

# Pressure balance in compact design Model CPB3800



WIKA data sheet CT 31.06

## Applications

- Primary standard for defining the pressure scale in a range up to 1,200 bar hydraulic
- Reference instrument 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 0.025 % of measured value
- Factory calibration includes traceability to national standards, as standard; with UKAS or DKD/DAkkS calibration possible as an option
- High long-term stability with recommended recalibration cycle every five years
- Masses manufactured from stainless steel, can be adjusted to local gravity
- Compact dimensions



Model CPB3800 pressure balance

## 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 CPB3800 is ideal for on-site use for maintenance and service.

### Basic principle

Pressure is defined as the quotient of force and area. The core component of the CPB3800 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 UKAS or DKD/DAkkS calibrated.

## Easy operation

The integrated dual-area pump enables rapid filling of the test system and smooth pressure generation up to 1,200 bar. At the same time, the precise adjustable spindle pump also serves for fine adjustment. A control schematic for pressure generation on the instrument base facilitates quick and easy operation.

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 item under test.

## Compact instrument design

The CPB3800 is also particularly notable for its compact dimensions, which are not altered during operation, since the spindle runs within the pump body.

With its compact dimensions, the exceptionally robust ABS plastic housing and the low weight associated with these, the CPB3800 is also particularly suited to on-site applications.

## The piston-cylinder system

The piston and cylinder are manufactured from tungsten carbide.

This pairing of materials, in comparison to other materials, has very low pressure and temperature coefficients of expansion, which results in a very good linearity for the cross-sectional area and a very high 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.

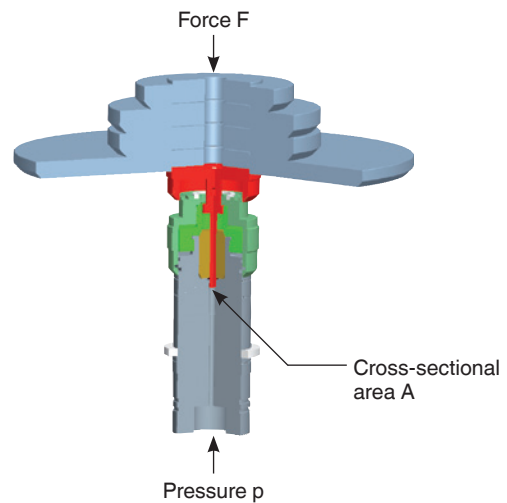
The masses are stacked on an overhang (bell jar), which sits on the piston shaft. The construction of the overhang (bell jar) provides a very low centre of gravity for the stacked weights, which minimises both the side thrust on the piston-cylinder system and the friction. For smaller starting pressures, the masses can also be stacked directly onto the piston shaft, without using the overhang (bell jar).

The overall design of the piston-cylinder unit and the very precise manufacturing of both the piston and the cylinder, ensures excellent operating characteristics with long free-rotation time and low sink rates.

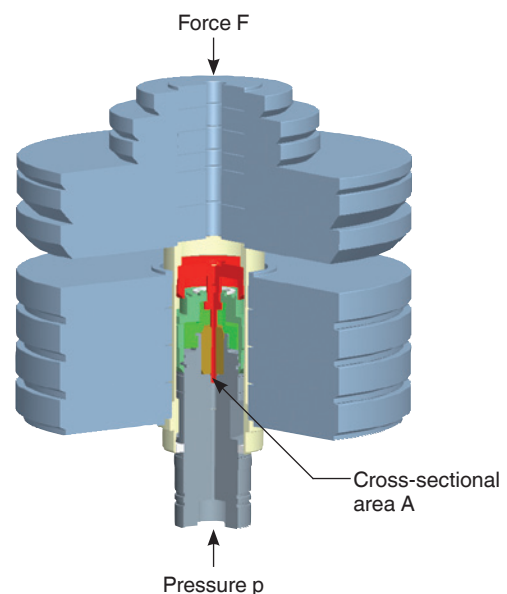
Thus a high long-term stability is ensured. Therefore the recommended recalibration interval is five years depending on the conditions of usage.



Control schematic on the CPB3800 instrument base



Piston-cylinder system with masses, without overhang (bell jar)



Piston-cylinder system with masses, with overhang (bell jar)

## Tables of masses

The following tables show, for the respective measuring range, the number of masses within a set of masses, with their resulting nominal pressures.

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.

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 9.

Measuring range [bar]	1 ... 120		2.5 ... 300		5 ... 700		10 ... 1,200	
	Quantity	Nominal pressure per piece [bar]	Quantity	Nominal pressure per piece [bar]	Quantity	Nominal pressure per piece [bar]	Quantity	Nominal pressure per piece [bar]
Piston and make-up weight	1	1	1	2.5	1	5	1	10
Piston, overhang (bell jar) and overhang make-up weight	1	20	1	50	1	100	1	200
Masses (stackable on overhang (bell jar))	3	20	3	50	4	100	3	200
Masses (stackable on piston)	1	20	1	50	1	100	1	200
	1	10	1	25	1	50	1	100
	2	4	2	10	2	20	2	40
	1	2	1	5	1	10	1	20
	1	1	1	2.5	1	5	1	10

Measuring range [lb/in <sup>2</sup> ]	10 ... 1,600		25 ... 4,000		50 ... 10,000		100 ... 16,000	
	Quantity	Nominal pressure per piece [lb/in <sup>2</sup> ]	Quantity	Nominal pressure per piece [lb/in <sup>2</sup> ]	Quantity	Nominal pressure per piece [lb/in <sup>2</sup> ]	Quantity	Nominal pressure per piece [lb/in <sup>2</sup> ]
Piston	1	10	1	25	1	50	1	100
Overhang (bell jar) and overhang make-up weight	1	190	1	475	1	950	1	1,900
Masses (stackable on overhang (bell jar))	5	200	5	500	7	1,000	5	2,000
Masses (stackable on piston)	1	200	1	500	1	1,000	1	2,000
	1	100	1	250	1	500	1	1,000
	2	40	2	100	2	200	2	400
	1	20	1	50	1	100	1	200
	1	10	1	25	1	50	1	100

### Scope of delivery

- Base
- Dual-area pump for filling, pressure generation and fine adjustment
- Piston connection with G ¼ B male thread
- Test item connection with G ½ female thread, free-running
- Adapter set for test item connection, G ½ B male to G ¼ and G ⅜ female threads
- Piston-cylinder system with overhang (bell jar)
- Set of masses manufactured to standard gravity (9.80665 m/s<sup>2</sup>)
- VG22 mineral oil (0.5 litre)
- Tool and maintenance set
- Operating instructions in German and English language
- Factory calibration certificate

### Options

- System with increased accuracy to 0.025 %
- Set of masses manufactured to local gravity
- Storage case for the base, mass set and the piston-cylinder system
- DKD/DAkkS or UKAS calibration certificate

# Specifications

## Model CPB3800

### Piston-cylinder systems

<b>Measuring range <sup>1)</sup></b>	bar	1 ... 120	2.5 ... 300	5 ... 700	10 ... 1,200
Required masses	kg	41	50	58	50
<b>Smallest step <sup>2)</sup></b> (Standard mass set)	bar	1	2.5	5	10
Nominal cross-sectional area of the piston	cm <sup>2</sup>	0.4032	0.1613	0.0807	0.0403
<b>Measuring range <sup>1)</sup></b>	lb/in <sup>2</sup>	10 ... 1,600	25 ... 4,000	50 ... 10,000	100 ... 16,000
Required masses	kg	38	47	58	47
<b>Smallest step <sup>2)</sup></b> (Standard mass set)	lb/in <sup>2</sup>	10	25	50	100
Nominal cross-sectional area of the piston	cm <sup>2</sup>	0.4032	0.1613	0.0807	0.0403

### Accuracies

Standard <sup>3) 4)</sup>	% of measured value	0.05
Option <sup>3) 4)</sup>	% of measured value	0.025

**Pressure transmission medium** Hydraulic fluid based on VG22 mineral oil (0.5 l included in scope of delivery)

### Material

Piston	Tungsten carbide
Cylinder	Tungsten carbide
Mass set	Stainless steel, non-magnetic

### Weight

Piston-cylinder system	kg	2.4			
BAR set of masses incl. overhang (bell jar)	kg	41.5	50.5	58.5	50.5
lb/in <sup>2</sup> set of masses incl. overhang (bell jar)	kg	38.5	47.5	58.5	47.5
Carrying case for set of masses (optional, 2 pieces required)	kg	5.8			

### Dimensions

Carrying case for set of masses (optional)	400 x 310 x 310 mm (W x H x D)
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- 1) Theoretical starting value; corresponds to the pressure value generated by the piston or the piston and its make-up weights (by their 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.

## Base

### Connections

Connection for piston-cylinder system	G ¾ B (male)
Test item connection	G ½ female thread, free-running, incl. adapter set to G ¼ and G ¾ female threads

### Material

Piping in instrument base	Stainless steel 6 x 1.5 mm
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**Pressure transmission medium** Hydraulic fluid based on VG22 mineral oil (0.5 l included in scope of delivery)

Reservoir	170 cm <sup>3</sup>
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### Weight

Base	13.5 kg
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Storage case for the base (optional)	8.5 kg
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### Permissible ambient conditions

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

Base	401 x 397 x 155 mm (W x D x H), for details, see technical drawings
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## Approvals and certificates

### CE conformity

Pressure equipment directive	97/23/EC (Module A)
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### Certificate

Calibration	3.1 calibration certificate Option: DKD/DAkkS calibration certificate or UKAS calibration certificate
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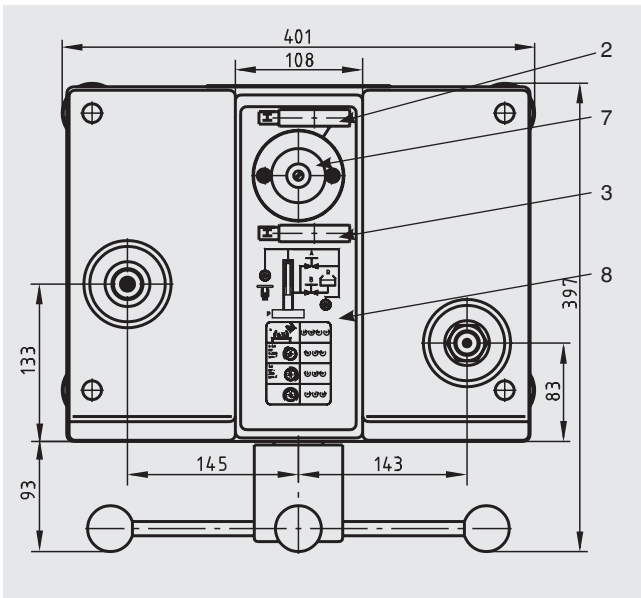
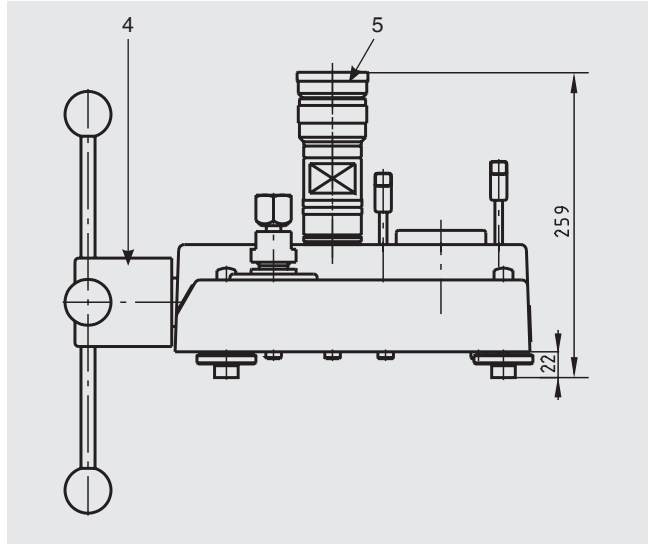
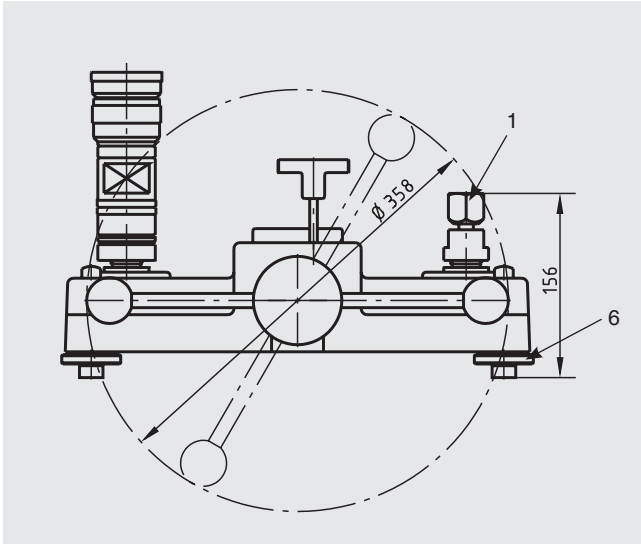
## Transport dimensions for complete instrument

The complete instrument, in its standard version and standard scope of delivery, consists of three packages with the following dimensions and weights, dependent upon measuring range.

Version	Box 1 with base, piston-cylinder system, standard accessories Dimensions: 590 x 490 x 380 mm		Boxes 2 and 3 with set of masses Dimensions: 320 x 320 x 280 mm	
	Weight in kg		Weight in kg (per box)	
	net	gross	net	gross
1 ... 120 bar	17	20	41.5	45
2.5 ... 300 bar	18.5	21.5	50.5	54
5 ... 700 bar	18.5	21.5	58.5	62.5
10 ... 1,200 bar	18.5	21.5	50.5	54
10 ... 1,600 lb/in <sup>2</sup>	17	20	38.5	42
25 ... 4,000 lb/in <sup>2</sup>	18.5	21.5	47.5	51
50 ... 10,000 lb/in <sup>2</sup>	18.5	21.5	58.5	62.5
100 ... 16,000 lb/in <sup>2</sup>	18.5	21.5	47.5	51

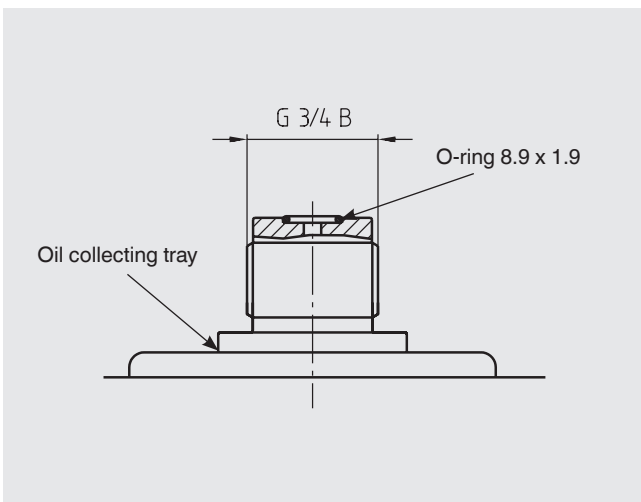
## Dimensions in mm

(without masses)

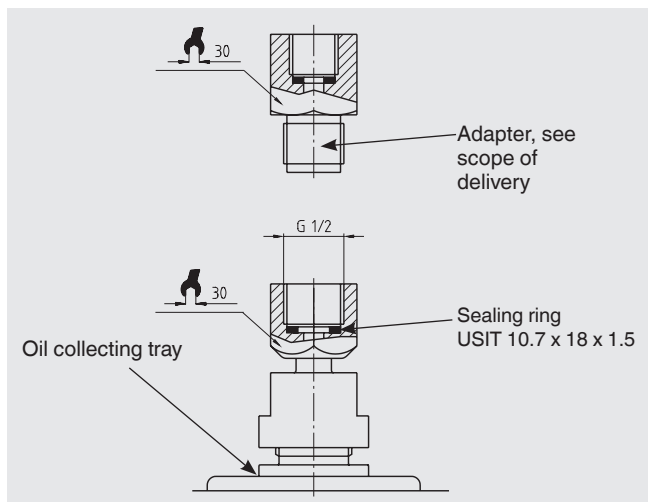


- (1) Test item connection
- (2) High-pressure shut-off valve
- (3) Low-pressure shut-off valve
- (4) Dual-area pump with star handle
- (5) Piston-cylinder system
- (6) Rotatable feet
- (7) Reservoir with screwed sealing plug
- (8) Pressure generation control schematic

### Standard connection piston-cylinder system



### Test item connection



## Further pressure balances within our calibration technology programme

### Model CPB5800 pressure balance

#### Measuring ranges:

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

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

For specifications see data sheet CT 31.11



Model CPB5800 pressure balance

### Model CPB5000 pressure balance

#### Measuring ranges:

- Pneumatic      -0.03 ... -1 up to +0.4 ... +100 bar or  
-0.435 ... -14 up to +5.8 ... +1,500 psi,  
respectively

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

For specifications see data sheet CT 31.01



Model CPB5000 pressure balance

### Model CPB5000HP pressure balance for high pressure

#### Measuring ranges:

- Hydraulic      25 ... 2,500, 25 ... 4,000 or 25 ... 5,000 bar or  
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

**Accuracy:**      0.025 % of measured value  
0.02 % of measured value (optional)

For specifications see data sheet CT 31.51



Model CPB5000HP pressure balance for high pressure

### Model CPB5000DP pressure balance for differential pressure

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

- Pneumatic      0.03 ... 2 up to 0,4 ... 100 bar or  
0.435 ... 30 up to 5.8 ... 1,500 psi
- Hydraulic      0.2 ... 60 up to 2 ... 1,000 bar or  
2.9 ... 1,000 up to 29 ... 14,500 psi,  
respectively

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

For specifications see data sheet CT 31.52



Model CPB5000DP pressure balance for differential pressure

## Accessories

### Trim-mass sets 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

### Test connections

With the existing standard test item connection, test items with radial connection points can be mounted. For units with rear connection points, a 90° angle connector is available. With a G 3/4 female to G 1/2 female, free-running connector, which can be mounted in place of the piston-cylinder system on the piston connector, the CPB3800 instrument base can be used as a comparison test pump.

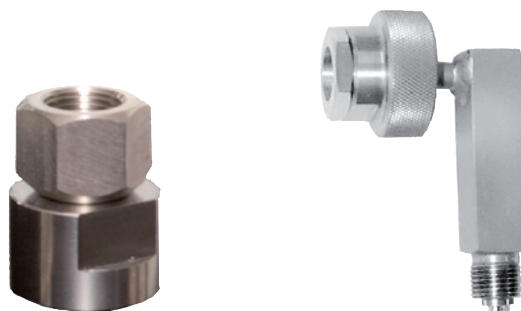


Fig. left: Gauge adapter, G 3/4 female to G 1/2 female  
Fig. right: Angle connector 90°

### Separators

The separators (with diaphragm) have been specifically designed for measuring instruments, which should not come into contact with the medium of the pressure balance or to protect against contamination of the pressure balance from the test items.

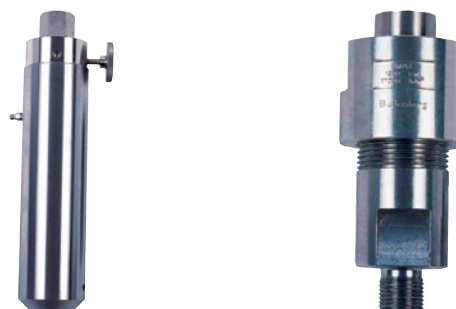


Fig. left: Separator (with diaphragm) 700 bar  
Fig. right: Separator (with diaphragm) 1,200 bar

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 2 carrying cases for set of masses	14031236
Storage case for CPB3800 instrument base	14031237
"BSP" adapter set for G 1/2 B male test item connector to G 1/8, G 1/4, G 3/8 and G 1/2 female	14031238
"NPT" adapter set for G 1/2 B male test item connector to 1/8 NPT, 1/4 NPT, 3/8 NPT and 1/2 NPT female	14031239
"Metric" adapter set for G 1/2 B male test item connector to M12 x 1.5 and M20 x 1.5 female	14031242
Test item connection, G 3/4 female to G 1/2 female, free-running	14031251
90° angle connection, for test items with back mounting connection	1564838
Separator (to separate two liquid media by a diaphragm), max. 700 bar	14031253
Separator (to separate two liquid media by a diaphragm), max. 1,200 bar	14031254
Sealing set for CPB3800 instrument base	14031255
Operating fluid for CPB series up to a max. 4,000 bar, 0.5 litre	2099954
Tool set consists of open-ended spanner, BSP adapter, replacement seals, pointer removal device and pointer press-on tool	14031263



## Model CPU5000 CalibratorUnit

The CPU5000 CalibratorUnit is a compact tool for use with a pressure balance. In particular when highly-accurate measuring values, with measurement uncertainties of less than 0.025 %, are required, complicated mathematical calculations and corrections are necessary. With the CPU5000, all critical ambient parameters can be registered and automatically corrected.

### CPU5000 basic package

The basic CalibratorUnit package converts masses into the corresponding pressure value, or vice versa, it calculates the masses required for a specific pressure value with consideration to the local gravity, for location-independent measurements. 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 such as room temperature, air pressure, relative humidity and piston temperature and to update calculations continually.

### Multimeter package

Furthermore, with the multimeter package, a calibrator function for pressure transmitters can be integrated. With this, the sensor to be tested, without additional power can be supplied with a DC 24 V voltage and the output signal (V, mA) can be measured. Besides the signal, the automatically converted pressure value is also shown on the display.

### Piston position display

With the extension for "piston position indication", the piston position can be measured (contact free) and shown on the CalibratorUnit with high resolution (not available for dual-range piston-cylinder systems).

Further specifications on the CPU5000 CalibratorUnit can be found in data sheet CT 35.01.

### Ordering information

CPB3800 / Instrument version / Accuracy / Gravity value g / Storage case / Calibration for pressure balance / Additional order information



Model CPU5000 CalibratorUnit

### Order variants

#### CPU5000 base packet (processor only)

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

#### Sensor package for measuring of:

- Ambient temperature
- Atmospheric pressure
- Humidity
- Cylinder temperature

#### Multimeter package

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

#### Piston position display

- Contact-free measuring of piston position

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