

APPLICATION NOTE

Cardinal point calibration of pressure dial gauges using the Fluke 2271A Industrial Pressure Calibrator

Traditional pressure dial gauges are used for a variety of applications throughout the industry. While these devices are often thought of as simple and straightforward, calibrating them can be relatively complicated. The automated 2271A Industrial Pressure Calibrator can make these calibrations simple and efficient when using the proper calibration process.



A key challenge when calibrating dial gauges is how to handle the lack of resolution on their display and how to interpret readings accurately and repeatedly when the pointer is between marks on the gauge face. You can diminish this source of error by performing a cardinal point calibration. This is done by adjusting the pressure so that the dial gauge pointer is aligned with the cardinal point. The pressure standard now reads a value slightly different than the dial gauge. This represents the error in the gauge. Since the display of the 2271A has higher resolution than the dial gauge, we can quantify this error to a higher resolution.

Setting up the equipment

Gauges should be calibrated in the same orientation as their normal usage. The 2271A is equipped with two vertical test port connections on the top of the unit. Connecting bottom-mount pressure gauges using the provided hand-tight adapters is easy and straightforward.

The test ports on the 2271A are designed for hand-tight operation without the use of PTFE tape. There are two test port types available:

- **P3K** – The test port is a stem with reverse threads. Adapters are provided to convert the connection to one of 10 different common female fitting types, including NPT, BSP, and metric connections. The pressure

seals on an O-ring and the reverse threads allow for the connection to be made tight while keeping the gauge facing forward.

- **HC20** – The test port has a female M20 swivel connection on the top. Adapters are provided to go from other size connections (including NPT and BSP) to this M20 connection. The test port and each of the adaptors include O-rings, making each connection a hand-tight connection that does not require the use of PTFE tape. If the gauge has a male M20 connection, then simply place it on top of the test port and use the swivel connection until the bottom of the gauge is pressed against the O-ring. If the gauge has a different connection type, attach the appropriate adaptor to the bottom of the gauge and then connect the gauge and adaptor combination to the test port of the 2271A.

Using the Step and Jog functions to perform quick tests

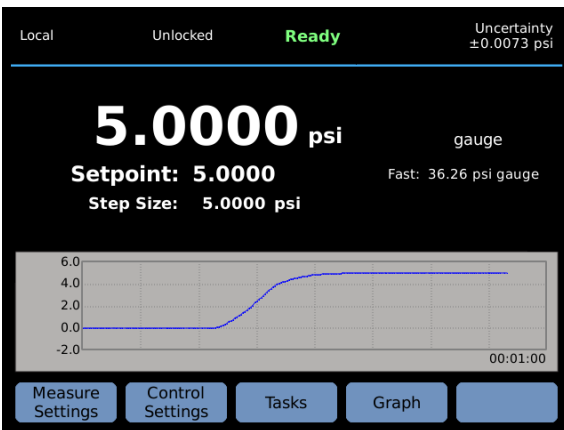


Figure 1. Controlling 5

The 2271A is equipped with Step and Jog features for quick testing of dial gauges. The Step feature allows you to specify a specific step size corresponding to the steps required for the calibration. For example, if the test is 25 % steps on a 1000 psi gauge (0, 250, 500, 750, and 1000 psi test points) then you should set the step size to 250 psi. Set the step size in the **Control Settings** menu (press **F2** from the main menu). To step the pressure during control, press the **setpoint** button. Press **F2** to step down or **F3** to step up. This changes the setpoint by the step size amount. The 2271A will immediately start controlling to the new setpoint.

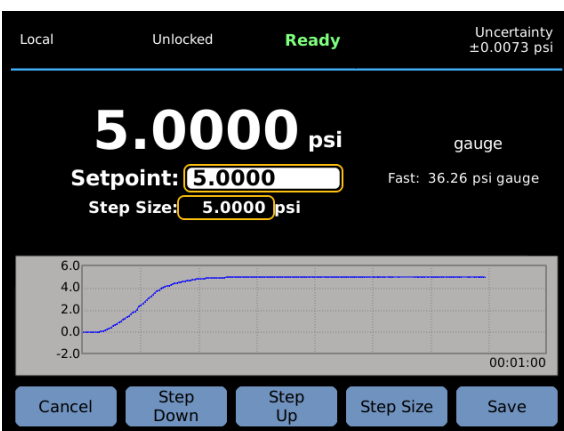


Figure 2. Entering the next Setpoint

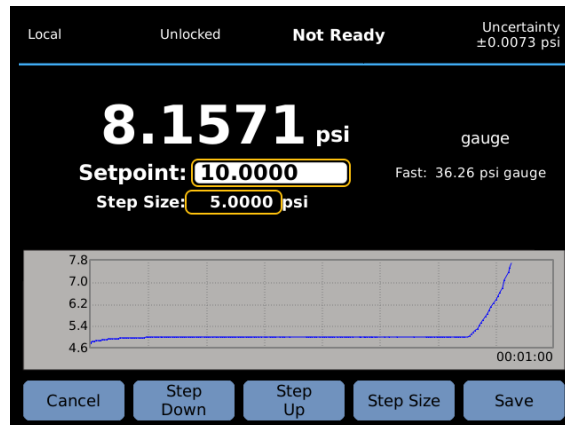


Figure 3. Press Step Up to increase setpoint to 10

When controlling pressure at a setpoint, you will need to make minor adjustments so that the dial gauge pointer is on the cardinal point. Use the jog wheel to do this. Rotating the jog wheel clockwise or counter clockwise increases or decreases the pressure setpoint. For large changes, the controller may need a few seconds to catch up to the change in setpoint. One click of the jog wheel corresponds to a single step in the last digit of displayed resolution on the front panel. To change the resolution on the front panel, and thus the jog resolution, go the **Measure Settings** menu by pressing **F1** from the main screen.

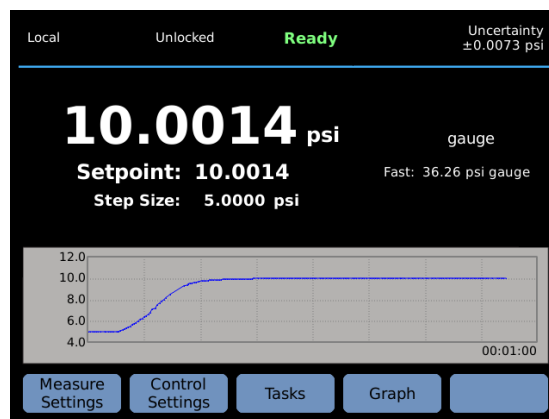


Figure 4. Setpoint jugged to 10.0014 psi

By using the Step and Jog functions, you can transition easily through each setpoint in the test while adjusting the pressure as needed at each set point.

Automating data collection using programmed tasks

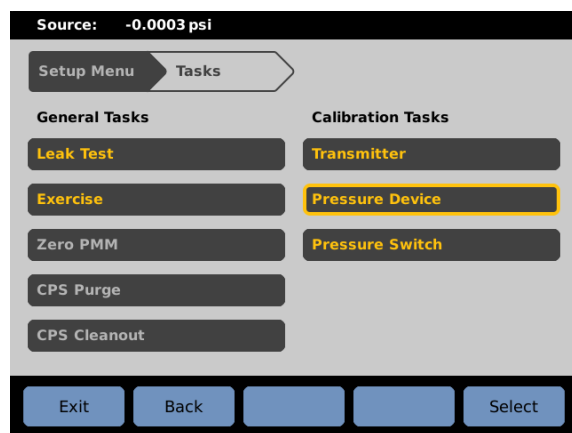


Figure 5. Task menu with Pressure Device highlighted

When using the Step and Jog functions alone, the 2271A does not collect and store any test results. By using the programmable tasks, you can extend the functionality of the 2271A to include storing data. To calibrate a dial gauge using a programmed task, first select **Tasks** from the main screen by pressing **F3**. Then select **Pressure Device** under **Calibration Tasks** in the right hand column.

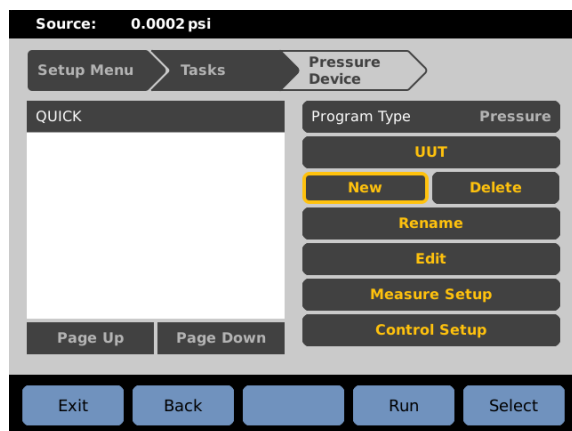


Figure 6. Pressure Device Task Screen with New highlighted

Creating a new program

Select **New** using the jog wheel (when you first enter the **Pressure Device Task** screen, **New** is selected) and press **Enter**. This takes you to the keyboard screen where you can enter a name for the procedure. Once you have keyed in the name of the procedure, press **F3** to save the name.

You now see a screen that allows you to auto fill the procedure with a set of pressure points. Enter the starting and ending procedure and the number of points in each direction. In determining the number of points, the first point doesn't count. For example, if you want to do 25 psi

increments to 100 psi (0, 25, 50, 75, 100) then you enter 4 points up. You can also specify a dwell time (the amount of time after the controller is ready at a set point before it records the reading) and max time. The max time is the maximum amount of time it will take to get to a set point before the controller reports an error. A max time setting of 0 turns off this feature. After selecting **Auto Fill**, the 2271A asks if you want the first point set to ATM. If a point is set to ATM, the controller vents at that point instead of trying to control 0. This is preferable in most applications. You now see the **Edit** screen for the newly created procedure.

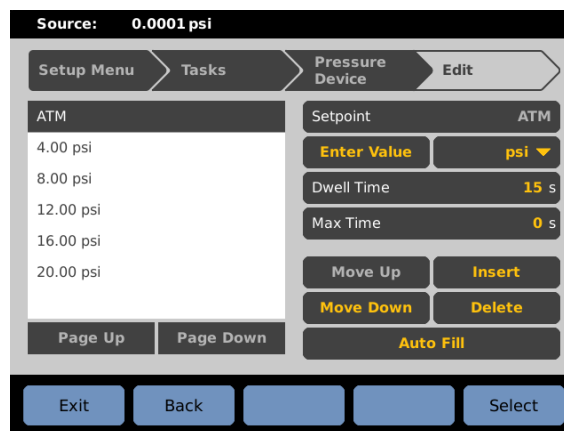


Figure 7. Edit screen

Editing a program

To reach the **Edit** screen, create a new procedure (as described above) or edit a previously generated procedure from the **Pressure Device Task** screen. While in the **Pressure Device Task** screen, use the jog wheel to highlight the list of procedures in the white box on the left. Use the **up** and **down arrow** keys to highlight the desired procedure in the list and press enter. Then use the jog wheel to select **Edit** on the right hand side of the screen.

In the **Edit** screen you can modify the settings for each specific pressure point. First, use the jog wheel to highlight the list of points in the white box on the left. Then use the **up** and **down arrows** to scroll through the list and press **Enter** once the desired setpoint is selected. Then you can use the jog wheel to highlight the setting you wish to change. You can change the setpoint pressure value (or change it to an ATM point) as well as the dwell time and max time for each point.

In addition to editing an individual point, you can change the order of points or add additional points by using the **Move Up**, **Move Down**, **Insert**, and **Delete** functions.

Once you have completed editing the procedure, press **F2** to go back to the **Pressure Device Task** screen.

Setting up the device under test

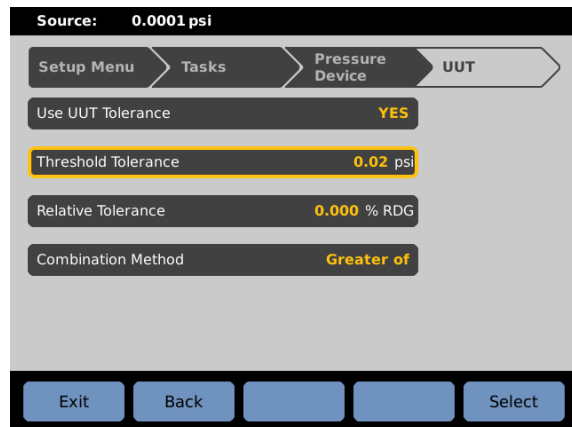


Figure 8. DUT screen

Once the program has been configured, you can then configure the **DUT** so that the proper tolerance is applied to determine if the unit is in or out of tolerance. Use the jog wheel to highlight **DUT** on the **Pressure Device Task** screen. Set **Use DUT Tolerance** to **Yes**. Then specify the specification for the device under test. If the unit has a % full scale specification, then calculate the specification in engineering units and enter it as the threshold tolerance. For example, if the gauge has a full scale of 20 psi and a specification of 0.1% FS enter 0.02 psi (20 psi X 0.1 %). Press **F2** to go back to the **Pressure Device Task** screen.

Running the procedure

To run the procedure from the **Pressure Device Task** screen, make sure the correct procedure is selected in the list on the left, then press **F4** to run the procedure. This brings up the keyboard screen where you can type in the ID for the device under test. This can be the serial number or ID tag, depending upon what is required by your quality policy. To enter numbers, you can select the **& 123** button in the bottom right or use the physical keypad on the 2271A front panel. Once you have entered the ID, press **F3** to continue. This starts the actual calibration process.

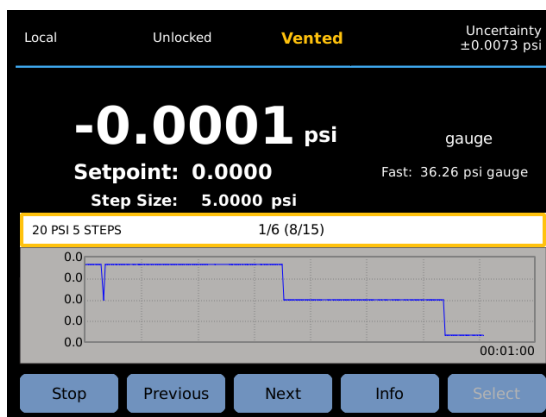


Figure 9. Test in Process

At each pressure point you have the option to jog the applied pressure by using the jog wheel. An entry box appears where you can enter the reading from the DUT. This is prefilled with the original setpoint. You should only change it if the dial gauge is not actually displaying the pressure as being equal to the setpoint. When doing a cardinal point calibration as described here, this value should be left as the default.

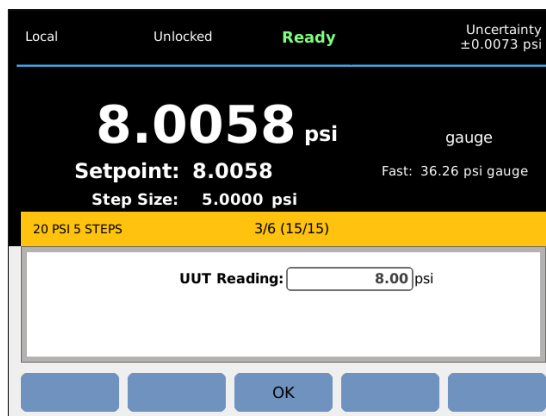


Figure 10. DUT Reading entry box

Once the test is completed, a summary screen appears. The full result file can be copied to a computer through the USB connection. Connect the 2271A to a computer using a USB-A-to-USB-B cable. The USB port on the 2271A can be set to emulate an RS-232 port. This needs to be turned off in order to allow the copying of results files. The RS-232 emulation mode can be toggled on and off in the **SETUP|Instrument Setup|Remote Port|USB** setup menu. With the RS-232 emulation mode turned off, the 2271A appears as a drive on the computer. The results files can then be copied from the 2271A onto the computer.

Summary

The 2271A simplifies and automates the calibration of analog dial gauges through the use of its Step, Jog, and Programmed Task functionality. With its modular design it can cover a wide pressure range, making it a versatile and powerful tool for your calibration laboratory or instrument shop.



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