

# Dead-weight tester High-pressure version Model CPB3800HP



WIKA data sheet CT 31.07



for further approvals  
see page 5

## Applications

- Primary standard for calibrating the pressure scale in a hydraulic range up to 2,600 bar (40,000 lb/in<sup>2</sup>)
- 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 up to 0.01 % of reading
- Dual-range piston-cylinder system 2,600 bar (40,000 lb/in<sup>2</sup>) with fully automated changing between ranges
- Factory calibration includes traceability to national standards, as standard, with UKAS calibration possible as an option
- Masses manufactured from stainless steel, can be adjusted to local gravity

## Description

### Proven primary standard

Pressure balances (dead-weight testers) 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.

The pressure balance (dead-weight tester) 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 purely mechanical measuring principle, the model CPB3800HP is ideal for on-site use for maintenance and service.



Dead-weight tester, high-pressure version, model CPB3800HP

### Basic principle

Pressure is defined as the quotient of force and area. The core component of the CPB3800HP is therefore a very precisely manufactured piston-cylinder system, onto which a mass load is applied in order to generate the individual test points.

The mass load is 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 m/s<sup>2</sup>), though they can be adjusted to a specific location and also UKAS calibrated.

### Easy operation

The integrated dual-area spindle pump enables rapid filling of the test system and smooth pressure generation up to 2,600 bar (40,000 lb/in<sup>2</sup>). At the same time, the precisely adjustable spindle pump also enables fine pressure 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 masses. 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.

### Compact instrument design

The CPB3800HP 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 case and the low weight associated with these, the CPB3800HP is also particularly suited for on-site applications.

The test item connection is equipped with a G ½ union nut with metal cone. M16 x 1.5, M20 x 1.5 und 9/16-18 UNF thread adapters with male threads are included in the scope of delivery.

### The piston-cylinder system

#### High accuracy over a wide measuring range

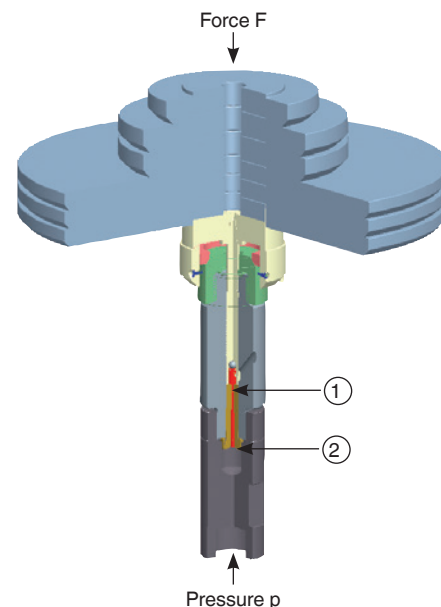
The dual-range piston-cylinder system offers two measuring ranges in one case with automatic measuring range switching from low-pressure to high-pressure pistons. This provides the user with an extremely flexible measuring instrument that can cover a wide measuring range with high accuracy, with only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

Both the piston and cylinder are manufactured from hardened steel or tungsten carbide, respectively. This pairings of materials has very low pressure and temperature coefficients of expansion, which results in a very good linearity for the effective area of the piston and a very high accuracy.

Piston and cylinder are very well protected, against contact, impacts or contamination from outside, in a solid stainless-steel/hardened tool steel case. 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 masses removal under pressure.



Control schematic on the CPB3800HP instrument base



Dual-range piston-cylinder system 2,600 bar (40,000 lb/in<sup>2</sup>)

The masses are stacked directly onto the piston shaft. This makes it easier to place the masses on and thus enables a lower start value.

The overall design of the piston-cylinder system 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 two to five years depending on the conditions of use.

- ① High-pressure piston
- ② Low-pressure piston = High-pressure cylinder

## 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 the instrument not be operated under reference conditions (ambient temperature 20 °C [68 °F], atmospheric pressure 1,013 mbar [14.69 psi], relative humidity 40 %), the measured values must be corrected arithmetically.

For the measurement of the ambient conditions, the CPU6000 CalibratorUnit can be used, see page 7.

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

Measuring range [bar]	1 ... 2,600		
	Quantity	1 ... 60	20 ... 2,600
		Nominal pressure per piece [bar]	Nominal pressure per piece [bar]
Piston and make-up weight	1	1	20
Mass carrier	1	10	200
Masses (stackable on mass carrier)	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
Set of fine increment masses (optional)	2	0.2	4
	1	0.1	2
	1	0.05	1
	2	0.02	0.4
	1	0.01	0.2

Measuring range [lb/in <sup>2</sup> ]	10 ... 40,000		
	Quantity	10 ... 800	200 ... 40,000
		Nominal pressure per piece [lb/in <sup>2</sup> ]	Nominal pressure per piece [lb/in <sup>2</sup> ]
Piston	1	10	200
Mass carrier	1	100	2.000
Masses (stackable on mass carrier)	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
Set of fine increment masses (optional)	2	2	40
	1	1	20
	1	0.5	10
	2	0.2	4
	1	0.1	2

# Specifications

## Model CPB3800HP

Piston-cylinder system	
Measuring range <sup>1)</sup>	1 ... 60 bar / 20 ... 2,600 bar
Required masses	107 kg
Smallest step <sup>2)</sup> (Standard mass set)	0.5 bar / 10 bar
Nominal effective area of the piston	1/8 in <sup>2</sup> / 1/160 in <sup>2</sup>
Measuring range <sup>1)</sup>	10 ... 800 lb/in <sup>2</sup> / 200 ... 40,000 lb/in <sup>2</sup>
Required masses	119 kg
Smallest step <sup>2)</sup> (Standard mass set)	5 lb/in <sup>2</sup> / 100 lb/in <sup>2</sup>
Nominal effective area of the piston	1/8 in <sup>2</sup> / 1/160 in <sup>2</sup>
Accuracies	
Standard <sup>3) 4)</sup>	0.025 % of reading
Premium <sup>3) 4)</sup>	0.01 % of reading
Pressure transmission medium	Hydraulic fluid based on VG22 mineral oil (0.5 litre included in scope of delivery)
Material	
Piston	Tungsten carbide / steel
Cylinder	Steel / tungsten carbide
Weight	
Piston-cylinder system	2 kg [4.4 lbs]
bar mass set, box 1	43.3 kg [95.5 lbs]
bar mass set, box 2	29.7 kg [65.5 lbs]
bar mass set, box 3	29.4 kg [64.8 lbs]
bar mass set, box 4	29.4 kg [64.8 lbs]
lb/in <sup>2</sup> mass set, box 1	40.5 kg [89.3 lbs]
lb/in <sup>2</sup> mass set, box 2	33.6 kg [74.1 lbs]
lb/in <sup>2</sup> mass set, box 3	33.6 kg [74.1 lbs]
lb/in <sup>2</sup> mass set, box 4	31.6 kg [69.7 lbs]
Dimensions (W x D x H)	
Carrying case 1 for mass set (optional)	400 x 310 x 310 mm [15.8 x 12.2 x 12.2 in]
Carrying case 2 - 4 for mass set (optional)	215 x 310 x 310 mm [8.5 x 12.2 x 12.2 in]




- 1) Theoretical starting value; corresponds to the pressure value generated by the piston or the piston and its make-up weight (by their own weight). To optimise the operating characteristics more masses should be loaded.
- 2) The smallest pressure change value that can be achieved based on the standard mass set. To reduce this, a set of fine increment masses is also available.
- 3) The accuracy from 10 % of the measuring range is based on the measured value. In the lower part the accuracy is 0.025 % of reading.
- 4) Measurement uncertainty assuming reference conditions (ambient temperature 20 °C [68 °F], atmospheric pressure 1,013 mbar [14.69 psi], 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 connection	G ½ union nut with metal cone, with three thread adapters as standard M16 x 1.5 / M20 x 1.5 and 9/16-18 UNF
Material	
Wetted parts	Austenitic stainless steel, high tensile brass, nitrile rubber
Pressure transmission medium	Hydraulic fluid based on VG22 mineral oil (0.5 l included in scope of delivery) <sup>5)</sup>
Reservoir	170 cm <sup>3</sup>

Base	
<b>Weight</b>	
Base	13.5 kg [29.8 lbs]
<b>Permissible ambient conditions</b>	
Operating temperature	18 ... 28 °C [64 ... 82 °F]
<b>Dimensions (W x D x H)</b>	
Base	401 x 397 x 155 mm [15.8 x 15.7 x 6.1 in], for details, see technical drawings

5) Other pressure transmission media on request.

## Approvals

Logo	Description	Country
	<b>EU declaration of conformity</b> Pressure equipment directive (Module A)	European Union
	<b>EAC</b> <ul style="list-style-type: none"> <li>■ EMC directive</li> <li>■ Pressure equipment directive</li> <li>■ Low voltage directive</li> <li>■ Machinery directive</li> </ul>	Eurasian Economic Community
	<b>UkrSEPRO</b> Metrology, measurement technology	Ukraine
-	<b>MTSCHS</b> Permission for commissioning	Kazakhstan

## Certificates

Certificate	
<b>Calibration</b>	
CPB3800HP	Standard: Calibration certificate Option 1: UKAS calibration certificate (pressure calibration with a mass set) Option 2: UKAS calibration certificate (area and mass calibration)
Set of fine increment masses	Standard: Calibration certificate Option 1: UKAS calibration certificate (pressure calibration with a piston-cylinder system) Option 2: UKAS calibration certificate (mass calibration)
<b>Recommended recalibration interval</b>	2 to 5 years (dependent on conditions of use)

Approvals and certificates, see website

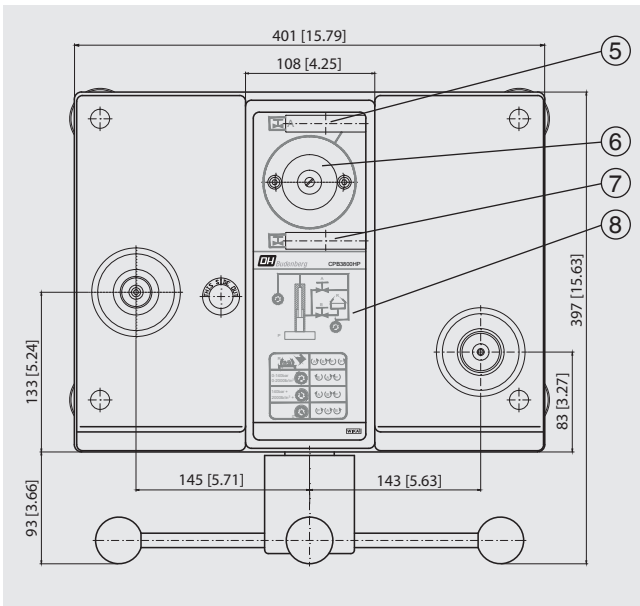
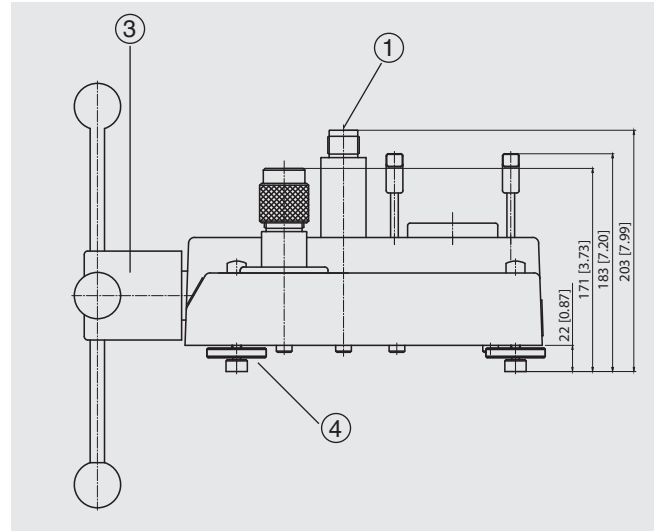
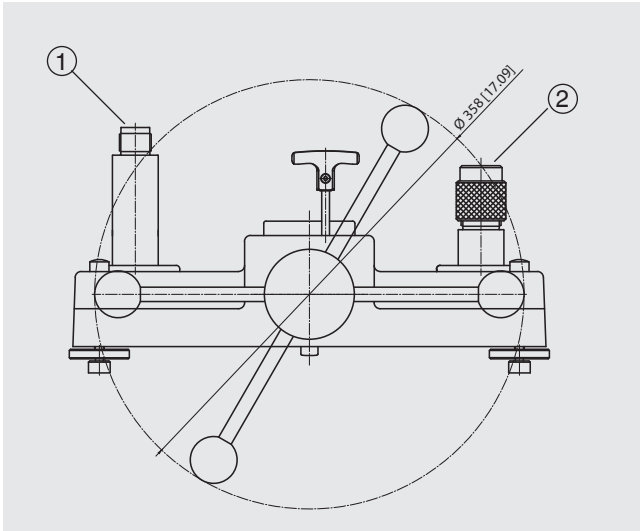
## Transport dimensions for complete instrument

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 [47.2 x 31.5 x 19.7 in] and 800 x 600 x 500 mm [31.5 x 23.6 x 19.7 in]. The overall weight is dependent on the measuring range.

Version	Weight	
	net	gross
1 ... 60 / 20 ... 2,600 bar	169 [372.6 lbs]	207 kg [456.4 lbs]
10 ... 800 / 200 ... 40,000 lb/in <sup>2</sup>	177 [390.3 lbs]	215 kg [474.1 lbs]

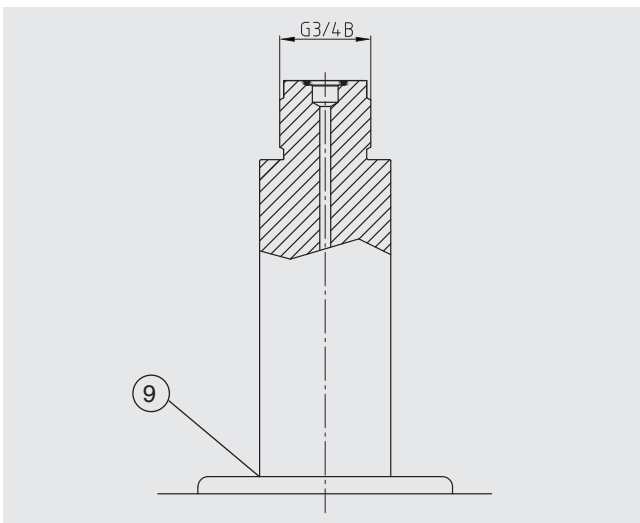
## Dimensions in mm [in]

(without masses)

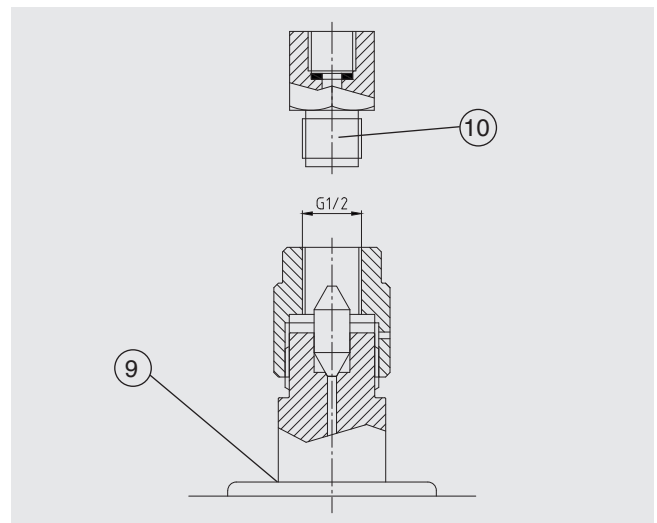


- ① Piston connection
- ② Test connection
- ③ Dual-area spindle pump with star handle
- ④ Rotatable feet
- ⑤ High-pressure shut-off valve
- ⑥ Reservoir with plug screw
- ⑦ Low-pressure shut-off valve
- ⑧ Pressure generation control schematic
- ⑨ Oil collecting tray
- ⑩ Adapter, see scope of delivery

### Standard connection piston-cylinder system



### Test connection



## CalibratorUnit model CPU6000

The models of the CPU6000 series are compact tools for use with a pressure balance (dead-weight tester). 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 CPU6000 in combination with the WIKA-Cal (PC software) all critical ambient parameters can be registered and automatically corrected.

### The CPU6000 series is made up of three instruments

#### Weather station, model CPU6000-W

The CPU6000-W provides measured values such as atmospheric pressure, relative humidity and the ambient temperature of the laboratory environment.

#### Pressure balance sensor box, model CPU6000-S

The CPU6000-S measures the piston temperature and displays the floating position of the masses.

#### Digital multimeter, model CPU6000-M

The CPU6000-M fulfils the function of a digital multimeter and power supply unit when electronic pressure transmitters must be calibrated.

### Typical application

#### WIKA-Cal PC software - Weight calculator

With the demo version of the WIKA-Cal software and a CPB series pressure balance (dead-weight tester), the masses to be applied and the corresponding reference pressure can be determined. The pressure balance data (dead-weight tester data) can be entered into the database manually or imported automatically via an XML file available online.

All ambient parameters and piston temperature can be entered manually into WIKA-Cal or can be measured automatically with the CPU6000 series, so that the highest accuracy can be achieved. WIKA-Cal demo version can be downloaded free of charge from the WIKA website.

Further specifications on the CPU6000 series can be found in data sheet CT 35.02.

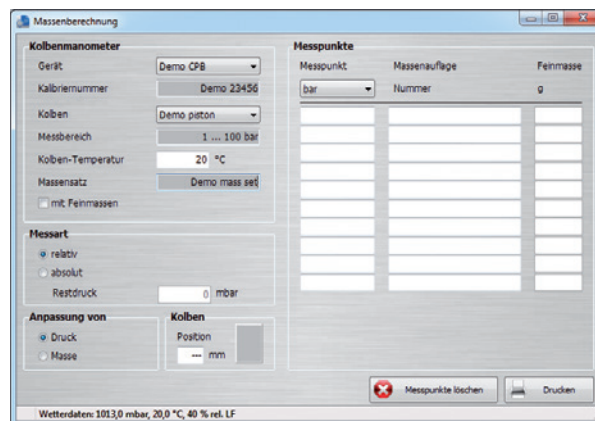
For details of the WIKA-Cal calibration software see data sheet CT 95.10.



CPU6000 series



Model CPU6000-W, CPU6000-S, CPB5800 and PC with WIKA-Cal software



WIKA-Cal PC software - Weight calculator

## Further pressure balances (dead-weight testers) within our calibration technology programme

### Dead-weight tester, model CPB3800

#### Measuring ranges:

Hydraulic 1 ... 120 to 10 ... 1.200 bar  
(10 ... 1.600 to 100 ... 16.000 lb/in<sup>2</sup>)

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

For specifications see data sheet CT 31.06



Dead-weight tester, model CPB3800

### Dead-weight tester, model CPB3500

#### Measuring ranges:

Pneumatic -0.015 ... -1 to +1 ... +120 bar  
(1 ... 100 to 10 ... 1,600 lb/in<sup>2</sup>)

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

For specifications see data sheet CT 31.22



Dead-weight tester, model CPB3500

### Pressure balance, model CPB5800

#### Measuring ranges:

Hydraulic Single-piston measuring ranges:  
1 ... 120 to 2 ... 300 bar  
(10 ... 1,600 to 30 ... 4,000 lb/in<sup>2</sup>)

Dual-piston measuring ranges:  
1 ... 60 bar / 10 ... 700 bar to  
1 ... 60 bar / 20 ... 1,400 bar  
(10 ... 800 lb/in<sup>2</sup> / 100 ... 10,000 lb/in<sup>2</sup> to  
10 ... 800 lb/in<sup>2</sup> / 200 ... 20,000 lb/in<sup>2</sup>)

**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 lb/in<sup>2</sup>)

**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



## Mass sets

### Set of fine increment masses M1 and F1

The masses included in the standard mass set are ideally suited for everyday use. If even smaller intermediate values need to be generated, using one of the class M1 or F1 set of fine increment masses with the following masses is recommended:

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 fine increment masses**

Accessories	Bestellcode
Fine increment masses in bar (smallest step 0.1 / 2 lb/in <sup>2</sup> )	CPB-A-CC-ZZ7ZZZ-Z
Fine increment masses in bar (smallest step 0.01 / 0.2 bar)	CPB-A-CC-ZZ6ZZZ-Z
1 storage case for instrument base (and CPB3800HP piston-cylinder system)	CPB-A-CC-ZZ8ZZZ-Z
Four flight cases for mass set	CPB-A-CC-ZZ9ZZZ-Z
Adapter for connection column, G ½ female thread with o-ring, max. 1,600 bar, mat.: 1.4571	CPB-A-CC-ZZFZZZ-Z
Adapter for connection column, 9/16-18 UNF male thread with sealing cone, mat.: hardened stainless steel	CPB-A-CC-ZZEZZZ-Z
Adapter for connection column, M20 x 1.5 male thread with sealing cone, mat.: hardened stainless steel	CPB-A-CC-ZZDZZZ-Z
Adapter for connection column, M16 x 1.5 male thread with sealing cone, mat.: hardened stainless steel	CPB-A-CC-ZZCZZZ-Z
Dual range piston-cylinder system 1 ... 50 / 20 ... 2,600 bar	CPB-A-CC-ZZ2ZZZ-Z
Dual range piston-cylinder system 10 ... 600 / 200 ... 40,000 lb/in <sup>2</sup>	CPB-A-CC-ZZ3ZZZ-Z
Sealing and maintenance set for instrument base	CPB-A-CC-ZZBZZZ-Z
Hydraulic fluid based on VG22 mineral oil in plastic bottle, content 0.5 litre	CPB-A-CC-ZZAZZZ-Z
Tool set consisting of open-ended spanners, replacement seals, pointer remover and pointer punch	CPB-A-CC-ZZGZZZ-Z

## Scope of delivery

- Base
- Dual-area spindle pump for filling, pressure generation and fine pressure adjustment
- Piston connection with G  $\frac{3}{4}$  B male thread
- Test connection with G  $\frac{1}{2}$  union nut with metal cone and three thread adapters M16 x 1.5 / M20 x 1.5 and 9/16-18 UNF
- Piston-cylinder system
- Masses manufactured to standard gravity (standard value: 9.80665 m/s<sup>2</sup>)
- VG22 mineral oil (0.5 litre)
- Tool and maintenance set consisting of:
  - 1 hexagon wrench key 3 mm A/F
  - 2 x 30 mm A/F open-ended spanners
  - 1 spirit level
  - 4 level plates
  - 1 set of hardened steel sealing rings
  - 1 set of replacement seals for base
- Operating instructions
- Factory calibration certificate

## Options

- Systems with increased accuracy to 0.01 %
- Further pressure transmission media
- Further pressure units
- Masses manufactured to local gravity
- Set of fine increment masses
- Further tools:
  - G  $\frac{1}{2}$  (1/2" BSP) angle connection
  - Pointer punch
  - Pointer remover
  - Test item connection
- UKAS calibration certificate

## Ordering information

Model / Package / Accuracy / Gravity value g / Fine increment masses / Storage case / Calibration for dead-weight tester / Calibration for fine increment masses / Accessories / Further approvals / Additional ordering information

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