

# 4322 Automated Pressure Calibration System



























## **Présentation du produit: 4322 Automated Pressure Calibration System**

### **4322 Automated Pressure Calibration System Components**

#### **4322 Pressure Controller**

The 4322 Pressure Controller is the primary component of the 4322 Automated Pressure Calibration System and is itself a highly capable calibrator. Very wide range measurement and control capabilities and advanced features are packed into one transportable, easy-to-use package.

##### **Simple, accurate pressure measurements**

The 4322 Pressure Controller provides 0.1% of reading total one-year measurement uncertainty from low pressure to 10,000 psi (70 MPa). The simple yet accurate percent-of-reading measurement performance enables you to calibrate a wide range of workload with confidence that the test uncertainty ratio (TUR) is adequate.

Four plug-and-play pressure measurement modules and a barometric pressure module are responsible for the pressure controller's very wide measurement range. The 4322 switches module ranges automatically and seamlessly during use to utilize the best pressure module for each test point and operation mode.

All pressure modules store characterization and calibration information onboard and are interchangeable between systems to simplify calibration support and prevent downtime. Modules can be removed easily and replaced through the front panel with finger-tight fasteners.

Each 4322 Pressure Controller pressure measurement module features three redundant pressure sensors. The output of the three sensors is averaged automatically to reduce overall measurement uncertainty. The patented CalCheck feature automatically monitors and compares all three sensors to detect damage or out-of-tolerance conditions in the module, preventing potential measurement escapes before they can result in critical errors and costly recalls.

##### **Automated pressure generation and control**

The 4322 Pressure Controller features automated pressure control from low absolute and negative gauge pressures to 10,000 psi (70 MPa). With breakthrough high-speed piezoresistive valve technology, the 4322 Pressure Controller can set and precisely control pressure to its highest range more quickly than even any other high-end benchtop or rack-mount controller available.

The pressure controller also features onboard automated vacuum and pressure generation and control, for calibrating devices from less than 1 inHg (0.5 psi, 3.5 kPa) absolute to 300 psi (2 MPa), without any external pressure or vacuum source. Patented pump-control technology enables the pressure controller to control faster, generate lower absolute pressure and control more precisely than other pump-based pressure calibrators.

The 4322 Pressure Controller offers adjustable control setting and multiple control modes to most efficiently meet the precision needs for the UUT being calibrated.

### Integrated contamination prevention system

The 4322 Pressure Controller features an integrated contamination prevention system (CPS) to prevent contamination that can lead to costly downtime, damage and measurement errors. The CPS prevents liquid and particulate contamination from entering the pressure controller by maintaining unidirectional flow away from the controller. Upward pressure excursions are accomplished when the controller introduces clean supply gas into the test circuit through the CPS. Downward pressure excursions are accomplished through a purge solenoid valve located on the CPS, external to the pressure controller. Rather than being drawn into the controller, the gas and any liquid it has drawn out of the UUT are expelled through the CPS into a waste bottle for disposal.

As an extra level of protection against cross contamination of UUTs, Fluke Calibration designed the CPS to be modular and easily exchanged. You can remove and replace a CPS module from the 4322 Pressure Controller in just seconds and with only one hand. Color-coded CPS modules are available to separate “clean” from “dirty” service. You can open and clean the CPS assembly itself in just minutes without tools.

### Intuitive user interface

The 4322 Pressure Controller features rubberized direct function keys for common operations and a keypad for numerical entry. A rotary selection/jog wheel allows you to quickly increase and decrease pressure during a pressure calibration and navigate efficiently through the menus.

The advanced graphical user interface (GUI) makes it easy to review and edit calibrator settings; set up, store and execute test profiles; and store and output results. The 4322 also features a full library of remote SCPI operation functions that you can access through USB 2.0 type B, IEEE 488.2 or RS-232 connections for full automation.

Despite being one of the most advanced, high-performance and feature-packed pressure calibrators available, the GUI makes the 4322 Pressure Controller remarkably easy to use. The “Normal” operating mode makes everyday calibration activities simple to perform, while the “Advanced” mode enables more experienced users to fully utilize the advanced features.

In “Normal Mode” operation, only necessary information is displayed as you are prompted through setup and execution of a calibration. The top half of the display consists of a window that clearly communicates pressure measurement and control values and settings. The bottom half of the display houses an instructional menu system that guides you step by step as you set up and execute pressure calibration sequences in an intuitive, linear workflow process. Calibration results with pass/fail criteria are displayed during the calibration and can be saved for electronic download at a later time.

“Advanced Mode” allows you to control and measure pressure without stepping through a structured calibration sequence. Use this mode to access settings, data, and less-frequently needed information.

## 4322 Pressure Intensifier

The 4322 Pressure Intensifier boosts supply gas from the N2 gas cylinder or other source of clean gas medium to as

high as 10,500 psi for high-pressure calibrations.

The pressure intensifier employs a patented rotary cam design that drives four pistons to quickly generate the targeted output pressure. Because pressure is generated by four pistons operating in series with alternating compression cycles, the 4322 Pressure Intensifier produces smooth high-pressure output, instead of the significant pressure surges typical with traditional single-piston gas boosters.

The pressure intensifier is powered by a high-performance brushless servo motor drive with variable speed control, resulting in quiet operation that does not require facility-grade compressed air to drive it, or liquid lubrication.

To operate, simply select the target intensifier pressure from 1,000 to 10,000 psi (7 to 70 MPa) in 1,000 psi (7 MPa) increments by pushing the appropriate key on the pressure intensifier's membrane keypad. The pressure intensifier controls the variable speed motor to generate and actively maintain the pressure supplied to the pressure controller.

The 4322 Pressure Intensifier generates pressure fast enough to keep pace with the 4322 Pressure Controller's gas consumption during a typical calibration. On-demand pressure generation saves you from having to pre-charge a high-pressure accumulator, thus reducing setup and operation time and improving safety.

## 4322 accessories

Accessories enable you to optimize a 4322 Automated Pressure Calibration System for various applications.

### Handheld Remote Control Pendant

Worksites do not always allow easy access to pressure measurement devices for calibration. The 4322 Handheld Remote Control Pendant enables you to calibrate even the most difficult-to-reach pressure devices while safely and effectively positioning both user and equipment.

The remote pendant is lightweight, compact and rugged. A rotary wheel, rubberized function keys and backlit graphical user interface mimic the controls and user interface on the 4322 Pressure Controller to allow one-handed pressure control and step-by-step execution of calibration sequences. The remote pendant features electrical switch test connections and test leads for fully automated pressure switch testing.

When combined with an optional 10 ft. (3 m) test hose, you can operate with agility in a tight or difficult workspace.

You might use the pendant to perform tasks like these:

- Operate the calibrator while reading the output of the UUT at a remote terminal, or from an otherwise obstructed angle.
- Set the calibrator on the floor or other stable surface while reading the output of the UUT at a different height.
- Stand at a safe distance or behind a barrier when performing calibrations in a hazardous location.

### Portable compressed gas cylinder assembly

An optional portable compressed gas cylinder is available to supply gas to the 4322 Pressure Calibration System for operation above the maximum pressure controller pump pressure of 300 psi (2 MPa). The lightweight, aluminum cylinder features a shut-off valve with protective valve guard and a soft shoulder strap for portability.



The cylinder can be charged with up to 2,000 psi (14 MPa) supply gas for in-situ calibration. A removable self-venting regulator and high-pressure supply hose with quick-connection adaptors are included so you can quickly and safely connect the cylinder to the 4322 Pressure Controller or Pressure Intensifier.

Note: The 4322 Portable Gas Cylinder is certified according to United States Department of Transportation (USDOT) regulations. Use, refill and transportation of the gas cylinder may be subject to local regulation and/or prohibited from use in certain locations.

## High-pressure flexible hoses and adaptors

The 4322 Automated Pressure Calibration System features test connection and hose options to further improve ease of use and safety.

High-pressure connections in the 4322 Automated Pressure Calibration System feature the Fluke Calibration IQC70 system. IQC70 adaptors are Interlocking quick-connect pressure fittings with working pressure of up to 10,000 psi (70 MPa). The male adaptor (stem) inserts easily into the female adaptor (coupler), where it snaps in and is held in place by retaining pins in the coupler. To disconnect, simply push a collar on the coupler, which releases the stem from the retaining pins. Applying pressure to the connection locks the collar and pins into place, preventing the stem and coupling from disconnecting until pressure is removed from the system.

The supply, output and test ports of the 4322 Pressure Controller, CPS and Pressure Intensifier are IQC70 couplers. IQC70 stem adaptors are available for various pressure connection types and sizes, allowing you to mount UUTs directly and easily to the 4322 Pressure Controller test port during calibration. The innovative IQC70 design allows the stem to rotate in the coupling even when pressurized, so you can position the UUT for best visibility.

Optional 10-foot (3 meter) test hoses are available to extend the test port if the UUT cannot mount directly to the pressure controller. The 4322 test hoses are rated to 10,000 psi (70 MPa) working pressure, yet are extremely light and flexible. A stainless steel braided sheath protects the durable high-pressure hose from accidental pinching or shearing. Test hoses are color-coded consistently with the CPS modules, so you can easily see the difference between “clean” and “dirty” service plumbing.

## Configuring a 4322 Automated Pressure Calibration System

4322 Automated Pressure Calibration System components can be combined in different configurations to meet a variety of needs for portability and performance.

### 4322 Pressure Controller unit only

With only ac mains power, the unit delivers automated vacuum and pressure control and measurement from 0.5 psi (3.5 kPa) absolute to 300 psi (2 MPa).

## 4322 Pressure Controller with portable nitrogen gas cylinder assembly

With a portable compressed gas cylinder or other source of compressed test gas supply, the 4322 Pressure Controller automated pressure control extends to 2,000 psi (14 MPa), or approximate source gas pressure.

## 4322 Pressure Controller with portable nitrogen gas cylinder assembly and pressure intensifier unit

The pressure intensifier unit generates on-demand pressure safely, quickly, and quietly using only ac mains power and compressed gas from a gas cylinder, extending automated pressure control to 10,000 psi (70 MPa).

## Spécifications: 4322 Automated Pressure Calibration System

General Specifications	
<b>Power Requirements</b>	100 V ac to 240 V ac (-15 %, +10 %), 50 Hz to 60 Hz
<b>Maximum Power Consumption</b>	Cooler: 110 VA Intensifier: 250 VA
<b>Operating Temperature Range</b>	0 °C to 50 °C
<b>Storage Temperature Range</b>	-30 °C to 71 °C
<b>Humidity</b>	5 % to 95 %
<b>Vibration</b>	Meets MIL-T-28800D
<b>Altitude (operation)</b>	2,000 m
<b>Weight</b>	Cooler: 12 kg (27 lb) Intensifier: 14 kg (31 lb) Accessory Kit with Handheld Cool: 12 kg (27 lb) Nitrogen Cylinder: 12 kg (26 lb)
<b>Dimensions</b>	Cooler, Intensifier, and Accessory Kit: 32.5 cm Height x 30.5 cm Width x 30.5 cm Depth (13 in Height x 12 in Width x 12 in Depth) Nitrogen Cylinder: 68.5 cm Height x 17.8 cm Diameter (27 in Height x 7 in Diameter)
<b>Remote Communications Interfaces</b>	RS-232, USB type B, IEEE-488.2, USB type A (PCL5 only)
<b>Pressure Range</b>	3.5 kPa (0.5 psi) absolute to 70 MPa (10,000 psi)

<b>Operating Medium</b>	Dry nitrogen supply, or ambient air compressed by on-board pump
<b>Warm-up Time</b>	15 minutes from power on, after at least 60 minutes ambient temperature acclimation time within the working temperature range

#### Cooler, intensifier, and nitrogen cylinder connections

Unit	Name	Type of Fiings [1]	Maximum Working Pressure Limit
Cooler	TEST Port	IQC70 female, located on CPS	70 MPa (10,000 psi)
	SUPPLY Port	IQC70 female	
	Hose Purge	IQC70 male	
Intensifier	SUPPLY Port	IQC70 female	70 MPa (10,000 psi)
	OUTLET Port	IQC70 female	
Nitrogen Cylinder	VALVE	CGA580 nipple	40 MPa (6,000 psi)
	Regulator Outlet	Miniature QC female	20 MPa (3,000 psi)

Notes:

1. IQC70 is a Fluke Calibration interlocking quick connection nominally rated to 70 MPa (10,000 psi).

#### Accessory kit fiings

Name	Type of Fiings[1]	Maximum Working Pressure Limit[2]
FITTING, 1/2 MALE PIPE THREAD (NPT)	IQC70 male	70 MPa (10,000 psi)
FITTING, 1/4 MALE PIPE THREAD (NPT)		
FITTING, 1/8 MALE PIPE THREAD (NPT)		
FITTING, 1/2 FEMALE PIPE THREAD (NPT)		
FITTING, 1/4 FEMALE PIPE THREAD (NPT)		
FITTING, 1/8 FEMALE PIPE THREAD (NPT)		
FITTING, HF4 EQUIVALENT		
FITTING, AN6 FEMALE		
FITTING, AN4 FEMALE		
FITTING, HM4 EQUIVALENT		
FITTING, AN6 MALE		
FITTING, AN4 MALE		
FITTING, 1/4 ID HOSE BARB	IQC70 male	700 kPa (100 psi)
FITTING, 1/8 ID HOSE BARB	IQC70 male	700 kPa (100 psi)

Notes:

1. IQC70 is a Fluke Calibration interlocking quick connection nominally rated to 70 MPa (10,000 psi).

2. Working pressures indicated are for adaptors only. Actual pressure capability may be limited by the integrity or maximum working pressure of the fiing to which the adaptor is connected.

#### Test hoses

Name	Type of Fiings [1]	Maximum Working Pressure Limit
Test Hose 3 m (10 ft)	IQC70 male at one end, and IQC70 female coupling at the other	70 MPa (10,000 psi)
Interconnect hose 1.8 m (6 ft)	IQC70 male at both ends	70 MPa (10,000 psi)
Supply hose 1.8 m (6 ft)	IQC70 male at one end, and miniature QC at the other	20 MPa (3,000 psi)[2]

Notes:

1. IQC70 is a Fluke Calibration interlocking quick connection nominally rated to 70 MPa (10,000 psi).

2. Hose limited to 3,000 psi due to miniature QC used to connect to the fiing on the regulator.

#### Measurement specifications

**Barometer Module Range** 70 kPa to 110 kPa absolute (10 psi to 16 psi)

#### Pressure Transducer Module Ranges [1]

A150k 3.5 kPa to 150 kPa absolute (0.5 psi to 21.5 psi)

G700k 50 kPa to 700 kPa gauge (7 psi to 100 psi)

G10M 700 kPa to 10 MPa gauge (100 psi to 1,500 psi)

G70M 10 MPa to 70 MPa gauge (1,500 psi to 10,000 psi)

**Resolution** To greater of 1 ppm of reading or of 1ppm of 4 psi (0.00004 psi or 2.5 Pa)

#### Measurement uncertainty

Gauge, Absolute, or Vacuum	Range	Uncertainty[1]
Gauge[2]	-98 kPa to +25 kPa (-14.2 to +4 psi)	±25 Pa (0.004 psi, 0.1 in H <sub>2</sub> O at 20°C)
	25 kPa to 70 MPa (4 to 10,000 psi)	±0.1 % of reading
Absolute	3.5 to 130 kPa (0.5 to 19 psi) absolute	±25 Pa (0.004 psi, 0.1 in H <sub>2</sub> O at 20°C)
	130 kPa to 70 MPa (19 to 10,000 psi) absolute	±0.1 % of reading
Vacuum[2]	0 kPa to 98 kPa (0 to 29 inHg)	±25 Pa (0.007 inHg)

Notes:

[1] Measurement uncertainty defined as the maximum deviation from the indicated value of measured pressure for 1 year after alignment including hysteresis, linearity, repeatability, stability, temperature, humidity effects, and calibration reference standard measurement uncertainty. Expression of uncertainty uses a coverage factor of 2 and conforms with the recommendations of the ISO Guide to the Expression of Uncertainty in Measurement.

[2] Negative gauge and vacuum pressure values assume the ambient atmospheric pressure is approximately 101 kPa (14.7 psi) absolute.

#### Pressure cool specifications

**Cool Precision** greater of ± 28 Pa (0.004 psi) or 0.025 % of reading

#### Cool ranges

Pressure Source	Gauge, Absolute, or Vacuum	Range
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On-board Pump	Gauge[1]	-98 kPa (-14.2 psig) to 2 MPa (300 psig)
	Absolute	3.5 kPa (0.5 psi) to 2 MPa (300 psi) absolute
	Vacuum (negative gauge) [1]	0 to 98 kPa (29 inHg)
Exteal Gas Supply	Gauge	28 kPa (4 psig) to 70 MPa (10,000 psig)
	Absolute	130 kPa (19 psi) to 70 MPa (10,000 psi) absolute

[1] Negative gauge and vacuum pressure values assume the ambient atmospheric pressure is approximately 101 kPa (14.7 psi) absolute.

#### Typical cool set times

Measure Mode	Range	Time (seconds) [5]
Gauge [7]	<28 kPa (4 psig)	90 [1] [6]
	28 to 700 kPa (4 to 100 psig)	30 [2]
	700 kPa (100 psig) to 7 MPa (1,000 psig)	30 [3]
	7 MPa (1,000 psig) to 70 MPa (10,000 psig)	60 [4]
Absolute	<14 kPa (2 psi) absolute	180 [1] [6]
	14 to 130 kPa (2 to 19 psi) absolute	90 [1] [6]
	130 to 700 kPa (19 to 100 psi) absolute	30 [2]
	700 kPa (100 psi) to 7 MPa (1,000 psi)	30 [3]
	7 MPa (1,000 psi) to 70 MPa (10,000 psi)	60 [4]
Vacuum [7]		
	>88 kPa (26 inHg) vacuum	180 [1] [6]
	0 to 88 kPa (0 to 26 inHg) vacuum	90 [1] [6]

[1] Assumes 1pp cc test volume, uses on-board pump cool

[2] Assumes 100 cc test volume with exteal gas supply.

[3] Assumes 50 cc test volume with exteal gas supply.

[4] Assumes 25 cc test volume with exteal gas supply.

[5] Set times assume pressure steps of no greater than 10% of target pressure and reflect time to ready using default cool limits in dynamic cool mode.

[6] Times for sub-atmospheric set points assume that the temperature is below the boiling point of any liquid in the UUT and CPS for the target pressure.

[7] Negative gauge and vacuum pressure values assume the ambient atmospheric pressure is approximately 101 kPa (14.7 psi) absolute.

## Modèles



### **4322-SYS**

4322-CONTR, 4322-INTFR, 6 ft. (2 m) high-pressure interconnect hose, spare parts kit

### **4322-SYS-CE**



4322-CONTR-CE, 4322-INTFR-CE, 6 ft. (2 m) high-pressure interconnect hose, spare parts kit

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#### **4322-SYS-USDOT**

4322-CONTR, 4322-INTFR, 4322-CYL-USDOT, 6 ft. (2 m) high-pressure interconnect hose, spare parts kit

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#### **4322-SYS-NAVAIR**

4322 Pressure Controller mainframe, 4322 Pressure Intensifier mainframe, US DOT nitrogen cylinder assembly, 4322 Accessory Kit with: blue CPS assembly, blue high pressure test hose, orange CPS assembly, orange high-pressure test hose, qty. 4 waste bottles, pressure regulator assembly, IQC70 adaptor kit (14 pieces), high-pressure interconnect hose, high-pressure supply hose, qty. 2 power cords, 4322 spare parts kit, PTFE tape, IEEE cable

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#### **4322-CONTR**

4322 Pressure Controller mainframe, blue CPS assembly, power cord, controller spare parts, IQC70 adaptors: ¼" NPT female, DH500 female (HiP HF4 equivalent) , qty. 2 x AN4 male

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#### **4322-CONTR-CE**

4322 Pressure Controller Unit mainframe (CE configuration), blue CPS assembly, power cord, controller spare part, IQC70 adaptors: ¼" NPT female, DH500 female (HiP HF4 equivalent) , qty. 2 x AN4 male

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#### **4322-REM**

4322 Remote Control Pendant, 10 ft. (3 m) remote pendant cable, switch test leads

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#### **4322-CYL-USDOT**

Nitrogen cylinder certified to US DOT with shutoff valve, port plug and valve guard, carrying strap, pressure regulator assembly with pressure gauges, CGA 580 adaptor and supply hose quick connect coupler, additional CGA 580 ¼ in adaptor, 6 ft. (2 m) high-pressure supply hose

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