

# Pressure balance

## High-pressure version

### Model CPB5000HP



WIKA data sheet CT 31.51

#### Applications

- Primary standard for defining the pressure scale in a range up to 5,000 bar
- 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 0.02 % of measured value
- Dual-range piston-cylinder system 2,600 bar with fully automated changing between ranges
- 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



Model CPB5000HP pressure balance for high pressure

#### 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.

##### 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 setting of the pressure is made via an integrated pump. For fine adjustment, a very precisely-controllable spindle pump is fitted, with a spindle running within it. 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.

## The piston-cylinder system

The piston-cylinder systems are available in two fundamentally different designs, depending on measuring range:

- Single-range piston-cylinder system (for measuring ranges 2,500, 4,000 and 5,000 bar)
- Dual-range piston-cylinder system (for measuring range 2,600 bar)

### High accuracy over a wide measuring range

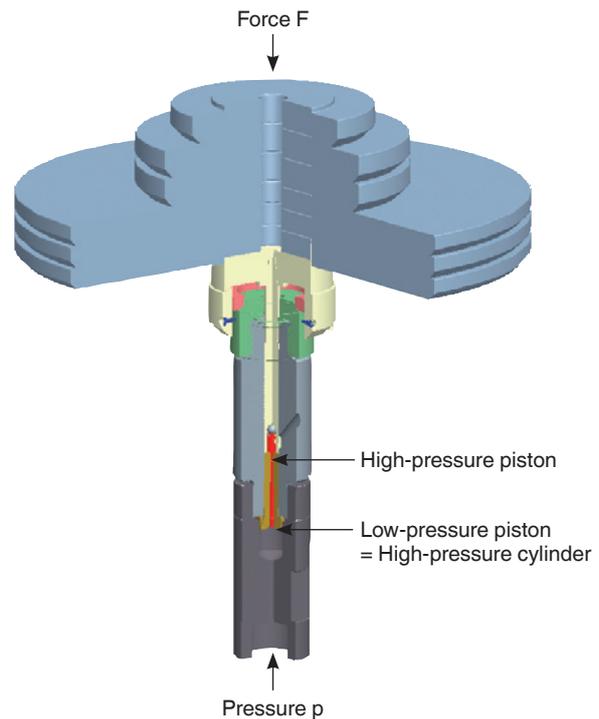
The dual-range piston-cylinder system offers two measuring ranges in one housing with automatic measuring range switching from low-pressure to high-pressure pistons. This provides the user with an extremely flexible measuring instrument that can cover a wide measuring range with high accuracy, with only one piston-cylinder unit and one set of weights. Additionally two test points can automatically be achieved by the operator loading masses once.

The piston and cylinder are manufactured from hardened steel and tungsten carbide, respectively. This pairing of 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. The overall design of the piston-cylinder unit and the very precise manufacturing of both the piston and the cylinder, ensure exceptionally low friction force, which results in 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.

Both test connections are fitted with knurled nuts and exchangeable thread adapters with sealing cones. M16 x 1.5, M20 x 1.5 und 9/16-18 UNF thread adapters with male threads are included within the scope of delivery.

### Robust instrument design

With the high-pressure model, calibrations up to a maximum pressure of 5,000 bar are possible. It is built into a stable base and offers exceptional ease-of-use. With the integrated priming pump and the 250 ml tank, large test volumes can also be easily filled and primed.



Dual-range piston-cylinder system 2,600 bar

## 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.

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.

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.

Single-piston measuring ranges						
Measuring range [bar]	25 ... 2,500		25 ... 4,000		25 ... 5,000	
	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece
	bar		bar		bar	
Piston incl. overhang (bell jar)	1	25	1	25	1	25
Masses 5 kg	-	-	6	250	10	250
Masses 4 kg	8	200	8	200	8	200
Masses 2 kg	9	100	9	100	9	100
Masses 1 kg	1	50	1	50	1	50
Masses 0.5 kg	2	25	2	25	2	25
Masses 0.2 kg	1	10	1	10	1	10
Masses 0.1 kg	1	5	1	5	1	5
Masses 0.05 kg	1	2.5	1	2.5	1	2.5

Single-piston measuring ranges						
Measuring range [psi]	350 ... 40,000		350 ... 60,000		350 ... 70,000	
	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece
	psi		psi		psi	
Piston incl. overhang (bell jar)	1	350	1	350	1	350
Masses 7 kg	2	5,000	6	5,000	8	5,000
Masses 3.5 kg	8	2,500	8	2,500	8	2,500
Masses 1.4 kg	8	1,000	8	1,000	8	1,000
Masses 1 kg	1	750	1	750	1	750
Masses 0.7 kg	2	500	2	500	2	500
Masses 0.35 kg	1	250	1	250	1	250
Masses 0.14 kg	1	100	1	100	1	100
Masses 0.07 kg	1	50	1	50	1	50

Dual-piston measuring range			
Measuring range [bar]	1 ... 2,600		
	Quantity	Nominal pressure per piece	Nominal pressure per piece
	[bar]		[bar]
Piston and make-up weight	1	1	20
Overhang (bell jar)	1	10	200
Masses (stackable on overhang (bell jar))	7	10	200
Masses (stackable on piston shaft)	3	10	200
	1	9	180
	1	5	100
	2	2	40
	1	1	20
	2	0.5	10
Fine increment weights (optional)	2	0.2	4
	1	0.1	2
	1	0.05	1
	2	0.02	0.4
	1	0.01	0.2

Dual-piston measuring range			
Measuring range [psi] or [lb/in <sup>2</sup> ]	10 ... 40,000		
	Quantity	Nominal pressure per piece	Nominal pressure per piece
	[psi]		[psi]
	[lb/in <sup>2</sup> ]		[lb/in <sup>2</sup> ]
Piston	1	10	200
Overhang (bell jar)	1	100	2,000
Masses (stackable on overhang (bell jar))	14	100	2,000
Masses (stackable on piston shaft)	4	100	2,000
	1	90	1,800
	1	50	1,000
	2	20	400
	1	10	200
	1	5	100
Fine increment weights (optional)	2	2	40
	1	1	20
	1	0.5	10
	2	0.2	4
	1	0.1	2

# Specifications

## Model CPB5000HP

### Piston-cylinder systems

Design		Single-piston measuring ranges			Dual-piston measuring range
<b>Measuring range</b> <sup>1)</sup>	bar	25 ... 2,500	25 ... 4,000	25 ... 5,000	1 ... 50 / 20 ... 2,600
Required masses	kg	50	80	100	107
Smallest step <sup>2)</sup> (Standard mass set)	bar	2.5	2.5	2.5	0.5 / 10
Nominal cross-sectional area of the piston	cm <sup>2</sup>	0.02	0.02	0.02	0.8065 / 0.0403
<b>Measuring range</b> <sup>1)</sup>	psi	350 ... 40,000	350 ... 60,000	350 ... 70,000	10 ... 600 / 200 ... 40,000
Required masses	kg	55	83	97	119
Smallest step <sup>2)</sup> (Standard mass set)	psi	50	50	50	5 / 100
Nominal cross-sectional area of the piston	cm <sup>2</sup>	0.02	0.02	0.02	0.8065 / 0.0403

#### Accuracies

Standard <sup>3) 4)</sup>	% of measured value	0.025	0.025
Premium <sup>3) 4)</sup>	% of measured value	0.02	0.007

<b>Pressure transmission medium</b>	up to 4,000 bar/60,000 psi: Hydraulic fluid based on VG22 mineral oil (1litre included in scope of delivery) 5,000 bar/70,000 psi: Sebacate oil (0.5 litre included in scope of delivery)		
-------------------------------------	--	--	--

Material			
Piston		hardened steel	Tungsten carbide / steel
Cylinder		Tungsten carbide	Steel / tungsten carbide
Piping in instrument base		1.4404 stainless steel, 6 x 2 mm	

#### Weight

Piston-cylinder system	kg	2.7 / 5.0 (incl. storage case)			
BAR basic set of masses, case 1	kg	34.0	34.0	34.0	43.3
BAR basic set of masses, case 2	kg	27.5	27.5	27.5	29.7
BAR basic set of masses, case 3	kg	--	--	--	29.4
BAR basic set of masses, case 4	kg	--	--	--	29.4
BAR extension set of masses, case 1	kg	--	33.5	33.5	--
BAR extension set of masses, case 2	kg	--	--	23.5	--
BAR basic set of masses, case 1	kg	51.0	51.0	51.0	40.5
BAR basic set of masses, case 2	kg	15.0	15.0	15.0	33.6
BAR basic set of masses, case 3	kg	--	--	--	33.6
BAR basic set of masses, case 4	kg	--	--	--	31.6
BAR extension set of masses, case 1	kg	--	31.8	31.8	--
BAR extension set of masses, case 2	kg	--	--	17.8	--

Dimensions		
Carrying case 1 for basic set of masses	mm	400 (W) x 310 (D) x 310 (H)
Carrying cases 2 - 4 for basic set of masses	mm	215 (W) x 310 (D) x 310 (H)
Carrying case for extension set of masses	mm	215 (W) x 310 (D) x 310 (H)
Storage case for the piston-cylinder system	mm	370 (W) x 150 (D) x 150 (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.

## Base

<b>Pressure transmission medium</b>	up to 4,000 bar/60,000 psi: Hydraulic fluid based on VG22 mineral oil (1litre included in scope of delivery) 5,000 bar/70,000 psi: Sebacate oil (0.5 litre included in scope of delivery)
Reservoir	250 cm <sup>3</sup>
<b>Connections</b>	
Connection for piston-cylinder system	M30 x 2, female thread with sealing cone
Test item connection	freely positionable, standard with three thread adapters M16 x 1.5 / M20 x 1.5 and 9/16-18UNF for further thread adapters, see accessories
<b>Material</b>	
Piping in instrument base	1.4404 stainless steel, 6 x 2 mm
<b>Weight</b>	
High-pressure base	32.5 kg
<b>Permissible ambient conditions</b>	
Operating temperature	18 ... 28 °C
<b>Dimensions</b>	
Base	460 (W) x 445 (D) x 265 (H), for details, see technical drawings

## Approvals and certificates

### CE conformity

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

### Certificate

Calibration 3.1 calibration certificate  
Option: DKD/DAkkS calibration certificate (for the single-piston measuring ranges of 2,500, 4,000 and 5,000 bar)  
Option: UKAS calibration certificate (only for the dual-piston measuring range 2,600 bar)

Further approvals and certificates can be found on the internet.

## Transport dimensions for complete instrument

The complete instrument, in its standard version and standard scope of delivery, is shipped on two pallets.

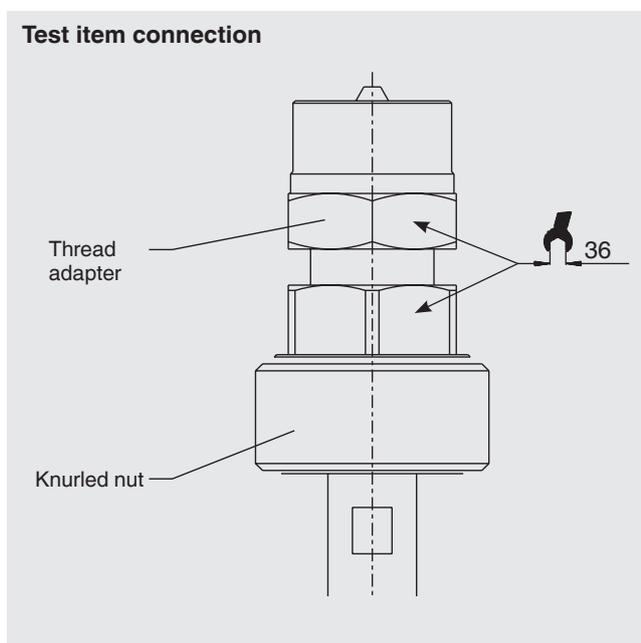
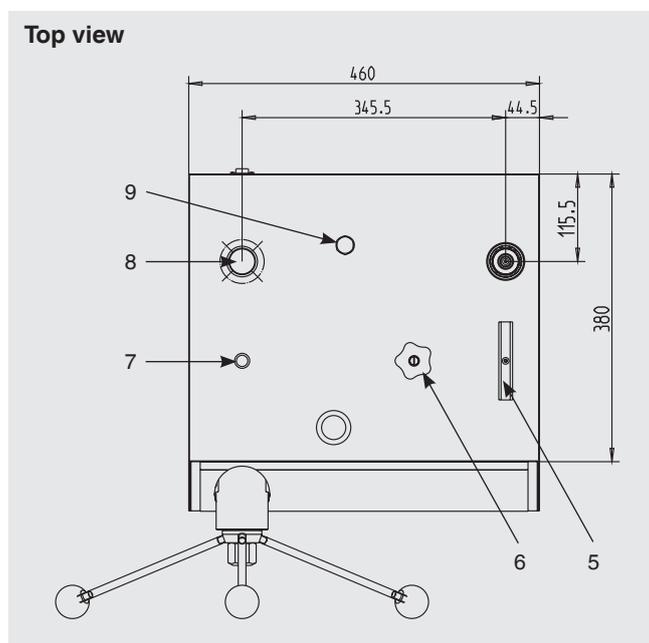
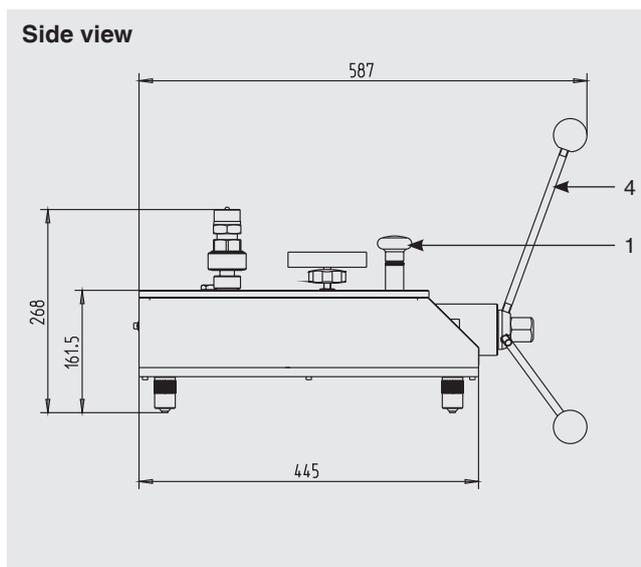
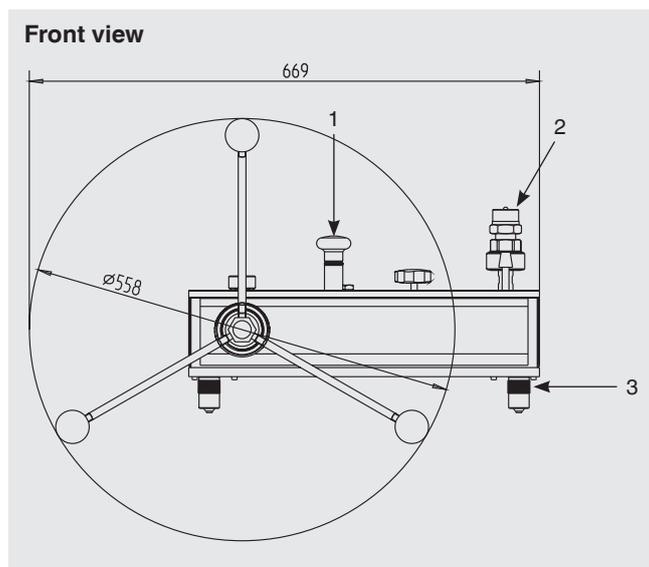
The dimensions are 1,200 x 800 x 500 mm and 800 x 600 x 500 mm.

The overall weight is dependent on the measuring range.

Version in bar	Weight in kg	
	net	gross
<b>Single-piston measuring ranges</b>		
25 ... 2,500 bar	100	130
25 ... 4,000 bar	133	166
25 ... 5,000 bar	156	194
<b>Dual-piston measuring range</b>		
1 ... 50 / 20 ... 2,600 bar	169	207

Version in psi	Weight in kg	
	net	gross
<b>Single-piston measuring ranges</b>		
350 ... 40,000 psi	104	134
350 ... 60,000 psi	136	169
350 ... 70,000 psi	153	191
<b>Dual-piston measuring range</b>		
10 ... 600 / 200 ... 40,000 psi	177	215

## Dimensions in mm



- (1) Priming pump
- (2) Test item connection
- (3) Rotatable feet
- (4) Spindle pump with star handle
- (5) High-pressure shut-off valve (HP)
- (6) Low-pressure shut-off valve (LP)
- (7) Level
- (8) Connector for piston-cylinder system
- (9) Reservoir with screwed sealing plug

## Further pressure balances within our calibration technology programme

### Model CPB3800 pressure balance

#### Measuring ranges:

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

**Accuracy:** 0.05 % of measured value  
0.025 % of measured value (optional)

For specifications see data sheet CT 31.06



Model CPB3800 pressure balance

### Model CPB5000 pressure balance

#### Measuring ranges:

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

**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 CPB5800 pressure balance

#### Measuring ranges:

- Hydraulic Single-piston measuring ranges:  
1 ... 120 to 2 ... 300 bar or  
10 ... 1,600 to 30 ... 4,000 psi

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

**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 CPB5000DP pressure balance for differential pressure

#### 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
- Hydraulic 0.2 ... 60 to 2 ... 1,000 bar or  
2.9 ... 1,000 to 29 ... 14,500 psi

**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

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
Adapter for test item connection with G 1/2 female thread, max. 1,600 bar, material - 1.4571 stainless steel	11095912
Adapter for M30 x 2 male thread to M16 x 1.5 male thread for piston-cylinder connector block, operation as comparison test pump possible	11360071
Operating fluid for CPB series up to a max. 4,000 bar, 1 litre	2099882
Operating fluid for CPB5000 up to a max. 5,000 bar, 0.5 litre	11123150

## Scope of delivery

- Base with dust protection cover
- Priming pump
- Spindle pump for pressure generation and fine adjustment
- Piston connection
- Connection for test item with three thread adapters; M16 x 1.5 / M20 x 1.5 and 9/16-18 UNF
- Piston-cylinder system
- Set of masses divided between several transport cases, see specifications
- Set of masses manufactured to standard gravity (9.80665 m/s<sup>2</sup>)
- VG22 mineral oil, 1.0 litre (up to 4,000 bar/60,000 psi)
- Sebacate oil, 0.5 litre (for 5,000 bar/70,000psi)
- Flats 36 and flats 46 open-ended spanner
- Operating instructions in German and English language
- Factory calibration certificate

## Options

- System with increased accuracy to 0.02 % or 0.007 %
- Set of masses manufactured to local gravity
- Fine increment weights
- DKD/DAkkS or UKAS calibration certificate

## 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 see data sheet CT 35.01.



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

### Ordering information

Model / Instrument version / Accuracy / Calibration for the pressure balance / Additional order information

© 2010 WIKA Alexander Wiegand SE & Co. KG, all rights reserved.  
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.

WIKA data sheet CT 31.51 · 05/2012

Page 9 of 9



**WIKAI**  
**WIKAI Alexander Wiegand SE & Co. KG**  
Alexander-Wiegand-Straße 30  
63911 Klingenberg/Germany  
Tel. (+49) 9372/132-0  
Fax (+49) 9372/132-406  
E-mail info@wika.de  
www.wika.de