------------	------	------

- There are four probe types to select from P100-385, P100-392, P100-JIS and CUSTOM. Use the SELECT option to select the desired probe type and the DONE option to store the change and return home.

Note: The default probe type is PT100-385.

SELECT RTD PROBE TYPE		
P100-385		
SELECT		DONE

- Pressing DONE leaves the temperature selection function

2.4.10 Switching damping on or off.

To give a more stable reading on fluctuating readings, the HPC600 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.

2.4.11 Switching HART resistor on or off.

An internal 250 ohm HART Resistor can be enabled when the JOFRA HPC600 is operated in the "mA Measure-24V" mode. This allows a HART Communicator to be connected across the mA terminals and eliminates the need for adding an external resistor.

Note: When the HART resistor is on the maximum load driving capacity is 750 ohms.

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.

2.4.12 Low resolution function.

Due to the high accuracy of the JOFRA HPC600 the measured values are displayed with many digits, this might be an disadvantage in some cases,

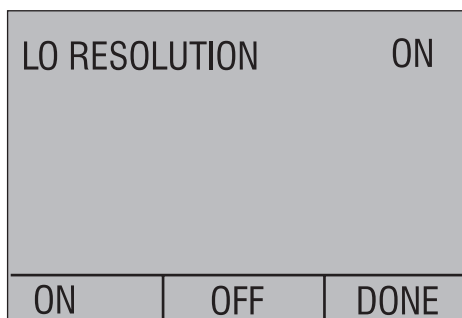
therefore the HPC has a low resolution function. The function takes away the last digit.

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.



3. Pressing DONE returns to main menu.

2.4.13 Pump Limits

To prevent overpressure of sensitive devices the maximum pressure (pump limit) can be set. When in this mode use the arrow keys to set the maximum pressure.

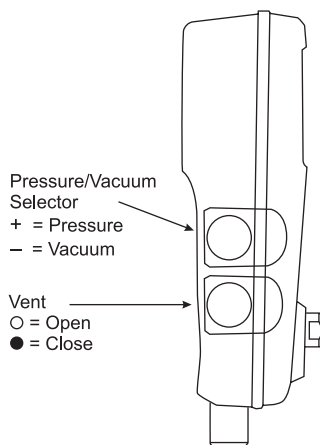
3. Initial Setup and Basic Pressure Generation

1. The JOFRA HPC600 is supplied with a special low volume calibration hose kit to facilitate faster pumping to pressure and quick pressure stabilization. the kit also comes with the required “quick-fit” hose connectors and a BSP adapter for non-NPT applications. It is highly recommended that this type of hose is used to achieve the best performance of the product. Once the fittings are installed and the calibrator is connected to the unit under test (UUT) the calibrator is ready for use. Figure 5 shows a typical setup.
2. Before generating pressure make sure you have the HPC600 configured for your application. If needed review section 2 of the manual again to select the proper configuration.
3. Make sure that the pressure vacuum knob is set for the function you want to perform (+ for pressure and – for vacuum).

4. Close the vent knob.
5. Press the pump key and watch the pressure (or vacuum) increase until you reach the desired pressure.

Note: The motor speed will start slowly when pressure is low (<15psi) to allow better control at low pressures.

6. Use the fine adjustment vernier to fine tune the pressure/vacuum reading as needed.
7. To reduce or bleed off the pressure entirely **slowly** rotate the vent knob to the open position. Doing this step carefully will allow you to control the pressure bleed rate to a high degree and will facilitate taking down-scale pressure readings.



3.1 Electric Pump Considerations

The JOFRA HPC600 is a small, lightweight, battery powered pneumatic pump that allows the user up to 10 bar (150 psi) quickly and with good control. Because the pump has an upper pressure generation limit of 11 bar (160psi) there may be atmospheric conditions where it cannot achieve the full scale pressure of 10 bar. High altitude use (about 3000 ft or 1000 meters) or use at cold temperatures may limit the pump to about 9 bar (135 psi). In these cases the vernier adjustment can be used to generate the additional pressure needed if full scale pressure must be generated.

In these situations the user should begin the calibration with the vernier in the full counter clockwise position and then when the electric pump reaches its limit turn the vernier in the clockwise direction to raise the pressure and to set the desired reading.

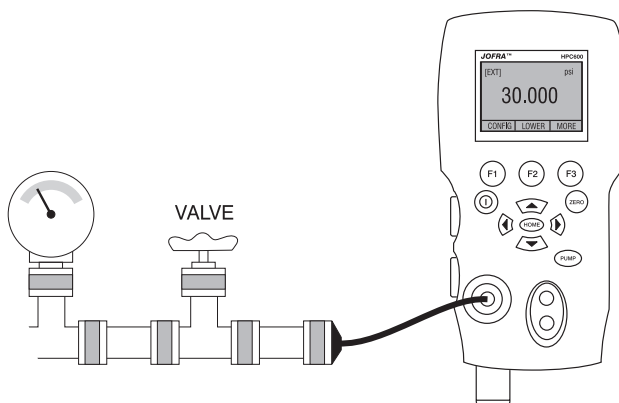


Figure 4

4. 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 internal sensor and many optional external sensors (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 110% of the nominal range of the sensor or when a vacuum in excess of 2 PSI is applied on gauge range sensors.

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 110% 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. See section 2.3.

4.1 Media Compatibility

The JOFRA HPC600 features a unique user accessible valve cleaning port to facilitate servicing the pump. Section 15.3 shows how to clean these valves. Even though servicing the pump is easy, care should be taken to only expose the calibrator to clean, dry gases.

4.2 Measuring Pressure with External Modules

The calibrator provides a digital interface to External Pressure Modules. These modules are available in various ranges and types including gauge, vacuum, differential and absolute. The modules work seamlessly with the calibrator. Simply plug them into the interface and select [EXT] (external sensor). Since the interface between the calibrator and the module is digital all the accuracy and display resolution is derived from the module.

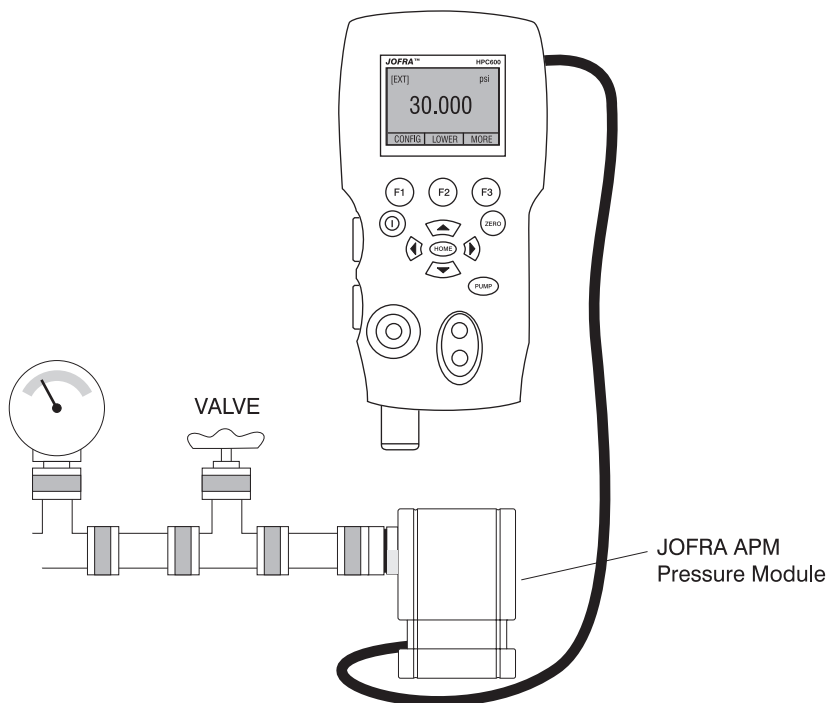


Figure 5

5. Measuring and Generating Current (4 to 20 mA)

1. To measure current use the input terminals in the front of the calibrator. Select the mA function on the lower display. 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.

For example:

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

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

2. To source current the same connections are used. From the configuration screen select mA source or mA Sim-2W.
3. **Note** that this function can only be done on the **LOWER** screen. Also in the source mode the calibrator will generate 0 to 24 mA using its own internal 24 volt supply whereas in the simulate mode the calibrator acts as a 2 wire transmitter and requires an external 24 volt supply.
4. Pressing any of the arrow keys will start the output mode and allow you to use the arrow keys to adjust the mA output.

5. While in the mA output mode if the loop is opened or the compliance is exceeded the unit will flash “OL” .

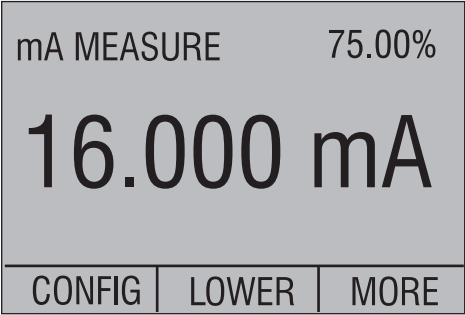


Figure 6-1

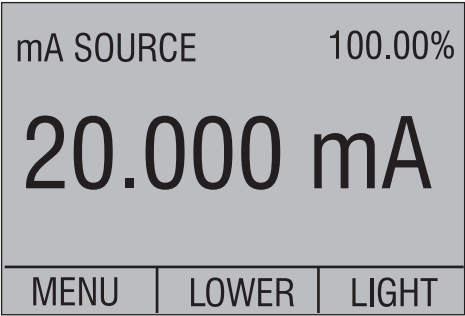
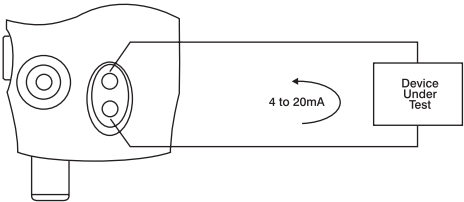


Figure 6-2

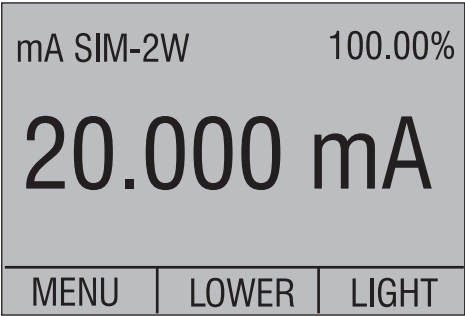
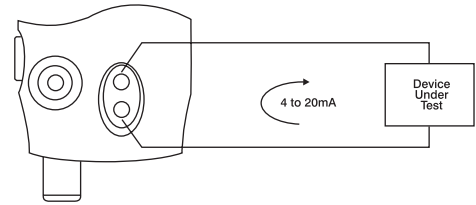
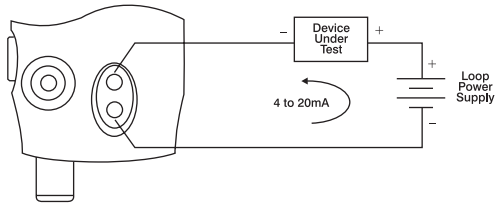


Figure 6-3



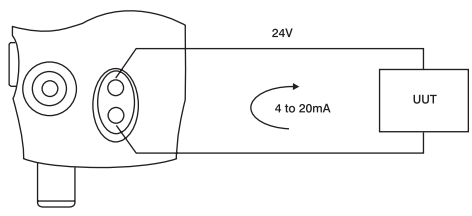
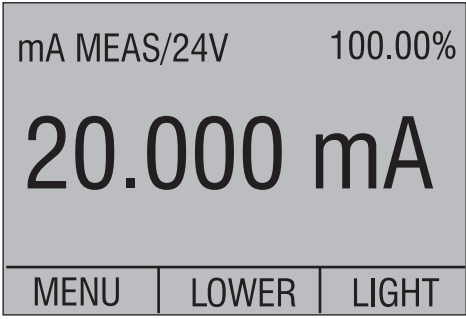


Figure 6-4

6. Measuring Voltage

To measure voltage use the input terminals in the front 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).

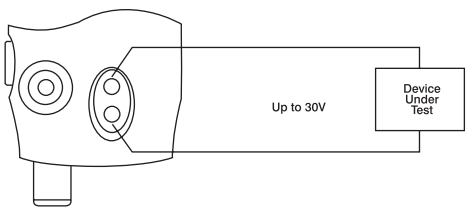
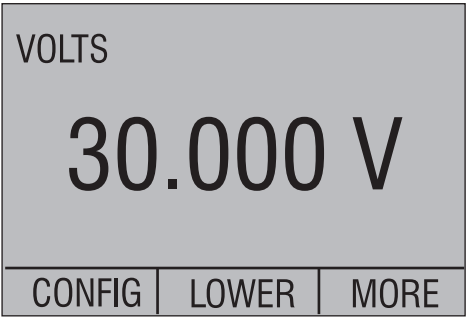


Figure 7

7. Measuring Temperature with an RTD

To measure temperature using an RTD probe you must select the RTD function on one of the displays. Make sure the proper probe type is selected. There are 4 probe types supported, P100-385, P100-392, P100-JIS and CUSTOM. The standard optional probe has a 250 mm insertion depth with a 4 mm diameter stainless steel sheath.

Note: The factory default type is PT100-385 so if the HPC600 is being used with the AMETEK/JOFRA sensor you do not have to set the probe type. Simply plug the probe into the HPC600 and configure the display to read temperature.

Note: The display will indicate "OL" when the measured temperature is outside the nominal measurement range of the RTD function (below -40°C or above 155°C).

If a custom probe is being used, or adjustment of a standard probe is wanted, entering of CvD parameters, R0 and coefficients is handled through the serial interface, see remote programming manual.

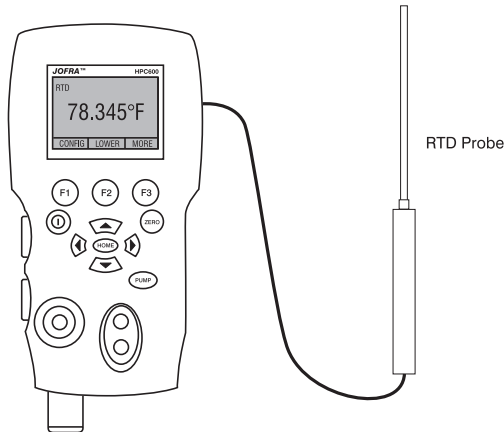


Figure 8

8. Performing a Pressure Switch Test

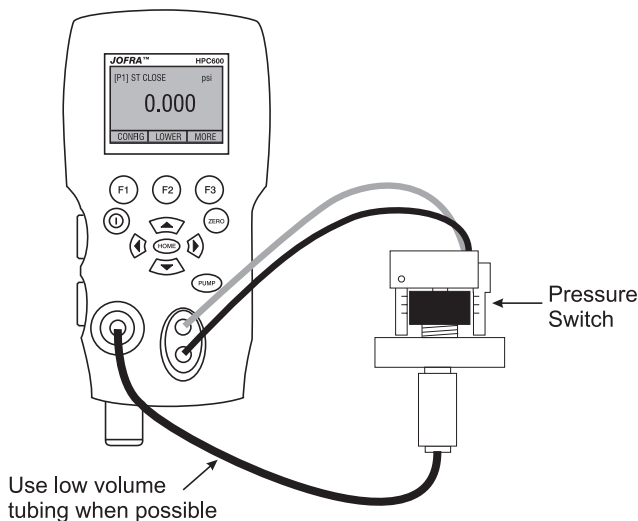


Figure 9

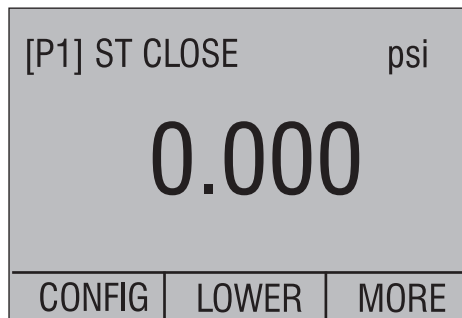
To perform a switch test, follow these steps:

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.

Important NOTE: The pressure Switch Test can be performed with the following functions[P1] ST, or EXT ST.

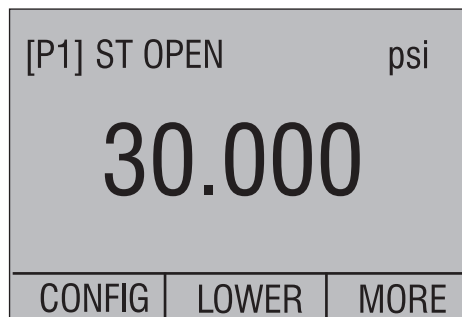
2. Connect the calibrator to the switch using the pressure switch terminals. The polarity of the terminals does not matter. Then connect the pump to the calibrator and the pressure switch.
3. Make sure the vent on the pump is open. Zero the calibrator if necessary. Close the vent after zeroing the calibrator.
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.

SW OPENED AT		psi
30.000		
NEW TEST	NEXT	DONE

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

SW CLOSED AT		psi
29.595		
NEW TEST	NEXT	DONE

SW DEADBAND		psi
0.405		
NEW TEST	NEXT	DONE

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.

Example:

[P1] ST will return to [P1].

Important NOTE: The previous 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”.

9. Calibrating Transmitters

9.1 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 MEASURE		100.00%
20.000 mA		
CONFIG	LOWER	MORE

[P1]		psi
30.000		
mA MEAS/24V		100.00%
20.000 mA		
CONFIG	LOWER	MORE

9.2 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.

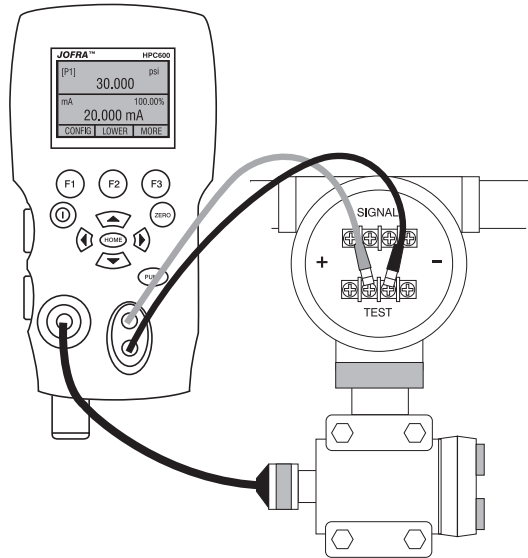


Figure 10.

9.3 Percent Error Function

The calibrator features a unique function which can calculate pressure vs. milliamp error as a percentage of the 4 to 20 mA loop span. The percent error mode uses all 3 screens and has a unique menu structure. It simultaneously displays pressure, mA and percent error.

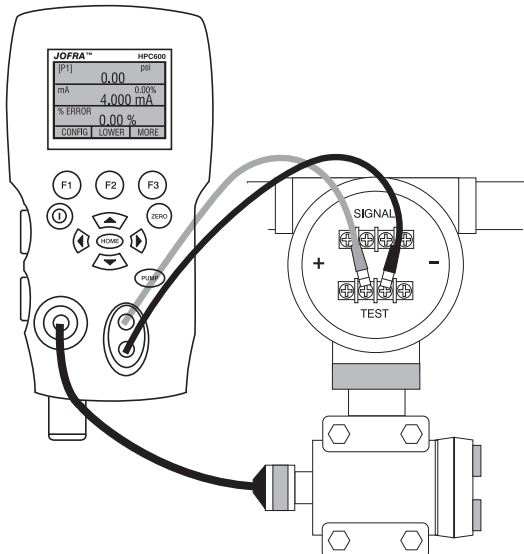


Figure 11.

Example:

Suppose a pressure transmitter under test is 30 psi (2 Bar) full scale and outputs a corresponding 4 to 20 mA signal. The user can program in a 0 to 30 psi pressure span into the calibrator and the calibrator will calculate and display the deviation or % Error from the expected 4 to 20 mA output. This eliminates the need for manual calculations and also helps if it becomes difficult to set an exact pressure with the pump.

To use the %ERROR function proceed as follows:

1. With the calibrator turned on and operating press the F3 key to activate the MORE menu option. Now press the F1 key to activate the %ERROR option.
2. Press the F1 key to select the CONFIG option.
3. The first option is setting the Port, use the select option to scroll through the port choices, when finished select the NEXT option.

% ERROR PORT		[P1]
SELECT	NEXT	DONE

4. LOOP POWER can be toggled on/off, select NEXT when done.

LOOP POWER		OFF
ON	OFF	NEXT

5. Use SELECT to toggle through the UNIT options, and select NEXT to move on.

SET UNIT		psi
SELECT	NEXT	DONE

6. Use the arrow keys to set the 100% point of the desired pressure range, select DONE SET when finished.

SET 100% BELOW	psi
30.000	
DONE SET	

7. Again, use the arrows to set 0% point and select DONE SET when finished and the %ERROR mode will be ready to use.

SET 0% BELOW	psi
0.000	
DONE SET	

Note: The 0% and 100% point will be saved in non-volatile memory until they are changed again by the user for the internal sensors, and external pressure modules. When using an external module the 0% and 100% are set to low and full scale of the module until the user changes it, or if it was previously saved.

[P1] psi		
0.0000		
mA measure -25.00%		
0.000 mA		
% Error		
-25.00%		
CONFIG	LIGHT	EXIT

10. Minimum and Maximum Storage Capability

The HPC600 has 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.

11. Leak Test

The calibrator features a leak test function which calculates leak rate. The timer can be set from 5 to 120 seconds, regardless of the set time the leak rate is calculated in leak per minute. The function gives a good and repeatable expression for the leak of a pressure system. This feature might be used before calibration to document / indicate leak rate.

To use the leak rate 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 LEAK TEST appears in the left text field. Now press the F1 key to activate the leak test option.
2. Press the F2 key to select the CONFIG option.
3. The first option is setting the Port, use the select option to scroll through the port choices, when finished select the NEXT option.

LEAKTEST PORT		[P1]
SELECT	NEXT	DONE

4. Use SELECT to toggle through the UNIT options, and select NEXT to move on.

SET UNIT		psi
SELECT	NEXT	DONE

5. Use cursor keys to set test time, and press DONE SET to confirm.

SET TIMER	
60 S	
DONE SET	

Note: The units and time will be saved in non-volatile memory until they are changed again by the user. They may be used at the next leak test without having to do the configuration each time.

6. To start leak test press F1 button, the time is counted down, and the Initial, Final and calculated leak rate in pressure pr. Minute is shown.

INITIAL		psi
5.00		
FINAL		psi
4.95		
[P1] LEAKRATE		
0.05		/M
RESET	CONFIG	EXIT

EXIT leaves the leak rate function.

12. Factory Setups

The Calibrator is loaded with five factory commonly used setups. These setups are shown below. **Note: Any of these setups can be changed and saved by the user.**

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

[P1]		psi
0.00		
mA measure		-25.00%
0.000		
MENU	LOWER	LIGHT

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

[P1]		psi
0.00		
RTD		
23.50		°C
MENU	LOWER	LIGHT

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

[P1] 0.00 psi		
RTD 23.50 °C		
mA measure 0.000 ^{-25.00%}		
MENU	LOWER	LIGHT

Setup 4: The lower display is set to [P1] switch test, the other displays are off.

[P1] ST CLOSE psi		
0.000		
CONFIG	LOWER	MORE

Setup 5: The upper display is set to [P1], the middle display is set to [EXT] and the lower display is set to RTD.

[P1] 0.00 psi		
[EXT] 0.00 psi		
RTD 23.50 °C		
MENU	LOWER	LIGHT

13. Custody Transfer / Flow Calibration

The Model HPC600 is ideal for flow computer calibration. Every manufacturer of flow computers has a different calibration procedure, but most call for calibration of three parameters: static pressure, differential pressure and temperature. To facilitate these measurements recall setup #5 on the HPC600.

1. Connect the calibrator to your static and differential pressures. ([P1], EXT) Then connect the RTD sensor to the calibrator.
2. Using the reading of your RTD, static, and differential pressures make sure the flow computer has the correct reading. If not, adjust the flow computer as necessary.

14. Remote Operation

14.1 Remote Interface

The calibrator can be remotely controlled using JOFRACAL software, or by a computer program running the calibrator in an automated system. It uses an RS232 serial port connection for remote operation. NOTE: The special RS232 cable is an option (Communication kit with cable and JOFRACAL software), and are used for adjustment procedures too. A detailed communication manual can be downloaded on www.jofra.com.

Typical RS232 remote configurations are shown in Figure 12.

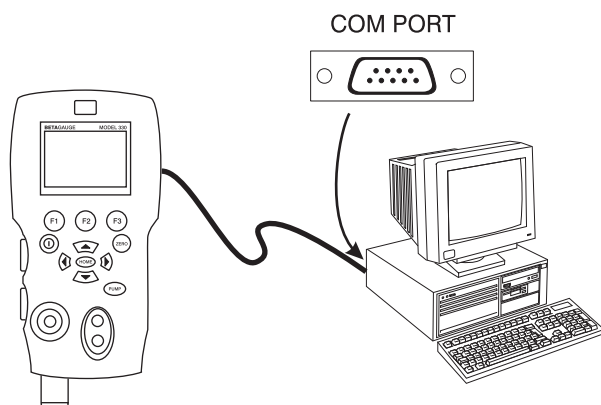


Figure 12. Calibrator-to-Computer Connection

15. Specifications (15 °C to 35 °C unless otherwise noted.)

General

Instrument Setup Recall	5; last used on power-up
Environmental Operating Temperature Storage Temperature	-10 °C to +50 °C (14 to 122 °F) -20 °C to +60 °C (4 to 140 °F)
Power Requirements Battery	12 VDC Eight (8) AA alkaline, Lithium or NiMh cells
Physical Dimensions Weight	(20.3cm x 10.2cm x 6cm) 8" H x 4" W x 2.375" D 2.5 lbs. (1.2 kg)
EMI/RFI Conformance	EN 61326, Annex A
Connectors/Ports	Pressure - one, combined 1/8" NPT / BSP Port-P pressure module adapter or RS232 cable RTD probe
Included Accessories	Soft case, batteries, manual, full NIST-traceable calibration certificate in psi, bar and Pa, test leads and hose kit.

Ranges

HPC600 002C	-0.82 to 2 bar (-12 to 30 psi) Compound
HPC600 002A	0.2 to 2 bar (3 to 30 psi) Absolute
HPC600 010C	-0.82 to 10 bar (-12 to 150 psi) Compound
HPC600 010A	0.2 to 10 bar (3 to 150 psi) Absolute
mA	0 to 24.000 mA measure and source
Volts	0 to 30.000 VDC
RTD	-40.0°C to 155.0°C (-40.0°F to 311.0°F)
Engineering Units	psi, bar, mbar, kPa, MPa, kgcm 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

Pressure All Ranges	$\pm 0.02\%$ of reading $\pm 0.015\%$ FS (18°C to 28°C) $\pm 0.03\%$ of reading $\pm 0.015\%$ FS (-10°C to 55°C)
Vacuum All Ranges	$\pm 0.025\%$ FS (18°C to 28°C) $\pm 0.035\%$ FS (-10°C to 55°C)
mA	$\pm 0.015\%$ of reading ± 0.002 mA
Volts	$\pm 0.015\%$ of reading ± 0.002 V
RTD (ohms)	$\pm 0.015\%$ of rdg ± 0.02 ohms; or $\pm 0.1^\circ\text{C}$ @ 0°C for Pt100
Temperature Effect (mA, volts, RTD) No effect on accuracy from 18°C to 28°C Add $\pm 0.001\%$ F.S. for temps $< 18^\circ\text{C}$ and $> 28^\circ\text{C}$	
Option T, RTD probe	Accuracy $\pm 0.15^\circ\text{C}$ @ -40 to 155 °C

16. Maintenance

16.1 Replacing Batteries

Replace batteries as soon as the battery indicator turns on to avoid false measurements. If the batteries discharge too deeply the JOFRA HPC600 will automatically shut down to avoid battery leakage.

Note: Use only AA size alkaline or Lithium batteries or optional rechargeable NiMh cells.

16.2 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.

16.3 Valve Cleaning Procedure

Occasionally, the JOFRA HPC600 may not work properly due to dirt or other contamination of the internal valve assembly. Use the following procedure for cleaning the valve assembly. If this procedure does not fix the problem, a

repair kit (part number 1010043) may be ordered.

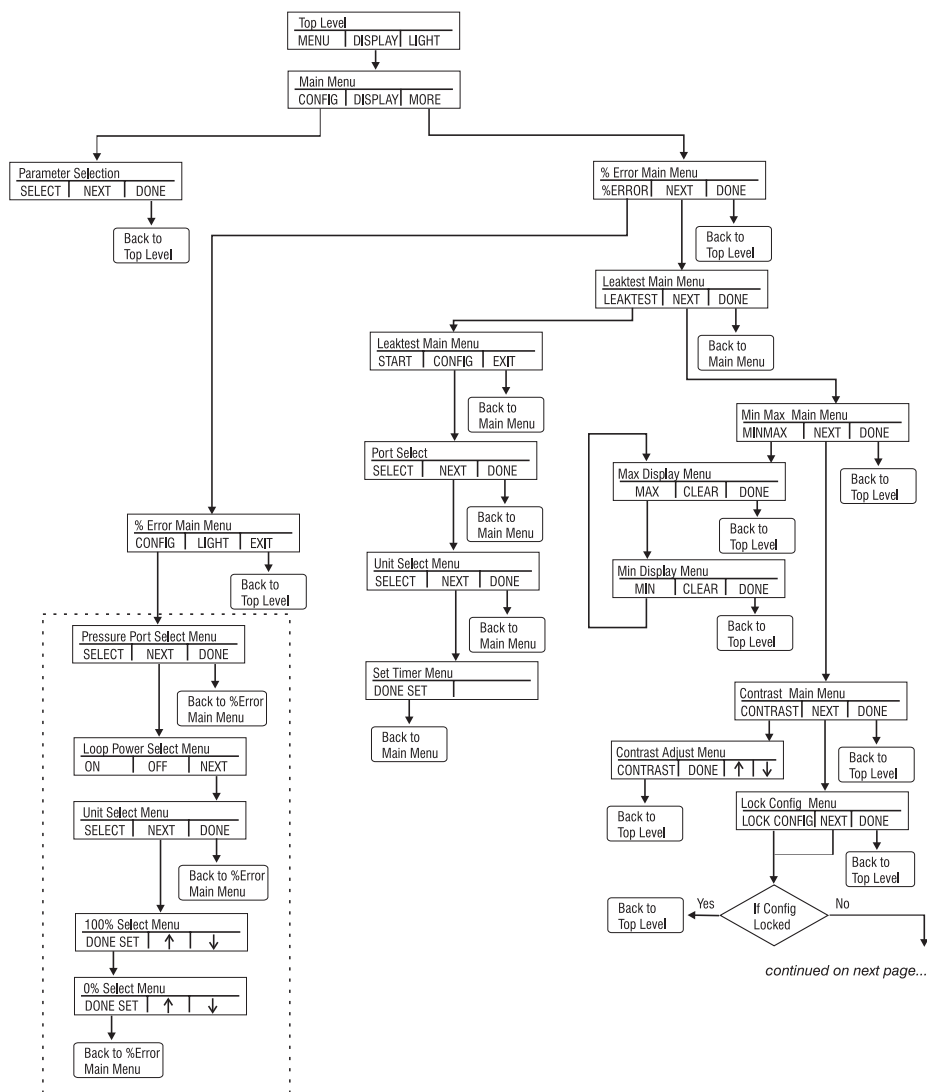
1. Using a small screwdriver, remove the 2 valve retention caps located in the battery compartment area (see Figure 1, page 4).
2. After the caps have been removed, gently remove the spring and o-ring assembly.
3. Set aside the valve assemblies in a safe area and clean out the valve body using a cotton swab soaked in IPA (isopropyl alcohol).
4. Repeat the process several times using a new cotton swab each time until there is no remaining evidence of contamination or dirt.
5. Operate the pump handles several times and recheck for contamination.
6. Clean the o-ring assembly and the o-ring on the retention caps with IPA and inspect the o-rings closely for any damage or excessive wear. Replacements are included in the repair kit, if needed.
7. Inspect the springs for wear or loss of tension. They should be approximately 8.6 mm long in the relaxed state. If shorter, they may not provide sufficient sealing tension. Replace if needed.
8. Once all parts have been cleaned and inspected, reinstall the o-ring and spring assembly into the valve body.
9. Reinstall the retention caps and gently tighten each cap.
10. Seal the output port and operate the pump to at least 50% of capacity.
11. Release the pressure and repeat several times to ensure that the o-rings seat properly.

16.4 Service Center Calibration or Repair

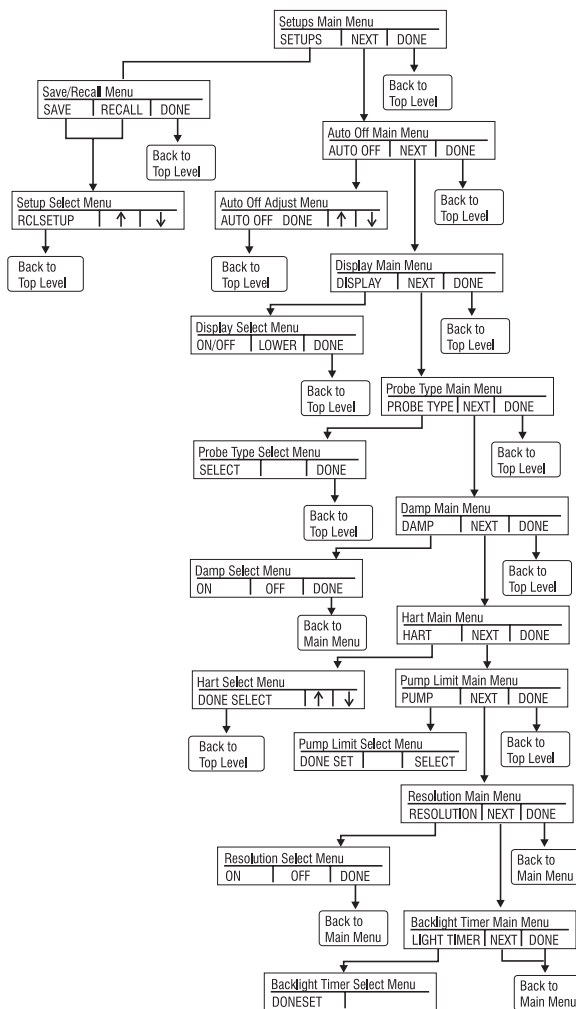
Only qualified service personnel should perform calibration, repairs, or servicing not covered in this manual. If the calibrator fails, check the batteries first, and replace them if needed.

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™ HPC600 Ranges and Resolutions

Range (PSI)		2.0 Bar / 30 PSI	10 Bar / 150 PSI
Burst Pressure (PSI)		300	300
Proof Pressure (PSI)		60	200
Engineering Unit	Factor		
Psi	1	30.000	150.00
bar	0.06894757	2.0684	10.3421
mbar	68.94757	2068.4	10342.1
kPa	6.894757	206.84	1034.21
MPa	.00689476	0.2068	1.03421
kg/cm2	0.07030697	2.1092	10.5460
cmH2O @ 4°C	70.3089	2109.3	10546.3
cmH2O @ 20°C	70.4336	2113.0	10565.0
mmH2O @ 4 °C	703.089	21093	N/A
mmH2O @ 20°C	704.336	21130	N/A
inH2O @ 4°C	27.68067	830.42	4152.1
inH2O @ 20°C	27.72977	831.89	4159.5
inH2O @ 60°F	27.70759	831.23	4156.1
mmHg @ 0°C	51.71508	1551.5	7757.3
inHg @ 0°C	2.03602	61.081	305.40

- Proof pressure - maximum allowable pressure without a shift in calibration
- Burst pressure - sensor damaged or destroyed; some risk of personnel injury
- Absolute ranges - the data for the 2 Bar / 30 PSI and 10 Bar / 50 PSI ranges also applies to the absolute pressure versions of those ranges.



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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