FLUKE®

2016–2017

PROCESS CALIBRATION TOOLS CATALOG

Electrical, Multifunction, and mA Loop Calibration

Data Acquisition

Pressure Calibration

Temperature Calibration

Software/Accessories

Pressure Applications

Temperature Applications

Process Calibration Tools

From Fluke and Fluke Calibration

Working in a process environment such as pharmaceutical, refining or other industrial area can be challenging. Whether you're working at a bench, out in the plant, or in the field, you need accurate tools that you can count on.

Finding the right tools for the specific challenges you face every day is important, so we've provided an "at-a-glance" guide to the wide range of multifunction, mA loop, pressure and temperature calibrators that we carry. For complete information on our field and bench solutions to all your calibration needs visit www.fluke.com, www.flukecal.eu, or one of the product pages listed in this catalog.

Electrical and multifunction calibration
Fluke offers a broad range of field and bench calibrators to source, simulate, and measure pressure, temperature, and electrical signals to help you verify and adjust your test equipment or almost any process instrument.

mA loop calibration
Loop calibrators are essential tools for working with 4–20 mA current loops. Fluke loop calibrators provide mA sourcing, simulation and measurement, readouts in both mA and % of span, 24 V loop supply, simple operation and accuracy you can count on.

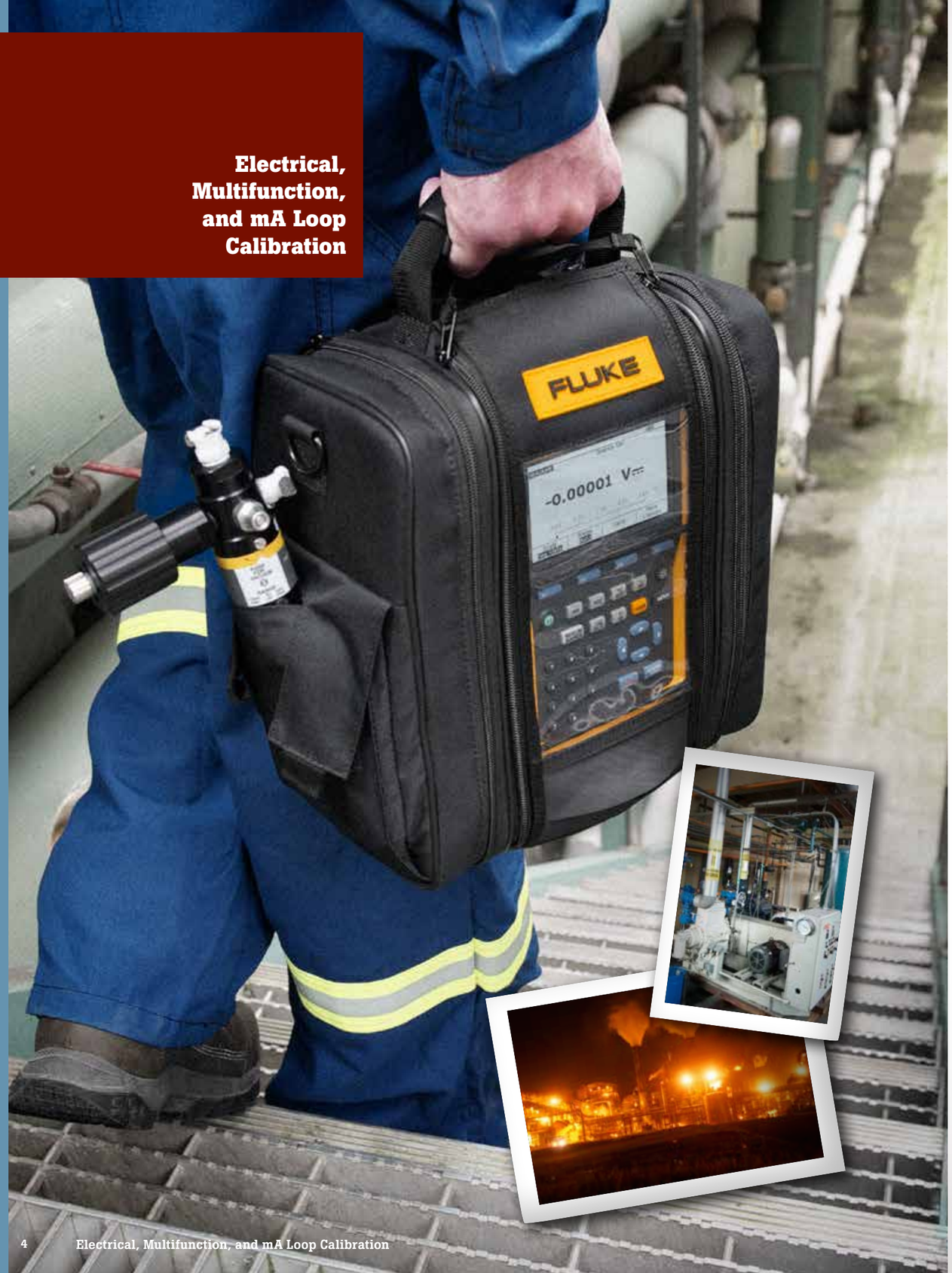
Pressure calibration
Instrumentation is found in virtually every process plant. Periodic calibration of these instruments is required to keep plants operating efficiently and safely. Fluke provides a wide selection of field and bench calibration tools to help you quickly and reliably calibrate your pressure instrumentation.

Temperature calibration
Temperature calibration refers to the calibration of any device used in a system that measures temperature—from sensors to transmitters to displays. Fluke offers bench and field solutions to ensure process temperature accuracy of not only the system's electronic temperature signals, but also the very temperature sensors that initiate those signals.

FLUKE

Process Calibration Tools

Electrical, Multifunction, and mA Loop Calibration



FLUKE

753

754

7526A

Multifunction Calibrators

These field and bench calibrators source, simulate, and measure pressure, temperature, and electrical signals with exceptional precision.

753 Documenting Process Calibrator

Rugged handheld tool for sourcing, simulating and measuring pressure, temperature, and electrical signals.

- Measure volts, mA, RTDs, thermocouples, frequency, and ohms to test sensors, transmitters and other instruments
- Source/simulate volts, mA, thermocouples, RTDs, frequency, ohms, and pressure to calibrate transmitters
- Power transmitters during test using loop supply with simultaneous mA measurement
- Download procedures and upload calibration results from field calibrations
- NIST traceable calibration

www.fluke.com/753

754 Documenting Process Calibrator with HART

Rugged, reliable tool for calibrating, maintaining, and troubleshooting HART and other instrumentation.

- Measure volts, mA, RTDs, thermocouples, frequency, and ohms to test sensors, transmitters and other instruments
- Source/simulate volts, mA, thermocouples, RTDs, frequency, ohms, and pressure to calibrate transmitters
- Supports popular models of HART transmitters, with more device-specific command support than any other HART field calibrator
- Download procedures and upload calibration results from field calibrations
- NIST traceable calibration

www.fluke.com/754

7526A Precision Process Calibrator

Best balance of economy and accuracy for calibration of temperature and pressure process measurement instrumentation.

- Sources and measures dc voltage, current, resistance, RTDs and thermocouples
- Measures pressure using Fluke 700/525A-P pressure modules
- Includes 24 V dc loop power supply, automated switch-test function and measures 4 mA to 20 mA
- NIST traceable calibration

www.flukecal.eu/7526A

726

725

725Ex

8808A

8845A/8846A

726 Precision Multifunction Process Calibrator

Designed specifically for the process industry with broad workload coverage, calibration power and unsurpassed accuracy. Includes all the features and functions of the 725 below plus:

- Enhanced accuracy
- Pulse count sourcing and pulse measurement totalizing
- Pressure switch test
- Error % calculation
- NIST traceable calibration

www.fluke.com/726

725 Multifunction Process Calibrator

A powerful and easy-to-use field calibrator to test and calibrate almost any process parameter.

- 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
- Measure/source pressure using any of 29 Fluke 700Pxx Pressure Modules
- Source mA with simultaneous pressure measurement to conduct valve and I/P tests
- NIST traceable calibration

www.fluke.com/725

725EX IS Multifunction Process Calibrator

Easy-to-use, intrinsically safe field calibrator can calibrate almost any process instrument needing service where explosive gasses may be present.

- ATEX II 1 G Ex ia IIB 171 °C KEMA 04ATEX 1303X
- I.S. Class I, Division 1 Groups B–D, 171 °C compliance
- Measure Volts dc, mA, RTDs, thermocouples, frequency and ohms
- Source or simulate volts dc, mA, RTDs, thermocouples, frequency and ohms
- Measure/source pressure using any of eight Fluke 700PEX Pressure Modules
- NIST traceable calibration

www.fluke.com/725EX

8808A Digital Multimeter

Versatile multimeter for manufacturing, development and service applications.

- 5.5 digit resolution
- Basic V dc accuracy of 0.015 %
- Dual display
- NIST traceable calibration

www.flukecal.eu/8808A

8845A/8846A Precision Multimeters

Precision and versatility for bench or systems applications.

- 6.5 digit resolution
- Basic V dc accuracy of up to 0.0024 %
- Dual display
- /C models include accredited calibration

www.flukecal.eu/8845A

709

709H

HART COMMUNICATION PROTOCOL

705

707

707EX

mA Loop Calibrators

Fluke loop calibrators are ideal for a wide variety of calibration applications from 4 to 20 mA.

705 Loop Calibrator

A cost-effective, integrated solution for calibration, repair and maintenance of current loops.

- mA sourcing, simulation and measurement
- Simultaneous mA and % of span display
- 24 V loop supply with mA measure
- 0 V dc to 28 V dc measurement to check loop voltage
- NIST traceable calibration

www.fluke.com/705

707 Loop Calibrator

A high performance, extremely fast and easy-to-use solution for calibration, repair and maintenance of current loops.

- mA sourcing, simulation and measurement
- 24 V loop supply with mA measure, including 250 Ω HART resistor
- 0 V dc to 28 V dc measurement to check loop voltage
- NIST traceable calibration

www.fluke.com/707

707EX IS Loop Calibrator

An intrinsically safe option for use in explosion endangered areas—certified in accordance with the ATEX directive (Ex II 2 G Ex ia IIC T4) in Zones 1 and 2.

- 1 µA resolution for mA source, simulate and measure
- Measures V dc to 28 V
- 0–20 mA or 4–20 mA default startup modes
- HART® compatible resistance is connected in series with the loop supply for compatibility with HART communicators
- NIST traceable calibration

www.fluke.com/707EX

709 Precision Loop Calibrator

Reduces the time it takes to measure or source voltage or current and power up a loop.

- Best-in-class accuracy at 0.01% reading
- Small rugged design operates on six standard AAA batteries
- Intuitive user interface with Quick-Set knob for fast setup, easy use
- Built-in selectable 250 Ω resistor for HART communication
- 24 V dc loop power with mA Measure Mode (–25% to 125%)
- Resolution of 1 µA on mA ranges and 1 mV on voltages ranges
- NIST traceable calibration

www.fluke.com/709

709H Precision Loop Calibrator with HART Communications/Diagnostics

Designed to save time and produce high-quality results

- HART Communication built in for easy HART device maintenance
- Best-in-class accuracy at 0.01% reading
- Small rugged design operates on six standard AAA batteries
- Intuitive user interface with Quick-Set knob for fast setup, easy use
- Built-in selectable 250 Ω resistor for HART communication
- 24 V dc loop power with mA Measure Mode (–25% to 125%)
- Resolution of 1 µA on mA ranges and 1 mV on voltage ranges
- NIST traceable calibration

www.fluke.com/709H

715

715 Volt/mA Calibrator

Outstanding performance, durability and reliability.

- Measure loop current (0–20 mA, 4–20 mA) signals with very high accuracy of 0.015% and 1 mA resolution
- Measure voltage output process signals from PLCs, transmitters
- Source or simulate 24 mA loop current
- Source voltage to 100 mV or 10 V
- 24 V loop supply with simultaneous current measurement
- Enhanced voltage and current measure and source accuracy
- NIST traceable calibration

www.fluke.com/715

787

787 ProcessMeter™

A complete troubleshooting solution in the palm of your hand with a digital multimeter and loop calibrator in one tool.

- 1000 V overload protection on V, ohms, frequency
- 150 V overload protection on mA, backed up by 440 mA 1000 V fuse
- 25 % manual step plus auto step and auto ramp on mA output
- CAT III 1,000V rating

www.fluke.com/787

789

789 ProcessMeter™

The 789 includes all the popular features of the 787 and adds:

- 24 V loop power supply
- 1200 ohm drive capability on mA source
- HART mode setting with loop power and a built-in 250 ohm resistor
- 0 % and 100 % buttons to toggle between 4 and 20 mA sourcing for a quick span check
- CAT IV 600 V rating

www.fluke.com/789

771/772/773

771 Milliamp Process Clamp Meter

Saves time by making fast, accurate measurements on 4–20 mA signal loops without breaking the circuit.

- 0.01 mA resolution and sensitivity
- Measure mA signals for PLC and control system analog I/O
- Measure 10 to 50 mA signals in older control systems using the 99.9 mA range

www.fluke.com/771

772 Milliamp Clamp Meter

Expanded features of the popular 771 mA Clamp Meter by adding loop power and mA sourcing to the capabilities.

- Measure 4 to 20 mA signals with in-circuit measurement
- Simultaneous mA in-circuit measurement with 24 V loop power for powering and testing transmitters
- Source 4 to 20 mA signals for testing control system I/O or I/Ps
- Automatically ramp or step the 4 to 20 mA output for remote testing

www.fluke.com/772

773 Milliamp Process Clamp Meter

The premier mA clamp meter, adds advanced troubleshooting features and voltage source/measure for testing voltage I/O. Icludes all the features of the 772 plus:

- DC voltage sourcing and measurement, verify 24 V power supplies or test voltage I/O signals
- Scaled mA output provides a continuous mA signal that corresponds to the 4 to 20 mA signal measured by the mA clamp
- Simultaneously source and measure mA signals

www.fluke.com/773

Data Acquisition

2638A

2638A-100

Data Acquisition System

Fluke Hydra Series III provides best-in-class thermocouple accuracy in a portable system.

2638A Hydra Series III

Price-performance breakthrough in a stand-alone data acquisition system

- DC accuracy of 0.0024 %
- Thermocouple accuracy of 0.5 °C
- Up to 66 universal differential isolated inputs
- On-screen color trend graphing andanalysis
- Easy-to-use menu system for setup and data management
- Input types: ac V, dc V, ac I, dc I, thermocouple, PRT (2, 3, 4 w), thermistor,resistance (2–4 w), frequency
- /C models include accredited calibration

2638A-100 Extra Universal Input Module for 2638A

- Dedicated low burden ac/dc current channels
- 20 universal channels and two dedicated low burden current channels (ac/dc) per module

Pressure Calibration

FLUKE

717

718

718EX

719PRO

Digital Pressure Calibrators

Built-in features like mA measure, loop power, switch test and transmitter error calculation make these pressure calibrators powerful tools that are easy to use.

717 Pressure Calibrator

Rugged, reliable and accurate calibrator with outstanding performance and durability.

- Measure pressure, 0.025 % of full scale with internal sensor up to 10,000 psi/690 bar sensor (10000G model)
- Measure mA with 0.015 % accuracy and 0.001 mA resolution, while sourcing 24 V loop power
- Measure pressure to 10,000 psi/700 bar using one of 29 Fluke 700Pxx Pressure Modules
- NIST traceable calibration

www.fluke.com/717

718 Pressure Calibrator with Pump

Provides a total pressure calibration solution for transmitters, gauges and switches.

- Pressure source and milliamp measurement to calibrate and maintain almost any pressure device
- Integrated pump is easily cleaned when accidently exposed to fluids that reduces cost of ownership and repairs and enables servicing the pump in the field
- 1 psi, 30 psi, 100 psi and 300 psi ranges mean few extra tools required
- NIST traceable calibration

www.fluke.com/718

719 and 719PRO Portable Electric Pressure Calibrators

Calibrate and test pressure devices quickly and easily with the built-in electric pump.

- Source mA with simultaneous pressure measurement to test valves and I/Ps
- Simulate mA signals to troubleshoot 4–20 mA loops
- Power transmitters during test using 24 V loop supply with simultaneous mA measurement
- New 300 psi range, generate up to 300 psi, with internal Electric pump (719PRO)
- Precision temperature measurement combined accuracy of ± 0.25 °C (0.45 °F) when using 720 RTD probe (optional accessory for use with 719PRO)
- NIST traceable calibration

www.fluke.com/719

718EX IS Pressure Calibrator

A powerful, intrinsically safe and self-contained pressure calibrator for use in explosion endangered areas.

- ATEX II 1G Ex ia IIC T4 compliant
- Built-in pressure/vacuum hand pump, with fine adjust vernier and bleed valve
- 30 psi, 100 psi, and 300 psi ranges (2 bar, 7 bar, and 20 bar)
- Pressure measurement to 200 bar using any of eight intrinsically safe Fluke 700PEx Pressure Modules
- NIST traceable calibration

www.fluke.com/718EX

750P

700PEX

721

P5510

P5513

750P Pressure Modules

A full range of differential, gage, absolute, vacuum, dual and intrinsically safe pressure modules are available, from –15 psi (–103 kPa) to 10,000 psi (69 MPa).

- Best-in-class 0.025 % reference uncertainty
- Rugged, chemical-resistant packaging
- Temperature compensated using proprietary micro-technology linearized output
- Digital communication to calibrators; no analog losses or errors
- NIST traceable calibration

www.fluke.com/700P

721 Dual Range Pressure Calibrator

Two measurement ranges plus *temperature measurement make the 721 ideal for gas custody transfer calibration applications.

- Fourteen models
- Up to (3) displayed measurement simultaneously
- Simplified user interface for ease of use
- Rugged, durable design with protective holster
- High accuracy, 0.025% total measurement uncertainty for one year
- Pt100 RTD input for precise temperature measurement, accurate to 0.1°C (0.2°F)
- Requires 720RTD probe sold separately as an accessory
- NIST traceable calibration www.fluke.com/721

700PEx IS Pressure Modules

Intrinsically safe pressure modules to create a complete pressure test solution.

- Certified by CSA: I.S. Class I, Div 1, Groups A–D T4, Ta = 0 °C to 50 °C
- ATEX II 1G Ex ia IIC T4 compliant
- NIST traceable calibration

www.fluke.com/700PEX

Pressure Comparators and Master Gauges

Precise pressure generation for comparing a device under test to a master gauge.

P5510 Gas Pressure Comparator

Easy, efficient pressure and vacuum generation in a single device.

- Pressure to 2 MPa (300 psi)
- Vacuum to –80 kPa (–12 psi)

www.flukecal.eu/P5510

P5513 Gas Pressure Comparator

High quality, precise gas pressure control.

- Precise pressure regulation to 210 MPa (3k psi) with high quality needle valves
- Built-in screw press for fine pressure adjustment
- Optional vacuum/pressure pump, –80 kPa to 2 MPa (–12 psi to 300 psi)

www.flukecal.eu/P5513

P5514

P5515

2700G

700G

P5514 Hydraulic Pressure Comparator

Easy, efficient hydraulic pressure generation.

- Generate and precisely adjust pressure to 70 MPa (10 k psi)
- Compatible with a wide range of fluids

www.flukecal.eu/P5514

P5515 Hydraulic Pressure Comparator

High quality, precise hydraulic pressure generation and control.

- Generate and precisely adjust pressure to 140 MPa (20 k psi)
- Integrated hand pump for system priming and large volume applications
- Compatible with a wide range of fluids

www.flukecal.eu/P5515

700G Precision Pressure Gauge Calibrator

Rugged construction for reliable measurements in the field.

- Twenty-three ranges from 10 inH20/1 bar to 10,000 psi/690 bar and 0.05 % accuracy
- Combine with a comparator kit for a complete solution
- Four new absolute pressure measurement ranges
- Use the 700G/TRACK Software to upload over 8,000 logged pressure measurements
- Up to 1500 hours battery life
- I.S. rating, CSA; Class 1, Div 2, Groups A–D rating, ATEX: rating: II 3 G Ex nA IIB T6
- NIST traceable calibration

www.fluke.com/700G

2700G Series Reference Pressure Gauges

Best-in-class accuracy from a master pressure gauge.

- Precision pressure measurement from 100 kPa (15 psi) to 70 MPa (10,000 psi).
- Accuracy to ± 0.02% of full scale
- Combine with the P55XX Pressure Comparators for a complete benchtop pressure calibration solution
- /C models include accredited calibration

www.flukecal.eu/2700G

Manual Pressure Calibrators

The Fluke Calibration pneumatic calibrators are an easy-to-use alternative to traditional deadweight testers.

These pressure calibrators are conveniently bundled with up to six 2700G Reference Pressure Gauges for a complete, benchtop pressure calibration solution to provide the accuracy, reliability, and capability you need to calibrate dial gauges, digital test gauges and pressure transmitters.

- Best-in-class accuracy of 0.02% full scale for each 2700G Reference Gauge.
- Expand lower range capability with additional 2700G Reference Gauges
- Adaptors to provide hand tight connection to common NPT, BSP, and metric fitting types
- Included reference gauges are battery operated and capable of using line power too
- Portable with a sturdy carrying case

3130

P3010/P3020/P3030

Reference Pressure Calibrators

Portable, high-quality pressure gauges

3130 Portable Pressure Calibrator

Everything you need for highly accurate calibrations of pneumatic field instruments.

- Measure and generate pressures from –12 psi (0.8 bar) to 2 MPa (300 psi, 20 bar)
- Accuracy of ±0.025% reading to ±0.01% FS
- Works with compressed plant air or internal pump
- 24 V loop power and electrical measurement for transmitters and switches
- Compatible with Fluke 700P pressure modules
- NiMH battery
- /C models include accredited calibration

www.flukecal.eu/3130

Bench Deadweight Testers

Deadweight testers are highly accurate, robust and flexible pressure measurement standards capable of calibrating a wide range of instruments.

P3010 Single Piston Gas Deadweight Tester

A high quality, high performance gas deadweight tester.

- 0.015 % of reading accuracy (0.008 % optional)
- Ranges cover from –100 kPa (–15 psi) vacuum to 3.5 MPa (500 psi) pressure
- Integrated vacuum/pressure pump available to 2 MPa (300 psi)
- Accredited calibration

www.flukecal.eu/P3010

P3020 Dual Piston Gas Deadweight Tester

Unique suspended piston design offers vacuum and pressure calibration in a single instrument.

- 0.015 % of reading accuracy (0.008 % optional)
- Ranges cover from 1.5 kPa (5 in H_2O) to 3.5 MPa (500 psi)
- All models feature vacuum measurement to –100 kPa (–15 psi)
- Integrated vacuum/pressure pump available to 2 MPa (300 psi)
- Accredited calibration

www.flukecal.eu/P3020

P3030 High Pressure Gas Deadweight Tester

Innovative liquid-lubricated piston offers low drop rates and high tolerance to contamination.

- 0.015 % of reading accuracy (0.008 % optional)
- Ranges cover from 100 kPa (10 psi) to 14 MPa (2000 psi)
- Integrated control valves and screw press for fine adjustment
- Accredited calibration

www.flukecal.eu/P3030

P3110/P3120/P3210/P3220

P3800

6531

6532

P3110 Single Piston Oil Deadweight Tester

High quality, high performance, easy to use oil pressure calibration.

- 0.015 % of reading accuracy (0.008 % optional)
- Ranges cover from 100 kPa (10 psi) to 140 MPa (20 k psi)
- Integrated pressure generation and control is standard
- Accredited calibration

www.flukecal.eu/P3110

P3120 Dual Piston Oil Deadweight Tester

Dual piston design offers maximum hydraulic pressure calibration workload coverage.

- 0.015 % of reading accuracy (0.008 % optional)
- 100 kPa (10 psi) to 110 MPa (16 k psi) in a single instrument
- Integrated pressure generation and control is standard
- Accredited calibration

www.flukecal.eu/P3120

P3210 Single Piston Water Deadweight Tester

Specially designed to use water as a test medium.

- 0.015 % of reading accuracy (0.008 % optional)
- Ranges cover from 100 kPa (10 psi) to 70 MPa (10 k psi)
- Integrated pressure generation and control is standard
- Accredited calibration

www.flukecal.eu/P3210

P3220 Dual Piston Water Deadweight Tester

Dual piston design offers maximum water pressure calibration workload coverage.

- 0.015 % of reading accuracy (0.008 % optional)
- 100 kPa (10 psi) to 70 MPa (10 k psi) in a single instrument
- Integrated pressure generation and control is standard
- Accredited calibration

www.flukecal.eu/P3220

P3800 High Pressure Oil Deadweight Tester

High performance, easy to use very high pressure oil calibration.

- 0.02 % of reading accuracy (0.015 % optional)
- Ranges up to 400 MPa (60 k psi)
- Integrated pressure generation, intensifier and control
- Accredited calibration

www.flukecal.eu/P3800

6531 Electronic Deadweight Tester

A digital alternative to the traditional deadweight tester.

- 0.02 % of reading from 10 % to 100 % of instrument range (10:1 turndown)
- Ranges from 7 MPa (1000 psi) to 200 MPa (30 k psi)
- Integrated hydraulic pressure generation and control
- Compatible with water and a wide range of oils and other fluids
- Onboard test routines, data storage, and other advanced features
- Accredited calibration

www.flukecal.eu/6531

6532 Extended Range Electronic Deadweight Tester

All the features of model 6531 with extended pressure range for maximum workload coverage.

- 0.02 % of reading from 1 % to 100 % of instrument range (100:1 turndown)
- Models with full scale ranges from 70 MPa (10 k psi) to 200 MPa (30 k psi)
- Accredited calibration

www.flukecal.eu/6532

Temperature Calibration

712

9142/9143/9144

714

724

Handheld Temperature Calibrators

Suitable for calibrating temperature transmitters, panel meters, and other devices that connect to temperature sensors.

712 RTD Process Calibrator

Delivers outstanding performance, durability and reliability in a compact, lightweight, and easy-to-carry tool.

- Measure temperature from RTD probe output
- Simulate RTD output
- Measure additional RTDs using ohms measurement function
- Simulate additional RTDs using ohms source function
- NIST traceable calibration

www.fluke.com/712

714 Thermocouple Calibrator

Delivers outstanding performance, durability and reliability in a compact, lightweight, and easy-to-carry device.

- Measure temperature from TC probe output
- Simulate TC output
- Calibrate linear TC transmitter with mV source function
- NIST traceable calibration

www.fluke.com/714

724 Temperature Calibrator

Powerful and easy to use to measure and source functions for testing and calibrating almost any temperature instrument.

- Measure RTDs, thermocouples, ohms, and volts to test sensors and transmitters
- Source/simulate thermocouples, RTDs, volts, and ohms to calibrate transmitters
- Perform fast linearity tests with 25 % and 100 % steps
- NIST traceable calibration

www.fluke.com/712

Multifunction Field Temperature Sources

Fast, lightweight and portable with precision temperature control traceable to national standards. Suitable for calibration of thermocouples, RTDs, PRTs, and other temperature sensors.

9142 Field Metrology Well

Maximizing portability, speed, and functionality for the industrial process environment.

- –25 °C to 150 °C temperature range
- Display accuracy of ± 0.2 °C over full range
- Built-in two-channel readout for PRT, RTD, thermocouple, 4–20 mA current
- Optional built-in reference thermometer readout
- Accredited calibration

www.flukecal.eu/9142

9143 Field Metrology Well

Maximizing portability, speed, and functionality for the industrial process environment.

- 33 °C to 350 °C temperature range
- Display accuracy of ± 0.2 °C over full range
- Built-in two-channel readout for PRT, RTD, thermocouple, 4–20 mA current
- Optional built-in reference thermometer readout
- Accredited calibration

www.flukecal.eu/9143

9144 Field Metrology Well

Precision calibration with fast temperature ramp-up rates for the industrial process environment.

- 50 °C to 660 °C temperature range
- Heat to 660 °C in 15 minutes
- Display accuracy from ± 0.35 °C at 420 °C to ± 0.5 °C at ± 660 °C
- Optional built-in reference thermometer readout
- Accredited calibration

www.flukecal.eu/9144

9100S

9102S

9103/9140

9009

9190A

Field Temperature Sources

Portable and flexible temperature-controlled dry-wells suitable for high-speed calibrations or certifications of thermocouples, RTDs, PRTs and other temperature sensors

9100S Handheld Dry-Well

World's smallest, lightest and most portable dry-well.

- Smallest dry-wells in the world
- Ranges from 35 °C to 375 °C
- Accuracy to ± 0.25 °C, stability of ± 0.07 °C at 50 °C
- NIST traceable calibration

www.flukecal.eu/9100S

9102S Handheld Dry-Well

High-performance, convenient and easy-to-use handheld dry-well.

- Smallest dry-wells in the world
- Ranges from –10 °C to 122 °C
- Accuracy to ± 0.25 °C, stability of ± 0.05 °C (full range)
- NIST traceable calibration

www.flukecal.eu/9102S

9009 Dual-Well Dry-Well

Two-in-one dry-well increases portability and productivity.

- Temperatures from –15 °C to 350 °C in one unit
- Display accuracy: hot block: ± 0.6 °C; cold block: ±0.2 °C
- Rugged, lightweight, water resistant enclosure
- NIST traceable calibration

www.flukecal.eu/9009

9103 Field Dry-Well

Great performance in a portable instrument.

- –25 °C to 140 °C
- Accuracy to ± 0.25 °C
- Stable to ± 0.02 °C at –25 °C and ± 0.04 °C at 140 °C
- NIST traceable calibration

www.flukecal.eu/9103

9140 Field Dry-Well

Lightweight and portable field dry-well small enough to easily carry in one hand.

- 35 °C to 350 °C
- Accuracy to ± 0.5 °C
- Stability to ± 0.03 °C at 50 °C and ± 0.05 °C at 350 °C
- NIST traceable calibration

www.flukecal.eu/9140

9190A Ultra-Cool Field Metrology Well

Very low temperatures, with no fluids and best-in-class stability

- 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
- Optional built-in two-channel readout for PRT, RTC, TC, 4–20 mA and reference thermometer
- Accredited calibration

www.flukecal.eu/9190A

9150

6102/7102/7103

9170/9171/9172/9173

9150 Thermocouple Furnace

Convenient, portable thermocouple furnace.

- 150 °C to 1200 °C
- Stability of ± 0.5 °C over full range
- NIST-traceable calibration included
- RS-232 port standard
- NIST traceable calibration

www.flukecal.eu/9150

6102/7102/7103 Micro-Baths

Calibrate a variety of probe dia-meters—no sleeves required.

- Three models covering temperatures from –30 °C to 200 °C
- World's smallest portable calibration baths
- Stability to ± 0.015 °C
- NIST traceable calibration

www.flukecal.eu/micro-baths

9170/9171/9172/9173 Metrology Wells

Best possible accuracy in a dry-block calibrator

- Best performing industrial temperature sources in the world (stability as good as ±0.005 °C)
- Immersion depth to 203 mm (8 in)
- Optional built-in readout reads reference PRTs to ± 0.006 °C
- Ranges:
  - 9170: –45 °C to 140 °C
  - 9171: –30 °C to 155 °C
  - 9172: 35 °C to 425 °C
  - 9173: 50 °C to 700 °C
- NVLAP accredited calibration ONLY with -R model

www.flukecal.eu/917X

Infrared Temperature Sources

Bench and field precision infrared calibrators for accurate and reliable calibrations of IR thermometers.

4180/4181 Precision Infrared Calibrators

Accredited performance for point and shoot calibrations.

- Calibrated radiometrically for meaningful, consistent results
- Accredited calibration included
- Accurate, reliable performance from –15 °C to 500 °C
- Large 152 mm (6 in) diameter target
- Accredited radiometric calibration report

www.flukecal.eu/418X

9132/9133 Field Infrared Calibrators

Precision when you need it for infrared temperature calibration.

- Verify IR pyrometers from –30 °C to 500 °C (–22 °F to 932 °F)
- RTD reference well for contact temperature measurement
- NIST traceable contact calibration

www.flukecal.eu/913X

4180/4181

9132

9133

1551A Ex/1552A Ex

Thermometer Standards

Delivering exceptional accuracy, wide measurement range, and designed to go where you work.

1551A Ex/1552A Ex "Stik" Thermometer

The best substitute for precision mercury-filled glass thermometers.

- 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)
- NVLAP-accredited, NIST-traceable calibration

www.flukecal.eu/155X

1523/1524

1523/1524 Handheld Thermometer Readout

Measure, graph and record three sensor types with one tool.

- High accuracy: PRTs: ± 0.011 °C; Thermocouples: ± 0.24 °C; Thermistors: ± 0.002 °C
- A simple user interface to see trends quickly
- Smart connectors to load probe information automatically
- Traceable cal as standard. -CAL versions with accredited cal

www.flukecal.eu/152X

1502A/1504

1502A/1504 Thermometer Readouts

Best performance thermometers in their price range.

- Single-channel reference thermometers, accurate to ±0.006 °C (meter only)
- Two models to choose from—reading PRTs or thermistors
- Best price/performance package
- Accredited calibration

www.flukecal.eu/150X

1529

1529 Four-Channel Thermometer Readout

Lab-quality accuracy on four channels for PRTs, thermistors and thermocouples.

- Accuracy of ±0.0025 °C (meter only)
- Displays eight user-selected data fields from any channel
- Logs up to 8,000 readings with date and time stamps
- Accredited calibration

www.flukecal.eu/1529

1620A

Ambient Conditions Monitor

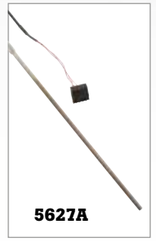
For precise measurement and recording of ambient temperature and humidity conditions wherever calibrations take place.

1620A Precision Thermo-Hygrometer

The most accurate temperature and humidity graphical data logger on the market.

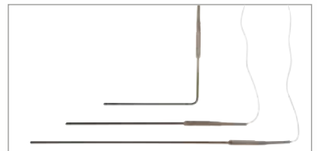
- Superior accuracy
- Network enabled
- Powerful logging and analysis tools
- Measures temperature to ± 0.125 °C and humidity to ± 1.5 % on two channels
- NIST-traceable NVLAP accredited temperature and humidity calibration

www.flukecal.eu/1620A



5627A

5615



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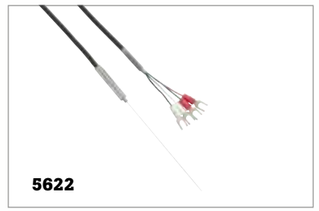
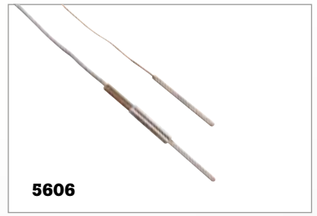


5622

5626/5628

5618B



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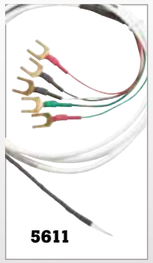
5610



5611

Precision PRTs

High accuracy reference temperature measurements in temperature sources on the bench or in the field.

5627A Precision Industrial PRT

- Vibration and shock resistant
- Calibration accuracy of ± 0.046 °C at 0 °C
- Available with a 90° bend
- NVLAP-accredited calibration included, lab code 200706-0

www.flukecal.eu/5627

5615 Secondary Reference Temperature Standards

- –200 °C to 420 °C
- Calibrated accuracy ± 0.010 °C at 0 °C
- NVLAP-accredited calibration included, lab code 200706-0

www.flukecal.eu/5615

5608/5609/5609-BND Secondary Reference PRTs

Drift rate of ± 0.01 °C at 0 °C after 100 hours at max temperature.

- 5608: –200 °C to 500 °C (80 mm minimum immersion)
- 5609: –200 °C to 670 °C (100 mm minimum immersion)
- Comes with certificate of compliance – optional NVLAP-accredited calibration

www.flukecal.eu/5608

5622 Fast Response PRTs

- Time constants as fast as 0.4 seconds
- Small probe diameters ranging from 0.5 mm to 3.2 mm (four models available)
- Available as DIN/IEC Class A PRTs or with optional NVLAP-accredited calibration, lab code 200348-0

www.flukecal.eu/5622

5626/5628 Secondary SPRT, PRT, Temperature Sensors

- Range to 661°C
- Meets all ITS-90 requirements for resistance ratios
- Rtp drift < 20 mK after 500 hours at 661°C
- Calibrated accuracy of ± 0.006 °C at 0 °C
- NVLAP accredited fixed point calibration

www.flukecal.eu/5622

5618B Small Diameter Industrial RTD

Fast response for time-dependent measurements.

- Small diameter sheath, 3.2 mm (0.125 in)
- Excellent stability
- Includes ITS-90 coefficients
- NVLAP accredited calibration, lab code 200706-0

www.flukecal.eu/5618B

5606 Full Immersion PRT

Fully immerse PRT transition junction inside freezers or furnaces.

- Transition junction designed to withstand full temperature range of probe
- -200 °C to 160 °C
- Calibration accuracy of ± 0.05 °C (full range)
- Optional NVLAP accredited calibration

www.flukecal.eu/5606

Thermistors

Providing accurate and rugged temperature measurements from 0 °C to 100 °C.

5610/5611/5611T Secondary Reference Thermistor Probes

Economical lab-grade thermistor probes with low drift susceptibility.

- Short-term accuracy to ± 0.01 °C; one-year drift < ± 0.01 °C
- 5610: 3.2 mm diameter stainless steel sheathed thermistor
- 5611: 1.5 mm diameter (tip) silicone coated thermistor
- 5611T: 3 mm diameter (tip) PTFE encapsulated thermistor

www.flukecal.eu/5610

5611T

Software/ Accessories

Software

750 SW DPC/TRACK2 Software™

DPC/TRACK2 Software 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

www.fluke.com/750DPCsoftware

700G/Track

Easy-to-use software for managing instruments and calibration data.

- Enables data download and logging configurations to the 700G Series gauges for a remote logging event
- Configure logging event reading rate, duration and measurement units
- Upload measurements logged remotely and display or export measurements

www.fluke.com/700Gsoftware

LogWare

Turn a Fluke Calibration single-channel handheld or 1502A/1504 readout into a real-time data logger.

- Collects realtime data
- Calculates statistics and displays customizable graphs
- Allows user-selected start times, stop times and sample intervals

www.flukecal.eu/logware

MET/TEAM® Test Equipment Asset Management Software

Manage more workload with less work.

- Browser-based calibration asset management software
- Fully integrated with MET/CAL® Software
- Microsoft SQL Server database
- Highly customizable
- Email automation
- On-site calibration

www.flukecal.eu/METTEAM

Temperature Calibration Software

MET/TEMP II Temperature Calibration Software v5.0

New version of the proven solution for automated temperature calibration

- Compatible with Windows 7 and 8 operating systems
- Adds support for 9190A Field Metrology Well and 9118A Thermocouple Furnace
- Fully automated calibration of RTDs, TCs, thermistors and many heat sources
- Calibrates up to 100 sensors at up to 40 temperature points

TQSoft Thermal Validation Software

FDA 21 CFR Part 11 compliant data collection
New version of the proven solution for automated temperature calibration

- Compliance with United States Food and Drug Administration (FDA) Title 21 CFR Part 11 regulations on electronic records and signatures for incubation, sterilization, freezing, drying and temperature mapping validation applications in pharmaceutical and biomedical industries.
- Developed in accordance with Good Automated Manufacturing Practice (GAMP) from the International Society for Pharmaceutical Engineering (ISPE).
- Compliance with European standards for sterilization, decontamination, and disinfecting (EN554, EN285, EN15883, HTM2010, HTM2030), ISO 15833 requirements for washer-disinfectors, and ISO 17025 competence requirements for testing and calibration laboratories.
- Has been audited by major pharmaceutical companies and its quality documentation has passed FDA audits.

TQAero Thermal Validation Software

AMS 2750 compliant data collection

- Compliance with National Aerospace and Defense Contractors Accreditation Program (NADCAP) and SAE nternational AMS 2750 guidelines covering industrial heat treating applications in aerospace and transportation industries
- Supports heat treatment processes validation by Temperature Uniformity Survey (TUS) and System Accuracy Test (SAT) procedures required by AMS 2750

Accessories

700HTP-2 Hydraulic Test Pump

The 700HTP-2 is designed to generate pressures up to 10,000 psi/700 bar. Use the Fluke 700PRV-1 adjustable relief valves to limit pressures from 1360 psi to 5450 psi. Use the 700HTH-1 test hose to connect from the pump to the device under test.

www.fluke.com/process_acc

700PTP-1 Pneumatic Test Pump

The 700PTP-1 is a handheld pressure pump designed to generate either vacuum to –11.6 psi/–0.8 bar or pressure to 600 psi/40 bar.

www.fluke.com/process_acc

700LTP-1 Low Pressure Test Pump

Hand operated pressure pump designed to generate either vacuum to –13 psi/–.90 bar or pressures to 100 psi/6.9 bar. Ideal for low pressure applications requiring accurate low pressure testing.

www.fluke.com/process_acc

700TTASK Premium Transmitter Test Hose Kit

Enables no-tools-required test connections from portable calibrator and hand pumps to transmitters with IEC standard input connections

700HTP-2

700PTP-1

700LTP-1

700TTASK

Pressure Applications

INTRODUCTION

Process pressure devices provide critical process measurement information to process plant's control systems. The performance of process pressure instruments are often critical to optimizing operation of the plant or proper functioning of the plant's safety systems. Process pressure instruments are often installed in harsh operating environments causing their performance to shift or change over time. To keep these devices operating within expected limits requires periodic verification, maintenance and calibration. There is no one size fits all pressure test tool that meets the requirements of all users performing pressure instrument maintenance.

APPLICATION SELECTION GUIDE

Model number	754	721/ 721Ex	719 Pro	719	718	717	700G	3130	2700G	Dead-weight Testers
Application										
Calibrating pressure transmitters (field)	▪	▪	Ideal	▪	▪	▪		▪		
Calibrating pressure transmitters (bench)	▪	▪	▪	▪	▪	▪		Ideal		▪
Calibrating HART Smart transmitters	Ideal									
Documenting pressure transmitter calibrations	Ideal									
Testing pressure switches in the field	Ideal	▪	▪	▪	▪	▪		▪		
Testing pressure switches on the bench	▪	▪	▪	▪	▪	▪		Ideal		
Documenting pressure switch tests	Ideal									
Testing pressure switches with live (voltage) contacts	Ideal									
Gas custody transfer computer tests	▪	Ideal	▪							
Verifying process pressure gauges (field)	Ideal	▪	▪	▪	▪	▪	▪			
Verifying process pressure gauges (bench)	▪	▪	▪	▪	▪	▪		▪	▪	Ideal
Logging pressure measurements	▪						Ideal		▪	
Testing pressure devices using a reference gauge									Ideal	
Hydrostatic vessel testing							Ideal			
Leak testing (pressure measurement logging)	▪						Ideal			

Products noted as "Ideal" are those best suited to a specific task.
Model 754 requires the correct range 750P pressure module for pressure testing.
Model 753 can be used for the same applications as model 754 except for HART device calibration.
Model 725 and 726 can be used for the same applications as model 753 except for documenting and live contact testing of switches.

Calibrating a HART smart pressure transmitter

Pressure transmitter manufacturers have improved the accuracy and technology designed into these smart pressure measurement devices. Many conventional calibration tools have become inadequate or simply unable to test and calibrate these high accuracy pressure transmitters. Better test solutions are required.

Verifying and documenting the performance and adjusting a HART smart pressure transmitter can require a bucket full of tools. Performing this task with a HART enabled calibrator like the Fluke 754 simplifies the task and reduces what you need to carry.

Before going to the field: install the pressure module adapter to the hand pump with thread seal. Once the adapter is properly installed on the pump, changing modules to different pressure ranges is a snap, no tools required.

To get the accuracy needed: to test these new high accuracy transmitters match the pressure measurement standard range closely to the device tested. For example, use a 100 psi pressure module to calibrate and test a transmitter ranged at 100 psi. Industry standards suggest the measurement standard should be 4–10 times more accurate than the device being tested so best-in-class accuracy is required.

The Fluke 754 utilizes the 750P series pressure modules and has built-in HART functionality to enable smart trims on transmitters. It can also document transmitter performance before and after adjustment and calculate pass/fail errors.

Suggested test tools

Fluke 754 Documenting Process Calibrator-HART

See pg 5

Fluke 700G Precision Pressure Gauge Calibrator

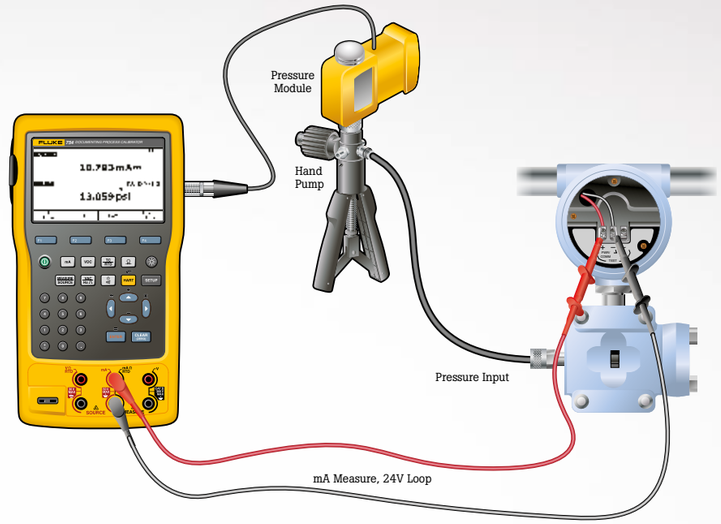
See pg 13

Fluke 750P Series Pressure Modules

See pg 12

Fluke 700PTP-1 Pneumatic Test Pump

See pg 23



To perform the test:

STEP 1 Isolate the transmitter from the process being measured and its loop wiring. If measuring the mA signal across the transmitter test diode leave the wires intact, but note this method does not give the best mA measurement accuracy.

STEP 2 Connect the mA measurement jacks of the 754 to the transmitter.

STEP 3 Connect the pressure module cable to the 754 and connect the transmitter test hose from the hand pump to the transmitter.

STEP 4 Press the HART button on the calibrator to see the configuration of the transmitter.

STEP 5 Press HART again and the calibrator will offer the correct measure/source combination for the test. If documenting the calibration press As-Found, input the test tolerance and follow the prompts. If the measured mA signal at the test points is found within tolerance the test is complete. If not, adjustment is required.

STEP 6 Select adjust and trim the transmitter's pressure zero, mA output signal and input sensor.

STEP 7 After adjustment select As-Left, document the condition of the transmitter after adjustment and if the test passes, it is complete.

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

See the smart pressure calibration video at:
www.fluke.com/pressurevideo

HART Smart Transmitter calibration application note at:
www.fluke.com/smarttranappnote

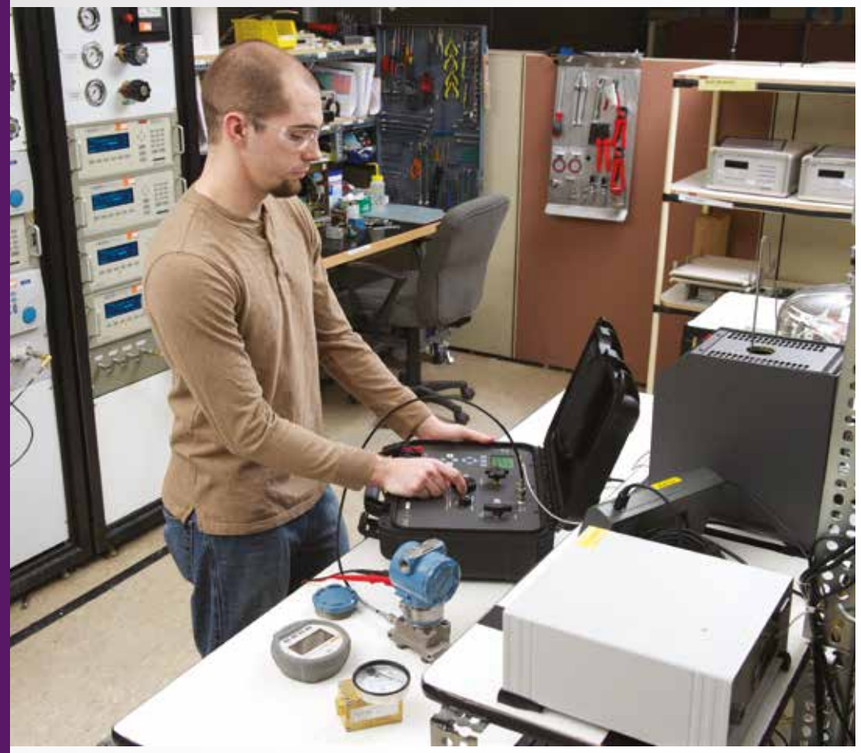
FLUKE

TECH TIPS

Sometimes it is necessary to trim the input sensor of the transmitter more than once. It is critical that the pressure module be zeroed before test and adjustment. For best ßadjustment success:

- After pressing Fetch for the pressure measurement, select the trim button quickly before the pressure measurement changes.
- Give the measured mA and pressure time to settle for best measurement results.
- Always de-bug the pressure test setup for leaks in the shop before going to the field, including installing the pressure module connection adapter to the hand pump.
- If the full scale value of the transmitter is less than 25 % of the full scale of the pressure module, select a lower range pressure module for best results.
- If performing higher pressure calibrations with a hydraulic pump, use the correct fluid such as mineral oil or de-ionized water. Standard tap water will leave deposits in the pump and cause erratic operation, leaks or difficulty priming.
- If the pass/fail accuracy is set at the limits for the transmitter, adjust the transmitter if the errors are greater than 25 % of limits.
- If the errors are less than 25 % of limits, it might be best to not adjust the transmitter as adjusting might make it less accurate.

Pressure transmitter calibration – at the bench



Technicians calibrate at the bench to ensure calibrations are effective and don't result in degradation of performance. They ensure that all components are in good working order prior to installation, and can evaluate them when component failure is suspected. The bench provides a stable ambient environment for calibration, an opportunity to use the most accurate equipment, and protection from factory conditions during the commissioning, testing, and calibration of pressure transmitters.

Suggested test tools

Fluke 3130 Portable Pressure Calibrator

See pg 14

Fluke 754 Documenting Process Calibrator–HART

See pg 5

Fluke 719Pro Electric Pressure Calibrator

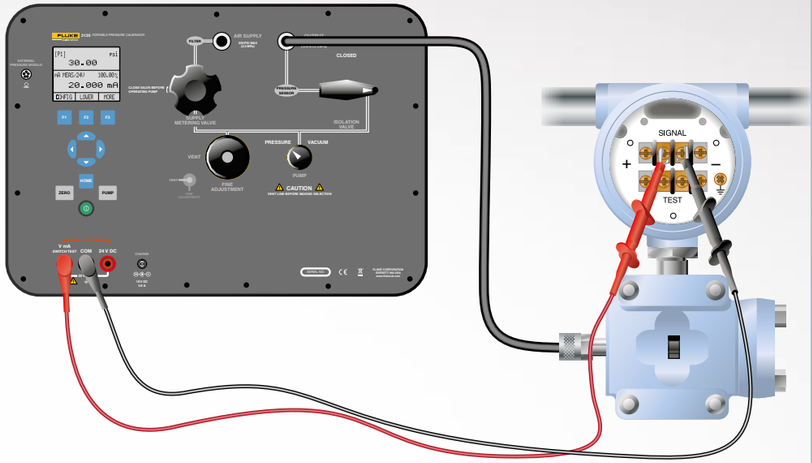
See pg 11

P3000 Hydraulic Deadweight Testers

See pg 14

Fluke 700PTP–1 Pneumatic Test Pump

See pg 23



To perform the test:

STEP 1 Connect the transmitter test hose from the calibrator to the transmitter

STEP 2 Connect the mA measurement jacks of the calibrator to the transmitter

STEP 3 Set the pressure/vacuum selection knob to the necessary function

STEP 4 Close the vent knob and supply metering valve

STEP 5 Apply pressure or vacuum from the pump by holding down the pump button and release when the necessary pressure is reached

STEP 6 Correct the pressure with the fine pressure adjustment

STEP 7 Read the reference pressure and the current output of the transmitter from the display

STEP 8 Repeat for all test points. If the measured mA signal at the test points is found within tolerance the test is complete. If not, then adjustment is required.

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

How to use a deadweight tester
Fluke 719 electric pressure calibrator demonstration

Transmitter Calibration with the Fluke 750 Series DPC
HART transmitter calibration

TECH TIPS

- Inaccurate calibration equipment will only degrade the performance of the transmitter.
- Manufacturers recommend using precise calibration equipment under stable, ambient conditions for best results.
- Commission transmitters at the bench so security settings and protection for failure modes can be set before exposing transmitter electronics to factory conditions.

Pressure switch testing– manual approach

Accurate calibration of pressure switches is a critical step in ensuring process quality and the safe operation of equipment. The setup is similar to pressure gauge calibration except now a voltage or continuity across a set of switch contacts needs to be read either by a (Digital Multimeter) DMM or the calibrator. The purpose of the calibration is to detect and correct errors in the set point and deadband of the pressure switch. Calibrators can save you time by reducing steps and reducing the amount of equipment you have to bring to the job. With the right calibrator the entire process can be automated.

Suggested test tools

Fluke 754 Documenting Process Calibrator–HART

See pg 5

Fluke 719Pro Electric Pressure Calibrator

See pg 11

Fluke 3130-G2M Portable Pressure Calibrator

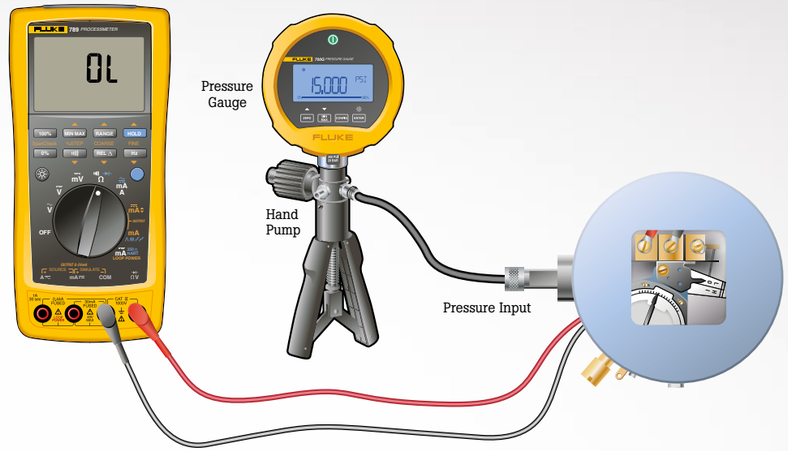
See pg 14

Fluke 750P Series Pressure Modules

See pg 12

Fluke 700PTP-1 Pneumatic Test Pump

See pg 23



To perform the test:

Setup

STEP 1 Safely disconnect the device from the process it controls.

STEP 2 Connect the calibrator or DMM to the common and NO (normally open) output terminals of the switch. The DMM or calibrator will measure an "open circuit". if measuring continuity. If measuring V ac be sure the tool is properly rated for the voltage being measured.

STEP 3 Connect the pressure switch to a pressure source such as a hand pump connected to a gauge.

Rising pressure

STEP 4 Increase the source pressure to the setpoint of the switch until the switch changes state from open to close. Manually record the pressure value when the DMM indicates a "short circuit" or if using a calibrator it will record the value for you.

Falling pressure

STEP 5 Continue to increase the pressure until the maximum rated pressure. Slowly reduce the pressure until the switch changes state again, and resets from closed to open, then record the pressure.

Calculation

STEP 6 The setpoint pressure was recorded when the pressure was rising. The deadband value is the difference between the rising setpoint pressure and the falling pressure reset point.

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

See the pressure switch test video at: www.fluke.com/pressureswitch

Calibrating pressure switches with a DPC

TECH TIPS

When you use a Fluke 754 or 3130 to automate the pressure switch calibration, vary the applied pressure slowly, back and forth across the setpoint and reset points. The display will make it apparent that the set/reset has changed and the actuals will be logged.

Pressure switch testing—documented

Classic methods for pressure switch testing have been superseded with the introduction of new pressure test tools. Today most pressure switches are tested with a pressure gauge mounted to a pump to supply and measure pressure, and a DMM set to continuity to verify the opening and closing of the switch. The technician or electrician making the test is required to interpret the pressure applied to the switch when the continuity beeper sounds indicating contact closure of the switch. A workable solution but new tools can make this task easier.

Modern calibrators can automatically record the pressure applied when a pressure switch changes from open to closed and from closed to open. In doing so the switch set point and reset point and deadband are much easier to determine.

Suggested test tools

Fluke 754 Documenting Process Calibrator–HART

See pg 5

Fluke 750P Series Pressure Modules

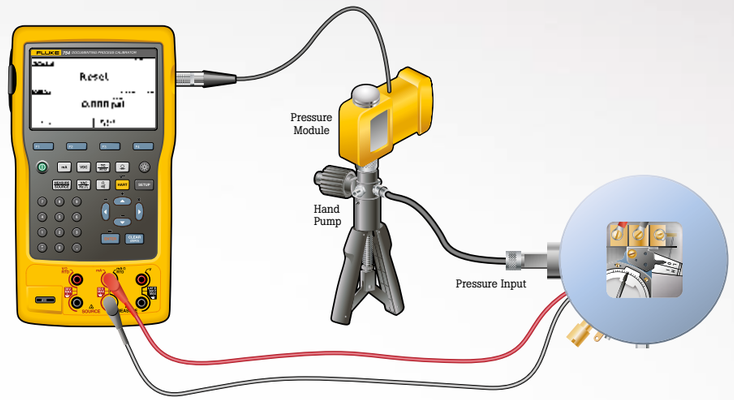
See pg 12

Fluke 700PTP–1 Pneumatic Test Pump

See pg 23

Fluke 71X Hose Kit Accessory

See pg 23



To perform the test:

With a modern documenting calibrator you can test for dry contacts opening and closing on the switch or if you are using the Fluke 753 or 754 you can leave the switch connected to the live voltage and the calibrator will measure the changing AC voltage and interpret it as opening and closing of the switch.

One cautionary note: it is always safer to test a de-energized circuit, but this is not always possible. Also, do not measure AC voltages above 300 V ac as that is the maximum rating of the 75X family. 480 V ac 3-phase voltages must be de-energized and disconnected from the switch if testing with the 75X family.

STEP 1 To get started testing the switch, connect as shown above. In this example we will test dry contacts and continuity. To measure continuity for the test select resistance measurement. Then toggle to the source screen mode and select pressure to display the pressure generated by the hand pump and measured by the pressure module. Advance the calibrator mode to the split screen test mode.

STEP 2 The next step is to describe the switch and whether it is normally open or closed at ambient pressure. The relaxed state of the switch is the reset state. The set state is the condition of the switch it changes to with applied pressure or vacuum. In this example the switch is normally open and is expected to close when the pressure applied exceeds 10 psi. Next the allowable pressure variance of the switch set state and deadband size needs to be defined. In this example the ideal switch set value is 10 psi and is allowed +/- 1 psi of deviation. The allowable reset pressure is described in the deadband tolerance. In this instance the reset state must be more than 1 psi less than the found set pressure but not greater than 3 psi less than the found set pressure.

STEP 3 Once the test tolerances are fully defined start the test. Increase the pressure until the calibrator captures the set state pressure value. Then decrease the pressure until the reset pressure is found. Repeat increasing and decreasing the pressure across the switch looking for repeatability in your set and reset pressure measurements. Once satisfied with the result press done to get the pass/fail evaluation of the switch. If the switch fails the test adjustment or replacement of the switch may be required. If the switch is adjusted repeat the test to document the As-Left condition of the switch before putting back into service. The test result is now documented and ready for upload to calibration management software.

TECH TIPS

- The key to a good switch test is repeatability. Repeatability is best achieved by applying a slow change in pressure to the switch as it approaches its set or reset pressure.
- When performing the test find out where the switch sets and make sure the vernier/fine adjustment of your test pump has enough adjustment to vary the pressure up to the set point. In this way the pressure can be changed slowly capturing an accurate switch set point pressure. Repeat this procedure for the reset point.
- With practice you can get the vernier of the pump within range of the set and reset point pressure and get excellent repeatability of your tests (within the limitations of the switch being tested).

Additional resources

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

Pressure switch video

Pressure switch application note

Pressure calibration application note

Gas custody transfer flow computer calibration

Gas custody transfer flow computers that calculate flow in pipelines by measuring the differential pressure across a flow restriction, such as an orifice plate or other differential pressure flow device, require special calibration to perform at optimum accuracy. Gas flow computers make three primary measurements to calculate flow: volumetric flow (difference in pressure across the orifice plate), static pressure in a pipeline and gas temperature. A calculation is performed using this data to determine the actual mass and volume of the gas flowing through the pipeline.

These calibrations can be made with three separate calibrators, a low pressure, high pressure and a temperature calibrator or use a multifunction calibration tool designed for this specific task.

An example of a calibrator purposed for this task is the Fluke 721 or 721Ex. It has two built-in pressure ranges and the ability to measure temperature. The most popular configuration is 16 psi/1 bar on the low pressure (P1) sensor side and 1500/100 bar or 3000 psi/200 bar on the high pressure (P2) sensor side. It measures temperature using a precision RTD accessory and can display all three measurements at once if desired.

Suggested test tools

Fluke 721 Precision Dual Range Pressure Calibrator

See pg 12

Fluke 700G Precision Pressure Gauge Calibrator

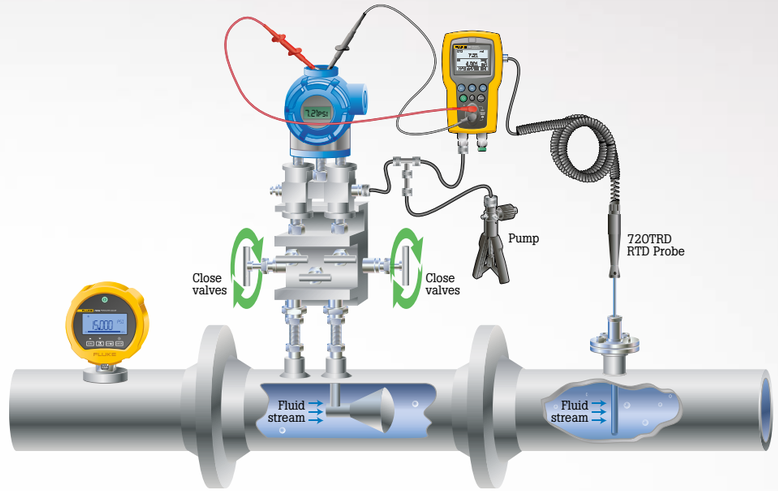
See pg 13

Fluke 754 Documenting Process Calibrator–HART

See pg 5

Fluke 750P Series Pressure Modules

See pg 12



To perform the test:

To get started, isolate the flow computer from the pipeline. It is normally installed with a 5 valve manifold. If so, closing the valves on the pipeline side of the manifold should isolate it. Be sure to follow local policy and safety procedures when performing this isolation step. Set the P1 sensor of the 721 to measure inH20 and the P2 sensor to measure PSI and the temperature sensor to measure degrees Celsius or Fahrenheit as needed.

STEP 1 **Low pressure differential pressure calibration** is performed using atmospheric pressure as a low side reference. Vent the low connection of the flow computer or pressure transmitter and connect the high pressure connection of the flow computer or transmitter to the low pressure port (P1) on the calibrator.

Connect the computer (PC) to the flow computer serial or USB port. The PC will instruct the user to apply one or more test pressures to the flow computer or transmitter. For example, 0, 100 and 200 inH20. Squeeze the pump to get close to the test pressure and use the vernier or fine pressure adjust to dial in.

STEP 2 **Static pressure calibration** will normally be applied to either the same high pressure port of the flow computer or both the high and low pressure ports. Refer to the manufacturer's instructions for details. Connect the high pressure sensor input (P2) to the appropriate port on the flow computer or transmitter and to the high pressure test source. The PC will instruct the pressures for the user to apply from the pressure source.

STEP 3 **Temperature calibration** of the temperature measurement on the flow computer is done with a single temperature point at the pipeline operating temperature. Insert the RTD probe into the test thermowell and allow time for the measurement to stabilize.

The PC will prompt the user to enter the temperature measured by the calibrator. Remove the RTD from the test thermowell and the calibration is complete.

STEP 4 **Flow Computers with 4 to 20 mA inputs:** Many flow computers utilize a low pressure, static and temperature transmitter to convert the measured parameters into 4 to 20 mA signals. In this instance these transmitters may need individual calibration if the test results are not satisfactory (see HART Transmitter Calibration application note or video for more details). Another source for errors in this configuration is the input A/D cards of the flow computer. These can be independently tested using a mA signal source from a loop calibrator.

FLUKE

TECH TIPS

- Always center the vernier of your hand pump before starting any pressure calibration. This will allow you to increase or decrease the pressure when making fine adjustments.
- Store the temperature probe in a protective case such as the built in slot of the 721 soft case. Exposing the RTD probe to mechanical stress can reduce the measurement accuracy of the probe.
- **Be careful to not connect the P1 low pressure side of the calibrator when doing high pressure calibrations or measurement or the sensor will be damaged and possibly rupture creating a dangerous condition.**
- Inserting the RTD probe prior to the pressure calibrations typically allows sufficient time to reach a stable temperature measurement.

Additional resources

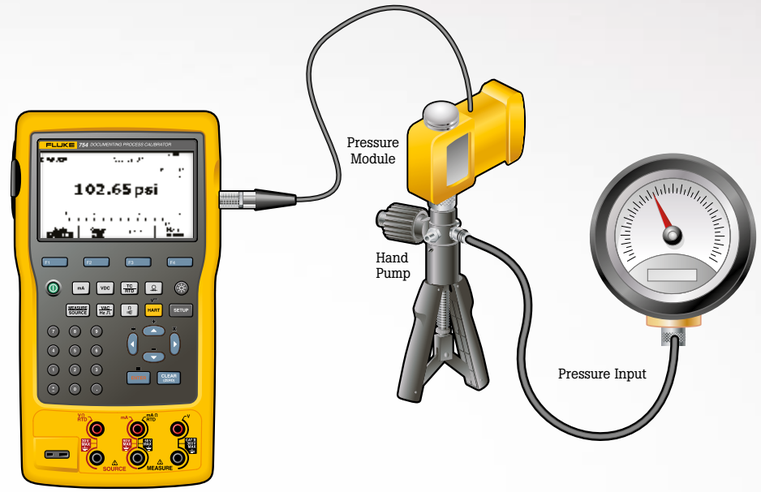
For more in depth information about this application check out these videos and application notes from Fluke.

HART pressure and HART smart RTD transmitter 754 videos

Custody Transfer calibration application note
HART transmitter calibration

Verifying process gauges, analog and digital

Both analog and digital process gauges need to be verified to detect errors related to drift, environment, electrical supply, addition of components to the output loop, and other process changes. Pressure gauges may be verified in the field or at the bench. Field calibration may save time, and allows for troubleshooting in the process environment. Multifunction calibrators make it easier to do this with one tool, and documenting calibrators make it easier to follow procedures, capture data and document results. Bench calibration provides an environment where the gauge can be cleaned, inspected, tested, and recertified under reference conditions for the best possible accuracy.



To perform the test:

STEP 1 Isolate the pressure gauge from the process using valves, or by removing the gauge from the process.

STEP 2 Connect the gauge to the calibrator or reference gauge. For hydraulic pressure gauges it's important to remove any gas that might be trapped in the fluid in the gauge, calibrator, and connections by priming the system. When generating pressure allow a few moments for stability. Compare the reading of the gauge under test with the master gauge or calibrator.

STEP 3 For hydraulic pressure gauges it's important prime the system. This will remove any gas that might be trapped in the fluid in the gauge, calibrator or connections.

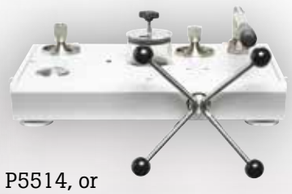
STEP 4 When generating pressure allow a few moments for the measurement to stabilize. When using a hydraulic hand pump as a source it can take several minutes for the pressure to stabilize due to the thermodynamic effect of fluids.

STEP 5 Compare the reading of the gauge under test with the master gauge or calibrator.

Suggested test tools

Traditional and Electronic Dead-weight Testers

See pg 14–15



P5514, or P5515 Hydraulic Pressure Comparator

See pg 13

2700G Series Reference Pressure Gauges

See pg 13

Fluke 3130 Portable Pressure Calibrator

See pg 14

TECH TIPS

- Safety First! Check all fittings, adapters and connecting tubing ratings for pressures used.
- Remember to tap analog gauges at each point due to friction in mechanical parts.
- Gas is preferred for cleanliness requirements but use caution when generating pressures above 2,000 psi.
- Industry standards usually desire calibration equipment to be 4–10 times more accurate than the device under test.
- When in the field, connect pressure gauges through a manifold or "tee" connector.
- Use adapter fittings when workloads require calibrating a wide variety of gauges.
- Consider first, the in-use orientation of a device and use an angle adapter at the bench to achieve similar orientation.
- Use a liquid-to-liquid separator to prevent contamination in hydraulic applications.

Additional resources

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

How to use a deadweight tester
Fluke 719 electric pressure calibrator demonstration

Transmitter Calibration with the Fluke 750 Series DPC
HART transmitter calibration

Calibrating at the bench with a deadweight tester

A deadweight tester is a proven method of pressure calibration that is usually chosen for bench applications when accuracy and reliability are the top requirements. Calibrations are performed at the bench for convenience and to maintain reference conditions. The bench is a convenient location to clean, inspect, calibrate and repair with all the necessary equipment available. Reference conditions are necessary to achieve the reference accuracy of the device under test and the calibration standards. Reference accuracy may be required to maintain the necessary test uncertainty ratios (TUR).

Suggested test tools

Using liquid:

P3100, P3200, or P3800 Series Hydraulic Dead-weight Tester

See pg 15

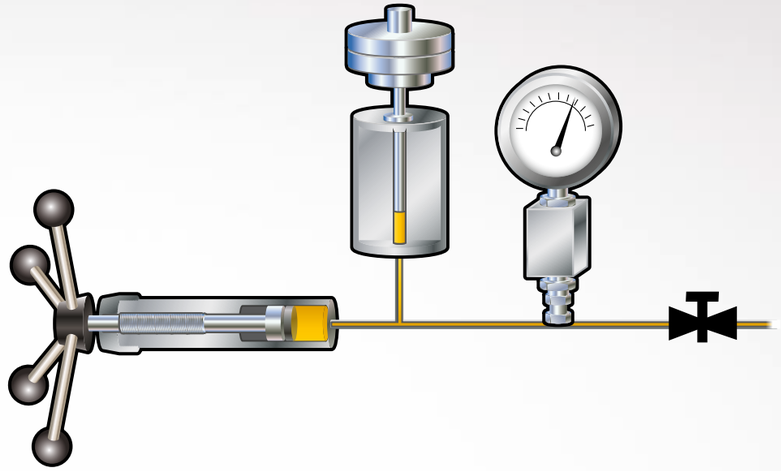
6531, 6532 Electronic Deadweight Tester

See pg 15

Using gas:

P3000 Series Pneumatic Deadweight Tester

See pg 14



To perform the test:

STEP 1 The pressure gauge should be mounted in the same orientation (vertical or horizontal) as in the process.

STEP 2 Measurement points should be distributed uniformly over the calibration range.

STEP 3 Calibrated weights are placed on the instrument corresponding to the measurement points.

STEP 4 Pressure is added with an internal pump or screw press until the piston holding the weights begins to float.

STEP 5 The piston and weight are spun by hand to minimize friction.

STEP 6 While the piston is floating the reading on the device under test is com-pared to the pressure corresponding to the sum of the selected weights.

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

Check out the 700G videos.

700G Data Sheet.
Interpreting Specifications for Process Calibrators, Application Note

FLUKE

TECH TIPS

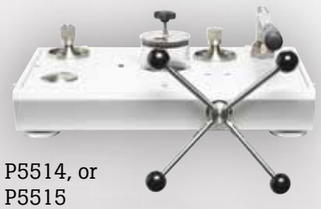
- Deadweight tester weights are calibrated to match a wide range of pressure units.
- Local gravity often is the largest factor affecting accuracy. Use Fluke PRESSCAL software to achieve accuracy of +/- 0.008%.
- To increase the number of available set points, use incremental weight sets.
- Forgo wrenches or PTFE tape by using adapters to fit multiple sizes and types of devices with leak tight seals to 20,000 psi.
- Safety First! Choose fittings, tubing and seals with pressure ratings above the full scale of the instrument.
- Hydraulic systems are preferable to gas systems for pressures above 2000 psi due to safety and ease of use.
- Consider achieving cleanliness using distilled water as a media or use a liquid separator from Fluke instead of gas.
- Lubrication can improve performance by using oil when it is allowed.

Calibrating at the bench with a pressure comparator

A pressure comparator is a convenient instrument for bench pressure calibration. Bench calibrations are performed to maintain reference conditions and to obtain the lowest possible uncertainties. The bench is also a convenient place to inspect, adjust, and repair the devices under test.

Suggested test tools

Using liquid:



P5514, or
P5515
Hydraulic Pressure Comparator

See pg 13

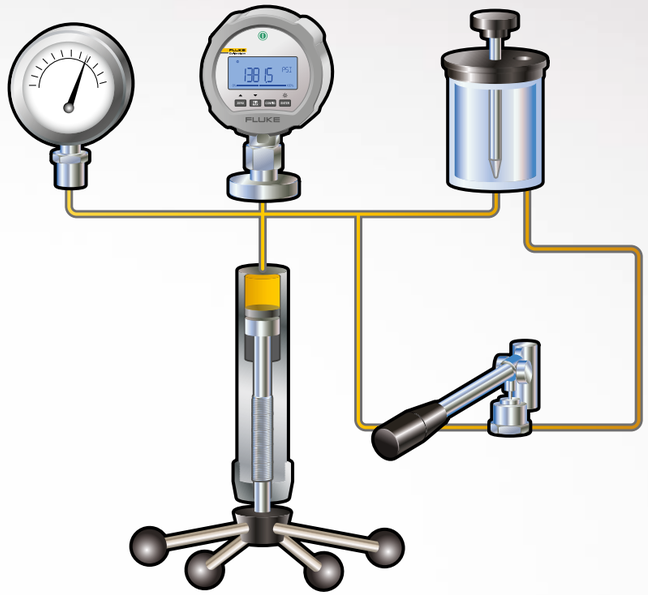
Using gas:

P5510, or P5513
Gas Pressure Comparator

See pg 12

2700G Series
Reference Pressure Gauges

See pg 13



To perform the test:

STEP 1 The pressure gauge should be mounted in the same orientation (vertical or horizontal) as in the process. An angle adapter such as the P5543 may be used.

STEP 2 The reference pressure gauge (2700G) should be mounted such that the display is easily seen.

STEP 3 For hydraulic comparators prime the fluid with the priming pump, to remove any bubbles.

STEP 4 Measurement points should be distributed uniformly over the calibration range. Conveniently source pressure with a manual pump up to 300 psi, after that use an external pressure supply.

STEP 5 For gas comparators use the fine needle valve or fine adjustment screw press to precisely meter the pressure.

STEP 6 With hydraulic models use the screw press to source and fine adjust the pressure.

STEP 7 The source pressure can be adjusted until the device under test is reading a nominal pressure or until the reference gauge reads the nominal pressure.

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

Check out the 700G videos.

700G Data Sheet.
Interpreting Specifications for Process Calibrators, Application Note

FLUKE

TECH TIPS

- Use a reference gauge with better accuracy to meet test uncertainty ratios over a wider range of pressures.
- Forgo wrenches or PTFE tape by using adapters to fit multiple sizes and types of devices with leak tight seals to 20,000 psi.
- Safety first! Always use fittings, tubing, and seals with pressure ratings above full scale of the instrument.
- If possible use oil for better lubrication.
- Use gas to improve cleanliness or a liquid-to-liquid separator available from Fluke.
- Hydraulic systems are preferable to gas systems for pressures above 2000 psi due to safety and ease of use.

Use and selection of hand pumps and pressure test gauges for field pressure testing

It's important to select the proper pump and gauge to match the testing application at hand—a good guideline is the testing device should be 4–10 times more accurate than the device being tested. To achieve this, match the measurement to be made as closely to the full scale value of the test gauge. This delivers the best accuracy from the gauge.

Suggested test tools

Fluke 700G Precision Pressure Gauge Calibrator

See pg 13

Fluke 700PTPK2 Pneumatic Test Pressure Kit

Fluke 700HTPK2 Hydraulic Test Pressure Kit

Fluke 700TTH 10K Transmitter Test Hose

See pg 23

To perform the test:

STEP 1 The pressure gauge should be mounted in the same orientation (vertical or horizontal) as in the process.

STEP 2 The reference pressure gauge (2700G) should be mounted vertically.

STEP 3 For hydraulic comparators prime the fluid with the priming pump, to remove any bubbles.

STEP 4 Measurement points should be distributed uniformly over the calibration range. Conveniently source pressure with a manual pump up to 300 psi, after that use an external pressure supply.

STEP 5 For gas comparators use the fine needle valve or fine adjustment screw press to precisely meter the pressure.

STEP 6 With hydraulic models use the screw press to source and fine adjust the pressure.

STEP 7 The source pressure can be adjusted until the device under test is reading a nominal pressure or until the reference gauge reads the nominal pressure.

Additional resources

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

Check out the 700G videos.

700G Data Sheet.
Interpreting Specifications for Process Calibrators, Application Note

TECH TIPS

- The key to a good experience in using a hand pump, either pneumatic or hydraulic, is to test and debug your test setup in the shop before going to the field. Minimizing the number of pressure connections minimizes the probability for leaks. Mount the test gauge carefully to the test pump in the shop.
- Be sure to consider the hoses that connect from the hand pump to the device to be tested. There are a variety of specialty "no tools required" connectors to connect to the test hose to make this easy. If these connectors are not available be sure to have a variety of adapters, wrenches and PFTE sealing tape to be able to connect from the test hose to the input port of the device for testing. If using "push fit" hoses it is likely they will eventually leak. Each time – a push fit hose is connected, it leaves a mark on the test hose and eventually does not seal well. To eliminate the leak cut off the affected portion of the test hose so there is a clean surface to connect to. This process will need to be repeated with use.
- When attempting to get maximum pressure out of a pneumatic pump, adjust the fine adjust vernier all the way to down to the stop so turning the vernier increases the pressure. When approaching the target pressure use the vernier to increase to your target pressure.
- When using hydraulic hand pumps remember the thermodynamic effect. Once any fluid is compressed, the temperature increases and the fluid expands. This becomes obvious when pumping to a target pressure with a hydraulic pump. Once the target pressure is met the fluid has expanded. As the fluid cools and contracts the pressure quickly bleeds down until it reaches temperature equilibrium, this can take 5 minutes or more. Once the temperature stops changing, dial the desired pressure back in with the vernier adjuster.

Temperature Applications

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.

APPLICATION SELECTION GUIDE

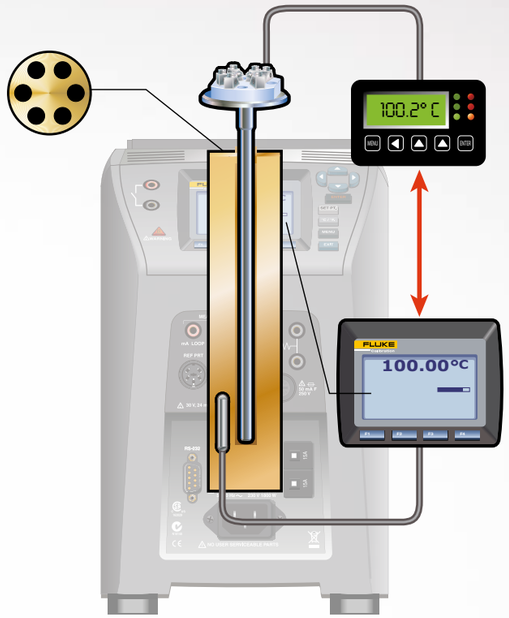
Model number	75X	72X	712B/ 714B	1551A/ 1552A	1523/ 1524	914X	7526A	418X
Application								
Calibrate and test RTD sensors	*▪	*▪	*712B	*	*	Ideal	*▪	
Calibrate and test thermocouple sensors	*▪		*714B	*	*	Ideal	*	
Simulate RTDs		▪	712B				▪	
Simulate thermocouples		▪	714B				▪	
Generate precision temperatures						▪		
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		

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

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.



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).

Suggested test tools

9144 Field Metrology Well and 5615 Secondary Reference Temperature Standard

See pg 17

9102S Handheld Dry-Well

See pg 18

9100S Handheld Dry-Well

See pg 18

9009 Industrial Dual-Block Thermometer Calibrator

See pg 18

726 Precision Multifunction Process Calibrator

See pg 6

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

See pg 19 and 20

FLUKE

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 17

9100S Handheld Dry-Well

See pg 17

9150 Thermocouple Furnace

See pg 19

6102 Micro-Bath Thermometer Calibrator

See pg 19

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).

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

712 RTD Temperature Calibrator

See pg 17

714 Thermocouple Temperature Calibrator

See pg 17

7526A Precision Process Calibrator

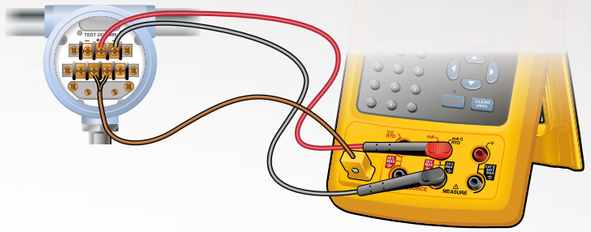
See pg 5

726 Precision Multifunction Process Calibrator

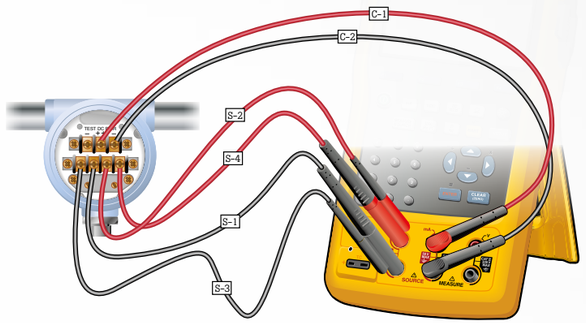
See pg 6

754 Documenting Process Calibrator

See pg 5



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 20

1524-P1
Reference
Thermometer

See pg 20

1551A Ex "Stik"
Thermometer
Readout

See pg 20

1552A Ex "Stik"
Thermometer
Readout

See pg 20

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.

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

TECH TIPS

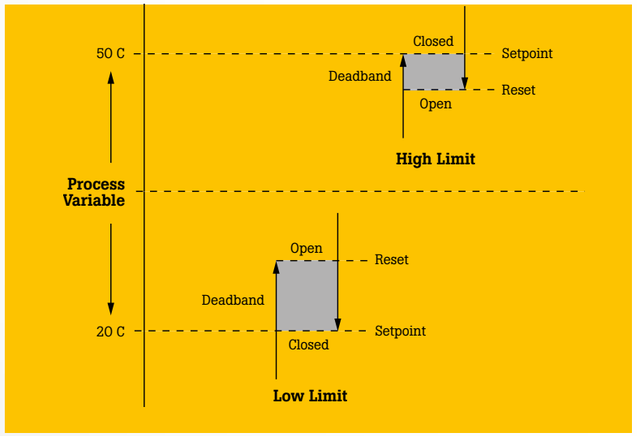
- For this type of application a battery powered digital thermometer is usually preferred.
- A graphing display helps the technician visualize trends such as stability quickly and easily.
- Ensure that both the probe and the readout of your temperature standard have traceable calibration certificates 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.

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 17

714B Thermocouple Temperature Calibrator

See pg 17

7526A Precision Process Calibrator

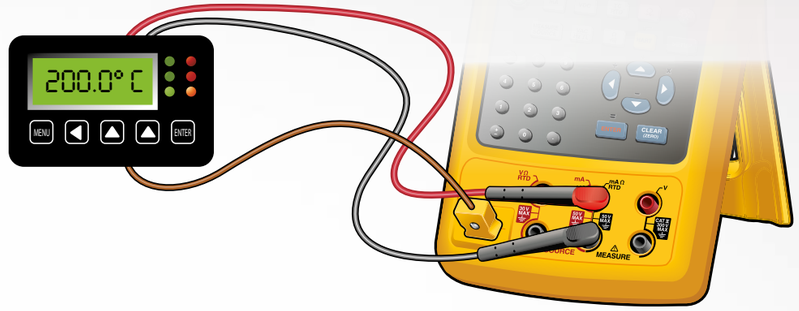
See pg 5

726 Precision Multifunction Process Calibrator

See pg 6

754 Documenting Process Calibrator

See pg 5



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

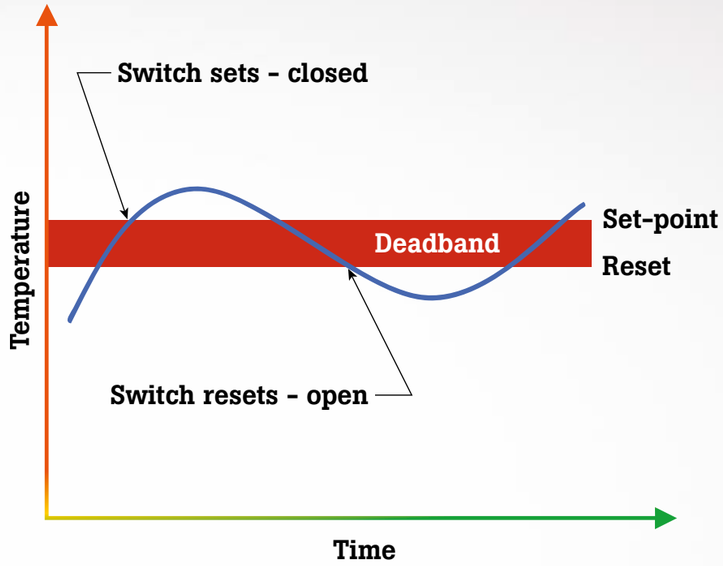
Temperature switch and controller testing at the bench

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.



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).

Suggested test tools

9142, 9143, 9144 Field Metrology Wells

See pg 17

6102 Micro-Bath Thermometer Calibrator

See pg 19

7103 Micro-Bath Thermometer Calibrator

See pg 19

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.

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).

Suggested test tools

7103 Micro-Bath Thermometer Calibrator

See pg 19

7102 Micro-Bath Thermometer Calibrator

See pg 19

6102 Micro-Bath Thermometer Calibrator

See pg 19

1523-P1 Reference Thermometer

See pg 20

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.

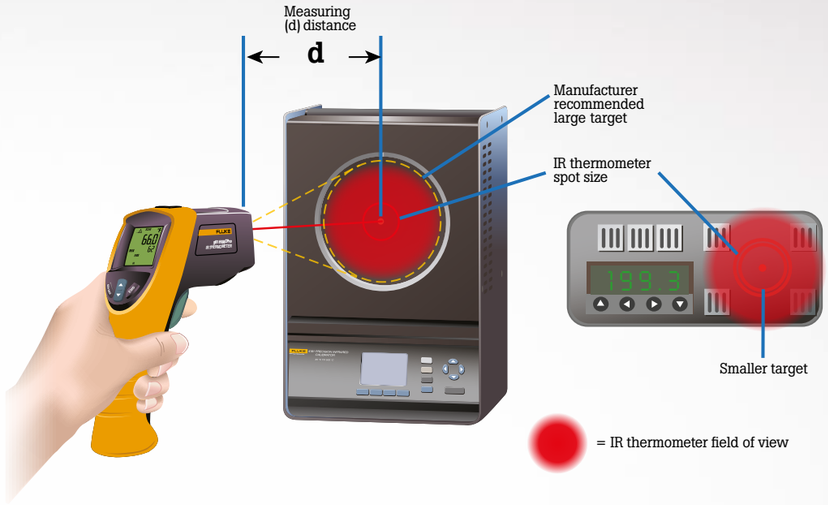
Suggested test tools

4181 Precision Infrared Calibrator

See pg 19

4180 Precision Infrared Calibrator

See pg 19



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.

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

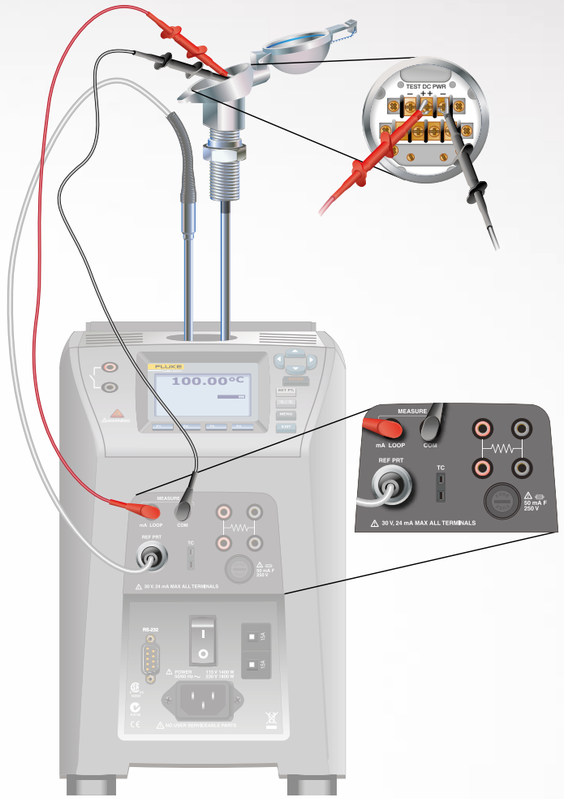
TECH TIPS

- 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.

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.



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.

Suggested test tools

9142, 9143, 9144 Field Metrology Wells

See pg 17

7526A Precision Process Calibrator with temperature source

See pg 5

754 Documenting Process Calibrator with temperature source

See pg 5

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

Fluke. *Keeping your world up and running®*

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