

# Model 2465

## Gas Piston Gauge

## Technical Data



### Features

- Autofloat controller and manually operated systems available
- Pressure range: -100 kPa to 7 MPa (-14.5 to 1000 psi) gauge, 1.4 kPa to 7 MPa (0.2 to 1000 psi) absolute
- Total uncertainty to 0.0010 % (10 ppm) of reading
- Precision better than 3 ppm
- Stability better than 1.5 ppm over two years
- Gauge, absolute, vacuum (negative gauge), and low pressure modes

The Model 2465 Gas Piston Gauge has a long history of serving national standards laboratories, commercial industry and government organizations as a primary pressure standard for over 40 years. Since its original introduction, enhancements have been made to increase performance and reduce operator workload. The autofloat controller configuration is a recent example of Fluke Calibration's commitment to provide an easy to use, high performance, primary standard to the pressure calibration and metrology community. The Model 2465 provides the capability of generating pressures to within a total expanded uncertainty of 10 parts per million to 0.7 MPa (100 psi) and 26 parts per million to 7 MPa (1000 psi).

The Model 2465 is available in a variety of configurations to meet individual requirements. The three basic components of the Model 2465 are the Instrument Base, one or more Piston/Cylinder Assemblies, and a single Mass Set. The Autofloat Controller can be added to minimize operator workload and skill requirements, or select the Manual Pressure Control Pack. Last, decide which accessories and options will be required.

### Instrument base

The instrument base is designed with functionality, economy and space conservation in mind. All electronic components are housed away from the instrument base to eliminate errors caused by thermal effects and magnetic fields. The thermally isolated motor drive is connected to the cylinder—eliminating pressure fluctuations and maximizing productivity. A durable, acrylic bell jar is provided to allow absolute and vacuum modes of operation. A KF16 fitting is provided to simplify installation and allow low reference pressures.

### Piston/cylinder assemblies

Piston and cylinder assemblies are manufactured from proven materials that have evidenced superior strength, durability, low distortion, low thermal coefficients and virtually undetectable hysteresis over the last several decades, and have an unparalleled record of long-term stability. Tungsten carbide is used for all pistons and cylinders, except where the demand for accurate low pressures is met by using high quality stainless steel (low range piston). The lower density of steel facilitates generating pressures down to 1.4 kPa (0.2 psi).

Four piston/cylinder combinations are now available to generate pressures over the total range of the system. The maximum sink rate for each piston/cylinder is 0.38 centimeters/minute (0.15 inches/minute). If lower sink rates are required, please refer to the Model 2468 Gas Piston Gauge.

### Mass set

Each mass is machined to a nominal value and is made from non-magnetic materials to provide long-term stability and eliminate sensitivity to magnetic fields. For ease of use, the entire mass set totals just 6 kilograms, with a maximum platter mass of 1 kilogram. A laboratory grade trim mass set is included to allow any pressure increment within the range and resolution of the piston/cylinder assembly.

### Autofloat controller

The autofloat controller provides a means of reducing operator workload while achieving the unparalleled performance provided by the Model 2465. The operator simply applies the mass load as instructed by the software, and then selects the autofloat icon on the menu bar. The autofloat controller automatically generates the desired pressure to establish the correct piston float position. A three-color status bar at the bottom of the software screen indicates when the piston is floating within acceptable limits and a reading from the device under test can be entered.

Once the pressure is established, the autofloat controller monitors the speed of piston rotation and automatically engages the Model 2465 motor as required. Since the motor rotates the cylinder, readings can be taken even when the motor is operating, avoiding time-consuming delays.

The autofloat controller also monitors piston temperature, float position, reference vacuum in the bell jar, and sink rate, along with ambient temperature, pressure and humidity to determine air density when used with the optional LEM. This data is transferred to the software which applies all environmental corrections and updates the generated pressure in real time. The autofloat controller also activates the vacuum pumps if required.

To provide additional capability, the autofloat controller is provided with a barometric reference sensor to allow system operation in absolute, vacuum (negative gauge) and low pressure mode.

The autofloat controller communicates through an RS-232C interface with WinPrompt® software, a powerful calibration management tool. The user can set up procedure files consisting of a table of pressures required to calibrate a particular device. Each time the device requires calibration, the operator opens the procedure file, generates each pressure setpoint, enters the reading from the device, and then saves the results as a calibration file. Calibration reports can be printed from WinPrompt.

For customization, WinPrompt supports the Dynamic Data Exchange (DDE) function of Windows so that all data can be easily transferred to word processing and spreadsheet programs for automated report generation and analysis.

For enhanced software capabilities, Fluke Calibration offers COMPASS for Pressure Calibration Management Software. COMPASS software can perform all of the same functions as WinPrompt and also can communicate directly to the device under test, eliminating potential errors in the calibration.

### Manual pressure control

For manual operation, the Model 2465 can be provided with a manually operated Pressure Control Pack, instead of the autofloat controller, for regulating and controlling the system pressure and float position. The optional Model 2456 Piston Gauge Monitor and WinPrompt software add further capability to the manual system (see separate Model 2456 data sheet for additional information and specifications).

### Operating modes

The Model 2465 is capable of operating in gauge, absolute and vacuum mode.

**Gauge mode:** pressure is achieved by simply loading the appropriate mass load to the top of the piston.

**Absolute mode:** A vacuum pump can be connected to the reference pressure port, using standard KF16 vacuum fittings. The appropriate mass load is applied and the bell jar is placed on the instrument base. The vacuum pump evacuates the bell jar and the residual amount of pressure is measured either automatically with the autofloat controller, (or with the Model 2456 Deadweight Gauge Monitor, in the manual configuration).

**Vacuum mode:** is achieved by generating a subatmospheric pressure with the Model 2465 and autofloat controller utilizing the internal, high accuracy, barometric reference sensor. The system subtracts the generated pressure from the barometric reference sensor and displays the result: a vacuum (negative gauge) pressure.

**Low pressure mode:** allows operation down to 0 gauge pressure, and is achieved by generating an absolute pressure at or above atmospheric pressure utilizing the barometric reference sensor in the autofloat configuration.

**Accessories**

**Model 2456 Piston Gauge Monitor and WinPrompt software:** For users who do not require the autofloat capability, but want to add a level of automation to the Model 2465. The Model 2456 continuously monitors piston temperature, float position, and sink rate, and optionally air density and reference vacuum. WinPrompt software calculates mass-to-pressure and pressure-to-mass values, and automatically reads and displays real-time piston gauge parameters.

**Lines and fittings kits:** Lines and fittings kits are available to ensure that you have all the components needed to install the system and begin performing calibrations.

**Vacuum pumps:** For applications where absolute or vacuum mode calibrations will be performed, two vacuum pumps are required. The autofloat configuration requires each pump to be equipped with an auto-vent valve so that the vacuum line is vented to atmosphere when the pump is turned off. Fluke Calibration can provide high quality vacuum pumps that meet these requirements. Fluke Calibration supplied pumps also include a backstream filter to prevent contamination of the Model 2465 and device under test along with a muffler for quiet operation.

**Specifications**

General	
Pressure range	Gauge mode: 1.4 kPa to 7 MPa (0.2 to 1 000 psi) Absolute mode: 1.4 kPa to 7 MPa (0.2 to 1 000 psi) Vacuum mode: -100 kPa to 0 kPa (-14.5 to 0 psi)
Temperature	Operating: 15 °C to 29 °C (7 °F to 92 °F) Storage: -20 °C to 70 °C (-4 °F to 158 °F)
Electrical power	115/230 V ac, 50/60 Hz, 15 W
Humidity	Operating humidity: 20 % to 75 % RH, non-condensing Storage humidity: 0 % to 90 % RH, non-condensing
Pressure medium	High purity nitrogen or dry, clean air with less than 0.5 ppm hydrocarbon and less than 5 ppm H <sub>2</sub> O content, dew point less than or equal to -50 °C (-58 °F), and less than 50 micron particulate size. Although lower quality gas can be used, the frequency of piston/cylinder cleaning will increase.
Piston/cylinder assemblies	
Low range	Nominal area: 3.4 cm <sup>2</sup> (0.52 in <sup>2</sup> ) Pressure range: 1.4 kPa to 172 kPa (0.2 to 25 psi) Minimum autofloat pressure: 7 kPa (1 psi) Total uncertainty: 0.001 % RDG or 0.07 Pa (0.00001 psi) Materials: Piston is 440C stainless steel, cylinder is cemented tungsten carbide Thermal coefficient: 1.5E-05/°C
Lower mid range	Nominal area: 0.84 cm <sup>2</sup> (0.13 in <sup>2</sup> ) Pressure range: 11.7 kPa to 0.7 MPa (1.7 to 100 psi) Minimum autofloat pressure: 34.5 kPa (5 psi) Total uncertainty: 0.001 % RDG or 0.28 Pa (0.00004 psi) Materials: Piston and cylinder are cemented tungsten carbide Thermal coefficient: 9.1E-06/°C
Upper mid range	Nominal area: 0.168 cm <sup>2</sup> (0.026 in <sup>2</sup> ) Pressure range: 14 kPa to 3.5 MPa (2 to 500 psi) Minimum autofloat pressure: 0.14 MPa (20 psi) Total uncertainty: 0.0026 % RDG or 2.8 Pa (0.0004 psi) Materials: Piston and cylinder are cemented tungsten carbide Thermal coefficient: 9.1E-06/°C
High range	Nominal area: 0.084 cm <sup>2</sup> (0.013 in <sup>2</sup> ) Pressure range: 14 kPa to 7 MPa (2 to 1000 psi) Minimum autofloat pressure: 0.24 MPa (35 psi) Total uncertainty: 0.0026 % RDG or 2.8 Pa (0.0004 psi) Materials: Piston and cylinder are cemented tungsten carbide Thermal coefficient: 9.1E-06/°C

Performance	
Precision (type A uncertainty)	Better than 3 ppm <sup>b</sup>
Long-term stability	Better than 1.5 ppm per two years <sup>b</sup>
Resolution <sup>c</sup>	1 ppm or 1 mg
Mass set	
Total mass	6 kg (13.2 lb)
Max platter mass	1 kg (2.2 lb)
Includes trim mass set	
Computer interface	
Requirements	Pentium level processor, RS-232C interface, monitor, mouse or other pointing device, keyboard; program requires 2 MB available hard disk space; Windows 95 or higher

**Specifications** cont.

Autofloat system									
Autofloat controller	Positive shut-off controller automatically generates pressure and maintains piston float position at desired pressure. Includes WinPrompt software.								
Autofloat range	Low range piston/cylinder: 7 kPa to 172 kPa (1 to 25 psi) Lower mid range piston/cylinder: 34.5 kPa to 0.7 MPa (5 to 100 psi) Upper mid range piston/cylinder: 0.14 MPa to 3.5 MPa (20 to 500 psi) High range piston/cylinder: 0.24 MPa to 7 MPa (35 to 1 000 psi)								
Float position <sup>d</sup>	Inductive sensor Float position resolution: 0.002 cm (0.001 in) Sink rate resolution: 0.001 cm/min (0.001 in/min)								
Piston temperature <sup>d</sup>	4-wire: 100 Ω PRT Accuracy: ± 0.1 °C (± 0.18 °F) Resolution: 0.01 °C (0.018 °F)								
Laboratory Environment Monitor (LEM) <sup>d</sup>	<table border="0"> <tr> <td><i>Sensor types</i></td> <td><i>Accuracy</i></td> </tr> <tr> <td>Temperature: thin film platinum 1000 Ω RTD</td> <td>Temperature: ± 2 °C (± 32.216 °F)</td> </tr> <tr> <td>Humidity: capacitive IC humidity sensor</td> <td>Humidity: ± 15 %</td> </tr> <tr> <td>Barometric pressure: piezoresistive, monolithic silicon pressure transducer</td> <td>Pressure: ± 5 mmHg</td> </tr> </table>	<i>Sensor types</i>	<i>Accuracy</i>	Temperature: thin film platinum 1000 Ω RTD	Temperature: ± 2 °C (± 32.216 °F)	Humidity: capacitive IC humidity sensor	Humidity: ± 15 %	Barometric pressure: piezoresistive, monolithic silicon pressure transducer	Pressure: ± 5 mmHg
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Vacuum module <sup>d</sup>	Thermopile sensor Accuracy: 10% of reading or 10 mTorr Resolution: 1 mTorr								
Barometric reference sensor	Accuracy: Better than ± 0.014 kPa (0.002 psi) per year Accuracy in low gauge mode: ± 2.8 Pa (0.0004 psi) Resolution: 1 Pa (0.00015 psi)								

<sup>a</sup> Vacuum pressure achieved depends on local barometric pressure  
<sup>b</sup> Values are reported at the 95 % confidence level (2σ)  
<sup>c</sup> Whichever is greater  
<sup>d</sup> Also applies to Model 2465 equipped with Model 2456 Piston Gauge Monitor.  
 Additional information is provided in Model 2456 and 2456-LEM literature

**Fluke Calibration.** Precision, performance, confidence.™

Electrical	RF	Temperature	▼	Pressure	Flow	Software
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**Fluke Calibration**  
 PO Box 9090,  
 Everett, WA 98206 U.S.A.

**Fluke Europe B.V.**  
 PO Box 1186, 5602 BD  
 Eindhoven, The Netherlands

**For more information call:**  
 In the U.S.A. (877) 355-3225 or Fax (425) 446-5116  
 In Europe/M-East/Africa +31 (0) 40 2675 200 or Fax +31 (0) 40 2675 222  
 In Canada (800)-36-FLUKE or Fax (905) 890-6866  
 From other countries +1 (425) 446-5500 or Fax +1 (425) 446-5116  
 Web access: <http://www.flukecal.com>

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