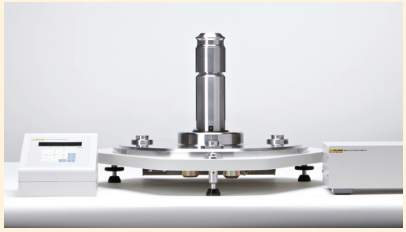
FLUKE Calibration

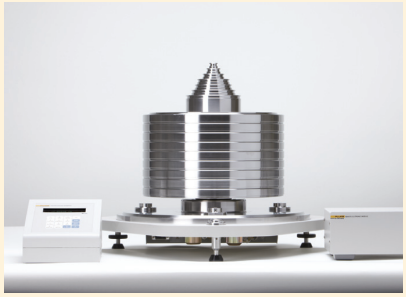
# PG9607 Piston Gauge

## Automated primary pressure reference for absolute and gauge pressures to 500 kPa

원문: Fluke Calibration PG9602/9607 데이터시트(영문) · 제조사 원문 자료입니다. 사양은 제조사 사정에 따라 변경될 수 있습니다.

# Designed for fundamental metrology research





The DH Instruments PG9607 is the next generation of absolute pressure piston gauge from Fluke Calibration. It supports the use of a 100 kg mass set to define gauge and absolute pressures from 11 to 500 kPa with a single piston-cylinder.

This piston gauge is designed for use as a true primary pressure reference in metrology and research institutes. Its performance is centered around a 50 mm piston-cylinder assembly with dimensional characteristics suitable for low-uncertainty dimensional traceability. The piston mounting post allows controlled clearance operation and reduced uncertainty on piston-cylinder temperature measurement. The new platform architecture promotes improved temperature stability around the piston-cylinder.

PG9607 features AMH automated mass handling technology to allow fully automated testing in both gauge and absolute mode. Manual steps are removed from its operation, saving time and delivering metrological advantages. When AMH is coupled with automatic pressure control and computer software, repeated and extended tests become practical, making PG9607 a powerful calibration and research tool.

PG9607 is the result of DH Instruments' extensive work with national metrology institutes (NMIs) to minimize pressure measurement uncertainty and years of supplying PG7000 piston gauges to NMIs and other top pressure metrology labs worldwide.

## Refined 50 mm piston-cylinder design

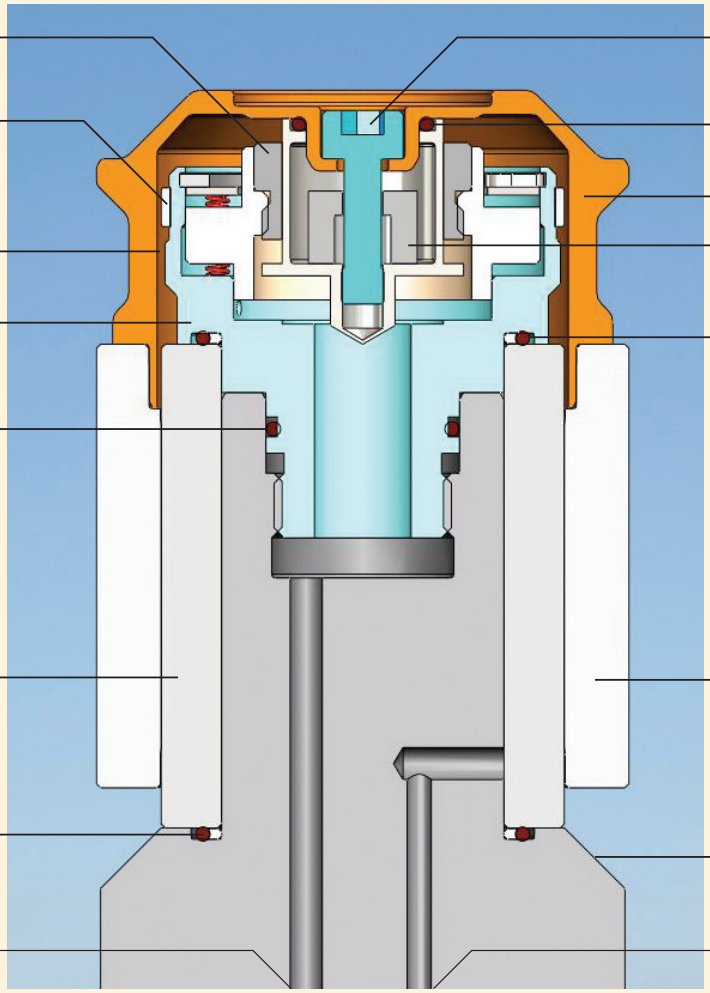
PG9607's piston-cylinder assembly builds upon more than 15 years of design, manufacture and calibration of 50 mm piston-cylinders. PC-9607-5 is a 5 kPa/kg piston-cylinder with a stationary piston and floating cylinder design. Improved manufacturing and testing methods are used to produce a very low distortion assembly. The 50 mm piston-cylinder provides exceptional performance up to 500 kPa with a 100 kg mass load. The PG9607 mounting post allows an independent controlled clearance pressure to be applied to the inside of the piston, thus predictably varying the size of the gap between the piston and cylinder for advanced study.

2 Fluke Calibration PG9607 Piston Gauge

원문: Fluke Calibration PG9602/9607 데이터시트(영문) · 제조사 원문 자료입니다. 사양은 제조사 사정에 따라 변경될 수 있습니다.

FLUKE Calibration

## PC-9607-5 piston cylinder assembly






원문: Fluke Calibration PG9602/9607 데이터시트(영문) · 제조사 원문 자료입니다. 사양은 제조사 사정에 따라 변경될 수 있습니다.

# Innovations to minimize uncertainty

Two decades ago, DH Instruments PG7000 family of piston gauges introduced the advantages of on-board sensing and monitoring technology, as well as other performance and ergonomic enhancements. The PG9000 platform adds several innovations to improve pressure measurements even further.

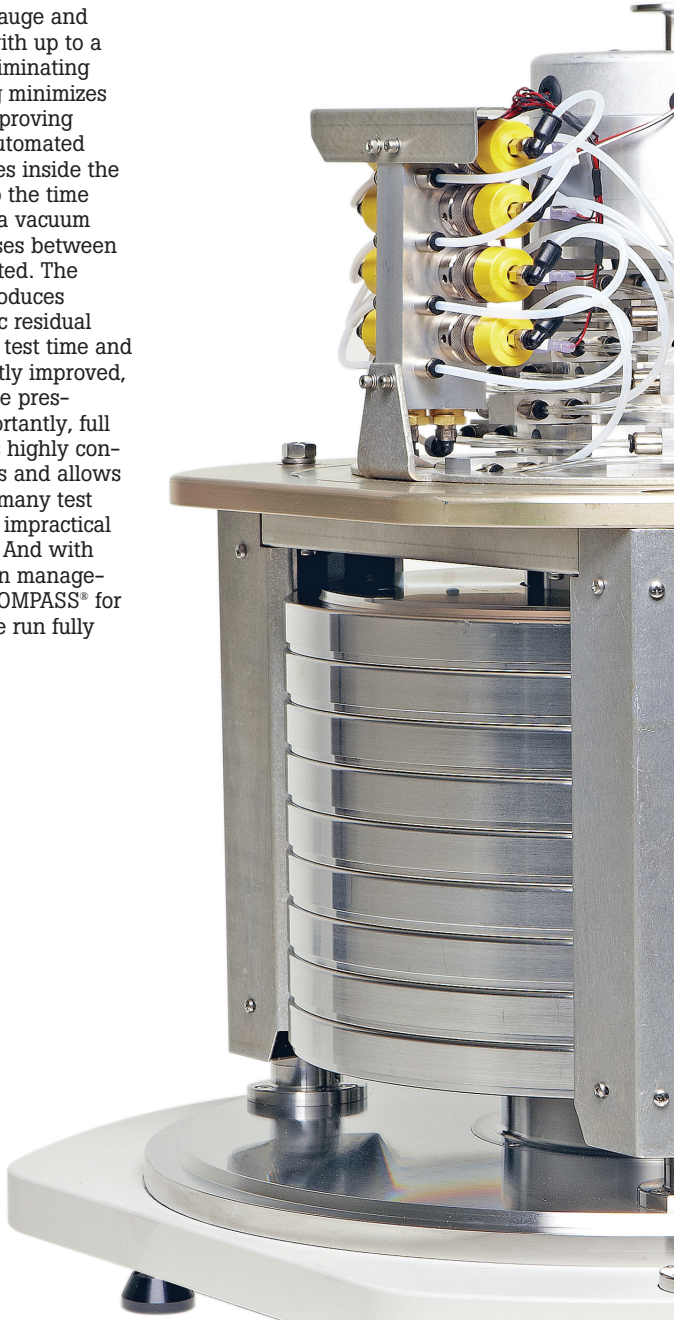
The platform consists of a PG terminal, a piston gauge base and a new remote electronics module. The terminal is the user interface. It stores metrological component data, reports operating and ambient condition status and calculates pressure.

The PG9000 piston gauge base supports automatic piston-cylinder rotation and mass handling, but all of the electronics to support the sensors and rotation control have been relocated to a remote electronics module. This architecture supports the best possible temperature stability at the base, even with prolonged vacuum operation, since any significant sources of heat are located away from the base.

The PG9607 mounting post has two integrated PRTs for reduced piston-cylinder temperature uncertainty. The PRTs are easily removed for calibration. A capacitance diaphragm gauge is included in the optional vacuum reference hardware for making residual vacuum measurements in absolute mode. PG9607 can also integrate the measurement output from virtually any user-supplied vacuum sensor.

## Metrology supported by automation

AMH automated mass handling technology is expanded on PG9607 to provide gauge and absolute operation with up to a 100 kg mass load. Eliminating manual mass loading minimizes mechanical wear, improving mass stability. The automated mass handler operates inside the evacuated bell jar, so the time to release and draw a vacuum while changing masses between test points is eliminated. The sustained vacuum produces lower and more static residual vacuum values. Total test time and productivity are greatly improved, especially on absolute pressure tests. More importantly, full automation promotes highly consistent measurements and allows extensive tests with many test points that would be impractical to perform manually. And with the help of calibration management software like COMPASS® for Pressure, tests can be run fully unattended.

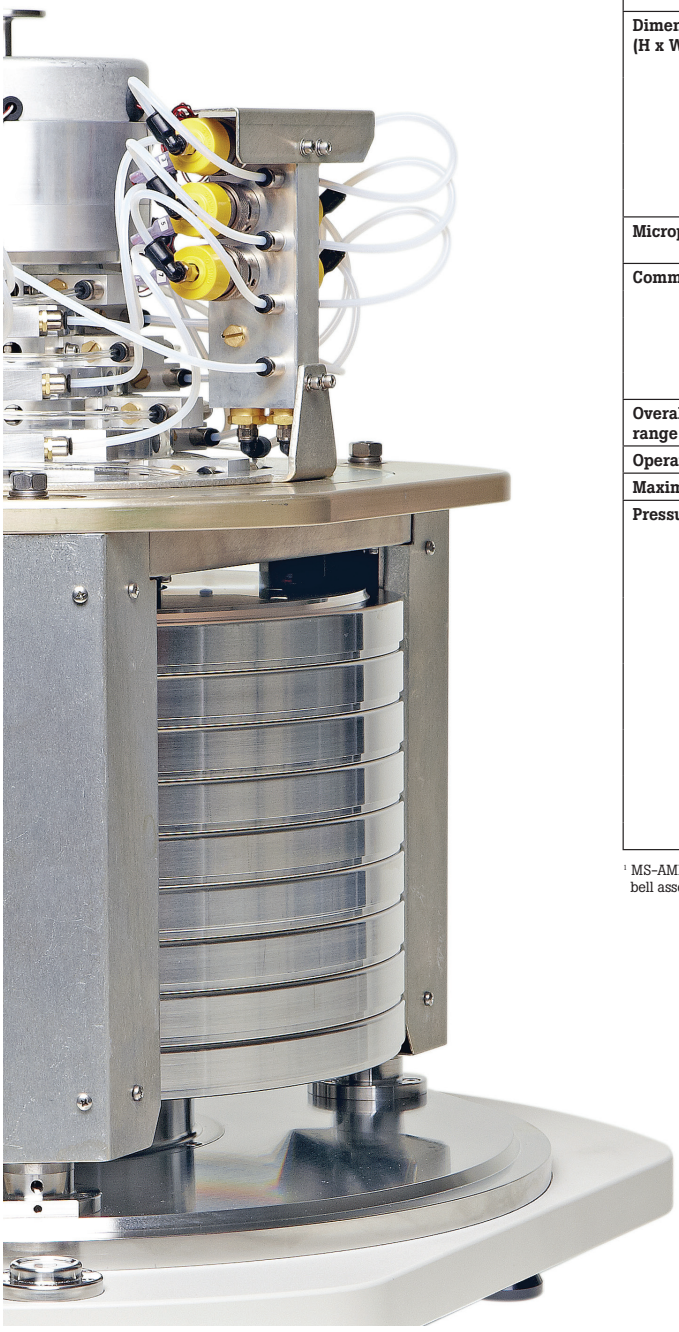


4 Fluke Calibration PG9607 Piston Gauge

원문: Fluke Calibration PG9602/9607 데이터시트(영문) · 제조사 원문 자료입니다. 사양은 제조사 사정에 따라 변경될 수 있습니다.

FLUKE Calibration

# Specifications



| General | | |
|---|---|---|
| **Electrical power** | 85/264 V ac, 50/60 Hz, 22 VA maximum consumption | |
| **Temperature** | Operating: 15 °C to 35 °C (59 °F to 95 °F)<br>Storage: -20 °C to 70 °C (-4 °F to 158 °F) | |
| **Humidity** | Operating: 5 % to 95 % RH, non-condensing | |
| **Weight** | Instrument platform with no mass or piston-cylinder loaded | |
| | PG9607 (without vacuum hardware): 34 kg (74 lb) | |
| | Remote electronics module: 1.9 kg (4 lb) | |
| | PG terminal: 1.4 kg (3 lb) | |
| | Optional vacuum reference hardware: 16 kg (36 lb) | |
| **Dimensions (H x W x D)** | PG9607 base (without vacuum hardware):<br>34.1 cm x 54.3 cm x 52.3 cm (13.4 in x 21.4 in x 20.6 in)<br>(Height: top of piston-cylinder assembly) | |
| | PG9607 base (with optional vacuum bell jar and vacuum gauge connected):56 cm x 54.3 cm x 52.3 cm (22 in x 21.4 in x 20.6 in)<br>(Height: Top of bell jar) | |
| | Remote electronics module: 10.2 cm x 35.1 cm x 19.6 cm<br>(4 in x 13.8 in x 7.7 in) | |
| | PG terminal: 12 cm x 15 cm x 20 cm (4.7 in x 5.9 in x 7.9 in) | |
| **Microprocessors** | Instrument platform: Motorola 68302<br>PG terminal: Hitachi 64180 | |
| **Communication ports** | RS-232 | COM1: Host computer |
| | | COM2: Residual vacuum sensor (external) |
| | | COM3: Automated pressure controller |
| | | COM4: Unused/spare |
| | IEEE-488 | Host computer |
| **Overall pressure range** | Gauge: 11 kPa to 500 kPa, 0.11 bar to 5 bar, (1.6 to 72.5 psi)[1]<br>Absolute: 11 kPa to 500 kPa, 0.11 bar to 5 bar, (1.6 to 72.5 psi)[1] | |
| **Operating media** | Gas: nitrogen, helium, dry air (dewpoint ≤ -40 °C) | |
| **Maximum mass load** | 100 kg[1] | |
| **Pressure connections** | PG 9607 base | Test port: DH200*<br>Controlled clearance pressure: DH200*<br>* Gland and collar fitting for 6.35 mm (0.25 in) coned and left hand threaded tubes. Equivalent to AE SF250C, HIP LF4, etc. |
| | AMH drive | Quick connector equivalent to Swagelok QM Series (QM2-B-200). Use with DESO (double end shut off) type stem. |
| | AMH vent | Quick connector equivalent to Swagelok QM Series (QM2-B-200). Use with SESO (single end shut off) type stem only. |
| | Remote electronics module | ATM port: 10-32 UNF |
| | Vacuum bell jar | 3x 40 mm ISO/KF flange, 1x 50 mm ISO/KF flange (top) |
| | CE conformance | All PG9000 models conform to CE requirements |

[1] MS-AMH-100 mass set contains approximately 104.5 kg of mass. Combined with the piston or cylinder and bell assembly, total mass loads may be up to 106 kg, resulting in pressures of up to 530 kPa (5.3 bar, 76.9 psi).



원문: Fluke Calibration PG9602/9607 데이터시트(영문) · 제조사 원문 자료입니다. 사양은 제조사 사정에 따라 변경될 수 있습니다.

# Specifications

## Embedded features

- Local control with 2 x 20 vacuum fluorescent display and 4 x 4 function driven keypad.
- Real time (1 second update rate) display and measurement of ambient (pressure, temperature, humidity) and instrument (piston-cylinder temperature, cylinder position, cylinder drop rate, cylinder rotation rate, cylinder rotation decay rate, reference vacuum) conditions.
- Real time (1 second update rate) mass-to-pressure and pressure-to-mass calculations taking into consideration all environmental and operational variables.
- Full gas fluid head corrections including DUT head correction and piston position head correction.
- Adjustable mass loading resolution 0.01 g to 0.1 kg.
- Audible prompts of instrument status (piston movement, Ready/Not Ready indication) with override capability.
- Integrated automated mass handling option (AMH-100-VAC).
- Interfacing and automatic exploitation of external barometer via RS-232.
- Interfacing and automatic exploitation of standard or user-supplied external vacuum gauge via RS-232.
- Automated differential mode to define low differential pressures at various static pressures between vacuum and atmosphere.
- Storage and one step activation of metrological data on up to 18 piston-cylinder modules, (3) mass sets and (3) mass loading bells.
- Continuous pressure Ready/Not Ready indication based on measured conditions.
- Motorized, intelligent piston drive system based measured rotation rate with operator alert and manual override.
- Integrated automated pressure control with standard DHI pressure controllers.
- Full RS-232 and IEEE-488 communications with multi-level commands to set and read all instrument functions.

| AMH-100-VAC Automated Mass Handler (optional) | |
|---|---|
| **Power requirements** | 15 V dc @ 2 A, 30 W max. consumption |
| **Temperature** | Operating: 15 °C to 35 °C (59 °F to 95 °F) |
| **Dimensions (H x W x D)** | 41 cm x 41 cm x 36 cm (16.3 in x 16.1 in x 14.1 in) |
| **Weight** | 12 kg (25 lbs) |
| **Power/communications** | Custom 8-pin connector |
| **AMH drive air supply** | 550 kPa (80 psi), ± 10 %, minimal flow |
| **AMH vacuum supply** | At least 50 kPa (7.5 pi) under atmosphere, minimal flow |
| **Pressure connections** | Pressure: Quick connector DESO (double end shut off) type stem<br>Vacuum: Quick connector SESO (single end shut off) type stem |

| Piston-cylinder assembly (PC-9607-5) | |
|---|---|
| The piston is mounted in a fixed position on the mounting post. The cylinder floats and is rotated. | |
| **Piston material** | Tungsten carbide |
| **Cylinder material** | Tungsten carbide |
| **Nominal diameter** | 50 mm (1.97 in) |
| **Nominal area** | 2000 $mm^2$ |
| **Mounting system** | Free deformation with controlled clearance pressure (CCP) available on inside of piston. |
| **Typical drop rate (Full mass load)** | < 0.25 mm/min (0.009 in/min) at 500 kPa |

| Mass sets | |
|---|---|
| All masses are delivered in molded, reusable, transit cases with custom inserts. | |
| **Masses > 50 g** | Material: 304L non-magnetic stainless steel |
| | Finish: Electropolished |
| | Adjustment tolerance: ± 20 ppm of nominal value (manual mass sets, AMH automated mass handler mass sets do not have fixed adjustment tolerances) |
| | Uncertainty of measured values:<br>± 5 ppm or 1 mg, whichever is greater |
| **Masses ≤ 50 g** | Uncertainty of measured values: ± 1 mg |

| Pressure measurements | |
|---|---|
| For uncertainty in piston-cylinder effective area and typical measurement uncertainty in pressure defined by the piston gauge, see the piston-cylinder calibration report and current revision of DHI Technical Note 0180TN12 Typical Pressure Measurement Uncertainty Defined by a PG9607 or PG9602 Piston Gauge. | |
| **Sensitivity**[1] | 0.005 Pa + 0.5 ppm |
| **Reproducibility**[2] | ± 2 ppm + 0.05 Pa |

[1] Sensitivity: The smallest variation in input detectable in output.
[2] Reproducibility: The root sum square of the stability of effective area and stability of the AMH-100 mass set for 1 year.

| Ambient and instrument condition measurements | | | | |
|---|---|---|---|---|
| | | **Range** | **Resolution** | **Measurement uncertainty** |
| **Temperature** | **Ambient** | 0 °C to 40 °C<br>(32 °F to 104 °F) | 0.1 °C<br>(32.18 °F) | ± 1 °C<br>(33.8 °F) |
| | **Piston cylinder module** | 0 °C to 40 °C<br>(32 °F to 104 °F) | 0.01 °C<br>(32.02) | ± 0.1 °C<br>(32.18 °F) |
| **Barometric pressure with internal sensor** | | 70 kPa to 110 kPa | 10 Pa | ± 140 Pa |
| | | Barometric pressure can also be read automatically with any RS-232 device such as a DHI RPM. | | |
| **Relative humidity** | | 5 % to 95 % RH | 1 % RH | ± 10 % RH |
| **Piston position** | | ± 4.5 mm | 0.1 mm | ± 0.2 mm<br>(0.008 in) |
| **Piston rotation (Rate and deceleration)** | | 2 rpm to 99 rpm | 1 rpm | |
| **Vacuum (optional)** | | 0 Pa to 13 Pa | 0.01 Pa | ± 0.05 Pa + 0.5 % of reading |



원문: Fluke Calibration PG9602/9607 데이터시트(영문) · 제조사 원문 자료입니다. 사양은 제조사 사정에 따라 변경될 수 있습니다.

# Ordering information

## Putting together a PG9607 system

### A typical PG9607 pressure standard consists of:

**3821488 PG9607 Platform**

Gas operated piston gauge

- Includes base, terminal, remote electronics module, and basic pneumatic interconnections to pressure controller and UUT.
- All platforms are CE compliant and vacuum-capable, but vacuum reference hardware is not included.
- Delivered with reusable shipping cases and calibration certificates

**3821513 PG9600-VAC-REF optional Vacuum Reference Hardware**

Hardware required for absolute pressure measurements. Consists of:

- Stainless steel vacuum chamber (bell jar) assembly including vent valve and accessories
- Vacuum measure kit with CDG, manual valve and interconnections, interface and accessories. Delivered with reusable shipping case and calibration certificate.

Vacuum pump and interconnections to bell jar assembly supplied separately.

**3782028 PC-9607-5 Piston-Cylinder Module**

Gas operated assembly

- Delivered with reusable shipping and storage case and calibration certificate.

| Designator | Pressure to mass ratio | Minimum pressure (using mass bell) (absolute and gauge) | Maximum pressure (100 kg mass) (absolute and gauge) |
|---|---|---|---|
| PC-9607-5 | 5 kPa/kg | 11 kPa (0.11 bar, 1.6 psi) | 500 kPa (5 bar, 72.5 psi) |

PC-9607-5 piston-cylinder is compatible with PG7607 piston gauge bases. Legacy PC-7607-5 piston-cylinders are also usable up to 190 kPa (1.9 bar, 27.5 psi) with the PG9607 base.

### Pressure control options

**Automatic**

**PPC4 A700Ku Automatic Pressure Controller/Calibrator**

Automatic pressure control and piston floatation is possible with PPC4

**Manual**

**3069536 MPC1-1000 Manual Gas Pressure Controller**

### 3070175 COMPASS® for Pressure Enhanced

Calibration management software enables full automation of tests and UUT data collection.



원문: Fluke Calibration PG9602/9607 데이터시트(영문) · 제조사 원문 자료입니다. 사양은 제조사 사정에 따라 변경될 수 있습니다.

# Ordering information

## Mass options

### Automatic

**3821508 AMH-100-VAC Automated Mass Handler**

AMH is recommended, but not required for PG9607 operation. Select AMH or manual mass set depending on whether AMH-100-VAC is selected. Note that AMH-100 (gauge pressure model) is not compatible with PG9607 without modification.

**3071440 MS-AMH-100 Mass Set (for automatic operation with AMH)**

MS-AMH mass sets for use with automated mass handler only. Mass sets smaller than 100 kg are available if the maximum pressure range is not required (see table). Mass set includes AMH mass carrying bell. Delivered with reusable mass shipping and storage cases and calibration certificate.

| AMH mass set designator | Item number | Nominal total mass |
|---|---|---|
| MS-AMH-40 | 3071528 | 40 kg |
| MS-AMH-60 | 3071519 | 60 kg |
| MS-AMH-80 | 3071504 | 80 kg |
| MS-AMH-100 | 3071440 | 100 kg |

### Manual

**3071537 MB-7002-0.8 Mass Bell**

Mass bell must be purchased to use manual mass sets with PG9607. Mass bell is not included with the PG9607 platform or manual mass sets.

**3070017 MS-7002-100 Mass Set (for manual operation without AMH)**

Manual 100 kg mass set is typically used when AMH is not purchased. Smaller mass sets are available when maximum pressure range is not required (see table). Delivered with reusable shipping and storage cases and calibration certificate.

Existing MS-7001/7002 mass sets from PG7000 piston gauge systems are compatible with PG9607.

| Manual mass set designator | Item number | Nominal total mass |
|---|---|---|
| MS-7002-35 | 3069861 | 35 kg |
| MS-7002-40 | 3070021 | 40 kg |
| MS-7002-45 | 3069980 | 45 kg |
| MS-7002-55 | 3069877 | 55 kg |
| MS-7002-80 | 3070000 | 80 kg |
| MS-7002-100 | 3070017 | 100 kg |

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

Electrical | RF | Temperature | Pressure | Flow | Software

**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. (800) 443-5853 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.fluke.com

©2010 Fluke Corporation. Specifications subject to change without notice.
Printed in U.S.A. 8/2010 3851679A B-EN-N, Pub ID: 11662-eng

**Modification of this document is not permitted without written permission from Fluke Corporation.**



원문: Fluke Calibration PG9602/9607 데이터시트(영문) · 제조사 원문 자료입니다. 사양은 제조사 사정에 따라 변경될 수 있습니다.