

Pneumatic dead-weight tester Model CPB3500



for further approvals
see page 6

Applications

- Primary standard for calibrating the pressure scale in a pneumatic range from -1 ... 120 bar (-14.5 ... 1,600 lb/in²)
- 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 starting from 0.015 ... 0.006 % of reading
- Five different piston-cylinder systems available for ranges ± 1 bar, 0.1 ... 7 bar, 0.2 ... 25 bar, 1 ... 70 bar and 1 ... 120 bar, or also for ranges in lb/in² and kPa
- Stable aluminium base with a strong impact-resistant ABS cover for heavy industrial use combined with compact dimensions and light weight
- Interchangeable pistons and mass sets for each model, mass sets manufactured from stainless steel
- Factory calibration included as standard, traceable to national standards; with UKAS calibration possible as an option



Pneumatic dead-weight tester, model CPB3500

Description

Proven primary standard

The model CPB3500 dead-weight tester is a genuine primary standard, which derives the measurement of pressure directly from its fundamental equation $p = F/A$. This mechanical measuring principle provides superior reliability and stability over time, eliminates most risks of measurement error and reduces calibration uncertainties. Thus the CPB3500 is the ideal tool for the calibration of any type of pressure measuring instruments on a daily basis.

Robustness and modularity

The instrument is built on a tough, stable aluminium base with high corrosion resistance and impact-resistant ABS case. Piston cylinders are interchangeable among the

various models within the CPB3500 series, so that in case of changing requirements any CPB3500 model can easily be upgraded on other available ranges.

Mass sets are fully interchangeable between pistons of the same range within the claimed standard accuracy. The mass set is made of non-magnetic stainless steel so that masses remain extremely stable over time.

Bases can also be quickly converted into a comparator by substituting the suitable transfer standard for the piston and mass set.

Easy to use

Two built-in precision soft seat valves combined with a volume adjuster provide fine pressure control capability. The safety pressure gauge on the base displays the approximate pressure. The masses are top loading (except for the 25 bar (400 lb/in²) range) to enable easier and faster operation. They are available in the most common pressure units.

The piston-cylinder system

Both the piston and cylinder are manufactured from materials with exceptionally low pressure and temperature coefficients. This leads to a high linearity of the effective area of the piston and results in a high measurement accuracy.

An integrated overpressure protection prevents the piston from being forced out vertically and thus avoids damage to the piston-cylinder system in the event of the removal of masses under pressure.

Piston and cylinder must only be operated with clean air/gas. The exceptions are the 70 bar (1,000 lb/in²) and 120 bar (1,600 lb/in²) ranges where the piston-cylinder system is oil-lubricated.

The masses are stacked on the piston-cylinder system - with the exception of the 25 bar (400 lb/in²) range, where the annular masses are stacked on a mass carrier, so as to have minimum side thrust and friction on the piston-cylinder system.

The entire construction design of the piston-cylinder system 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 two to five years dependent on the conditions of use.

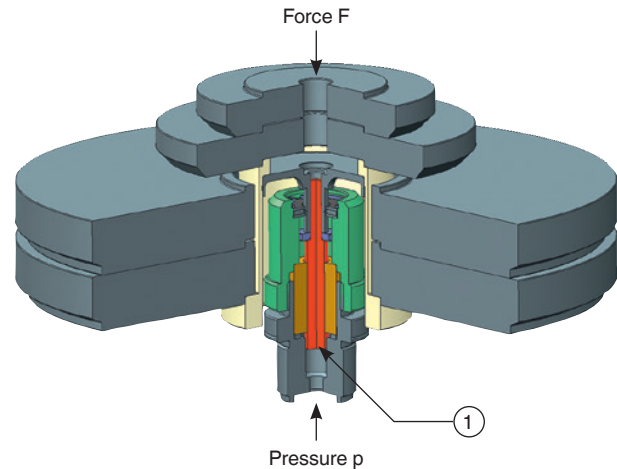
Tables of masses

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 9.

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/s²), though they can be adjusted to a specific location and also UKAS calibrated.



Piston-cylinder system model CPS3500

As standard, all instrument bases are equipped with a G 1 female thread as connection for the piston-cylinder system.

① Effective area A

The masses are manufactured, as standard, to the standard gravity of 9.80665 m/s², although they can also be adjusted for any local gravity.

The mass sets can be manufactured for the following different pressure units, bar, kg/cm², kPa, MPa or lb/in² and can be used with the same piston-cylinder system.

Measuring range [bar] ¹⁾	0.015 ... 1		0.015 ... 2		0.1 ... 7		0.2 ... 25		1 ... 70		1 ... 120	
	Quantity	Nominal pressure per piece [mbar]	Quantity	Nominal pressure per piece [mbar]	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	0.015	1	0.015	1	0.1	1	0.2	1	1	1	1
Standard mass set	1	0.005	1	0.005	1	0.4	1	0.3	2	1	2	1
	3	0.02	3	0.02	2	0.5	1	4.5	5	10	1	18
	2	0.01	2	0.01	5	1	3	5	1	9	4	20
	6	0.05	6	0.05	2	0.2	2	2	2	4	1	10
	6	0.1	6	0.1	1	0.1	1	1	1	2	2	4
	-	-	1	1	1	0.05	1	0.5	1	0.5	1	2
	-	-	-	-	-	-	-	-	-	-	1	0.5
Set of fine increment masses (optional)	-	-	-	-	2	0.02	2	0.2	1	0.4	1	0.4
	-	-	-	-	1	0.01	1	0.1	1	0.2	1	0.2
	-	-	-	-	1	0.005	1	0.05	1	0.1	1	0.1
	-	-	-	-	-	-	2	0.02	2	0.04	2	0.04
	-	-	-	-	-	-	1	0.01	1	0.02	1	0.02

Measuring range [lb/in ²] ¹⁾	0.2 ... 15		0.2 ... 30		1 ... 100		3 ... 400		15 ... 1,000		10 ... 1,600	
	Quantity	Nominal pressure per piece [lb/in ²]	Quantity	Nominal pressure per piece [lb/in ²]	Quantity	Nominal pressure per piece [lb/in ²]	Quantity	Nominal pressure per piece [lb/in ²]	Quantity	Nominal pressure per piece [lb/in ²]	Quantity	Nominal pressure per piece [lb/in ²]
Piston	1	0.2	1	0.2	1	1	1	3	1	10	1	10
Standard mass set	1	0.05	1	0.05	1	4	1	7	2	10	2	10
	1	0.1	1	0.1	2	5	1	90	1	180	1	180
	2	0.2	2	0.2	8	10	2	100	3	200	6	200
	1	0.5	1	0.5	2	2	1	50	1	100	1	100
	1	0.8	1	0.8	1	1	2	20	2	40	2	40
	1	1	1	1	1	0.5	1	10	1	20	1	20
	2	2	2	2	-	-	1	5	1	5	1	5
	2	4	2	4	-	-	-	-	-	-	-	-
	-	-	1	15	-	-	-	-	-	-	-	-
Set of fine increment masses (optional)	-	-	-	-	2	0.2	2	2	1	4	1	4
	-	-	-	-	1	0.1	1	1	1	2	1	2
	-	-	-	-	1	0.05	1	0.5	1	1	1	1
	-	-	-	-	-	-	2	0.2	2	0.4	2	0.4
	-	-	-	-	-	-	1	0.1	1	0.2	1	0.2

1) Other ranges like "in. water column" and "mm. water column" also available on request.

Measuring range [kPa] ¹⁾	1.5 ... 100		1.5 ... 200		10 ... 700		20 ... 2,500		100 ... 7,000		100 ... 12,000	
	Quantity	Nominal pressure per piece [kPa]	Quantity	Nominal pressure per piece [kPa]	Quantity	Nominal pressure per piece [kPa]	Quantity	Nominal pressure per piece [kPa]	Quantity	Nominal pressure per piece [kPa]	Quantity	Nominal pressure per piece [kPa]
Piston and make-up weight	1	1.5	1	1.5	1	10	1	20	1	100	1	100
Standard mass set	1	0.5	1	0.5	1	40	1	30	2	100	2	100
	3	2	3	2	2	50	1	450	1	1,000	1	1,800
	2	1	2	1	5	100	3	500	1	1,800	4	2,000
	6	5	6	5	2	20	2	200	2	400	1	1,000
	6	10	6	10	1	10	1	100	1	200	2	400
	-	-	1	100	1	5	1	50	1	50	1	200
	-	-	-	-	-	-	-	-	2	2,000	1	50
Set of fine increment masses (optional)	-	-	-	-	2	2	2	20	1	40	1	40
	-	-	-	-	1	1	1	10	1	20	1	20
	-	-	-	-	1	0.5	1	5	1	10	1	10
	-	-	-	-	-	-	2	2	2	4	2	4
	-	-	-	-	-	-	1	1	1	2	1	2

1) Other ranges like "in. water column" and "mm. water column" also available on request.

Specifications



Model CPB3500

Piston-cylinder systems						
Measuring range in bar ²⁾	0.015 ... 1	0.015 ... 2	0.1 ... 7	0.2 ... 25	1 ... 70	1 ... 120
Required masses	3.3 kg	6.54 kg	22.5 kg	21 kg	29 kg	49.5 kg
Smallest step ³⁾ (Standard mass set)	0.005 bar	0.005 bar	0.05 bar	0.3 bar	0.5 bar	0.5 bar
Smallest step ⁴⁾ (set of fine increment masses)	--	--	0.005 bar	0.01 bar	0.02 bar	0.02 bar
Nominal effective area of the piston	1/2 in ²	1/2 in ²	1/2 in ²	1/8 in ²	1/16 in ²	1/16 in ²
Measuring range in lb/in² ²⁾	0.2 ... 15	0.2 ... 30	1 ... 100	3 ... 400	15 ... 1,000	10 ... 1,600
Required masses	3.3 kg	6.54 kg	22.6 kg	22.4 kg	26.9 kg	45.5 kg
Smallest step ³⁾ (Standard mass set)	0.05 lb/in ²	0.05 lb/in ²	0.5 lb/in ²	5 lb/in ²	5 lb/in ²	5 lb/in ²
Smallest step ⁴⁾ (set of fine increment masses)	--	--	0.05 lb/in ²	0.1 lb/in ²	0.2 lb/in ²	0.2 lb/in ²
Nominal effective area of the piston	1/2 in ²	1/2 in ²	1/2 in ²	1/8 in ²	1/16 in ²	1/16 in ²
Measuring range in kPa ²⁾	1.5 ... 100	1.5 ... 200	10 ... 700	20 ... 2,500	100 ... 7,000	100 ... 12,000
Required masses	3.3 kg	6.54 kg	22.5 kg	21 kg	29 kg	49.5 kg
Smallest step ³⁾ (Standard mass set)	0.5 kPa	0.5 kPa	5 kPa	30 kPa	50 kPa	50 kPa
Smallest step ⁴⁾ (set of fine increment masses)	--	--	0.5 kPa	1 kPa	2 kPa	2 kPa
Nominal effective area of the piston	1/2 in ²	1/2 in ²	1/2 in ²	1/8 in ²	1/16 in ²	1/16 in ²
Accuracies						
Standard ⁵⁾	0.015 % of reading					
Premium ⁶⁾	0.008 % of reading		0.006 % of reading			
Material						
Piston	High chromium steel			Tungsten carbide	High chromium steel	
Cylinder	High chromium steel			Tungsten carbide	Bronze	
Mass set	Stainless steel, non-magnetic					
Weight						
Piston-cylinder system	0.5 kg (1.1 lb)	0.5 kg (1.1 lb)	1 kg (2.2 lb)	1 kg (2.2 lb)	2 kg (4.4 lb)	2 kg (4.4 lb)
bar mass set incl. mass carrier	4 kg (8.8 lb)	7.6 kg (16.8 lb)	23 kg (50.8 lb)	24 kg (53.0 lb)	32 kg (70.7 lb)	53 kg (117 lb)
kPa mass set incl. mass carrier	4 kg (8.8 lb)	7.6 kg (16.8 lb)	23 kg (50.8 lb)	24 kg (53.0 lb)	32 kg (70.7 lb)	53 kg (117 lb)
lb/in ² mass set incl. mass carrier	4 kg (8.8 lb)	7.6 kg (16.8 lb)	23 kg (50.8 lb)	24 kg (53.0 lb)	30 kg (66.3 lb)	49 kg (108 lb)
Storage case for mass set (optional, 2 pieces required)	5.8 kg (12.8 lbs)					
Dimensions (W x H x D)						
Storage case for mass set (optional)	400 x 310 x 310 mm and 215 x 310 x 310 mm (15.8 x 12.2 x 12.2 in and 8.5 x 12.2 x 12.2 in)					

- 2) 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.
- 3) The smallest pressure change value that can be achieved based on the standard mass set.
- 4) The smallest pressure change value that can be achieved based on the optional set of fine increment masses. For further reductions, an accessory of class M1 or F1 set of fine increment masses is available.
- 5) The accuracy is in reference to the measured value, from 10 % of the measuring range to compensate for effects of gravity, temperature and actual area of piston unit. Standard accuracy without any corrections for the actual area down to 0.02 %.
- 6) Available as high-accuracy class dead-weight testers supplied with UKAS calibration certificates for area and mass.

Base	
Connections	
Connection for piston-cylinder system	G 1 female thread
Test item connection	G 1/2 female thread, loose union connection, incl. adapter set to G 1/4 and G 3/8 female threads
External pressure connection	G 1/4 female thread, G 1/4 B to 1/4 NPT (female) adapter included in delivery
Pressure transmission medium	
Base	Pneumatic based on clean, dry and non-corrosive gases (e.g. air or nitrogen)
Weight	
Base	12 kg (26.5 lbs)
Permissible ambient conditions	
Operating temperature	10 ... 30 °C (50 ... 86 °F)
Dimensions (W x D x H)	
Base	510 x 490 x 300 mm (20.1 x 19.39 x 11.8 in) For details, see technical drawing

Approvals

Logo	Description	Country
	EAC <ul style="list-style-type: none"> ■ EMC directive ■ Pressure equipment directive ■ Low voltage directive ■ Machinery directive 	Eurasian Economic Community
-	MTSCHS Permission for commissioning	Kazakhstan
	UkrSEPRO Metrology, measurement technology	Ukraine

Certificates

Certificate	
Calibration	
CPB3500	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 mass	Standard: without Option 1: UKAS calibration certificate (pressure calibration with a piston-cylinder system) Option 2: UKAS calibration certificate (mass calibration)
Recommended recalibration interval	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, consists of up to 3 packages on a single pallet.

The dimensions are 1,200 x 800 x 500 mm (47.3 x 31.5 x 19.7 in).

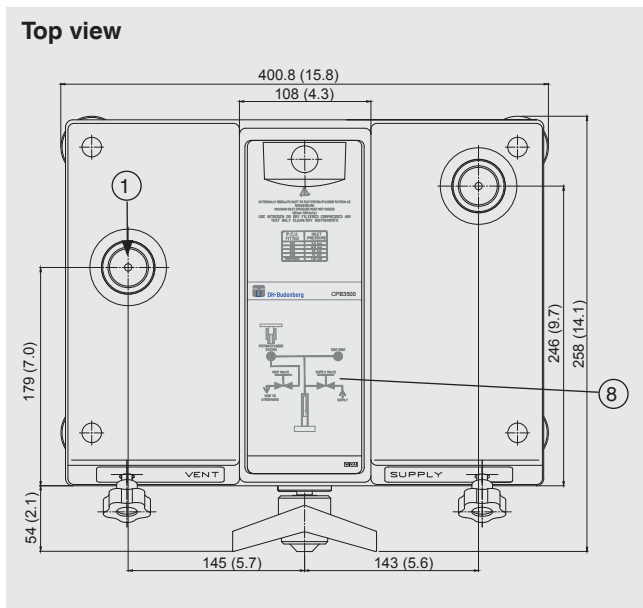
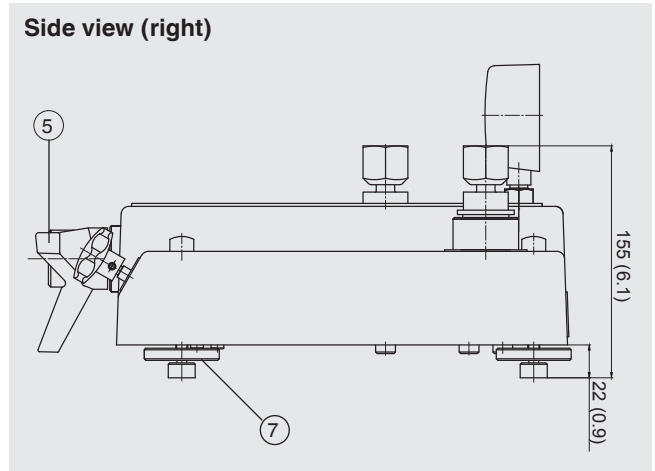
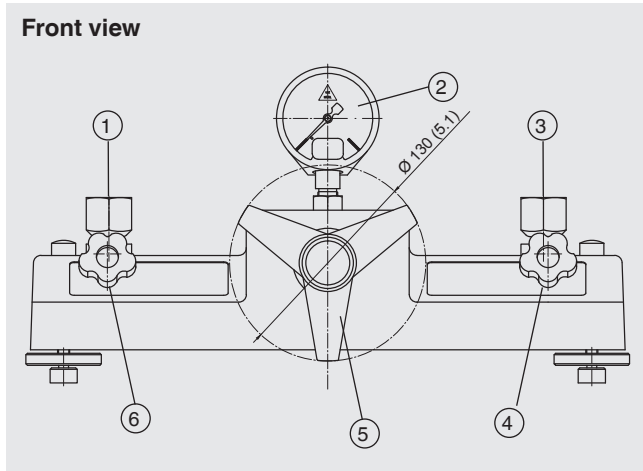
The overall weight is dependent on the measuring range.

Version in bar	Weight	
	net	gross
0.015 ... 1 bar	14 kg (30.9 lbs)	35 kg (77.2 lbs)
0.015 ... 2 bar	17.6 kg (38.8 lb)	38.6 kg (85.1 kg)
0.1 ... 7 bar	34 kg (75.0 lbs)	55 kg (121.3 lbs)
0.2 ... 25 bar	32 kg (70.6 lbs)	53 kg (116.9 lbs)
1 ... 70 bar	36 kg (79.4 lbs)	57 kg (125.7 lbs)
1 ... 120 bar	62 kg (136.7 lbs)	83 kg (183.0 lbs)

Version in lb/in ²	Weight	
	net	gross
0.2 ... 15 lb/in ²	14 kg (30.9 lbs)	35 kg (77.2 lbs)
0.2 ... 30 lb/in ²	17.6 kg (38.8 lb)	38.6 kg (85.1 kg)
1 ... 100 lb/in ²	34 kg (75.0 lbs)	55 kg (121.3 lbs)
3 ... 400 lb/in ²	34 kg (75.0 lbs)	55 kg (121.3 lbs)
15 ... 1,000 lb/in ²	36 kg (79.4 lbs)	57 kg (125.7 lbs)
10 ... 1,600 lb/in ²	58 kg (127.9 lbs)	79 kg (174.2 lbs)

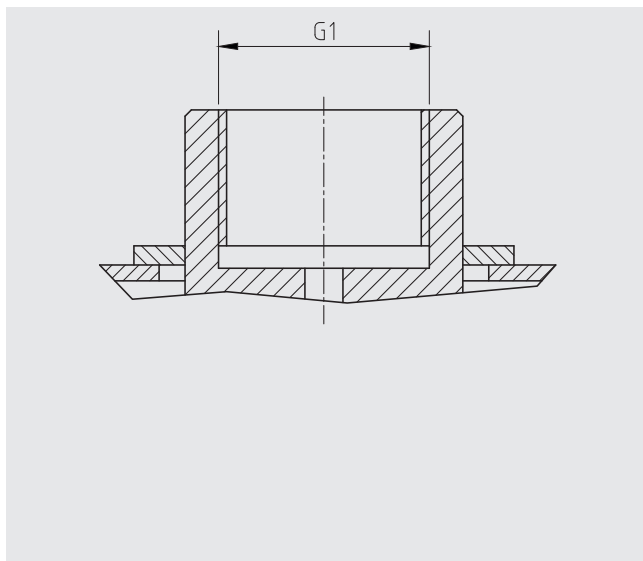
Version in kPa	Weight	
	net	gross
1.5 ... 100 kPa	14 kg (30.9 lbs)	35 kg (77.2 lbs)
1.5 ... 200 kPa	17.6 kg (38.8 lb)	38.6 kg (85.1 kg)
10 ... 700 kPa	34 kg (75.0 lbs)	55 kg (121.3 lbs)
20 ... 2,500 kPa	32 kg (70.6 lbs)	53 kg (116.9 lbs)
100 ... 7,000 kPa	36 kg (79.4 lbs)	57 kg (125.7 lbs)
100 ... 12,000 kPa	62 kg (136.7 lbs)	83 kg (183.0 lbs)

Dimensions in mm (in)

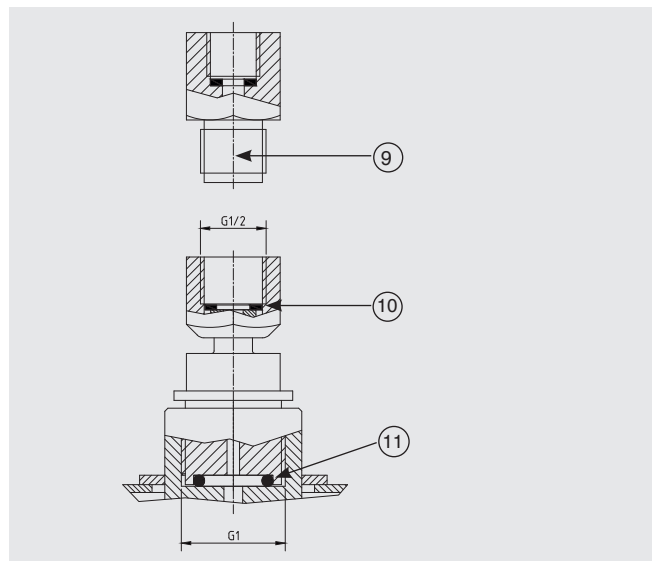


- ① Connector for piston-cylinder system
- ② Pressure measuring instrument
- ③ Test connection
- ④ Inlet valve
- ⑤ Volume adjuster with star handle
- ⑥ Exhaust valve
- ⑦ Rotatable feet
- ⑧ Pressure generation control schematic
- ⑨ Adapter, see scope of delivery
- ⑩ Sealing ring USIT 10.7 x 18 x 1.5
- ⑪ O-ring 18.4 x 3.5

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.

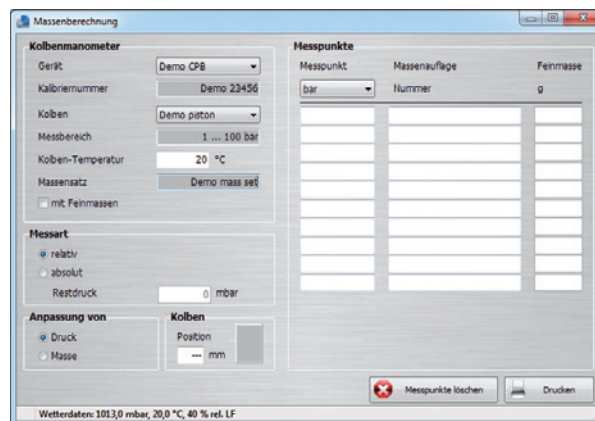
For details of the WIKA-Cal calibration software see data sheet CT 95.10.



CPU6000 series



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



WIKA-Cal PC software - Weight calculator

Accessories

Pneumatic/hydraulic separator

For calibrating low-pressure hydraulic instruments with gas, a gas/liquid separator is used. It can also be used to protect the pressure balance (dead-weight tester) from contamination.



Pneumatic/hydraulic separator, model 35

Adapter set

As standard, the pressure balance (dead-weight tester) is equipped with a connector for connecting the test item. For this purpose, the following threaded inserts, which can be easily changed, are available:

- Adapter set (BSP): G 1/8, G 1/4, G 3/8, G 1/2
- Adapter set (NPT): 1/8 NPT, 1/4 NPT, 3/8 NPT and 1/2 NPT
- Adapter set (metric): M12 x 1.5, M20 x 1.5

Vacuum adapter

Used for calibrating in the vacuum range to -1 bar (-14.5 lb/in²) (for measuring ranges 1 bar and 100 kPa only).



Vacuum adapter

Dirt trap, separator

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 (dead-weight tester).

The separator (without diaphragm) has been specifically developed for measuring instruments where the filling medium should not come into contact with the pressure balance (dead-weight tester). It is typically used with pressure balances (dead-weight testers) for the calibration of instruments with water as the test medium as well as with pneumatic pressure balances (dead-weight testers) (only with external pressure supply) for the calibration of instruments with water or oil as the test medium.



Fig. left: Separator

Fig. right: Dirt trap

Accessories	Order code
Set of fine increment masses in bar	CPB-A-AA-2ZZZZZ-Z
Set of fine increment masses in lb/in ²	CPB-A-AA-3ZZZZZ-Z
Set of fine increment masses in kPa	CPB-A-AA-4ZZZZZ-Z
Adapter set "BSP" G 1/2 male on G 1/8, G 1/4, G 3/8 and G 1/2 female	CPB-A-AA-5ZZZZZ-Z
Adapter set "NPT" G 1/2 male on 1/8 NPT, 1/4 NPT, 3/8 NPT and 1/2 NPT female	CPB-A-AA-6ZZZZZ-Z
Adapter set "metric" G 1/2 male on M12 x 1.5 and M20 x 1.5 female	CPB-A-AA-7ZZZZZ-Z
Vacuum adapter (for measuring ranges 1 bar and 100 kPa only) (model 24)	CPB-A-AA-8ZZZZZ-Z
1 storage case for instrument base (and CPB3500 piston-cylinder system)	CPB-A-AA-AZZZZZ-Z
2 storage case for mass set	CPB-A-AA-BZZZZZ-Z
Test item connection, G 1 male to G 1/2 female, rotating	CPB-A-AA-CZZZZZ-Z

Accessories	Order code
Dual test item connection, G 1 male to 2 x G ½ female, rotating (Model 27)	CPB-A-AA-DZZZZZ-Z
Separator 0 ... 35 bar (model 35)	CPB-A-AA-EZZZZZ-Z
Hydraulic fluid based on VG22 mineral oil in plastic bottle, content 0.5 litre	CPB-A-AA-FZZZZZ-Z
Sealing and maintenance set for instrument base	CPB-A-AA-GZZZZZ-Z
Tool set consisting of open-ended spanners, BSP adapter, replacement seals, pointer remover and pointer punch	CPB-A-AA-HZZZZZ-Z

Scope of delivery

- Instrument base with ABS cover
- Piston-cylinder system
- Masses manufactured to standard gravity (standard value: 9.80665 m/s²)
- 1 x 500 ml bottle of oil (for 70 and 120 bar (1,000 and 1,600 lb/in²))
- Standard tool kit with:
 - 1 - Hex spanner 2 mm A/F
 - 1 - Hex spanner 3 mm A/F
 - 2 - 30 mm A/F open-ended spanner
 - 1 - Level
 - 4 - Compensating plates
 - 1 - Bag with sealings
 - 1 - G ½ B connection for test item
 - 1 - Pointer punch
 - 1 - Pointer remover
 - 1 - Adapter for inlet connection
 - 1 - Set of connections as ordered
 - 1 – (BSP) G ¼, G ⅜, G ½
 - 1 – (NPT) ¼ in, ⅜ in, ½ in
 - 1 – (metric) M12 x 1.5, M20 x 1.5
- Operating instructions
- Factory calibration certificate

Options

- Systems with premium accuracies to 0.006 %
- Carrying case for piston-cylinder systems
- Masses manufactured to local gravity
- Sets of fine increment masses
- UKAS calibration certificate

Ordering information

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

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