

Deadweight Tester / Pressure balance Type CPB5000

Applications

- Primary standard for defining the pressure scale in a range up to 100 bar (pneumatic) or 1,000 bar (1200 bar) (hydraulic)
- Reference instrument for testing, adjusting and calibrating pressure measuring instruments in factories and calibration laboratories
- Self-contained, complete system also suitable for on-site measurements/calibrations

Special features

- Total uncertainty of measurement down to 0.008 % of reading
- Factory calibration certificate as standard, traceable to National Standards, DKD/DAkkS calibration certificate available as an option
- High long-term stability with a recommended recalibration cycle of 5 years
- Masses manufactured from stainless steel and aluminium, local gravity adjustment possible at no additional charge
- The patented ConTect quick-change system enables fast and secure exchange of the piston cylinder system in order to change the measuring range.

Description

Proven primary standard

Pressure balances are the most accurate instruments for the calibration of electronic or mechanical pressure measuring instruments. The direct measurement of pressure, ($P = F/A$) and the use of high-quality materials, result in small measurement uncertainties and an excellent long-term stability of five years (Recommendation in accordance with the German Calibration Service DKD/DAkkS).

For these reasons pressure balances have already been used in the calibration laboratories of industry, national institutes and research laboratories for many years.

Self-contained operation

Due to the integrated pressure generation and the purely mechanical measuring principle, the CPB5000 is ideally suited to on-site use as well as service and maintenance purposes.



Deadweight Tester / Pressure balance CPB5000

Basic principle

Pressure is defined as the quotient of force and area. Correspondingly, the core of the CPB5000 is a very precisely-manufactured piston cylinder system, which is loaded with masses in order to generate the individual test points.

The weight applied is proportional to the desired pressure and accomplished by using optimally graduated weights. These weights are manufactured to standard gravity (9.80665 m/s^2) although, for fixed location usage, they can be adjusted to a customer-specified local gravity.

Easy operation

Depending on the instrument version the pressure is set via an integrated pump or via an external pressure supply by the use of control valves. For fine adjustment a very precisely adjustable spindle pump with a precision spindle running only within the pump body is mounted.

Piston cylinder system

Both the piston and cylinder are manufactured from Tungsten Carbide. Compared to other materials, Tungsten Carbide has very small pressure and thermal expansion coefficients, which results in a very good linearity of the effective cross-sectional area of the piston and high measurement accuracy.

Piston and cylinder are very well protected in a solid stainless steel housing, against contact, impacts or contamination from outside. In addition, overpressure protection is integrated, which prevents the piston from being forced out vertically and avoids damage to the piston cylinder system in the event of weight removal under pressure.

The weight discs are stacked on a bell jar which is fitted to the piston skirt. Due to the construction of the bell jar, the centre of gravity for the stacked weights is very low, which minimises both the side thrust on the piston cylinder system and the friction. For relatively low starting pressures, a lighter aluminium plate can be used instead of the bell jar.

The overall design of the piston cylinder unit and the very precise manufacturing of both the piston and the cylinder ensure excellent operating characteristics with a long free-rotation time, low sink rates and a very high long-term stability. Therefore the recommended recalibration interval is 5 years.

High-performance instrument range

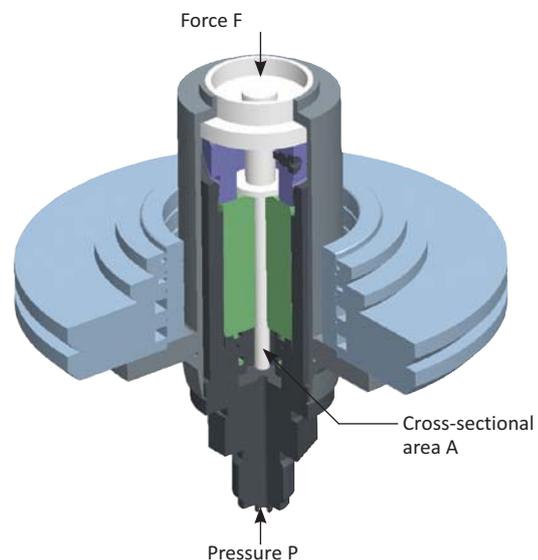
The CPB5000 instrument bases are available in the following 4 designs:

- Low-pressure pneumatic base
 - up to a max. 10 bar/150 psi
 - with integrated pressure generation through inlet pressure pump and spindle pump
- High-pressure/Vacuum pneumatic base
 - up to a max. 100 bar/1,500 psi
 - Connection for an external pressure supply or vacuum
- Pneumatic base with integrated gas to oil separator
 - up to a max. 400 bar/5,000 psi
 - Connection for an external pressure supply
 - for the use with hydraulic piston cylinder systems with M30 x 2 connection
 - Test item can be calibrated easily, dryly and cleanly with air

As soon as the measuring system reaches equilibrium, there is a balance of forces between pressure and mass applied. The excellent quality of the system ensures that this pressure remains stable over several minutes, so that the device under test can be calibrated or time-consuming adjustments can be carried out without any problems.

The standard connection for the piston cylinder system is an M30 x 2 male thread.

The patented ConTect quick-connect system, for easy measuring range changes without tools, is available as an option.



Piston cylinder system of CPB5000

- Hydraulic base
 - up to a max. 1,000 bar/14,500 psi
 - with integrated pressure generation through inlet pressure pump and spindle pump
 - up to 1,200 bar/17,400 psi available as special version

As a standard all instrument bases are equipped with a connection for the piston cylinder system with M30 x 2 female threads.

Optionally, the integrable patented ConTect quick-change adapter enables fast and secure changing of the measuring range, without the need for tools. In this way you can build a price-optimised complete system from one universal base and up to 3 ConTect piston cylinder systems for different measuring ranges, which can be operated with only one mass set.

Tables of masses

The following tables show the number of weights per measuring range, within a weight set, with their nominal mass values and the resulting nominal pressures. Should you not operate the device under reference conditions (ambient temperature 20 °C, air pressure 1013 mbar, relative humidity 40 %), corrections must be considered, if necessary.

These weights are manufactured to standard gravity (9.80665 m/s²) although, for fixed location usage, they can be adjusted to a customer-specified local gravity.

Measuring range [bar]	Pneumatic models					Hydraulic models																	
	-0.03 ... -1		0.03 ... 2		0.2 ... 10		0.4 ... 50		0.4 ... 100		0.2 ... 60		0.2 ... 100		1 ... 250		1 ... 400		2 ... 600		2 ... 1,000		
	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	
	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	
Piston	1	0.03	1	0.03	1	0.2	1	0.4	1	0.4	1	0.2	1	0.2	1	1	1	1	1	1	2	1	2
Bell jar	-	-	1	0.16	1	0.8	1	4	1	4	1	1.6	1	1.6	1	8	1	8	1	16	1	16	
Aluminium plate	1	0.07	1	0.01	1	0.05	1	0.25	1	0.25	1	0.1	1	0.1	1	0.5	1	0.5	1	1	1	1	1
Masses 4 kg	-	-	-	-	-	-	-	-	-	-	6	8	11	8	5	40	11	40	6	80	11	80	
Masses 2 kg	-	-	-	-	-	-	-	-	5	10	2	4	2	4	2	20	2	20	2	40	2	40	
Masses 1 kg	-	-	9	0.2	9	1	9	5	9	5	1	2	1	2	1	10	1	10	1	20	1	20	
Masses 0.5 kg	8	0.1	1	0.1	1	0.5	1	2.5	1	2.5	1	1	1	1	5	1	5	1	10	1	10		
Masses 0.25 kg	1	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Masses 0.2 kg	-	-	1	0.04	1	0.2	1	1	1	1	1	0.4	1	0.4	1	2	1	2	1	4	1	4	
Masses 0.12 kg	-	-	1	0.024	1	0.12	1	0.6	1	0.6	-	-	-	-	-	-	-	-	-	-			
Masses 0.1 kg	2	0.02	1	0.02	1	0.1	1	0.5	1	0.5	1	0.2	1	0.2	1	1	1	1	1	1	2	1	2
Masses 0.07 kg	-	-	1	0.014	1	0.07	1	0.35	1	0.35	-	-	-	-	-	-	-	-	-	-			
Masses 0.05 kg	1	0.01	1	0.01	1	0.05	1	0.25	1	0.25	1	0.1	1	0.1	1	0.5	1	0.5	1	1	1	1	1

Measuring range [psi]	Pneumatic models						Hydraulic models													
	-0.435... -14		0.435... 30		2.9 ... 150		5.8 ... 500		5.8 ... 1,000		5.8 ... 1,500		2.9 ... 1,000		14.5 ... 5,000		29 ... 10,000		29 ... 14,500	
	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece	Pieces	Nominal pressure per piece
	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi
Piston	1	0.435	1	0.435	1	2.9	1	5.8	1	5.8	1	5.8	1	2.9	1	14.5	1	29	1	29
Bell jar	-	-	1	2.22	1	11.1	1	55.5	1	55.5	1	55.5	1	23.1	1	115.5	1	231	1	231
Aluminium plate	1	0.565	1	0.22	1	1.1	1	5.5	1	5.5	1	5.5	1	1.1	1	5.5	1	11	1	11
Masses 3.5 kg	-	-	-	-	-	-	-	-	-	-	9	100	9	500	9	1000	14	1000		
Masses 1.4 kg	-	-	5	4	5	20	-	-	5	100	8	100	1	40	1	200	1	400	1	400
Masses 1 kg	-	-	2	3	2	15	2	75	2	75	2	75	1	30	1	150	1	300	1	300
Masses 0.7 kg	4	2	4	2	4	10	4	50	4	50	9	50	2	20	2	100	2	200	2	200
Masses 0.35 kg	4	1	3	1	3	5	3	25	3	25	3	25	1	10	1	50	1	100	1	100
Masses 0.19 kg	-	-	1	0.548	1	2.74	1	13.7	1	13.7	1	13.7	-	-	-	-	-	-	-	
Masses 0.175 kg	1	0.5	-	-	-	-	-	-	-	-	-	-	1	5	1	25	1	50	1	50
Masses 0.14 kg	-	-	1	0.4	1	2	1	10	1	10	1	10	1	4	1	20	1	40	1	40
Masses 0.12 kg	-	-	1	0.345	1	1.725	1	8.625	1	8.625	1	8.625	-	-	-	-	-	-	-	
Masses 0.07 kg	2	0.2	1	0.2	1	1	1	5	1	5	1	5	1	2	1	10	1	20	1	20
Masses 0.035 kg	1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Specifications

Model CPB5000

Version		pneumatic					
Measuring range ⁵⁾	bar ¹⁾	-0.03 ... -1	0.03 ... 2	0.2 ... 10	0.4 ... 50	0.4 ... 100	
Required weights	kg	5	10	10	10	20	
Smallest step	bar ²⁾	0.01	0.01	0.05	0.25	0.25	
Nominal cross-sectional area of the piston	cm ²	5	5	1	0.2	0.2	
Version		pneumatic					
Measuring range ⁵⁾	psi ¹⁾	-0.435 ... -14	0.435 ... 30	2.9 ... 150	5.8 ... 500	5.8 ... 1,000	5.8 ... 1,500
Required weights	kg	5	10	10	7	13	20
Smallest step	psi ²⁾	0.1	0.2	1	5	5	5
Nominal cross-sectional area of the piston	cm ²	5	5	1	0.2	0.2	0.2
Version		hydraulic					
Measuring range ⁵⁾	bar ¹⁾	0.2 ... 60	0.2 ... 100	1 ... 250	1 ... 400	2 ... 600	2 ... 1,000
Required weights	kg	30	50	25	40	30	50
Smallest step	bar ²⁾	0.1	0.1	0.5	0.5	1	1
Nominal cross-sectional area of the piston	cm ²	0.5	0.5	0.1	0.1	0.05	0.05
Version		hydraulic					
Measuring range ⁵⁾	psi ¹⁾	2.9 ... 1,000	14.5 ... 5,000	29 ... 10,000	29 ... 14,500		
Required weights	kg	34	34	34	50		
Smallest step	psi ²⁾	2	10	20	20		
Nominal cross-sectional area of the piston	cm ²	0.5	0.1	0.05	0.05		
Accuracy ³⁾	% of reading	0.015 / optional: 0.008 ⁴⁾					
Instrument base version							
<ul style="list-style-type: none"> ■ Pneumatic, low pressure ■ Pneumatic, high pressure/vacuum ■ Pneumatic, with separator 		up to max. 10 bar/150 psi; with internal pressure supply up to max. 100 bar/1,500 psi; for external supply and vacuum up to max. 400 bar/5,000 psi; for external supply with integrated gas to oil separator for the use for hydraulic pistons with M30 x 2 connection					
<ul style="list-style-type: none"> ■ Hydraulic 		up to max. 1,000 bar/14,500 psi; with internal pressure supply up to max. 1,200bar/17,400 psi on request					
Connection of the piston cylinder system		M30 x 2 male thread / Optional: ConTect quick connector					
Connection for the test specimen		Quick connector G ½ B female thread as standard, freely rotating, changeable, (for other threaded inserts, see accessories)					
Pressure transmission medium	pneumatic	clean dry non-corrosive gases (e.g. air or nitrogen)					
	hydraulic	Operating fluid (1 litre is included in delivery), other mediums on request					
Oil reservoir	cm ³	250					
External pressure connection		6 mm SWAGELOK [®] tube fitting; max. 110 % of the assigned measuring range; only with instrument base version, pneumatic high pressure/vacuum and with separator					
Material							
<ul style="list-style-type: none"> ■ Piston ■ Cylinder ■ Mass-set ■ Piping in instrument base 		Tungsten Carbide Tungsten Carbide Stainless steel 1.4305 and Aluminium, non-magnetic pneumatic low pressure: flexible hose from polyurethane, 4 x 0.75 mm pneumatic high pressure/vacuum and with separator: stainless steel 1.4571, 3 x 1 mm hydraulic: stainless steel 1.4404, 6 x 2 mm					
Operating temperature	°C	18 ... 28					
Weight							
<ul style="list-style-type: none"> ■ Instrument base pneumatic, low pressure ■ Instrument base pneumatic, high pressure ■ Instrument base, pneumatic, with separator ■ Instrument base hydraulic ■ Piston cylinder system ■ BAR mass-set vacuum ■ BAR basic mass-set, pneumatic ■ BAR mass-set extension, pneumatic ■ BAR basic mass-set, hydraulic ■ BAR mass-set extension, hydraulic 	kg	18.0 / 19.0 (incl. optional ConTect quick connector) 18.0 / 19.0 (incl. optional ConTect quick connector) 16.5 20.5 / 21.5 (incl. optional ConTect quick connector) 1.5 / 5.7 (incl. bell jar and aluminium plate at optional storage suit case) 13.1 (incl. piston cylinder system at carrying case) 16.2 (incl. carrying case) 14.0 (incl. carrying case) 36.0 (incl. carrying case) 24.0 (incl. carrying case)					

Continuation, specifications

Model CPB5000

Weight		
■ PSI mass-set vacuum	kg	13.0 (incl. piston cylinder system at carrying case)
■ PSI basic mass-set, pneumatic	kg	12.5 (incl. carrying case)
■ PSI mass-set extension 1, pneumatic	kg	11.0 (incl. carrying case)
■ PSI mass-set extension 2, pneumatic (only for 1,500 psi)	kg	18.5 (incl. carrying case)
■ PSI basic mass-set, hydraulic	kg	42.0 (incl. carrying case)
■ PSI mass-set extension, hydraulic	kg	21.5 (incl. carrying case)
Dimensions		
■ Instrument base	mm	400 (W) x 375 (D) x 265 (H), for details see technical drawing
■ Carrying case for basic mass-set	mm	400 (W) x 310 (D) x 310 (H)
■ Carrying case for mass-set extension	mm	215 (W) x 310 (D) x 310 (H)
■ Carrying case for piston cylinder system (optional)	mm	300 (W) x 265 (D) x 205 (H)
CE-conformity		
■ Pressure equipment directive		97/23/EG (Module A) only for version 1,200 bar/17,400 psi
Calibration		Factory calibration certificate (optional: DKD calibration certificate)

- 1) Theoretical starting value; corresponds to the pressure value generated by the piston (by its own weight). To optimise the operating characteristics more weights should be loaded.
- 2) The lowest pressure change value that is reached based on the standard weight set. A fine weight set is also available for lower values.
- 3) The accuracy is in reference to the measurement value, from 10 % of the measurement range. A fixed error is considered in the lower area in reference to 10 % of the area.
- 4) Measurement uncertainty assuming reference conditions (room temperature 20 °C, air pressure 1013 mbar, relative humidity 40 %). Corrections may be required for use without CalibratorUnit.
- 5) Other on request.

Intelligent Calibration Module IKM

The Intelligent Calibration Module IKM is a compact tool for use with a deadweight tester / pressure balance. Particularly when highly-accurate measuring values, with uncertainties of measurement of less than 0.025 %, are required, complicated mathematic calculations and corrections are necessary. With the IKM all critical ambient parameters can be registered and automatically corrected.

Basis package IKM

The basic IKM package converts masses into the corresponding pressure value, or vice versa, it calculates the masses required for a specific pressure value by considering the local gravity on-site. The conversion can be carried out in all common pressure units. The input of all parameters takes place manually.

Sensor package

The sensor package extension includes sensors to automatically register all critical parameters like room temperature, air pressure, relative humidity and piston temperature and a continual updating of the calculations possible.

Multimeter package

Furthermore with the multimeter package, a calibrator function for pressure transmitters can be integrated, so that a voltage of 24 V DC can be supplied to the test item sensors and sensor signals (V, mA) can be measured without any additional devices. Besides the signal the automatically converted pressure value is also shown on the display.

Piston position display

By upgrading the IKM with the extension for float position indication, the piston position can be measured contact-free and shown on the IKM with high resolution.

Further specifications to IKM see data sheet IKM.



Intelligent Calibration Module IKM

IKM Order variants

IKM Basis package (only processor)

- Calculation of the mass-loads
- Manual input of all parameters

Sensor package for measuring of:

- Ambient temperature
- Air pressure
- Air humidity
- Piston temperature

Multimeter package

- Power supply 24 V DC
- Measuring of output signal (V, mA) incl. conversion into pressure values

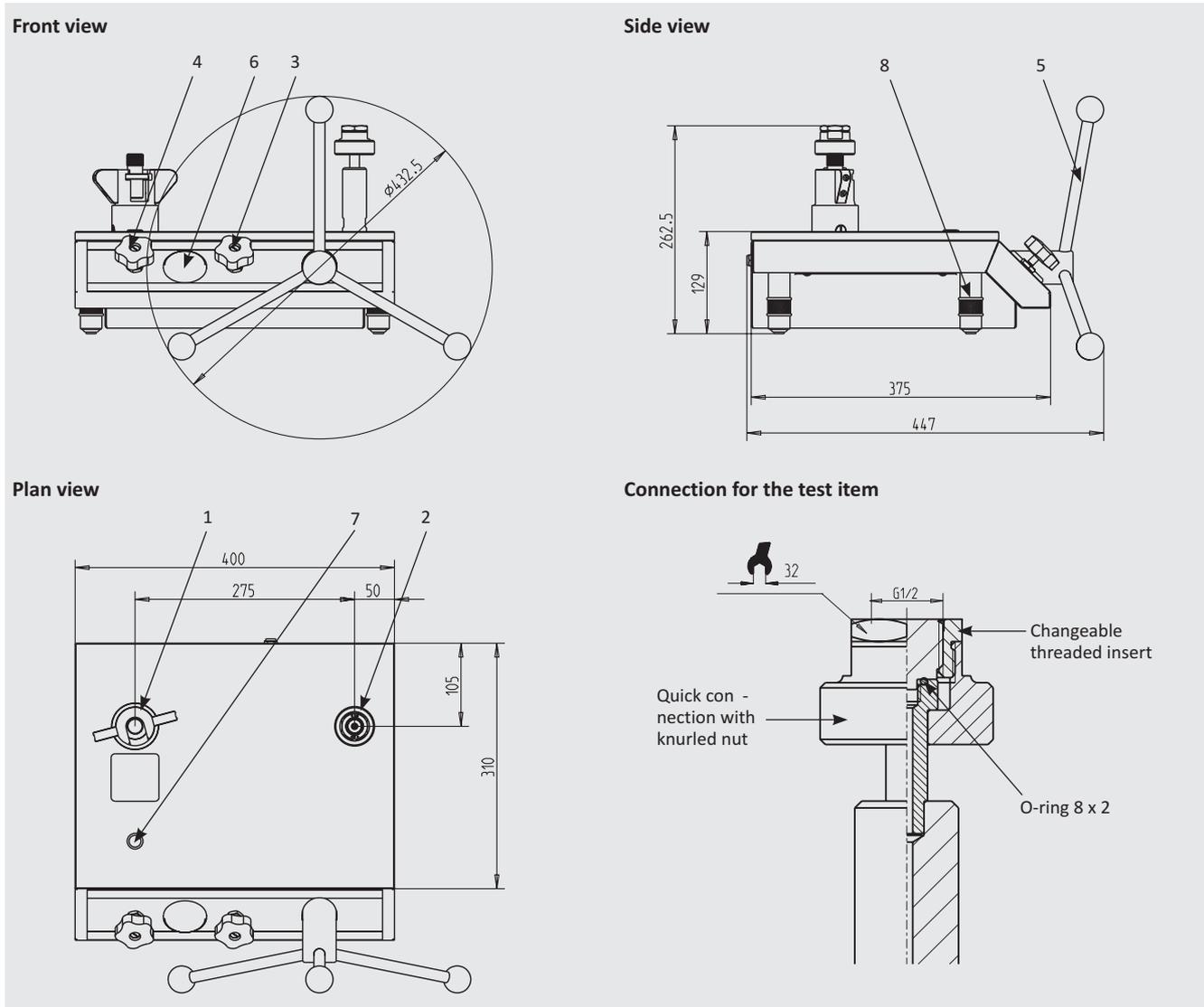
Piston position display

- Contact-free measuring of piston position

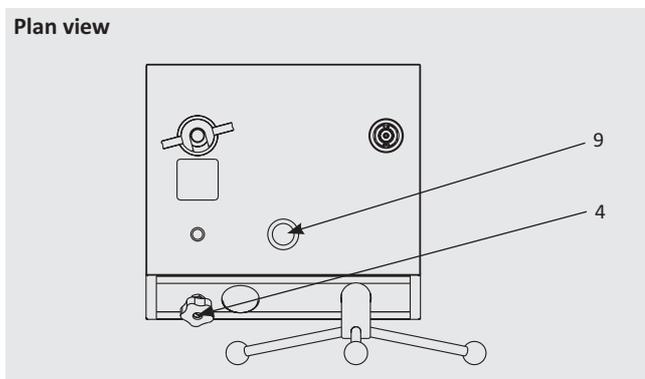
Dimensions in mm

The drawing shows a pneumatic, high-pressure CPB5000 base with the ConTect quick-connect option.

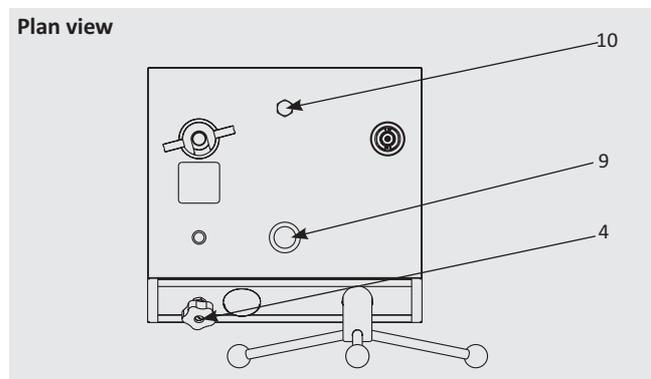
The pneumatic low-pressure version and hydraulic version differ only in the arrangement of the control elements, and not dimensionally.



Base low-pressure pneumatic



Base hydraulic



- (1) Adapter piston cylinder system
- (2) Adapter test item
- (3) Inlet-valve (only pneumatic high-pressure)
- (4) Outlet-valve
- (5) Spindle pump with star handle, removable

- (6) Test-pressure gauge (only up to max. 1,000 bar/14,500 psi)
- (7) Water level
- (8) Rotating base
- (9) Inlet pressure pump
- (10) Oil reservoir screw plug

Accessories

Set of trim-masses

The weights included in the standard scope of delivery are ideally suited for everyday use. If you would like to generate intermediate values, however, we recommend using a set of class F1 trim-masses, with the following weights:

1 x 50 g / 2 x 20 g / 1 x 10 g / 1 x 5 g / 2 x 2 g / 1 x 1 g /
1 x 500 mg / 2 x 200 mg / 1 x 100 mg / 1 x 50 mg /
2 x 20 mg / 1 x 10 mg / 1 x 5 mg / 2 x 2 mg / 1 x 1 mg



Set of trim-masses

Set of adapters for quick connector

As a standard, the pressure balance is equipped with a quick connector for connecting the test item. For this purpose, various threaded adapters, which can be easily exchanged, are available:

- Set of adapters: G ¼, G ⅜, ½ NPT, ¾ NPT and M20 x 1.5
- Set of adapters NPT: ⅛ NPT, ¼ NPT, ⅜ NPT and ½ NPT

Additionally the sets of adapters include spare O-rings as well as a spanner, 32 flats and 14 flats, for exchanging the adapters.

Other threaded inserts are available on request.



Set of adapters

Dirt trap, purifier

For test objects that are very dirty, the use of a dirt trap is recommended in order to avoid the penetration of dirt particles into the pressure balance.

The purifier (without diaphragm) has been specially designed for measuring instruments where the fill fluid should not come into contact with the pressure balance.

It is typically used with pneumatic pressure balances for the calibration of instruments with the test media water but also for pneumatic pressure balances (only with external pressure supply) for calibrating devices with test medium water or oil.



Fig. left: Purifier

Fig. right: Dirt trap

Description / Features

Trim-masses (1 mg up to 50 g), class F1

Set of adapters for quick-connector, in a case with threaded inserts G ¼, G ⅜, ½ NPT, ¾ NPT and M20 x 1.5 for fitting to the knurled nut of the test item connection.

Set of "NPT" adapters for quick-connection in a case with threaded inserts ⅛ NPT, ¼ NPT, ⅜ NPT and ½ NPT for fitting to the knurled nut of the test item connection

Angle connection 90°, for test specimens with back mounting connection

Purifier, max. 1,000 bar

Dirt trap, -1 ... +1,000 bar volume 0.2 litre

Dirt trap, -1 ... +1,000 bar, volume 0.03 litre

Set of O-rings consisting of 5 spare 8 x 2 and 5 spare 4 x 2.2

Operating fluid for CPB5000 up to 4,000 bar, 1 litre

Cleaning set for ConTect-systems, pneumatic version

Cleaning set for ConTect-systems, hydraulic version

Special test item admission with quick-connector, to the adaptation into the ConTect system admission, operation as comparison test pump possible

Scope of supply

- Instrument base with dust cover
- Inlet pressure pump (not with pneumatic high-pressure/vacuum base and with separator)
- Spindle pump for pressure generation/fine adjustment
- Piston adapter with M30 x 2 female thread
- Quick connection of test devices
- Piston cylinder system with bell jar
- Basic mass set in the carrying case
- Mass-set extension in carrying case (dependent on the measuring range)
- Mass-set manufactured to standard gravity (9.80665 m/s²)

- Operating fluid 1.0 litre (only for hydraulic version) resp. 0.25 litre (for separator version)
- Operating instructions in German and English
- Factory calibration certificate

Options

- Systems with increased accuracy to 0.008 %
- Piston adapter with ConTect quick-connect
- Storage suit case for piston cylinder systems
- Mass-set manufactured to local gravity
- DKD/DAkkS calibration certificate

Further Deadweight Tester / Pressure Balances within our LR-Cal programme

Deadweight Tester / Pressure Balance LDW 1000

Measuring ranges:

- hydraulic: 60 bar up to 1,000 bar resp.
1,000 psi up to 14,500 psi

Accuracy: 0.025 % of reading

Specifications according to data sheet LDW 1000



Deadweight Tester / Pressure Balance LDW 1000

High-pressure Deadweight Tester / Pressure Balance CPB5000-HP

Measuring ranges:

- hydraulic: 2,500 bar, 4,000 bar or 5,000 bar resp.
40,000 psi, 60,000 psi or 70,000 psi

Accuracy: 0.025 % of reading
0.02 % of reading (optional)

Specifications according to data sheet CPB5000-HP



High-pressure Deadweight Tester/Pressure Balance CPB5000-HP

Differential pressure Deadweight Tester / Pressure Balance CPB5000-DP

Measuring ranges

(= static line pressure + differential pressure):

- pneumatic: 2 bar up to 100 bar resp.
30 psi up to 1,500 psi
- hydraulic: 60 bar up to 1,000 bar resp.
1,000 psi up to 14,500 psi

Accuracy: 0.015 % of reading
0.008 % of reading (optional)

Specifications according to data sheet CPB5000-DP



Differential Deadweight Tester / Pressure Balance CPB5000-DP

The specifications given in this document represent the state of engineering at the time of publishing.
We reserve the right to make modifications to the specifications and materials.