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Temperature Calibration

APPLICATIONS AND SOLUTIONS

INTRODUCTION

Temperature devices in process manufacturing environments provide measurements to the process plants' control systems. The performance of these temperature instruments is often critical to optimized operation of the process manufacturing plant or proper functioning of the plant's safety systems.

Process temperature instruments are often installed in harsh operating environments, causing their performance and the performance of their sensors to shift or change over time. Keeping these devices measuring temperature within expected limits requires periodic verification, maintenance and adjustments.

This brochure illustrates a number of methods and differentiated tools for calibrating and testing the most common temperature instruments.

APPLICATION SELECTION GUIDE

Model number	75X	72X	712B/ 714B	1551A/ 1552A	1523/ 1524	914X	7526A	418X	1586A
Application									
Calibrate and test RTD sensors	*•	*•	*712B	*	*	Ideal	*•		*•
Calibrate and test thermocouple sensors	*•		*714B	*	*	Ideal	*		*•
Simulate RTDs		•	712B				•		
Simulate thermocouples		•	714B				•		
Generate precision temperatures						•			
Documenting temperature transmitter calibrations	Ideal								
Temperature transmitter calibration with sensor	*•					•			
Calibrating HART smart temperature transmitters	Ideal								
Temperature switch/ controller testing and calibration	Ideal	726				•	•		
Temperature switch/ controller testing live contacts	Ideal								
Infrared thermometer test and calibration								Ideal	
Verifying process temperature gauges				•	•	•			•
Logging temperature measurements	•			1552A	Ideal				•
Precision temperature measurement				•	Ideal				
Automated batch testing of temperature sensors**						Ideal			Ideal

* Requires a dry-well such as 914X or 910X
** Requires both a dry-well and a 1586A

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APPLICATIONS

PRODUCTS

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Automating Transmitter and Sensor Calibrations

Temperature transmitter calibrations are often performed without taking into account temperature sensor performance.

For many processes this has been an acceptable practice, although the sensor typically contributes more errors than the transmitter.

This practice can be problematic for critical process measurements or those that need a higher degree of confidence or accuracy.

Testing the transmitter and its respective process sensor together provides a more complete test. If performed with the proper test equipment, error contributions from the sensor can be minimized by matching the device to the transmitter electronics.

Suggested test tools

754 Documenting Process Calibrator

See pg 29

9144 Field Metrology Well

See pg 34

9100s Handheld Dry-Well

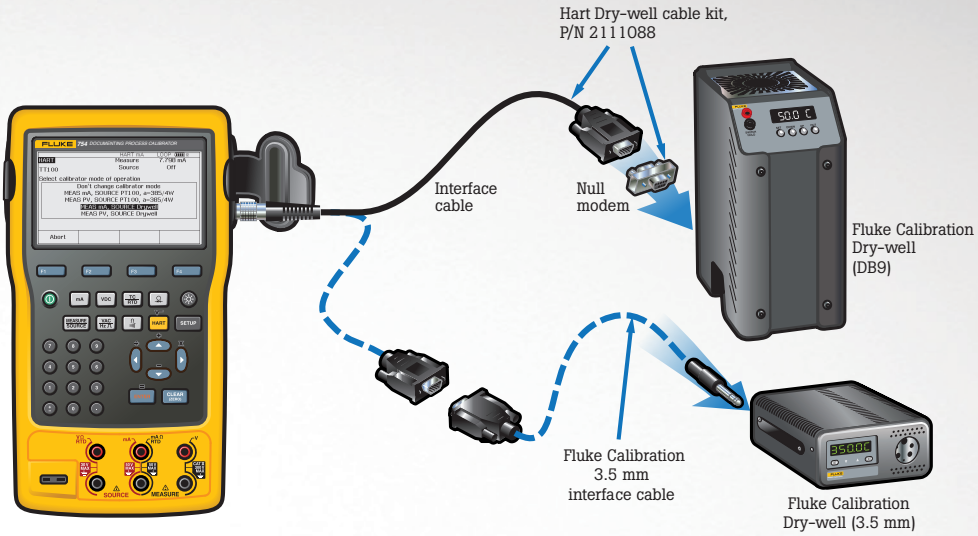
See pg 33

HART Dry-Well Communication Cable

See pg 38

6102 Micro-Bath Thermometer Calibrator

See pg 32



To perform the test:

To use a dry-well calibrator with a Fluke 754 to automatically test a transmitter with sensor:

STEP 1 Remove the process measurement sensor and install into the dry-well temperature calibrator.

STEP 2 Connect the mA measurement jacks of the 754 to the transmitter and connect the dry-well communication cable between the 754 and the dry-well.

STEP 3 Press HART to query the transmitter for its configuration.

STEP 4 Enable Loop Power on the 754 as required.

STEP 5 Press HART again and configure the calibrator for the test; select "Measure mA, Source Dry-Well."

STEP 6 Select "As-Found" to configure for documenting the test. Be sure to set the delay time long enough to allow the dry-well to change temperatures and stabilize.

STEP 7 Record the As-Found test either using Auto-Test, with the settling time for the dry-well in the test delay time, or manually while observing for stable test temperatures.

STEP 8 After the As-Found test select "Adjust" and select "Yes" when prompted to use a dry-well for adjusting the transmitter input. The applied temperature and adjustment will adjust the transmitter input block to output the correct measurement by adjusting the transmitter and sensor's output together.

STEP 9 After adjusting the input with sensor, adjust the transmitter mA output using "Output Trim."

STEP 10 After adjustment is completed, record the post adjustment of the transmitter As-Left and errors of the input. Sensor and output errors of the transmitter should be nominalized, resulting in improved temperature measurement performance.

TECH TIPS

- Resistance Temperature Detectors (RTDs) are almost always more accurate than thermocouples (TCs). As long as the temperature measured is within the range of the RTDs, they are a better choice when accuracy matters.
- Thermocouples have a wider temperature range and are more durable than RTDs.
- Thermocouples are a good choice for applications with rough service that experience destructive vibrations and repeated temperature cycling.
- Above ambient, dry-well calibrators stabilize at temperature faster with increasing temperatures than decreasing temperatures.
- If the stabilization time for the dry-well is difficult to estimate, consider selecting "Manual Test" on the 754 and wait for the temperature to stabilize before recording the measurement.
- HART smart transmitters with RTD probe inputs may allow for entry of the probe's certification constants. By inputting these constants, the sensor is matched and measurement system errors are minimized.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

Testing, troubleshooting, calibrating process temperature devices webinar

Selecting a Dry-Well Temperature Calibrator

Temperature calibration application note

Eliminating sensor errors in loop calibrations

Automating Temperature Calibration at the Bench

Automating temperature calibration has many advantages. For example, technicians need automation because they are under tremendous pressure to do more with limited resources, and automation can help reduce the number of repetitive time-consuming tasks required to complete a calibration.

Managers need automation to improve the productivity of their workforce, to reduce the skills required to complete calibration tasks, and to ensure compliance with documented procedures every time.

Automated calibration can be performed in the plant or shop without software when an instrument such as the Fluke 754 Documenting Process Calibrator or Fluke 1586A Precision Temperature Scanner is connected to a temperature source such as a Fluke dry-well or Micro-Bath. A degree of automation can also be achieved with Field Metrology Wells alone, as they can record data while running custom programs to a set of predetermined temperatures.

In a laboratory or shop environment, calibration software may be used for more complicated calibrations that require multiple temperature sources or generation of calibration coefficients.

Suggested test tools

1586A/1DS
Super-DAQ Precision
Temperature Scanner

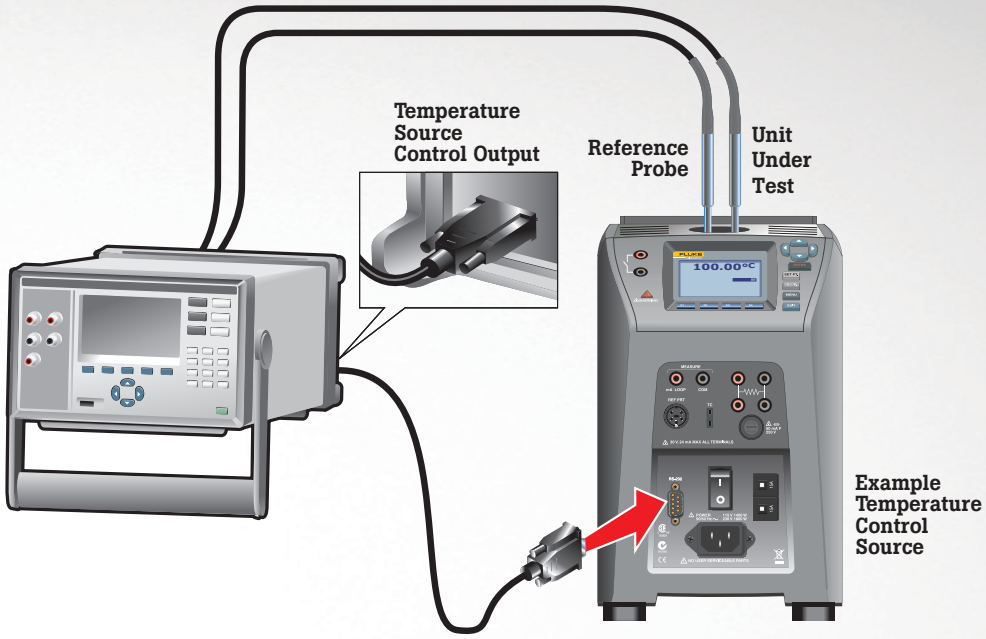
See pg 32

1586A/1HC Super-DAQ
Precision Temperature
Scanner with
temperature source

See pg 32

754 Documenting
Process Calibrator with
temperature source

See pg 29



To perform the test:

STEP 1 Connect the calibrator to the temperature source with the appropriate data cable.

STEP 2 Insert the temperature standard and probes to be tested into the precision temperature source (i.e. a dry-well).

STEP 3 Connect the probes to be tested and the temperature standard to the calibrator, and enable the channels they are connected to.

STEP 4 Select the test points and the order they are to be executed.

STEP 5 Start the program.

STEP 6 Move on to another job or unrelated task.

STEP 7 Return to collect and analyze your data.

TECH TIPS

- Only one temperature source can be connected at a time.
- The 1586A allows you to set the required stability band to accept a temperature measurement.
- The 1586A comes with Fluke DAQ 6.0 software, which allows you to handle and visualize your data.
- Easily export data to a USB stick in .csv format for analysis on a computer in a spreadsheet program.

Additional resources
For more in depth information about this application check out these videos and application notes from Fluke.

1586A Automating Temperature Sensor Calibration Video

Automated Temperature Sensor Calibration with the 1586A Super-DAQ
Eliminating Sensor Errors in Loop Calibrations

HART Smart Temperature Transmitter Calibration

Smart temperature transmitters, with their flexibility and enhanced accuracies, have become the number one temperature calibration workload for instrumentation professionals.

Calibrating a HART smart temperature transmitter requires an accurate temperature simulator or temperature source, mA measurement, and a HART communication tool for calibration. You can use separate tools or a calibrator that integrates all three to perform this task.

Before going to the field: Gather the needed calibration and communication test tools. If testing a RTD transmitter, be sure to bring extra test leads for connections. Testing a 3-wire RTD requires five (5) test leads, three for simulating the RTD sensor and two for measuring the mA signal. If using a separate communicator, you will need its test lead set as well.

For thermocouple (TC) calibrations, be sure to have the correct TC test wire type with a mini-connector terminated with the correct TC connector type, (i.e. Type K wires and connector to simulate a Type K thermocouple).

To get the accuracy needed: As a rule of thumb, your mA measurement tool and temperature source calibrator should be at least four times more accurate than the device being tested. To make that determination, the data sheets of both the transmitter and the calibrator being tested need to be considered. Be sure to account for temperature and stability (time) in addition to the accuracy the devices have specified. For more information on determining accuracy and interpreting accuracy, see the "Interpreting Specifications" application note referenced at the end of this article.

Suggested test tools

712B RTD Temperature Calibrator

See pg 30

714B Thermocouple Temperature Calibrator

See pg 30

7526A Precision Process Calibrator

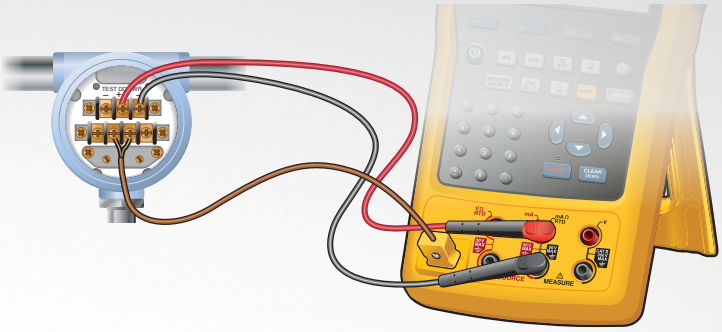
See pg 31

726 Precision Multifunction Process Calibrator

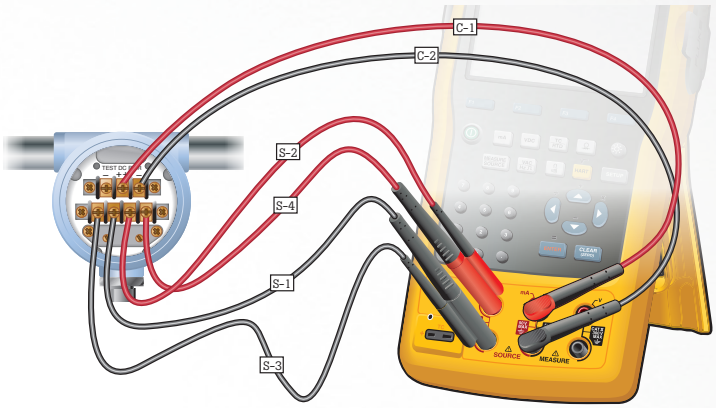
See pg 30

754 Documenting Process Calibrator

See pg 29



TC transmitter calibration connection



RTD transmitter calibration connection

To perform the test:

To use a calibrator with integrated HART communication to perform a calibration on a HART smart temperature transmitter:

STEP 1 Disconnect the process measurement sensor.

STEP 2 Connect the mini-connector from the test wires to the TC source connection of the calibrator if a TC transmitter; if an RTD, make connections to all three RTD input connections (assuming a 3-wire RTD).

STEP 3 Connect the measurement tool to the tested devices mA output.

STEP 4 Verify the devices range or span. This can be done by performing a HART query of the device by the calibrator.

STEP 5 Use the HART device configuration to configure the calibrator for the test (this is automatic if using the Fluke 754).

STEP 6 Enter the test tolerance and select the test strategy (number of points to test).

STEP 7 Use the calibrator to apply the input temperatures, measure mA values and, if a documenting calibrator is used, calculate and record measurement errors for the pre-adjustment As-Found test.

STEP 8 If the test passes within limits, you are done. Otherwise, adjust the transmitter (HART input trim and mA output trim).

STEP 9 After adjustment repeat the test As-Left and verify that the measured mA values are within expected limits.

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TECH TIPS

- When simulating a thermocouple signal from a simulator, always use the correct thermocouple wire for the test, either the exact same TC wire type or a compatible extension wire type.
- When simulating temperature with a calibrator with active reference junction compensation, remember that the calibrator actively compensates for temperature changes. Changes in ambient temperature should be compensated for automatically.
- Smart transmitters with multiple input sensors likely deploy pulsed excitation current when measuring RTD resistance. In this instance, select an active calibrator with a fast response time like the 754 that responds in 1 mS.
- If it is necessary to verify the sensor and transmitter electronics together, refer to the application detailed on page 5.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

Testing, troubleshooting, calibrating process temperature devices webinar

Temperature calibration application note

Hart Transmitter Calibration

Understanding specifications for process calibrators

Multifunction calibration using the 7526A Precision Process Calibrator

Calibrating and Testing RTD Sensors

Typically RTDs are checked while calibrating the connected device, such as a panel meter or temperature transmitter. However, if a problem is suspected with a temperature sensor, sensor calibrations can be performed separately from the calibration of process electronics.

Field checks of temperature sensors can be easily performed with a dry-block or Micro-Bath. For best results, a full calibration of a temperature sensor is performed at the bench.

Suggested test tools

9144 Field Metrology Well and 5615 Secondary Reference Temperature Standard

See pg 34

9102S Handheld Dry-Well

See pg 33

9100S Handheld Dry-Well

See pg 33

9009 Industrial Dual-Block Thermometer Calibrator

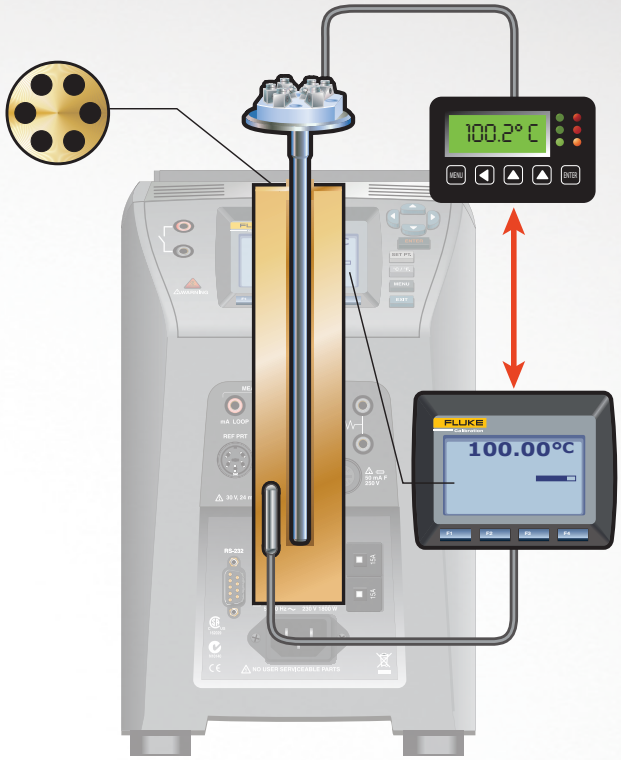
See pg 33

726 Precision Multifunction Process Calibrator

See pg 30

6102 Micro-Bath Thermometer Calibrator and 1523-P1 Reference Thermometer

See pg 32



To perform the test:

STEP 1 Isolate the sensor from the process.

STEP 2 Fully immerse the sensor into a precision temperature source, such as a dry-well or bath capable of covering the required temperature range.

STEP 3 For best accuracy, also fully immerse a temperature standard into the dry-well or bath for comparison (the process version of Field Metrology Wells have a built-in precision readout for the temperature standard).

STEP 4 To check the calibration of the RTD separately from the control system temperature indicator, disconnect the RTD from the electronics.

STEP 5 Connect the RTD to a precision instrument capable of measuring resistance. (The process version of Field Metrology Wells have the required electronics built in.)

STEP 6 Adjust the temperature of the bath or dry-well to each of the test points (With Field Metrology Wells these test points can be preprogrammed and automated.)

STEP 7 At each test point record the readings of the temperature standard and RTD.

STEP 8 If measuring the RTD separate from its measurement electronics, compare the measured resistances to the expected resistance from the applicable temperature table. Otherwise, compare the reading on the instrument display to the reading of the temperature standard (which may be the dry-well).

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TECH TIPS

- Dry-wells have inserts that are interchangeable and have a variety of hole patterns to accommodate various probe sizes.
- To achieve published performance levels, the insert's hole size should be no more than a few hundredths of an inch larger than the probe being calibrated.
- Avoid placing fluids in a dry-well. If fluids are required, use a Micro-Bath instead.
- If climbing a ladder is required, dry-wells are safer than baths, and handheld dry-wells may be the most convenient.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

How to Calibrate an RTD Using a Dryblock Calibrator webinar

914X Field Metrology Wells Video Series

Industrial Temperature Calibrators Workload Matrix

Calibrating and Testing Thermocouple Sensors

Thermocouples are common in industry because they are inexpensive and cover a wide temperature range.

They should be tested during commissioning and again when removed from a process to verify that tolerances were met. Additionally, thermocouples may be tested at regular calibration intervals and when suspected of failing to meet their performance specifications.

Often thermocouples need to be calibrated prior to use for mapping a temperature controlled enclosure, or they have to be calibrated for use as a temperature standard.

Due to the unique characteristics of thermocouples, they are best calibrated in situ (in place) by comparison to a temperature standard. However, in situations where that is not practical, it is necessary to remove the thermocouple and place it in a precision temperature source such as a dry-well.

Suggested test tools

9144 Field Metrology Well

See pg 34

9100S Handheld Dry-Well

See pg 33

9150 Thermocouple Furnace

See pg 33

6102 Micro-Bath Thermometer Calibrator

See pg 32

To perform the test:

STEP 1 Isolate the sensor from the process.

STEP 2 Fully immerse the sensor into a precision temperature source such as a dry-well or bath capable of covering the required temperature range.

STEP 3 To check the calibration of the thermocouple separately from control system temperature indicator, disconnect the thermocouple from the electronics.

STEP 4 Connect the thermocouple to a precision instrument capable of measuring millivolts. (The process version of Field Metrology Wells have the required electronics built in.)

STEP 5 If the thermocouple has a reference junction (most do not), then ensure that the reference junction is also immersed at the required reference temperature. Usually, this is 0 °C.

STEP 6 Typically, the thermocouple will not have a reference junction. In that case, ensure that the precision voltage measurement device has reference junction compensation (may be identified as RJC or CJC) turned on.

STEP 7 Adjust the temperature of the bath or dry-well to each of the test points. (With Field Metrology Wells these test points can be preprogrammed and automated.)

STEP 8 At each test point record the readings of the temperature standard and thermocouple.

STEP 9 If measuring the thermocouple separate from its measurement electronics, compare the measured voltage to the expected voltage from the applicable temperature table. Otherwise, compare the reading on the instrument display to the reading of the temperature standard (which may be the dry-well).

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TECH TIPS

- Depending on the thermocouple, incorrectly setting reference junction compensation may result in a temperature error of around 23 °C. Also, the reference junction compensation accuracy of the meter may be the largest contributor to the error.
- Thermocouple wire generates a voltage whenever two adjacent points along the wire are at different temperatures.
- The whole length of the wire (not just the probe tip) generates the voltage. This means the whole wire needs to be treated carefully and considered during the calibration.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

Thermocouple Fundamentals application note

Simulating Thermocouples and RTDs for Calibration and Testing

Thermocouples and RTDs are the most common sensors used in process temperature measurements.

Simulating a process sensor signal into a process instrument or control system input enables a technician to verify whether the device responds correctly to the temperature measured by the instrument. There are many different ways to simulate these sensors for testing purposes.

You can use a mV dc source and a mV vs temperature look up table (below on the left), for simulating thermocouples or a resistance decade box and resistance vs temperature look up table (below on the right), for simulating RTDs. This method, however, has become outdated with modern temperature calibrators that do the conversion for the user. With modern calibrators, simply select the sensor type to simulate, input the temperature to source and connect to the devices under test.

Thermocouple Table – Temperature vs mV

°C	0	1	2	3
0	0.000	0.039	0.079	0.119
10	0.397	0.437	0.477	0.517
20	0.796	0.838	0.879	0.919
30	1.203	1.244	1.285	1.326
40	1.612	1.653	1.694	1.735
50	2.023	2.064	2.106	2.147
60	2.436	2.478	2.519	2.561
70	2.851	2.893	2.934	2.976
80	3.267	3.308	3.350	3.391
90	3.682	3.723	3.765	3.806
100	4.096	4.136	4.179	4.220

RTD Table – Temperature vs Resistance

°C	Ohm	Diff.	°C	Ohm	Diff.	°C	Ohm	Diff.
0	100.00	0.39	10	103.90	0.39	20	107.79	0.39
1	100.39	0.39	11	104.29	0.39	21	108.18	0.39
2	100.78	0.39	12	104.68	0.39	22	108.57	0.39
3	101.17	0.39	13	105.07	0.39	23	108.96	0.39
4	101.56	0.39	14	105.46	0.39	24	109.35	0.39
5	101.95	0.39	15	105.85	0.39	25	109.73	0.39
6	102.34	0.39	16	106.24	0.39	26	110.12	0.39
7	102.73	0.39	17	106.63	0.39	27	110.51	0.39
8	103.12	0.39	18	107.02	0.39	28	110.90	0.39
9	103.51	0.39	19	107.40	0.38	29	111.28	0.38

Suggested test tools

712B RTD Temperature Calibrator

See pg 30

714B Thermocouple Temperature Calibrator

See pg 30

7526A Precision Process Calibrator

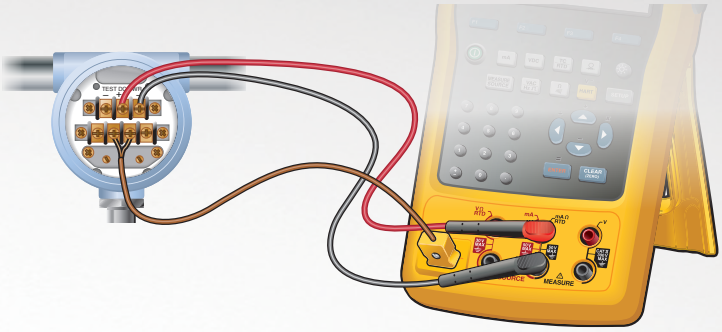
See pg 31

726 Precision Multifunction Process Calibrator

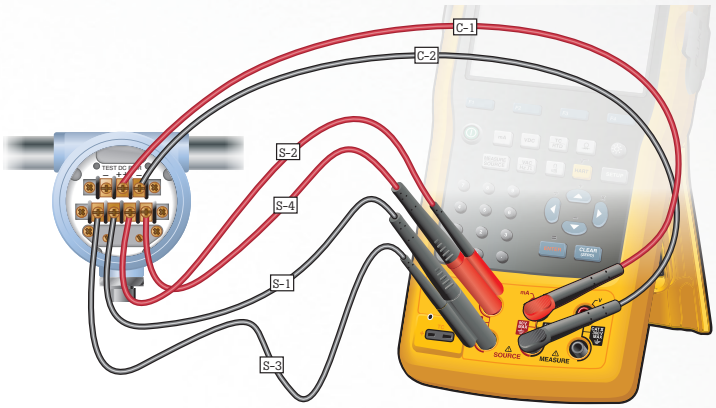
See pg 30

754 Documenting Process Calibrator

See pg 29



TC transmitter calibration connection



RTD transmitter calibration connection

To perform the test:

To use a thermocouple simulator to test a device with a thermocouple input:

STEP 1 Disconnect the process measurement sensor and connect the test connection wires in its place (Figure A).

STEP 2 Connect the mini-connector from the test wires to the TC source connection of the calibrator.

STEP 3 Connect a DMM or other measurement tool to the tested device's mA output.

STEP 4 Verify the devices range or span. Apply the 0% value with the simulator and verify with the DMM that the output mA value or voltage is as expected.

STEP 5 Repeat the test, applying the 50% and 100% temperature signals.

STEP 6 If the measured output of the device is within limits, the test is complete. If not, adjust the device at zero (offset, 0%) and span (gain, 100%).

STEP 7 Repeat steps 4 and 5 and verify for a correct response.

To use an RTD simulator to test a device with an RTD input:

STEP 1 Connect the calibrator to the device input as shown in figure B.

STEP 2 Connect the calibrator output with the right combination to match the device configuration (2, 3 or 4-wire).

STEP 3 Use the test procedure at left for thermocouple testing, starting at step 3.

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TECH TIPS

- When simulating a thermocouple signal from a simulator, always use the correct thermocouple wire for the test, either the exact same TC wire type or a compatible extension wire type.
- When simulating temperature using a calibrator with active reference junction compensation, remember the calibrator actively compensates for temperature changes. Changes in ambient temperature should be compensated for automatically.
- When testing 3-wire RTD circuits make sure to connect all three wires from the sourcing RTD simulator to the device being tested. Shorting out the compensation wire at the transmitter defeats the lead compensation circuit and introduces measurement errors.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

Testing, troubleshooting, calibrating process temperature devices webinar

Temperature calibration application note

Fluke temperature calibrators deliver high accuracy, speed, and convenience

Using a Precision Thermometer for Single Point Process Temperature Verification

It's not always possible or practical to remove instruments from a process for calibration. In situ verification at a single point may be the only way to know whether an instrument is performing as expected. A single point verification is most effective over a narrow temperature range and when combined with other trends and information related to the process and equipment. It also requires the process not to be in a dynamic state of change.

In a single point process temperature verification, a temperature standard such a reference PRT connected to a readout such as a 1523A is placed in thermal equilibrium with the sensor of the instrument to be verified without removing it from the process. Usually this is accomplished with a test well that is installed in a location adjacent to the sensor to be tested.

The reading from the temperature standard is compared to the reading on the panel meter, controller, or transmitter to determine the error and prove the tolerance condition of the loop.

Suggested test tools

1523-P1
Reference
Thermometer

See pg 31

1524-P1
Reference
Thermometer

See pg 31

1551A Ex "Stik"
Thermometer
Readout

See pg 31

1552A Ex "Stik"
Thermometer
Readout

See pg 31

To perform the test:

STEP 1 The test well (thermowell) should be within a few inches of the temperature transmitter and sensor assembly to be tested.

STEP 2 Make sure that the probe of the temperature standard is long enough to reach the bottom of the test well and that air gaps between the probe and well are minimized.

STEP 3 Wait for the temperature standard to reach the temperature of the test well. This will take a few minutes.

STEP 4 Check for temperature stability. A graphing digital thermometer such as the 1524 makes stability easier to recognize.

STEP 5 Record the reading from the measurement system and the temperature standard to determine whether the measurement system's readings are suspect.

TECH TIPS

- For this type of application a battery powered digital thermometer is usually preferred.
- A graphing display helps the technician visualize trends such as stability quickly and easily.
- Ensure that both the probe and the readout of your temperature standard have traceable calibration certificates from a competent laboratory.
- If the probe and readout separate from each other, smart connectors, which include probe calibration constants, provide a best practice method of ensuring that the readout is using the correct probe calibration in its temperature readings.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

Temperature measurement and calibration: What every instrument technician should know

Industrial temperature readout and probe selection guide

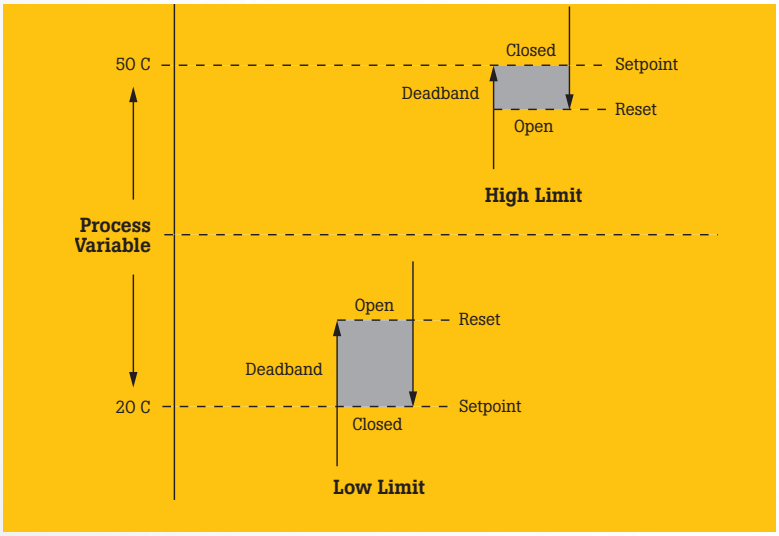
Process Calibration Tools: Temperature Applications

Temperature Switch and Controller Testing in the Field

Temperature switches and controllers are commonly used in small processes and in control loops where a programmable logic controller (PLC) or larger distributed control system (DCS) are not warranted.

Temperature controllers provide both switching capability based on rising and dropping temperatures, as well as a local indication of the measured temperature.

Most temperature controllers have some form of tuning, using damping and PID (Proportional, Integral and Derivative values) for smoothing out the measured process temperature, reducing variability.



The terminology around switches can be confusing. The set state of the switch is the action the switch takes when an input stimulus above or below a specified value is applied. This stimulus can prompt an action such as closing a switch, which in turn starts or stops a motor, or opens and closes a valve. The reset point is considered the relaxed state of the switch, which is typically referred to as "Normally Open" or "Normally Closed." This describes the default condition of the switch. Lastly, deadband is the band of temperature equal to the difference between the temperatures where a switch sets, and resets. See illustration at left.

Suggested test tools

712B RTD Temperature Calibrator

See pg 30

714B Thermocouple Temperature Calibrator

See pg 30

7526A Precision Process Calibrator

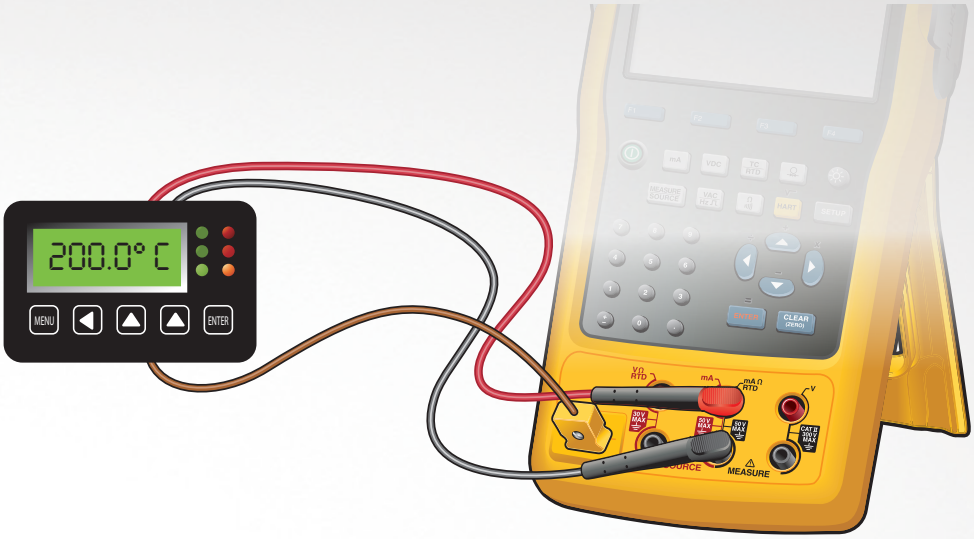
See pg 31

726 Precision Multifunction Process Calibrator

See pg 30

754 Documenting Process Calibrator

See pg 29



To perform the test:

To use a thermocouple simulator to test a switch with a thermocouple input:

STEP 1 Disconnect the process measurement sensor.

STEP 2 Connect the mini-connector from the test wires to the TC source connection of the calibrator (figure above).

STEP 3 Connect the calibrator resistance measurement terminals to the switch contacts to measure continuity.

STEP 4 Set the calibrator to source/simulate the correct thermocouple type and to measure resistance.

STEP 5 Configure the calibrator for the switch test describing the expected setpoint temperature, allowable deviation and expected deadband values.

STEP 6 Run the test and evaluate the test results.

STEP 7 Adjust the switch as needed and repeat the test, confirming that the adjustment was successful and the switch is performing as expected.

TECH TIPS

- When testing the temperature switch, the applied temperature should agree with the temperature displayed on the controller or switch's display. If it does not agree, the device's input A/D may need adjustment per manufacturer's procedure.
- When testing a switch with damping (delay of output change for a change on the input) set, it might be necessary to test the switch manually by slowly changing the temperature in small tests.
- When testing a mechanical temperature switch (no external sensor), use a field temperature bath calibrator for best results.
- To test live switch contacts switching 24 V dc or 120–240 V ac, select a calibrator that can measure these live voltages, such as the Fluke 75X family of Documenting Process Calibrators. Most other temperature calibrators can only measure continuity changes when testing switches.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

Testing, troubleshooting, calibrating process temperature devices webinar

Testing a temperature switch with the Fluke 754

Process and temperature switch applications with documenting process calibrators

Temperature calibration application note

Fluke temperature calibrators deliver high accuracy, speed, and convenience

Temperature Switch and Controller Testing at the Bench

A temperature switch is a device that protects a thermal system by sensing temperature and closing or opening a switch to shut down a process or equipment if the temperature is outside the safe range.

Temperature switches are often calibrated or tested for safety reasons to determine how accurate and repeatable the device is. The temperature at which a switch activates is called the set point and is an important value that needs to be verified during testing.

Another critical safety related value is called the deadband. Below the low end of the deadband, the heating system turns on. Above the high end of the deadband, the heating system turns off.

Switch tests may be operated manually or automatically. If the electronics are not built into the dry-well for a switch test, then a DMM will be needed to determine the open/close condition. Metrology Wells and most Field Metrology Wells have built-in routines to automate switch testing.

Suggested test tools

9142, 9143, 9144 Field Metrology Wells

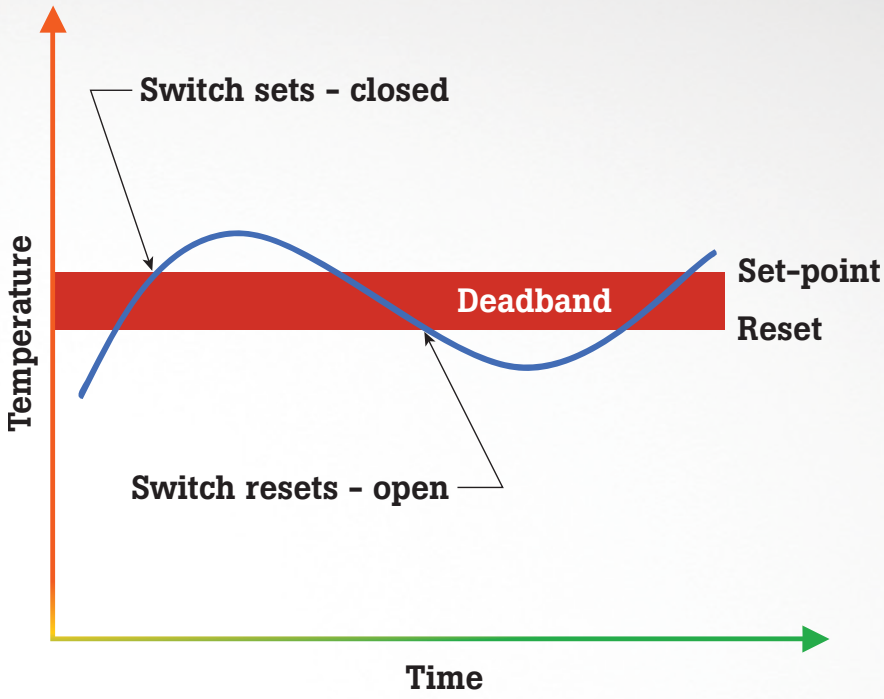
See pg 34

6102 Micro-Bath Thermometer Calibrator

See pg 32

7103 Micro-Bath Thermometer Calibrator

See pg 32



To perform the test:

STEP 1 Isolate the switch from the process.

STEP 2 Fully immerse the switch into a precision temperature source such as a dry-well or bath capable of covering the required temperature range.

STEP 3 Connect the leads of the switch to a digital multimeter or to the switch test inputs of the dry-well.

STEP 4 If using a Metrology Well or Field Metrology Well, increase the temperature to the set point. Continue raising the temperature until the switch changes state and record that temperature.

STEP 5 Decrease the temperature until the switch resets (changes state again) and record the temperature.

STEP 6 Repeat the process as many times as needed, but reduce the ramp rate and target the last measured set point and reset points to verify accuracy and repeatability.

STEP 7 Record the deadband (difference between the set point and the reset point).

FLUKE®

TECH TIPS

- Set the scan rate to a low value, i.e. 1.0 °C per minute, for better accuracy.
- If the scan rate is too low, the duration of the test may be longer than necessary.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

914X Field Metrology Wells Video Series

Best practices in temperature calibration

Testing Temperature Switches Using Metrology Wells

Calibrating with a Micro-Bath

Instrument technicians need to calibrate a wide variety of temperature sensors including liquid-in-glass thermometers, dial gauges, and sensors that come in odd shapes and sizes.

Problems of fit and immersion that may occur with short, square, or odd-shaped sensors are practically eliminated in a Micro-Bath because the probes are immersed in a fluid that is magnetically stirred for optimal stability.

Micro-Baths combine the portability of a dry-well with the stability and versatility of a calibration bath. They are lighter and smaller than most dry-wells and come with a spill-proof lid.

Suggested test tools

7103 Micro-Bath Thermometer Calibrator

See pg 32

7102 Micro-Bath Thermometer Calibrator

See pg 32

6102 Micro-Bath Thermometer Calibrator

See pg 32

1523-P1 Reference Thermometer

See pg 31

To perform the test:

STEP 1 Place the calibrator on a flat surface with at least six inches of free space around the instrument.

STEP 2 Carefully insert the probe basket into the well and fill with the appropriate fluid.

STEP 3 For optimal performance allow the manufacturer-recommended warm-up period.

STEP 4 Insert the test probe to be calibrated into the well of the bath. For best performance, also insert a temperature standard for comparison.

STEP 5 Once the probe is inserted to the full depth of the bath, allow adequate stabilization time for the test probe temperature to settle.

STEP 6 Once the probes have settled to the temperature of the bath, their indication may be compared to the calibrator display temperature (or to a temperature standard such as a 1551A).

FLUKE®

TECH TIPS

- **Caution:** the fluid level rises with higher temperatures and with the number and size of the probes placed into the fluid.
- Best results are obtained with the probe inserted to the full depth of the well.
- The stabilization time of the Micro-Bath depends on the conditions and temperatures involved. Typically stability is achieved within ten minutes.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

Industrial Temperature Calibrators Workload Matrix

Process Calibration Tools: Temperature Applications

Infrared Thermometer Test and Calibration

Infrared thermometer calibrations can be accurate with the proper setup and planning. It's important to choose a calibrator with a radiometrically calibrated target that is large enough to accommodate the recommended calibration distance of common infrared thermometers, along with their various fields of view.

Common errors include pressing the infrared calibrator too close to the hot surface of the calibrator or simply moving the infrared thermometer back and forth until the desired reading is achieved.

The manufacturer will have calibrated the infrared thermometer at a specific distance with a source that meets certain size requirements and has a specific emissivity (often but not always 0.95). To have a meaningful calibration that determines whether the instrument continues to operate within its design specifications, those conditions need to be reproduced as closely as possible.

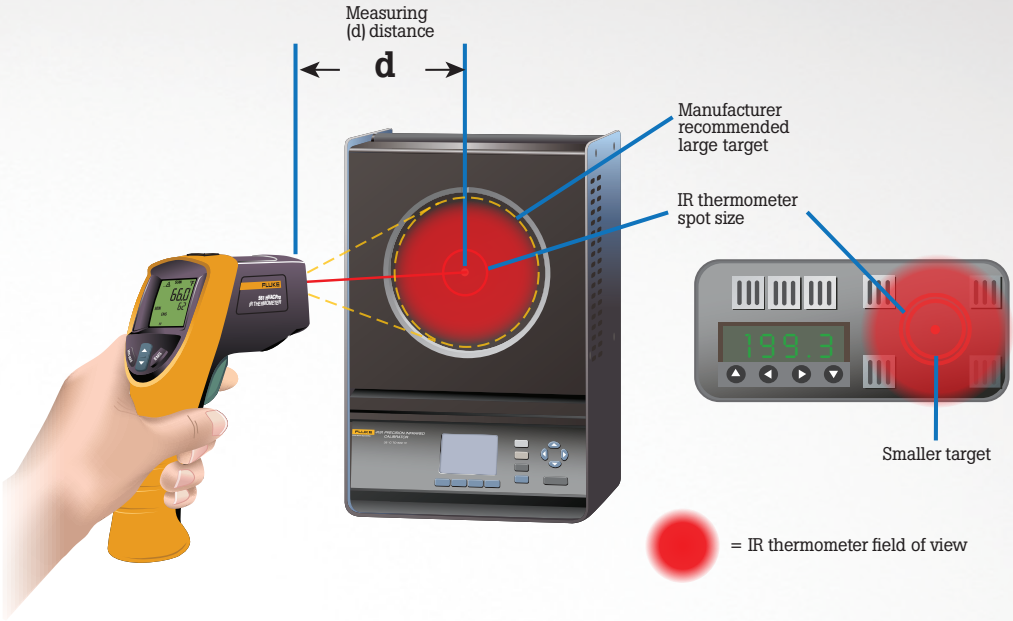
Suggested test tools

4181 Precision Infrared Calibrator

See pg 32

4180 Precision Infrared Calibrator

See pg 32



To perform the test:

STEP 1 Allow at least 15 minutes for the IR thermometer to reach the temperature of the shop or laboratory.

STEP 2 Set the radiation source to the desired calibration temperature. Depending on the temperature range a low, high, and midpoint temperature may be chosen.

STEP 3 If the infrared thermometer has an emissivity setting, it should be set to match the calibrated emissivity of the source.

STEP 4 Position the infrared thermometer at the manufacturer's recommended calibration distance.

STEP 5 Center the infrared thermometer on the calibrator surface. Do this by adjusting the aim slightly side to side and up and down to maximize the signal.

STEP 6 The measurement time should be ten times longer than the infrared thermometer's response time. This is typically five seconds for Fluke infrared thermometers.

STEP 7 Record the calibrator indicated reading and the indicated reading of the thermometer under test to determine the error and tolerance status of the thermometer at each set point.

STEP 8 Repeat for the other set point temperatures.

TECH TIPS

- Emissivity makes a big difference in infrared temperature measurement.
- The temperature and emissivity of the 4180 and 4181 are calibrated radiometrically for the most reliable and traceable results.
- The Fluke 4180 and 4181 can be set to match the emissivity setting of fixed emissivity thermometers.
- The large area of the 4180 and 4181 target allows infrared thermometers to be calibrated at the recommended distance without including unwanted surfaces in the field of view.
- Use a mounting device such as a tripod to maintain the calibration distance.
- Measure the calibration distance from the flat plate surface to the surface of the front housing of the infrared thermometer.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

Emissivity makes a difference
How to Calibrate an IR Thermometer webinar

Infrared Temperature Calibration 101 application note
Infrared Thermometer Calibration – A Complete Guide

Loop Calibration with a Temperature Transmitter at the Bench

In industrial process industries, temperature measurement equipment usually has two components: a sensing device such as an RTD or thermocouple and a transmitter to read and relay the signal to the control system.

All sensors, including RTDs, drift with time. Thus, testing the transmitter and not the sensor could result in misjudgment regarding a system's performance. To avoid this potential problem, process instrument manufacturers recommend including the temperature sensor in loop calibration to prove the effectiveness of the entire system.

Suggested test tools

9142, 9143, 9144 Field Metrology Wells

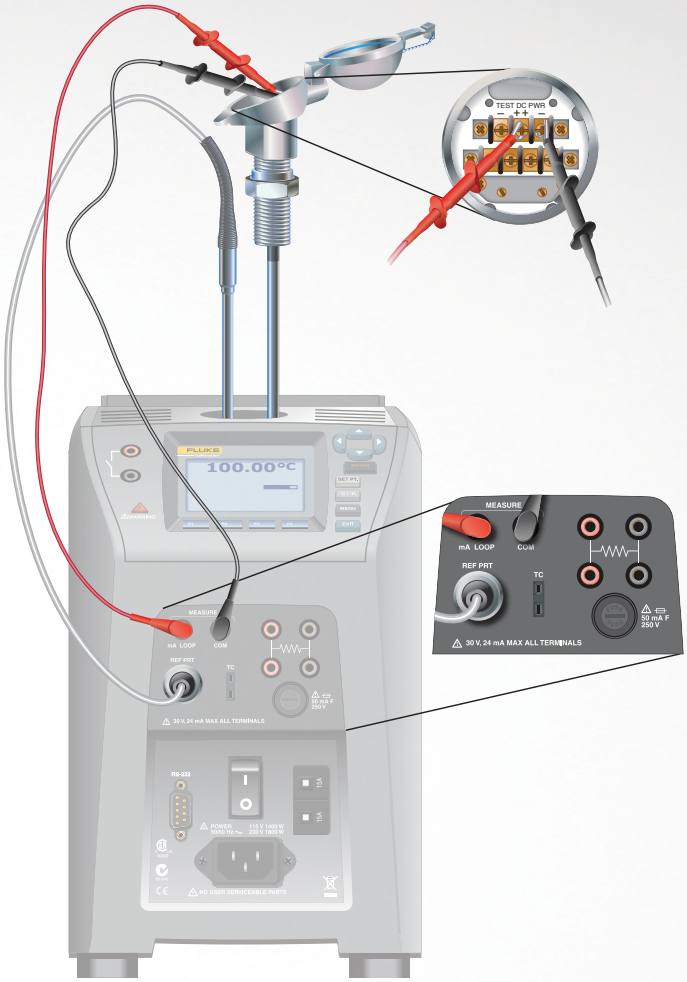
See pg 34

7526A Precision Process Calibrator with temperature source

See pg 31

754 Documenting Process Calibrator with temperature source

See pg 29



To perform the test:

STEP 1 Isolate the sensor from the process.

STEP 2 Fully immerse the sensor into a precision temperature source such as a dry-well or bath capable of covering the required temperature range.

STEP 3 Connect the temperature standard and 4–20 mA output of the transmitter to a suitable meter or calibrator (for example, the process electronics on a Fluke Field Metrology Well or the inputs of a Fluke 754).

STEP 4 Power the loop. (The Fluke 754 and the process electronics in a Field Metrology Well have this capability.)

STEP 5 Adjust the temperature of the bath or dry-well to each of the test points. (With Field Metrology Wells, these test points can be preprogrammed and automated.)

STEP 6 At each test point, monitor and record the readings of the temperature standard and the local or remote readings connected to the transmitter output.

STEP 7 Also, record the 4–20 mA output of the transmitter to determine which device needs adjustment if an adjustment is required.

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TECH TIPS

- Streamline the process with automation and provide documentation using a Fluke 754.
- Seventy-five percent of the errors in a temperature measurement system comes from the sensor.
- At minimum, you need a calibrator, and a device to measure 4–20 mA and power the loop.
- Choose a temperature standard with a 90 degree angle bend to ensure both the temperature standard and the transmitter fit in the dry-well at the same time.

Additional resources

For more in depth information about this application check out these videos and application notes from Fluke.

Eliminating Sensor Errors in Loop Calibrations

Multifunction calibration using the 7526A Precision Process Calibrator

Improving loop calibration temperature accuracy

TEST TOOLS

Pick the right temperature tool for you

TEMPERATURE TOOLS SELECTION GUIDE

	Models											
	712B/ 714B	724/ 725/ 726	753/ 754	9142/9143/ 9144/9190A	9100S/ 9102S	9009	6102/ 7102/ 7103	4180/ 4181	1551/ 1552	1523/ 1524/ 1586A	1620A	7526A
Applications												
Temperature sensor calibration				•	•	•	•	•	•	•		•
Temperature transmitter calibration		•	•	•								•
Temperature Switch testing		725Ex/726	•	•			•					
Source												
Temperature simulation RTD or TC (Source)	712B RTD, 714B TC	•	•									•
Infrared temperature sourcing								•				
Temperature (dry well)				•	•	•						
Temperature (Bath)							•					
4-20mA signal		725/726	•									•
DC voltage		•	•									•
Frequency		725/726	•									
Resistance		•	•									•
Measure												
Temperature (RTD)	712B	•	•	Process version					•	•		•
Temperature (Thermocouple)	714B	•	•	Process version						•		•
Temperature (Thermistor)										•		•
Multi-Channel Measurement										1524 / 1586A	•	
Internal Reference Temperature (dry-well/bath)				x	•	•	•					
External Reference Temperature (dry-well/bath)				Process version					•	•		•
Differential Temperature										1524		
4 to 20 mA signals	•	•	•									•
Resistance	712B	•	•	Process version						•		•
Temperature/Humidity											•	
DC Voltage	714B	•	•									•
Frequency		725/726	•									
Features												
4 to 20 mA signals			•						1552	•	•	
Resistance			•									
Temperature/Humidity		725Ex							•			
DC Voltage			•									
Frequency			•	•						1586A		

Fluke 754 Documenting Process Calibrator-HART

The Fluke 754 Documenting Process Calibrator–HART does the work of several tools – sourcing, simulating and measuring pressure, temperature, and electrical signals in one rugged, handheld device. HART communication capability is combined to deliver an integrated communicating calibrator. This rugged, reliable tool is ideal for calibrating, maintaining, and troubleshooting HART smart and other process instrumentation.

Key features:

- Add one or more (50) 750P series pressure modules to make the 754 a documenting pressure calibrator
- Simultaneous source/measure enables testing of almost any process device
- HART smart communication enables the 754 to take on nearly all the day-to-day tasks performed with a separate communicator
- To create a seamless/paperless calibration management system add the Fluke DPCTrack2 Calibration Management software
- 3-year warranty

Summary specifications

- Source: mA, DC voltage, frequency, resistance, thermocouples, RTDs
- Measure: mA, mA with loop power, AC voltage, DC voltage, frequency, thermocouples, RTDs
- CAT II 300 V overvoltage protection, measure up to 300 V ac
- Fast RTD source circuit for pulsed RTD circuits

Application coverage

- Temperature and pressure transmitter calibration
- Temperature and pressure switch test and calibration
- I/P transducers and control valves test and calibration
- Verify process I/O with mA and voltage source/simulate/measure
- Add a Fluke Calibration dry-block for full loop temperature calibration
- Test results for upload/download for paperless calibration management

Fluke 724 Temperature Calibrator

The Fluke 724 Temperature Calibrator can measure and source thermocouples and RTDs, plus volts and ohms. Now you can carry one tool to expertly test all the temperature sensors and transmitters in your plant.

Key features:

- Easy to read dual display lets you view input and output simultaneously
- Perform fast linearity tests with 25% and 100% steps
- Power transmitters during test using loop power supply with simultaneous mA measurement

Summary specifications

- Source and measure (12) thermocouple types
- Source and measure (8) RTD types
- Source and measure V DC and mV
- Measure mA to 24 mA
- Fast RTD source circuit for pulsed RTD circuits
- 24 V loop power supply

Application coverage

- Test process temperature sensors
- Measure RTDs, thermocouples, ohms, and volts to test sensors and transmitters
- Source/simulate thermocouples, RTDs, volts, and ohms to calibrate transmitters

Fluke 725 Multifunction Process Calibrator

The Fluke 725 is a powerful yet easy-to-use field calibrator. Use the measure and source functions to test and calibrate almost any process parameter. Measure and source mA, volts, temperature (RTDs and thermocouples), frequency, ohms, and pressure, using optional pressure modules.

Key features:

- Small, streamlined shape, rugged, reliable design stands up to field use
- Easy-to-read measure/source screen lets you view input and output simultaneously
- Measure volts, mA, RTDs, thermocouples, frequency, and ohms to test sensors and transmitters
- Source/simulate volts, mA, thermocouples , RTDs, frequency, ohms, and pressure to calibrate transmitters
- Power transmitters during test using loop supply with simultaneous mA measurement

continued on page 30

continued from page 29

Summary specifications
- Measure and source mA and voltage to 0.02%
- Source and measure RTDs to +/- 0.2 °C
- Source and measure Thermocouples to 0.7 °C
- Source and measure frequency to 10 Khz

Application coverage
- Calibrate RTD and Thermocouple input temperature transmitters Add 750P pressure modules to calibrate pressure transmitters
- Verify process sensors

Fluke 726 Precision Multifunction Calibrator

The Fluke 726 is designed specifically for the Process industry with broad workload coverage, calibration power and unsurpassed accuracy in mind. The 726 adds additional accuracy to the functionality of the popular 725 Calibrator. The 726 will also interpret results without the help of a calculator and store measurement data for later analysis.

Key features:
- More precise measurement and calibration source performance, accuracies of 0.01%.
- Measure volts, mA, RTDs, thermocouples, frequency, and resistance to test sensors and transmitters
- Source/simulate volts, mA, thermocouples, RTDs, frequency, and pressure to calibrate transmitters
- Source and totalize pulse counts
- Input RTD probe constants to match characterized probes for enhanced temperature measurement accuracy

Summary specifications
- Measure and source mA and voltage to 0.01%
- Source and measure RTDs to ± 0.15 °C
- Source and measure thermocouples to 0.5 °C
- Source and measure frequency to 15 Khz
- Source up to 10,000 pulses
- Measure/count to 100,000 pulses

Application coverage
- Calibrate RTD and thermocouple input temperature transmitters.
- Verify process sensors
- Add 750P pressure modules to calibrate pressure transmitters and test pressure switches

Fluke 712B and 714B Temperature Simulation/Measurement Calibrators

For the temperature calibration professional that wants a highly accurate, easy-to-use, single function temperature calibrator the 712B and 714B are ideal. For temperature calibration professionals, these temperature calibrators deliver outstanding performance, durability and reliability and each calibrator is EMI tolerant, dust- and splash-resistant, and features a removable battery door for quick battery changes.

Key features:
- The 712B can measure and simulate 13 different RTD types and resistance
- The 714B can measure and simulate 17 different thermocouple types and millivolts
- Measure 4 to 20 mA signals while simultaneously sourcing a temperature signal
- Configurable 0 % and 100 % source settings for quick 25 % linearity checks
- Linear ramp and 25 % step auto ramp based on 0 % and 100 % settings

Summary specifications
- 712B: Source or measure RTDs to 0.2 °C
- 712B: Source or measure resistance to 4000 ohms
- 714B: Source or measure thermocouples to 0.2 °C
- 714B: Source or measure voltage to 75 mV
- Measure mA with 0.01% accuracy

Application coverage
- 712B: Calibrate and test RTD input transmitters
- 712B: Simulate RTD signals into temperature controllers
- 714B: Calibrate and test thermocouple input transmitters
- 714B: Simulate thermocouple signals into temperature controllers

Fluke 1551A, 1552A Stik Thermometer

The Fluke 1551A and 1552A Stik Thermometers are an accurate and repeatable substitute to mercury-in-glass thermometers. Whether working outdoors in environments where potentially explosive gases may be present or on the floor of a processing plant, these intrinsically-safe, battery operated, portable reference thermometer are designed to go where you work.

Key features:

- User-configurable temperature Trend/Stability indicator
- Display temperature in °C or °F
- Optional data logging to internal memory
- 300-hour battery life
- NVLAP-accredited, NIST-traceable calibration included

Summary specifications

- Accuracy of ± 0.05 °C (± 0.09 °F) over full range
- Intrinsically safe (ATEX and IECEx compliant)
- Two models to choose from (-50 °C to 160 °C or -80 °C to 300 °C)

Application coverage

- Single point process temperature verification
- Calibration using a temperature standard
- Replacing mercury-in-glass thermometers

Fluke 1523, 1524 Handheld Thermometer Readouts

The Fluke 1523 and 1524 Reference Thermometers measure, graph, and record PRTs, thermocouples, and thermistors. These thermometer readouts deliver exceptional accuracy, wide measurement range, logging, and trending, all in a handheld tool you can take anywhere.

The 1523 and 1524 also let you handle field applications, laboratory measurements, and data logging with ease. And with the dual channel measurement capabilities of the model 1524, you can do twice the work in half the time.

Key features:

- 1523 models are single channel standard models with memory for 25 readings
- 1524 models have two channels; memory for logging 15,000 measurements; real-time clock for time and date stamps

Summary specifications

- PRTs: up to ± 0.011 °C
- Thermocouples: up to ± 0.24 °C
- Precision thermistors: ± 0.002 °C

Application coverage

- Single point process temperature verification
- Calibration using a temperature standard
- Differential temperature measurement (e.g. efficiency testing)
- Precision temperature monitoring

7526A Precision Process Calibrator

The Fluke Calibration 7526A Precision Process Calibrator offers the best balance of economy and accuracy for benchtop calibration of temperature and pressure process instrumentation. Easily calibrate RTD and thermocouple readouts, pressure gauges, temperature transmitters, digital process simulators, data loggers, multimeters and more.

Key features:

- Sources and measures dc voltage, current, resistance, RTDs and thermocouples
- Precision pressure measurement using Fluke 700 series pressure modules
- Includes 24 V dc transmitter loop power supply
- Measures 4-20 mA loop current
- Includes automated switch-test function
- Accepts ITS-90 coefficients for accurate SPRT measurements
- Compatible with MET/CAL® Calibration Software
- Includes certificate of calibration traceable to national standards (optional A2LA accredited calibration available upon request)

Summary specifications

- Thermocouple output/input: –10 mV to 75 mV ±(30 ppm of reading +2 µV)
- Transmitter output:0 mA to 24 mA (input with loop power) ±(100 ppm +1 µA)
- Resistance output: 5 Ω to 400 Ω ±0.015 Ω

Application coverage

- Temperature and pressure transmitter calibration
- Temperature calibrator calibration
- Temperature indicator calibration

6102, 7102, 7103 Micro-Baths

Micro-Baths provide a convenient way to eliminate the problems of fit and immersion when calibrating short, square, or odd-shaped sensors. Proprietary controllers make the Fluke 6102, Fluke 7102, and Fluke 7103 Micro-Baths extremely stable. They are lighter and smaller than most dry-wells, have a spill-proof lid, and a convenient carrying handle, so you can easily take them where you need to go without a cart and without removing the fluid.

Key features

- Perfect size for calibrating on site
- Calibrates sensors of any size or shape
- Stability to ±0.015 °C
- Ranges from –30 °C to 200 °C
- Spill-proof lid
- Convenient handle

Summary specifications

48 mm (1.9 in) diameter,
140 mm (5.5 in) deep tank

6102: 35 °C to 200 °C, 10 lb with fluid

7102: –5 °C to 125 °C, 15 lb with fluid

7103:–30 °C to 125 °C, 22 lb with fluid

Application coverage

- RTD and thermocouple calibration
- Temperature switch calibration
- Liquid-in-glass and bimetallic thermometer calibration

4180 and 4181 Precision Infrared Calibrators

The Fluke Calibration 4180 and 4181 Precision Infrared Calibrators give more consistent, accurate and reliable calibrations because emissivity is radiometrically calibrated, and the target size minimizes size of source effect errors. In addition, these infrared calibrators simplify calibration because they uniquely compensate for errors caused by thermometer emissivity settings.

Key features:

- Calibrated radiometrically for meaningful, consistent results
- Accredited calibration included
- Accurate, reliable performance from –15 °C to 500 °C
- Large target size of 152 mm (6 in) is required for calibrating most thermometers
- Light instrument weight of 8.6 kg (19 lbs) makes it easy to lift and carry
- Intuitive, easy-to-read display that indicates when temperature is stable

Summary specifications

- 4180 –15 °C to 120 °C
  ± 0.40 °C at 0 °C
- 4181 35 °C to 500 °C
  ± 0.70 °C at 200 °C

Application coverage

- Infrared thermometer calibration

1586A Super-DAQ Precision Temperature Scanner

The 1586A Super-DAQ automates calibration when connected to Fluke Calibration temperature source. It is a powerful thermometer readout and the most accurate and flexible temperature data acquisition system on the market. It scans and records temperature, dc voltage, dc current, and resistance for up to 40 input channels and scan speeds as fast as 10 channels per second.

Key features:

- Measure thermocouples, PRTs, thermistors, dc voltage, dc current, and resistance
- Best-in-class temperature measurement accuracy
- Input channels: Up to 40 isolated universal inputs
- Flexible configuration: Internal High-Capacity Module and/or DAQ-STAQ Multiplexer
- Fluke DAQ 6.0 software included to visualize and handle data.
- USB

Summary specifications

- PRTs: ±0.005 °C
- Thermocouples: ±0.3 °C
  (Type K,T,J w/ internal CJC)
- Thermistors: ±0.002 °C

Application coverage

- Precision reference thermometer for benchtop sensor calibration
- Automate temperature calibration in the shop or on the factory floor with dry-wells and Micro-Baths
- Multi-channel data logging

9100S, 9102S
Handheld Dry-Well Calibrators

The Fluke Calibration 9100S and 9102S are the world's smallest, lightest and most portable dry-wells. With an easy-to-use interface and temperature range to 375 °C (707 °F) the 9100S is ideal for checking RTDs, thermocouple, and small bimetal thermometers in the field. For work in the temperature range of -10 °C to 122 °C the 9102S is ideal for dial gauges, digital thermometers, bulb switches, and other sensors that need calibration below ambient.

Key features:

- Smallest dry-wells in the world
- Interchangeable and customizable inserts available
- RS-232 interface with 9930 Interface-it v3.81 software

Summary specifications

- Ranges from –10 °C to 375 °C
- Accuracy to ±0.25° C
- Stability of ±0.05 °C at 0 °C

Application coverage

- Check RTDs, thermocouples, and switches
- Check bimetallic dial gauge thermometers
- Easily carry to jobsite

9009 Industrial Dual-Block Thermometer Calibrator

The Fluke Calibration 9009 includes two independently controlled temperature blocks. The hot block provides temperatures from 50 °C to 350 °C, while the cold block covers the range –15 °C to 110 °C. Each block is controlled by a precision Fluke Calibration temperature controller.

Key features:

- Temperatures from –15 °C to 350 °C in one unit
- Two wells in each block for simultaneous comparison calibrations
- Rugged, lightweight, water-resistant enclosure

Summary specifications

- Hot block: ±0.6 °C
- Cold block:±0.2 °C
- Weight: 10 lb

Application coverage

- Calibrate thermometers
- Get quick zero and span measurements

9150 Thermocouple Furnace

The 9150 is a low cost portable thermocouple furnace. It has a removable well insert for versatility and rapid cool-down and heat-up times. With interchangeable inserts, you can check thermocouples as small as 1/16 of an inch in diameter. The 9150 works with 115 or 230 V AC power.

Key features

- Low-cost thermocouple furnace
- NIST-traceable calibration included
- RS-232 port standard

Summary specifications

Stability: ±0.5 °C

Temperature range: 150 °C to 1200 °C

Controller accuracy: ±5 °C across its entire range

Applications

Thermocouple calibration

9170, 9171, 9172, 9173
Metrology Well Calibrators

Metrology Wells are accurate enough for lab use and portable enough to take anywhere. Metrology Wells with a reference probe provide sufficient accuracy to calibrate Class A RTDs, thermocouples, and other sensor types.

Key features:

- Best-performing industrial heat sources (accuracy, stability, uniformity) in the world
- Immersion depth to 203 mm (8 in)
- Optional ITS-90 reference input reads PRTs to ±0.006 °C

Summary specifications

- 9170 –45 °C to 140 °C
  ± 0.1 °C full range
- 9171 –30 °C to 155 °C
  ± 0.1 °C full range
- 9172 35 °C to 425 °C
  Better than ±0.2 °C
- 9173 50 °C to 700 °C
  Better than ±0.25°C

Application coverage

- Calibrate high accuracy temperature probes
- Switch testing

To find the best Fluke Calibration industrial temperature calibrator for your workload download the Industrial Temperature Calibrators Workload Matrix

9142, 9143, 9144
Field Metrology Wells

Whether you need to calibrate 4–20 mA transmitters or a simple thermostatic switch, a Field Metrology Well is the right tool for the job. With three models covering the range of –25 °C to 660 °C, this family of Metrology Wells calibrates a wide range of sensor types. The optional process version (models 914X-X-P) provides a built-in two-channel thermometer readout that measures PRTs, RTDs, thermocouples, and 4–20 mA transmitters which includes the 24 V loop supply to power the transmitter.

Key features:

- Lightweight, portable, and fast
- Cool to –25 °C in 15 minutes and heat to 660 °C in 15 minutes
- Built-in two-channel readout for PRT, RTD, thermocouple, 4–20 mA current
- True reference thermometry with accuracy to ±0.01 °C
- Automate calibration with the Fluke 754 or Fluke 1586A or use onboard automation with process version

Summary specifications

- 9142 –25 °C to 150 °C ± 0.2 °C Full Range
- 9143 33 °C to 350 °C ± 0.2 °C Full Range
- 9144 50 °C to 660 °C ± 0.35 °C to 420 °C ± 0.5 °C at 660 °C

Application coverage

- RTD and thermocouple calibration
- Temperature transmitter calibration
- Automated calibration

9190A
Ultra-Cool Field Metrology Well

The Fluke Calibration 9190A Ultra-Cool Field Metrology Well is the most accurate and stable, cold temperature dry-block on the market. It's ideal for applications that demand strict quality control and regulatory process compliance. These applications include on-location validation and calibration of RTDs, thermocouples, thermometers, and sensors used with process control equipment such as medical freezers, laboratory refrigerators, cold rooms, blood banks, sterilizers (autoclaves), and freeze dryers.

Key features:

- Optional built-in two-channel readout for PRT, RTC, TC, 4–20 mA and reference thermometer
- Automate calibration with the Fluke 754 or Fluke 1586A or use onboard automation with process version

Summary specifications

- Wide temperature range from –95 °C to 140 °C
- Best-in-class stability: ± 0.015 °C full range
- Accuracy using built-in reference thermometer readout: ± 0.05 °C full range
- Display accuracy: ± 0.2 °C full range

Application coverage

- Calibrate RTDs, PRTs, thermocouples, and transmitters down to –95 °C
- Characterize thermocouples and RTDs for chamber mapping

INTRINSICALLY SAFE TEMPERATURE TOOLS

The **Fluke 1551A and 1552A "Stick" Thermometer Readouts** are an intrinsically safe digital substitute for your mercury-in-glass thermometers. Accurate and repeatable to ± 0.05 °C over their full range, the 1551A and 1552A are the "gold standard" of industrial temperature calibration. Whether working outdoors in environments where potentially explosive gases may be present or on the floor of a processing plant, the intrinsically-safe, battery operated, portable reference thermometer is designed to go where you work.

Summary specifications:

- Accuracy of ± 0.05 °C (± 0.09 °F) over full range
- Intrinsically safe (ATEX and IECEx compliant)
- Two models to choose from (-50 °C to 160 °C or -80 °C to 300 °C)

The **725Ex** is an intrinsically safe multifunction process calibrator for usage in areas where explosive gases are known to be present. This calibration tool sources and measures almost all process parameters. Measure and source temperature (RTDs and thermocouples), volts, mA, frequency, ohms, and pressure, using optional pressure modules.

Summary specifications:

- ATEX II 1 G Ex ia IIB 171°C KEMA 04ATEX 1303X
- CSA Class I, Division 1 Groups B-D, 171 °C compliance
- Source and measure 12 different thermocouple types
- Source and measure 7 different RTD types
- Source and measure mV and resistance for testing custom temperature sensors

ACCESSORIES

Precision PRTs

Fluke Calibration offers these and other precision thermometer probes to meet the needs of a wide variety of industrial calibration applications. When ordering a PRT, indicate the length of the probe and the type of readout it will connect to by adding the following extensions to the model number: For length use (-6 for 6 in, -9 for 9 in or -12 for 12 in). To indicate the model of the readout use (-P for 1523/1524, -L for 1586A, –A for 914X, and –D for 917X). For example a 6-inch 5627A used with a model 1523 Precision Thermometer readout would be ordered as a 5627A-6-P.

5627A Precision Industrial PRT

This precision PRT for industrial applications is vibration and shock resistant, and comes with an accredited calibration certificate. The calibrated accuracy is ± 0.046 °C and temperature range of –200°C to 420 °C make it ideal for many industrial temperature applications. This probe is available in 6 in, 9 in and 12 in configurations and a version with a 90 degree bend is also available for convenience with use in tight spaces.

5615 Secondary Reference Temperature Standards

When accuracy and temperature range are critical, the 5615 Secondary Reference Temperature Standards are the way to go, with a calibrated accuracy of ±0.010 °C at 0 °C and a temperature range of –200 °C to 420 °C. These probes come with an accredited calibration certificate. They are available in 6 in, 9 in, and 12 in configurations.

5622 Fast Response PRTs

These RTDs have small probe diameters ranging from 0.5 mm to 3.2 mm for time constants as fast as 0.4 seconds. They meet DIN/IEC Class A requirements for interchangeable use and also come with an accredited calibration certificate.

5606 Full Immersion PRT

The 5606 Full Immersion PRT is specially designed to allow the entire probe, including the transition junction and cable, to be placed into a freezer or furnace without damaging the probe. It has a temperature range from –200 °C to 160 °C and a calibration accuracy of ±0.05 °C (full range).

Dry-well inserts

Dry-wells are designed with a set of interchangeable inserts that contain holes bored into them matching standard diameters used for RTDs, PRTs, and thermocouples. Each set of inserts is designed and optimized for the size and temperature range of a specific dry-well model. Hole patterns matching a variety of probe sizes in both metric and imperial units are available for each dry-well.

Thermocouples

Fluke 700TC1 Thermocouple Mini-Plug Kit (11 types)

For use with: Fluke 700, 720 or 750 Series Process Calibrators, Fluke 714 Thermocouple Thermometer.

Description: A kit of 10 mini-plug connectors:
Type J (black), one
Type K (yellow), one
Type T (blue), one
Type E (purple), one
Type R/S (green), one
Type B or Cu (white), one
Type L (J-DIN) (blue), one
Type U (T-DIN) (brown), one
Type C (red), one
Type N (orange), one

FLUKE®

Fluke 700TC2 Thermocouple Mini-Plug Kit Type J, K, T, E, R/S

For use with: Fluke 700, 720 or 740 Series Process Calibrators, Fluke 714 Thermocouple Thermometer.

Description: A kit of seven mini-plug connectors:
Type J (black), two
Type K (yellow), two
Type T (blue), one
Type E (purple), one
Type R/S (green), one

Temperature probes

These temperature probes expand the functionality of Fluke thermometers, while offering the same rugged reliability of Fluke test tools.

General purpose measurements

80PJ-1 or 80PK-1 Bead Probe

Type J or K thermocouple probe for general-purpose applications. Ideal for troubleshooting.

- 1 m (39 in) lead
- 1 mm (0.04 in) probe with Teflon® insulation
- Measurement range: -40 °C to 260 °C (-40 °F to 500 °F)

80PJ-9 or 80PK-9 General Purpose Probe

Type J or K thermocouple probe for air and non-caustic gases. The sharp tip pierces pipe insulation and the flat surface makes good contact.

- 1 m (39 in) lead
- 15.25 cm (6 in) stainless steel probe
- Measurement range: -40 °C to 260 °C (-40 °F to 500 °F)

80PK-26 SureGrip™ Tapered Temperature Probe

Type K thermocouple probe with tapered tip for speedy air, surface, non-caustic gas, and liquid measurements.

- 1 m (39 in) lead
- 203 mm (8 in) stainless steel probe
- Measurement range: -40 °C to 816 °C (-40 °F to 1500 °F)

Surface measurements

80PK-3A Surface Probe

Type K thermocouple with exposed junction for flat or slightly convex surfaces such as plates and rollers.

- 1.3 m (4 ft) lead
- 9.525 cm (3.75 in) probe with Teflon® insulation
- Measurement range: 0 °C to 260 °C (32 °F to 500 °F)

80PK-27 SureGrip™ Industrial Surface Temperature Probe

Type K thermocouple probe for surfaces in rugged environments.

- 1 m (39 in) lead
- 20.32 cm (8 in) stainless steel probe
- Measurement range: -127 °C to 600 °C (-197 °F to 1112 °F)

Piercing measurements

80PK-25 or 80PT-25 SureGrip™ Piercing Temperature Probe

Type K or T thermocouple suitable for food industry, liquids, and gels. Sharp tip pierces solid surfaces.

- 1 m (39 in) lead
- 10.16 cm (4 in) stainless steel probe
- Measurement range:
  –Type K: -40 °C to 350 °C (-40 °F to 662 °F)
  –Type T: -196 °C to 350 °C (-321 °F to 662 °F)

Air measurements

80PK-24 SureGrip™ Air Temperature Probe

Type K thermocouple probe for air and non-caustic gas measurements.

- 1 m (39 in) lead
- 21.59 cm (8.5 in) Inconel® probe
- Bead protected by perforated baffle
- Measurement range: -40 °C to 816 °C (-40 °F to 1500 °F)

Immersion measurements

80PK-22 SureGrip™ Immersion Temperature Probe

Type K thermocouple probe for use in liquids and gels.

- 1 m (39 in) lead
- 21.27 cm (8.375 in) Inconel® probe
- Measurement range: -40 °C to 1090 °C (-40 °F to 1994 °F)

Pipe measurements

80PK-8 and 80PK-10 Pipe Clamp Temperature Probe

Type K thermocouple clamps securely to pipes for fast temperature and superheat measurements.

- Durable ribbon sensor
- 1 m (39 in) lead
- 80PK-8 for pipe diameters 6.4 mm to 34.9 mm (0.25 in to 1.375 in)
- 80PK-10 for pipe diameters 32 mm to 64 mm (1.25 in to 2.5 in)
- Measurements are repeatable to 0.56 °C (1 °F)
- Measurement range: -29 °C to 149 °C (-20 °F to 300 °F)

80PK-11 Type-K Velcro® Thermocouple Temperature Probe

Type K Velcro cuff for use with any temperature-measuring instrument that accepts type K thermocouples.

- Use multiples and leave in place for route-based routine maintenance
- 1 m (39 in) lead
- 48 cm (19 in) Velcro® cuff
- Measurement range: -30 °C to 105 °C (-22 °F to 221 °F)

Other temperature accessories

HART Dry-Well Communication Cable

An interface cable kit that includes a null modem to connect the Fluke 754 Documenting Process Calibrator with Fluke Calibration dry-wells and Micro-Baths to automate and document the calibration of temperature sensors and transmitters in the field or at the bench.

80CJ-M or 80CK-M Male Mini-Connectors

Type J or K thermocouple, suitable for up to 20-gauge thermocouple wire.

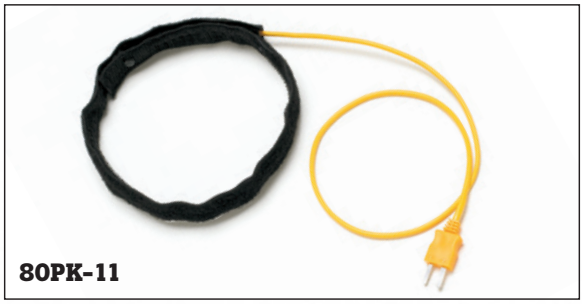
- Isothermal screw terminal for J wire
- Two per package

80PJ-EXT, 80PK-EXT, or 80PT-EXT Extension Wire Kit

This kit extends and repairs type J, K, or T thermocouple wires for thermometers.

- Includes 3 m (118 in) of thermocouple wire and one pair of male/female mini-connectors
- Maximum continuous exposure temperature: 260 °C (500 °F)

80PK-8
80PK-10



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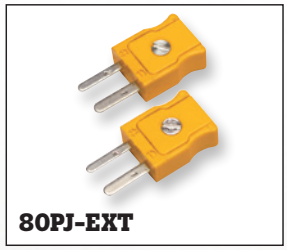
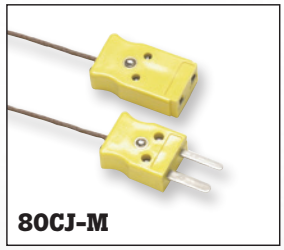
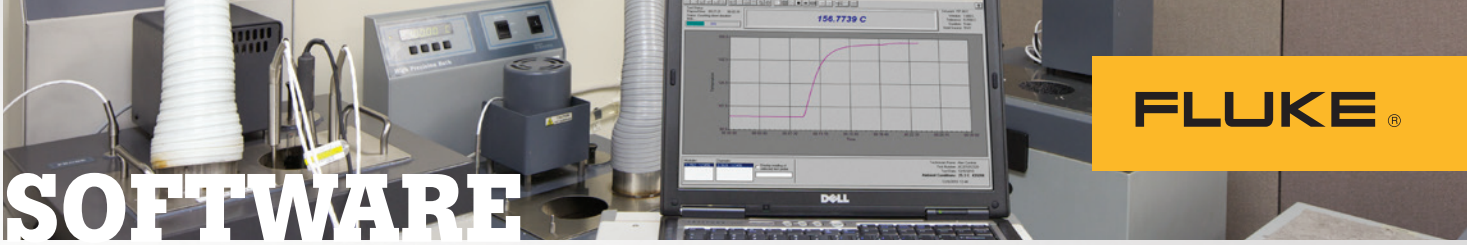


80PJ-EXT



80CJ-M



SOFTWARE

MET/TEMP II

MET/TEMP II is automated temperature calibration software that allows you to eliminate long manual temperature calibration processes. Test thermocouples (all types), RTDs, SPRTs, thermistors, and even liquid-in-glass thermometers (LIGs). Virtually any sensor with a resistance or voltage output can be tested, up to 100 sensors at a time. With MET/TEMP II software, simply place your test sensors in a heat source, connect them to a readout, enter your setup information, and start the test and return about fifteen minutes later.

- Fully automated calibration of RTDs, thermocouples, thermistors and many heat sources
- Calibrates up to 100 sensors at up to 40 points
- Performs coefficient calculations and generates tables and reports
- Reports conform to ANSI and NCSL standards

MET/TEMP II Software Kit

LogWare

LogWare temperature calibration software was designed for temperature data acquisition and lets you acquire data to your PC graphically and store it to a text file. It also performs statistical functions automatically on each data set. Set high and low alarm conditions, program a delayed start time, store a data log for a fixed number of readings or length of time, program the acquisition interval from 1 second to 24 hours, and then let the software take readings from the readout while you get the rest of your work done.

- Collects real-time data using Fluke Calibration handheld and Tweener readout
- Calculates statistics and displays customizable graphs
- Allows user-selected start times, stop times and sample intervals
- Provides user-defined alarms that trip customizable alarm events
- Includes tools to read/write probe coefficients and other readout settings

LogWare III

LogWare III is a client/server application that can be used enterprise-wide for environmental data logging and monitoring. It records, retrieves, and analyzes temperature and relative humidity data. LogWare III can be installed in either a client/server, multi-user environment or on a single PC as a stand-alone system.

- Data from many DewKs can be logged in real time via Ethernet, RS-232, or wireless connections
- Supports "hot-swapping," which allows you to remove and replace sensors without shutting down the log session
- Exports real-time data for use with MET/CAL calibration software
- Selectable sample interval from 1 second to 24 hours
- Selectable delayed start date/time for off-hours real-time data logging
- Selectable end log options (to stop session after specified time or number of readings)
- Logs all readings to a central database
- Selectable high and low alarm settings with user defined events (can be configured to play .WAV file or launch an application, such as pager software, when an alarm trips)

DPC/TRACK2™ Software

DPC/TRACK2 is a specialized calibration management database that can help you manage your instrumentation and address the documentation requirements of quality programs and regulations. With DPC/TRACK2 and a 754 DPC you can:

- Manage your inventory of tags and instruments, schedule for calibration
- Create tag specific procedures with instructions and comment
- Load those procedures to your DPC, and later upload the results to your PC
- Select and execute automated As-Found/As-Left procedures in the field, automatically capturing results
- Examine the calibration histories of your tags and instruments and print reports
- Import and export instrument data and procedures as ASCII text
- Import legacy DPC/TRACK data

Consider the 754 and DPCTrack2 bundle (FLUKE-754/750SW BU) for big savings.

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Software, continued from page 39

TQAero Thermal Validation Software for AMS 2750 Compliance

TQAero software provides qualification, reporting, documentation and audit trail management to support compliance with National Aerospace and Defense Contractors Accreditation Program (NADCAP) and SAE International AMS 2750 guidelines covering heat treating applications in aerospace and transportation industries. The software operates with Fluke data acquisition products including the 1586A and many Fluke Calibration dry-wells and baths. It includes a thermal validation test set-up for the chamber test space and requires Windows XP, 7, or 8.

TQSoft Thermal Validation Software for 21 CFR Part 11 Compliance

TQSoft software provides qualification, reporting, documentation and audit trail management to support compliance with U.S. FDA Title 21 CFR Part 11. TQSoft operates with Fluke data acquisition products including the 1586A and many Fluke Calibration dry-wells and baths. The software includes IQ/OQ documentation on CD, and Thermal validation test set-up of the chamber test space. It is compliant with 21 CFR Part 11 regulations on electronic records/signatures and EU standards for sterilization, decontamination and disinfecting (EN554, EN285, EN15883, HTM2010, HTM2030, ISO 15833 and 17025)

Fluke. *Keeping your world up and running.*®

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