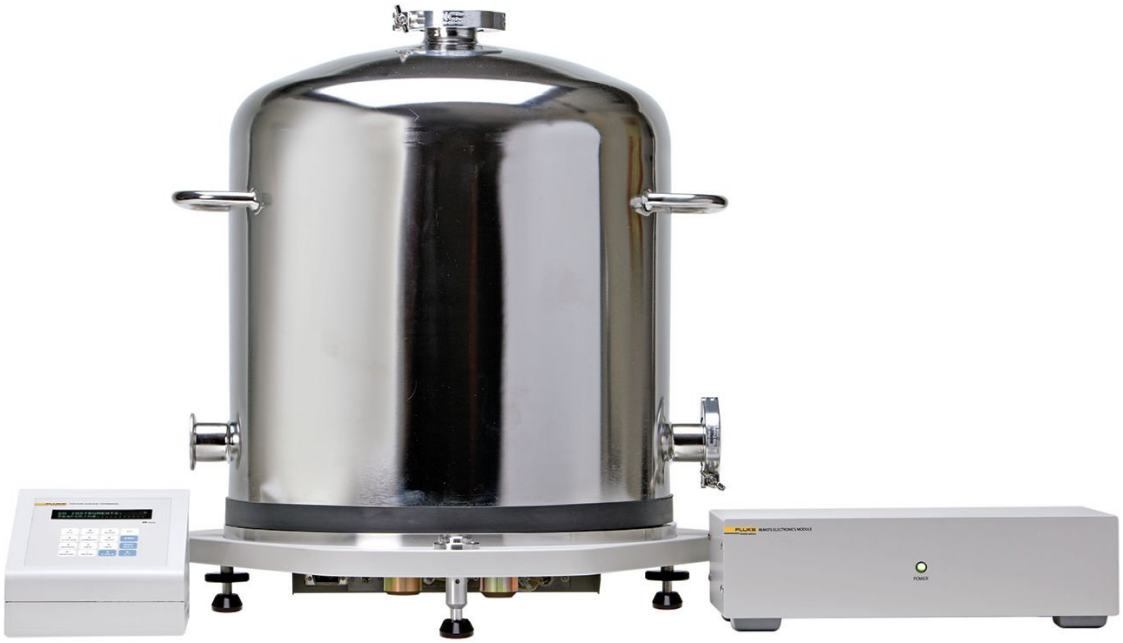
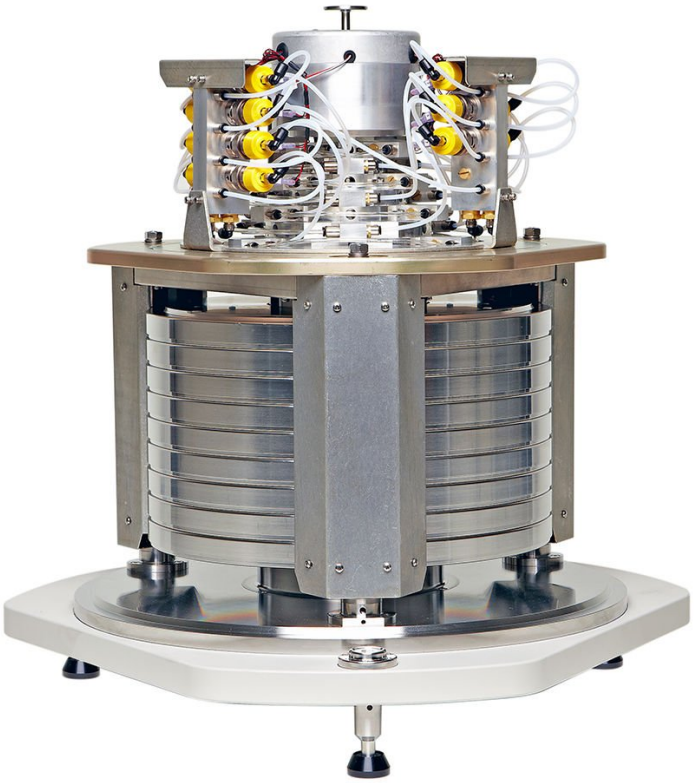
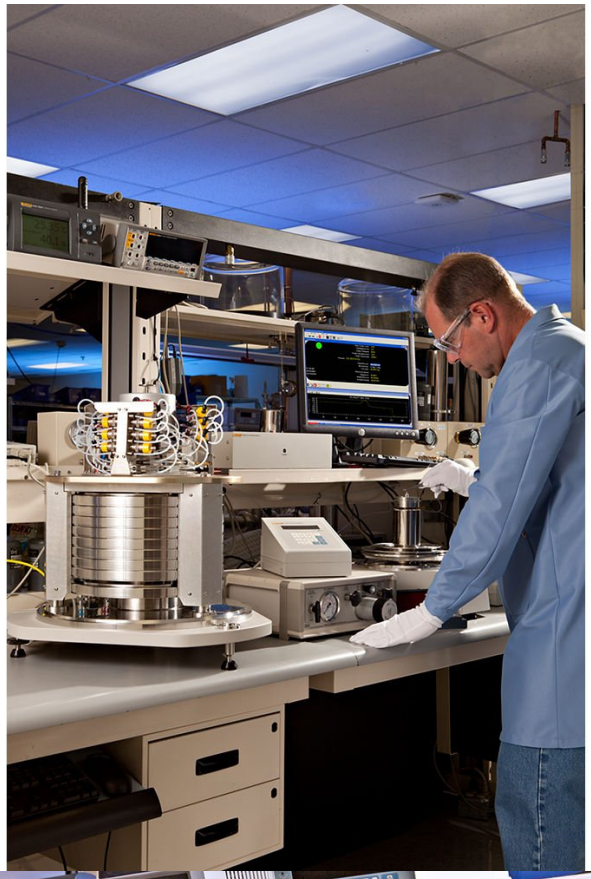
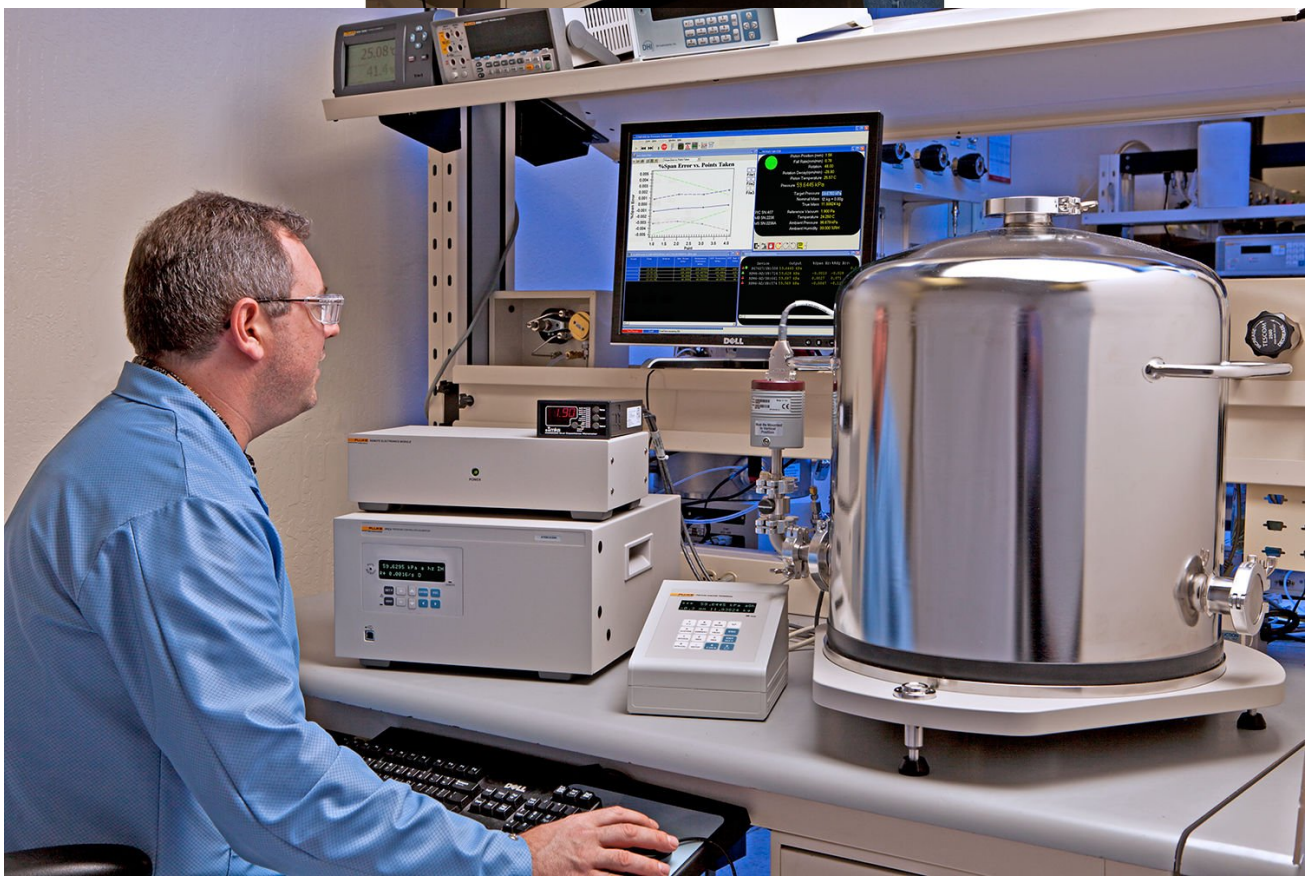
TECHNICAL DATA

PG9602/9607 Piston Gauge









Key features

- Automated pressure reference for pressures up to 500 kPa, supporting a 100 kg mass set.
- Multiple piston cylinder range options for pressure measurements from 12 kPa to 10 MPa.
- 50 mm piston-cylinder assembly with low uncertainty dimensional traceability.
- Automated mass handling technology for efficient testing.
- Automatic pressure control and software, enables repeated and extended tests.

Product overview: PG9602/9607 Piston Gauge

Refined 50 mm piston-cylinder design

PG9602/9607'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

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 PG9602/9607 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 PG9602/9607 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.

Specifications: PG9602/9607 Piston Gauge

General specifications	
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) 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 PG9602/9607 (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)	PG9602/9607 base (without vacuum hardware): 34.1 cm x 54.3 cm x 52.3 cm (13.4 in x 21.4 in x 20.6 in) (Height: top of piston-cylinder assembly) PG9602/9607 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) (Height: Top of bell jar) Remote electronics module: 10.2 cm x 35.1 cm x 19.6 cm (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 PG terminal: Hitachi 64180
Communication ports	RS-232 COM 1: Host computer COM2: Residual vacuum sensor (exteal) COM3: Automated pressure cooller 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] 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* Coolled clearance pressure: DH200* * Gland and collar fiing 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).

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 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 coolled 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			
Piston-cylinder assembly	**PC-9602-10**	**PC-9602-20**	**PC-9602-50**	**PC-9602-100**

Compatible platform	PG9602	PG9602	PG9602	PG9602
Pressure to mass ratio	10 kPa/kg	20 kPa/kg	50 kPa/kg	100 kPa/kg
Minimum pressure (using mass bell)	13 kPa (1.9 psi)	20 kPa (2.9 psi)	50 kPa (7.3 psi)	100 kPa (14.5 psi)
Maximum pressure (100 kg mass)	1,000 kPa (145 psi)	2,000 kPa (290 psi)	5,000 kPa (725 psi)	10,000 kPa (1450 psi)
Piston material	Tungsten carbide	Tungsten carbide	Tungsten carbide	Tungsten carbide
Cylinder material	Tungsten carbide	Tungsten carbide	Tungsten carbide	Tungsten carbide
Nominal diameter (mm)	35	25	16	11
Nominal area (mm^2)	1,000	500	200	100
Mounting system	Simple Free Deformation	Simple Free Deformation	Simple Free Deformation	Simple Free Deformation
Typ. N2 drop rate with full mass load (mm/min)	0.3	0.5	0.7	1.2
Sensitivity[1]	0.02 Pa + 0.5 ppm	0.04 Pa + 0.5 ppm	0.1 Pa + 0.5 ppm	0.2 Pa + 0.5 ppm
Reproducibility[2] (ppm)	2	2	2	3

[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

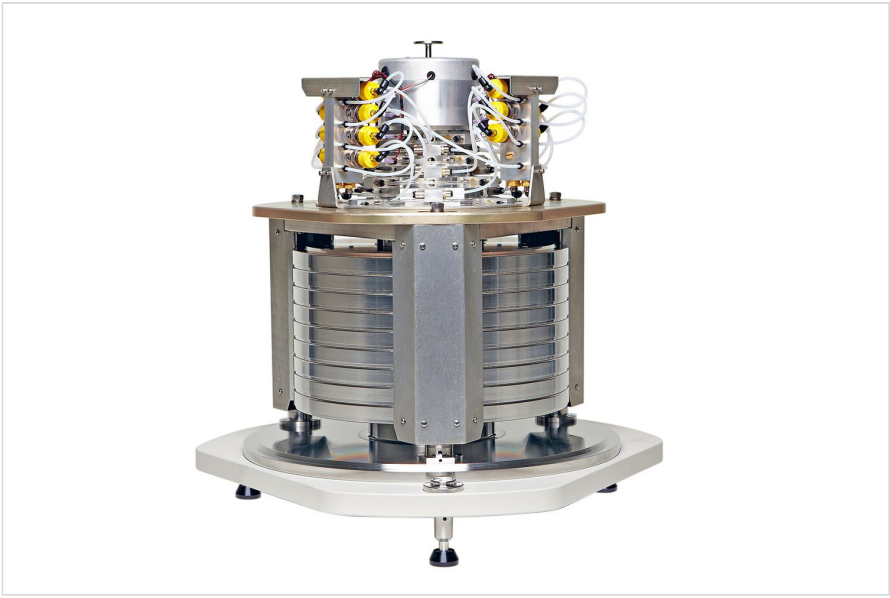
Mass sets	
All masses are delivered in molded, reusable, transit cases with custom inserts.	
Masses	Material: 304L non-magnetic stainless steel Finish: Electropolished Adjustment tolerance: ± 20 ppm of nominal value (manual mass sets, AMH automated mass handler mass sets do not have fixed adjustment tolerances) Uncertainty of measured values: ± 5 ppm or 1 mg, whichever is greater 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 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	
Temperature (Ambient)	Range: 0 °C to 40 °C (32 °F to 104 °F) Resolution: 0.1 °C (32.18 °F) Measurement uncertainty: ± 1 °C (33.8 °F)
Temperature (Piston-cylinder module)	Range: 0 °C to 40 °C (32 °F to 104 °F) Resolution: 0.01 °C (32.02) Measurement uncertainty: ± 0.1 °C (32.18 °F)
Barometric pressure with inteal sensor	Range: 70 kPa to 110 kPa Resolution: 10 Pa Measurement uncertainty: ± 140 Pa Barometric pressure can also be read automatically with any RS-232 device such as a DHI RPM.
Relative humidity	Range: 5 % to 95 % RH Resolution: 1 % RH Measurement uncertainty: ± 10 % RH
Piston position	Range: ± 4.5 mm Resolution: 0.1 mm
Piston rotation (Rate and deceleration)	Range: 2 rpm to 99 rpm Resolution: 1 rpm
Vacuum (optional)	Range: 0 Pa to 13 Pa Resolution: 0.01 Pa Measurement uncertainty: ± 0.05 Pa + 0.5 % of reading

Ordering information



PG9607

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 for all components that require calibration certificates

PG9600-VAC-REF

Optional Vacuum Reference 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 for CDG. Vacuum pump and interconnections to bell jar assembly supplied separately.

PC-9607-5

PC-9607-5 Piston-Cylinder Module
Gas operated assembly

- Delivered with reusable shipping and storage case and calibration certificate
- Pressure to mass ratio: 5 kPa/kg
- Minimum pressure (using mass bell)
  (absolute and gauge): 11 kPa (0.11 bar, 1.6 psi)
- Maximum pressure (100 kg mass)
  (absolute and gauge): 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.

MS-7001-35
Mass Set (for manual operation without AMH)
Nominal total mass: 35 kg

MS-7002-35
Mass Set (for manual operation without AMH)
Nominal total mass: 35 kg

MS-7002-40
Mass Set (for manual operation without AMH)
Nominal total mass: 40 kg

MS-7002-45
Mass Set (for manual operation without AMH)
Nominal total mass: 45 kg

MS-7002-55
Mass Set (for manual operation without AMH)
Nominal total mass: 55 kg

MS-7002-80
Mass Set (for manual operation without AMH)
Nominal total mass: 80 kg

MS-7002-100
Mass Set (for manual operation without AMH)
Nominal total mass: 100 kg

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.
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

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.

AMH-100

Automated mass handler, 100 kg maximum

MS-AMH-100

100 kg mass set, AMH

MS-AMH-60

60 kg mass set, AMH

MS-AMH-90

Mass Set (for automatic operation with AMH)

Nominal total mass: 90 kg

Mass set includes AMH mass carrying bell. Delivered with reusable mass shipping and storage cases and calibration certificate.

Mass sets smaller than 100 kg are available if the maximum pressure range is not required.

MB-7002-0.8

Mass Bell

Mass bell must be purchased to use manual mass sets with PG9000 . Mass bell is not included with the PG9000 platform or manual mass sets.

PG9602

PG9602 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 for all components that require calibration certificates

PC-9602-10

PC-9602-10 Piston-Cylinder Module
Gas operated assembly

- Delivered with reusable shipping and storage case and calibration certificate
- Pressure to mass ratio: 10 kPa/kg
- Minimum pressure (using mass bell)

(absolute and gauge): 13 kPa (1.9 psi)
- Maximum pressure (100 kg mass)
(absolute and gauge): 1 000kPa (145 psi)

PC-9602-20 Piston-Cylinder Module

Gas operated assembly

- Delivered with reusable shipping and storage case and calibration certificate
- Pressure to mass ratio: 20 kPa/kg
- Minimum pressure (using mass bell)
(absolute and gauge): 20 kPa (2.9 psi)
- Maximum pressure (100 kg mass)
(absolute and gauge): 1 100kPa (160 psi)

PC-9602-50 Piston-Cylinder Module

Gas operated assembly

- Delivered with reusable shipping and storage case and calibration certificate
- Pressure to mass ratio: 50 kPa/kg
- Minimum pressure (using mass bell)
(absolute and gauge): 50 kPa (7.3 psi)
- Maximum pressure (100 kg mass)
(absolute and gauge): 2 750kPa (400 psi)

PC-9602-100 Piston-Cylinder Module

Gas operated assembly

- Delivered with reusable shipping and storage case and calibration certificate
- Pressure to mass ratio: 100 kPa/kg
- Minimum pressure (using mass bell)
(absolute and gauge): 100 kPa (14.5 psi)
- Maximum pressure (100 kg mass)
(absolute and gauge): 10 000kPa (1450 psi)

PPC4 A700Ku

Automatic Pressure Control to 700 kPa (100 psi)

PPC4 A2Mu

Automatic Pressure Control to 2 MPa (300 psi)

MPC1-1000

Manually operated gas pressure controller, pressure range vacuum to 7 MPa (1,000 psi)

PPC4 A14Mu

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