

# Pneumatic pressure balance Model CPB5000



WIKA data sheet CT 31.01



## Applications

- Reference instrument for defining the pressure scale in the range up to 100 bar pneumatic or to 400 bar pneumatic with an gas to oil separator.
- Primary standard for factory and calibration laboratories for the testing, adjustment and calibration of pressure measuring instruments
- Complete, stand-alone system, also suitable for on-site use

## Special features

- Total measurement uncertainty to 0.008 % of reading
- Factory calibration includes traceability to national standards, as standard; with DKD/DAkkS calibration possible as an option
- High long-term stability with recommended recalibration cycle every five years
- Masses manufactured from stainless steel and aluminium, can be adjusted to local gravity
- Quick and safe replacement of the piston-cylinder system for measuring range changes via patented ConTect quick-release system as an option

## Description

### Proven primary standard

Pressure balances are the most accurate instruments available on the market for the calibration of electronic or mechanical pressure measuring instruments. The direct measurement of the pressure ( $p = F/A$ ), as well as the use of high-quality materials enable a very small measurement uncertainty, in conjunction with an excellent long-term stability of five years (recommended in accordance with the German Calibration Service DKD/DAkkS).

The pressure balance has therefore been used for years in factory and calibration laboratories in industry, national institutes and research laboratories.

### Stand-alone operation

Due to its integrated pressure generation and the pure mechanical measuring principle, the model CPB5000 is ideal for on-site use for maintenance and service.



Pneumatic pressure balance model CPB5000

### Basic principle

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

The masses applied are proportional to the target pressure and this is achieved through optimally graduated masses. As standard, these masses are manufactured to the standard gravity ( $9.80665 \text{ m/s}^2$ ), though they can be adjusted to a specific location and also DKD/DAkkS calibrated.

## Easy operation

The pressure setting depends on the instrument design and is either done via an integrated pump or from external pressure supply via a metering valve. For further pressure increases and fine adjustment, a very precisely controllable spindle pump is fitted, which only runs within the pump body.

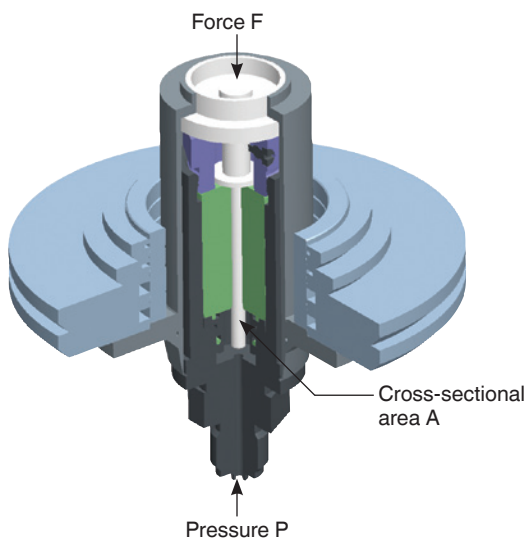
## The piston-cylinder system

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 thus a high measurement accuracy.

Piston and cylinder are very well protected against contact, impacts or contamination from outside in a solid stainless-steel housing. At the same time, 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 mass removal under pressure.

The masses are stacked on an overhang (bell jar), which sits on the piston shaft. The construction of the overhang (bell jar) provides a very low centre of gravity for the stacked weights, 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 overhang (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 five years.



**Piston-cylinder system model CPS5000**

As soon as the measuring system reaches equilibrium, there is a balance of forces between the pressure and the mass load applied. The excellent quality of the system ensures that this pressure remains stable over several minutes, so that the pressure value for comparative measurements can be read without any problems, or also so that more complex adjustments can be carried out on the test item.

The connection of the piston-cylinder system is a M30 x 2 male thread as standard.

The patented ConTect quick-release connector, for easy measuring range changes without the need for tools, is available as an option.

## High-performance instrument range

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

- Pneumatic base, low pressure
  - up to a max. 10 bar / 150 psi
  - with integrated pressure generation through priming pump and spindle pump
- Pneumatic base, high pressure/vacuum
  - up to a max. 100 bar / 1,500 psi
  - connection for external pressure supply or vacuum
- Pneumatic base with integrated gas to oil separator
  - up to a max. 400 bar / 5,000 psi
  - connection for external pressure supply
  - for use with hydraulic piston-cylinder systems with M30 x 2 connection
  - test items can be easily, dryly and cleanly calibrated with air

As standard, all basic instruments are fitted with a connection for the piston-cylinder system with a M30 x 2 female thread. The optional, integratable, patented ConTect quick-release connector enables a quick and safe changing of the measuring range without tools. Thus one can build a price-optimised complete system out of a universal system base and up to 3 ConTect piston-cylinder systems of different measuring ranges, which can be operated with only one set of masses.

The hydraulic measuring ranges of the model CPS5000 piston-cylinder systems can be used on the instrument base of the CPB5800 hydraulic pressure balance. For this, the ConTect quick-release connector is needed.

## Tables of masses

The following tables show the number of masses within a mass set with their nominal mass values and the resulting nominal pressures for the respective measuring ranges. Should you not operate the instrument under reference conditions (ambient temperature 20 °C, air pressure 1,013 mbar, relative humidity 40 %), the relevant corrections

must be made, for example with the CPU5000 CalibratorUnit, see page 10.

The masses are manufactured, as standard, to the standard gravity (9.80665 m/s<sup>2</sup>) although they can be adjusted for any particular location.

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				
	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	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	2	1	2	1	2		
Overhang (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	1	16	
Piston 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	1	
Masses 4 kg	-	-	-	-	-	-	-	-	-	-	6	8	11	8	5	40	11	40	6	80	11	80	11	80	
Masses 2 kg	-	-	-	-	-	-	-	-	5	10	2	4	2	4	2	20	2	20	2	40	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	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	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	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	2	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	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	
	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	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
Overhang (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
Piston 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	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

### Piston-cylinder systems model CPS5000

Version		pneumatic					
Measuring range <sup>5)</sup>	bar <sup>1)</sup>	-0.03 ... -1	0.03 ... 2	0.2 ... 10	0.4 ... 50	0.4 ... 100	
Required masses	kg	5	10	10	10	20	
Smallest step	bar <sup>2)</sup>	0.01	0.01	0.05	0.25	0.25	
Nominal cross-sectional area of the piston	cm <sup>2</sup>	5	5	1	0.2	0.2	
Version		pneumatic					
Measuring range <sup>5)</sup>	psi <sup>1)</sup>	-0.435 ... -14	0.435 ... 30	2.9 ... 150	5.8 ... 500	5.8 ... 1,000	5.8 ... 1,500
Required masses	kg	5	10	10	7	13	20
Smallest step	psi <sup>2)</sup>	0.1	0.2	1	5	5	5
Nominal cross-sectional area of the piston	cm <sup>2</sup>	5	5	1	0.2	0.2	0.2
Version		hydraulic					
Measuring range <sup>5)</sup>	bar <sup>1)</sup>	0.2 ... 60	0.2 ... 100	1 ... 250	1 ... 400	2 ... 600	2 ... 1,000
Required masses	kg	30	50	25	40	30	50
Smallest step	bar <sup>2)</sup>	0.1	0.1	0.5	0.5	1	1
Nominal cross-sectional area of the piston	cm <sup>2</sup>	0.5	0.5	0.1	0.1	0.05	0.05
Version		hydraulic					
Measuring range <sup>5)</sup>	psi <sup>1)</sup>	2.9 ... 1,000	14.5 ... 5,000	29 ... 10,000	29 ... 14,500		
Required masses	kg	34	34	34	50		
Smallest step	psi <sup>2)</sup>	2	10	20	20		
Nominal cross-sectional area of the piston	cm <sup>2</sup>	0.5	0.1	0.05	0.05		
Accuracy <sup>3)</sup>	% of reading	0.015 / optional: 0.008 <sup>4)</sup>					

#### Material

Piston		Tungsten carbide
Cylinder		Tungsten carbide
Mass set		1.4305 stainless steel and aluminium, non-magnetic

#### Weight

Piston-cylinder system	kg	1.5 / 5.7 (incl. overhang (bell jar) and piston plate in optional storage case)
BAR vacuum set of masses	kg	13.1 (incl. piston-cylinder system in carrying case)
BAR basic mass set, pneumatic	kg	16.2 (incl. carrying case)
BAR extension mass set, pneumatic	kg	14.0 (incl. carrying case)
BAR basic mass set, hydraulic	kg	36.0 (incl. carrying case)
BAR extension mass set, hydraulic	kg	24.0 (incl. carrying case)
PSI vacuum set of masses	kg	13.0 (incl. piston-cylinder system in carrying case)
PSI basic mass set, pneumatic	kg	12.5 (incl. carrying case)
PSI extension mass set 1, pneumatic	kg	11.0 (incl. carrying case)
PSI extension mass set 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 extension mass set, hydraulic	kg	21.5 (incl. carrying case)

#### Dimensions

Carrying case for basic mass set		400 x 310 x 310 mm (W x D x H)
Carrying case for extension mass set		215 x 310 x 310 mm (W x D x H)
Storage case for the piston-cylinder system (optional)		300 x 265 x 205 mm (W x D x H)

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 smallest pressure change value that can be achieved based on the standard weight set. To reduce this, a set of trim masses is also available.

3) The accuracy from 10 % of the measuring range is based on the measured value. In the lower range, a fixed error based on 10 % of the range applies.

4) Measurement uncertainty assuming reference conditions (ambient temperature 20 °C, air pressure 1,013 mbar, relative humidity 40 %). For operation without a CalibratorUnit, corrections must be made if required.

5) Others on request

## Base, model CPB5000

### Base version

Pneumatic, low pressure	up to a max. 10 bar / 150 psi; with internal pressure generation
Pneumatic, high pressure/vacuum	up to a max. 100 bar / 1,500 psi; for external supply and vacuum
Pneumatic, with separator	up to a max. 400 bar / 5,000 psi; for external supply with integrated gas to oil separator for use with hydraulic pistons with M30 x 2 connection

### Pressure transmission medium

Pneumatic	Clean, dry, non-corrosive gases (e.g. air or nitrogen)
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### Connections

Connection for piston-cylinder system	M30 x 2 female thread/optional: ConTect quick-release connector
Test item connection	Quick connector G ½ B female thread as standard, freely rotating, changeable, for further threaded inserts, see accessories
External pressure connection	6 mm SWAGELOK® tube fitting; max. 110 % of the assigned measuring range; only with pneumatic high-pressure/vacuum base version and with separator

### Material

Piping in instrument base	pneumatic low-pressure: plastic tubing from polyurethane, 4 x 0.75 mm pneumatic high-pressure/vacuum and with separator: 1.4571 stainless steel, 3 x 1 mm
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### Weight

Pneumatic base, low pressure	18.0 kg / 19.0 kg (incl. optional ConTect quick-release connector)
Pneumatic base, high pressure	18.0 kg / 19.0 kg (incl. optional ConTect quick-release connector)
Pneumatic base, separator	16.5 kg

### Permissible ambient conditions

Operating temperature	18 ... 28 °C
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### Dimensions

Base	400 x 375 x 265 mm (W x D x H), for details, see technical drawings
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## Approvals and certificates

### Approvals

GOST	Metrology/measurement technology, Russia
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### Certificates

Calibration	Standard: factory calibration certificate Option: DKD/DAkkS calibration certificate
Recommended recalibration interval	5 years (depending on the conditions of usage)

Approvals and certificates, see website

## Transport dimensions for complete instrument

The complete instrument, in its standard version and standard scope of delivery, consists of 3 packages on a single pallet.

The dimensions are 1,200 x 800 x 500 mm.

The overall weight is dependent on the measuring range.

Version in bar	Weight in kg	
	net	gross
<b>Pneumatic</b>		
-1 bar	32.5	47.5
2 bar / 10 bar / 50 bar	36.0	51.0
100 bar	50.0	65.0
<b>Pneumatic with separator</b>		
60 bar / 250 bar	54.0	69.0
100 bar / 400 bar	78.0	93.0
<b>Hydraulic with CPB5800 base</b>		
60 bar / 250 bar / 600 bar	56.5	71.5
100 bar / 400 bar / 1,000 bar	80.5	95.5

Version in psi	Weight in kg	
	net	gross
<b>Pneumatic</b>		
-14 psi	32.0	47.0
30 psi / 150 psi / 1,000 psi	43.0	58.0
500 psi	32.0	47.0
1,500 psi	61.5	76.5
<b>Pneumatic with separator</b>		
1,000 psi / 5,000 psi	60.0	75.0
<b>Hydraulic with CPB5800 base</b>		
1,000 psi / 5,000 psi / 10,000 psi	62.5	77.5
14,500 psi	84.0	99.0

## Scope of delivery

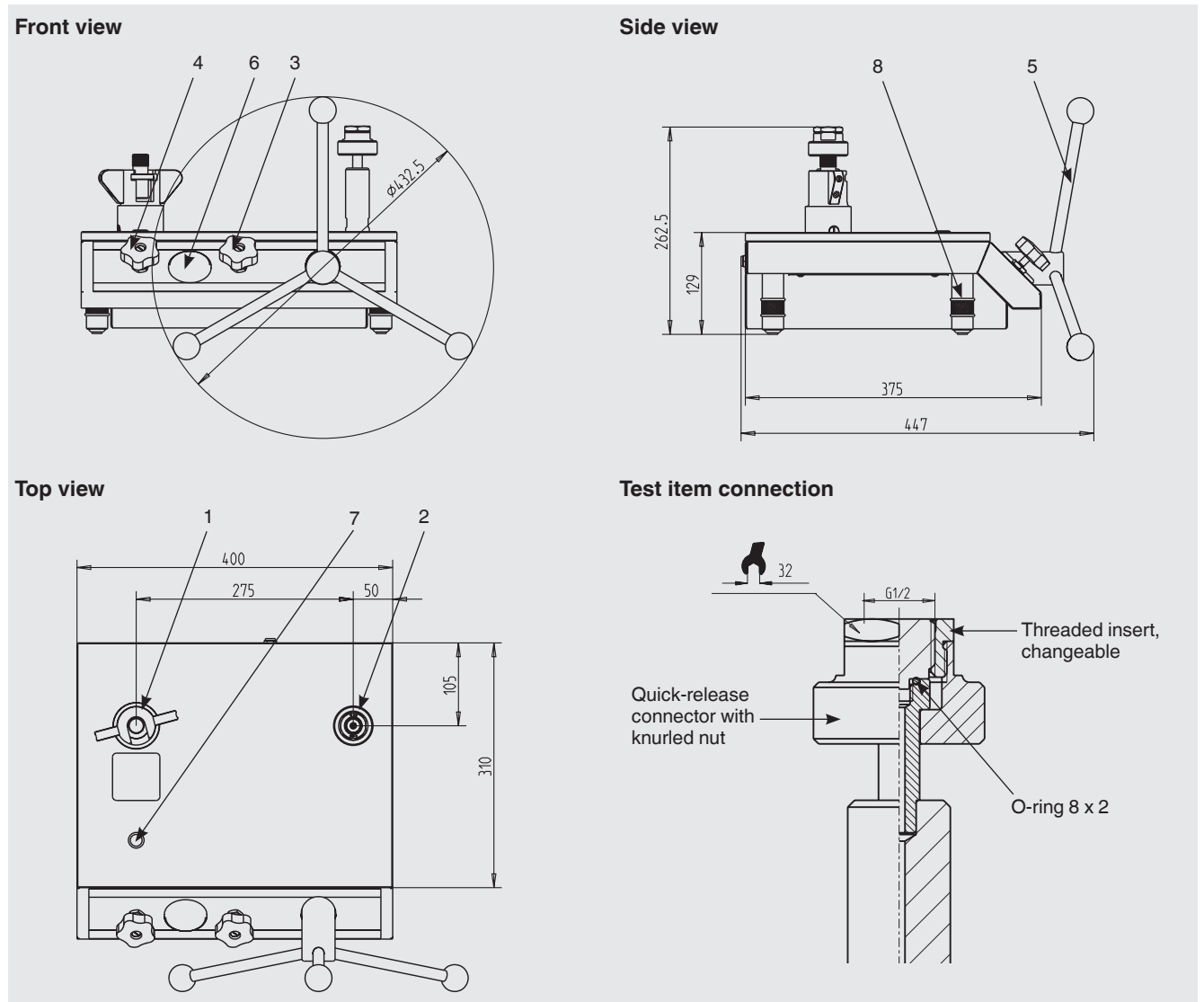
- Base with dust protection cover
- Priming pump (not on pneumatic base high pressure/ vacuum)
- Spindle pump for pressure generation/fine adjustment
- Piston connection with M30 x 2 female thread
- Quick connector for test items
- Piston-cylinder system with overhang (bell jar)
- Basic mass set in carrying case
- Extension mass set in carrying case (depending on the measuring range)
- Mass set manufactured to standard gravity (9.80665 m/s<sup>2</sup>)
- VG22 mineral oil, 0.25 litre (for separator variant)
- Operating instructions in German and English language
- Factory calibration certificate

## Options

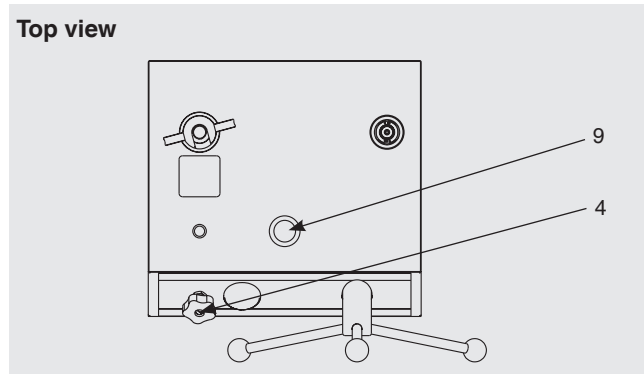
- Systems with increased accuracy to 0.008 %
- Piston connection with ConTect quick-release connector
- Storage case for piston-cylinder systems
- Mass set manufactured to local gravity
- DKD/DAkkS calibration certificate

## Dimensions in mm

The drawing shows a CPB5000 pneumatic high-pressure base unit with the ConTect quick-release connector option. The variants for pneumatic low-pressure and pneumatic with integrated gas to oil separator do not differ from it dimensionally, only in the arrangement of the control elements.

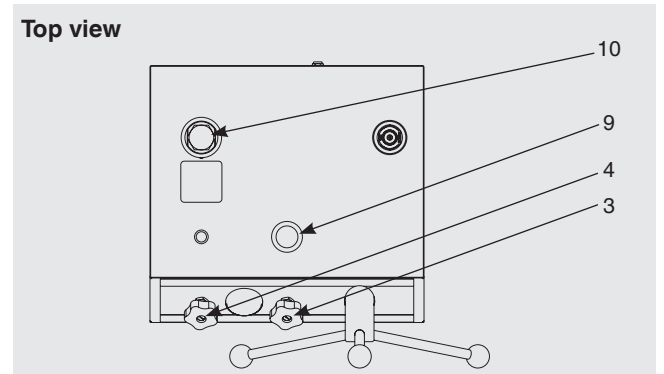


### Pneumatic base, low pressure



- (1) Connector for piston-cylinder system
- (2) Test item connection
- (3) Inlet valve (not for pneumatic low pressure)
- (4) Outlet valve
- (5) Spindle pump with star handle, removable

### Pneumatic base with integrated gas to oil separator



- (6) Test pressure gauge
- (7) Level
- (8) Rotatable feet
- (9) Priming pump
- (10) Connector for piston-cylinder system with integrated gas to oil separator

## Accessories

### Set of trim-masses M1 and F1

The weights included in the standard mass set are ideally suited for everyday use. If smaller intermediate values need to be generated, we recommend using a set of class M1 or 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

### Sets of adapters for quick-release connector

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

- Set of adapters: G 1/4, G 3/8, 1/2 NPT, 1/4 NPT and M20 x 1.5
- Set of NPT adapters: 1/8 NPT, 1/4 NPT, 3/8 NPT and 1/2 NPT

Additionally, the sets of adapters include spare O-rings as well as a spanner with SW32 flats and SW14 flats, for changing the adapters.

Other threaded inserts are available on request.



Set of adapters

### Dirt trap

For strongly soiled test items, a sediment trap should be used. This helps prevent the ingress of contaminants into the pressure balance.



Dirt trap

Designation/Variant	Order no.
Set of trim-masses (1 mg up to 50 g), class F1	7093874
Set of trim-masses (1 mg up to 50 g), class M1	14025325
Set of adapters for quick-release connector in case with G 1/4, G 3/8, 1/2 NPT, 1/4 NPT and M20 x 1.5 threaded inserts for insertion in the knurled nut on the test item connector	2036941
Set of "NPT" adapters for quick-release connector in case with 1/8 NPT, 1/4 NPT, 3/8 NPT and 1/2 NPT threaded inserts for insertion in the knurled nut on the test item connector	12563626
90° angle connection, for test items with back mounting connection	1564838
Dirt trap, -1 ... +1,000 bar, volume 0.2 litres	2015820
Dirt trap, -1 ... +1,000 bar, volume 0.03 litres	2015714
O-ring set consisting of 5 pcs. 8 x 2 and 5 pcs. 4 x 2.2	12328562
Operating fluid for CPB5000 up to a max. 4,000 bar, 1 litre	2099882
Cleaning set for ConTect systems, pneumatic	12485943
Cleaning set for ConTect systems, hydraulic	12481425
Special test port with quick-release connector, for connection to the ConTect system entry, operation as a comparison test pump is possible	2152634



## Further pressure balances within our calibration technology programme

### Pressure balance model CPB3800

#### Measuring ranges:

- Hydraulic 1 ... 120 to 10 ... 1,200 bar or  
10 ... 1,600 to 100 ... 16,000 psi,  
respectively

**Accuracy:** 0.05 % of reading  
0.025 % of reading (optional)

For specifications see data sheet CT 31.06



Pressure balance model CPB3800

### Pressure balance model CPB5800

#### Measuring ranges:

- Hydraulic Single-piston measuring ranges:  
1 ... 120 to 2 ... 300 bar or  
10 ... 1,600 to 30 ... 4,000 psi, respectively  
  
Dual-piston measuring ranges:  
1 ... 60 / 10 ... 700 bar to  
1 ... 60 / 20 ... 1,400 bar or  
10 ... 800 / 100 ... 10,000 psi to  
10 ... 800 / 200 ... 20,000 psi, respectively

**Accuracy:** 0.015 % of reading  
up to 0.006 % of reading (optional)

For specifications see data sheet CT 31.11



Pressure balance model CPB5800

### Pressure balance for high pressure, model CPB5000HP

#### Measuring ranges:

- Hydraulic 25 ... 2,500, 25 ... 4,000 or  
25 ... 5,000 bar  
350 ... 40,000, 350 ... 60,000, or  
350 ... 70,000 psi, respectively  
  
50 / 2,600 bar dual piston or  
600 / 40,000 psi dual piston, respectively

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

For specifications see data sheet CT 31.51



Pressure balance for high pressure, model CPB5000HP

### Pressure balance for differential pressure, model CPB5600DP

#### Measuring range (= static pressure + differential pressure):

- Pneumatic 0.03 ... 2 to 0.4 ... 100 bar or  
0.435 ... 30 to 5.8 ... 1,500 psi, respectively
- Hydraulic 0.2 ... 60 to 25 ... 1,600 bar or  
2.9 ... 1,000 to 350 ... 23,200 psi,  
respectively

**Accuracy:** 0.015 % of measured value  
0.008 % of measured value (optional)

For specifications see data sheet CT 31.56



Pressure balance for differential pressure, model CPB5600DP

