

Pneumatic dead-weight tester Model CPB3500



WIKA data sheet CT 31.22

Applications

- Primary standard for calibrating the pressure scale in a pneumatic range from -1 ... 120 bar / -14.5 ... 1,600 psi
- 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 psi 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 includes traceability to national standards, as standard; with UKAS calibration possible as an option

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 measurement principle provides superior reliability and stability over time, eliminates most risks of measurement error and reduces calibration uncertainties. It makes the CPB3500 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 light weight corrosion and impact-resistant ABS case. Piston cylinders are interchangeable among the various models within the CPB3500, so that in case of changing requirements any CPB3500 tester can easily be upgraded on other available ranges.



Pneumatic dead-weight tester, model CPB3500

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 suitable transfer standard for the piston and mass set.

Ease of operation

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

The mass load is proportional to the target pressure and this is achieved through optimally graduated disc weight. As standard, these disc weights are manufactured to the standard gravity (9.80665 m/s^2), though they can be adjusted to a specific location and also UKAS calibrated.

The piston-cylinder system

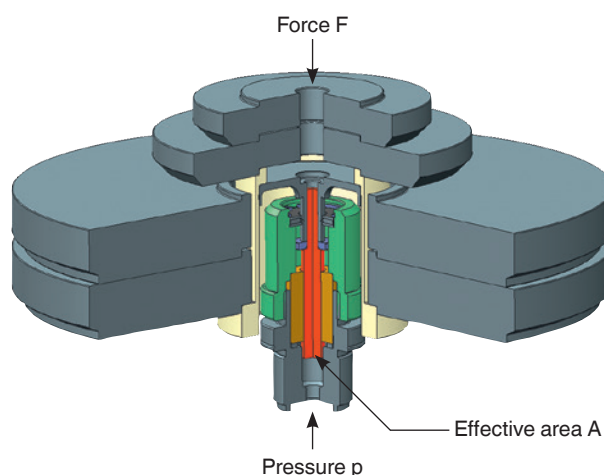
Both the piston and cylinder are manufactured from materials with very small pressure and thermal expansion coefficients, which results in a very good linearity of the effective area of the piston and thus a high measurement accuracy.

An 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 disc weights removal under pressure.

The piston and cylinder are clean air/gas only systems apart from the 70 bar/1,000 psi and 120 bar/1,600 psi ranges where the piston-cylinder system is oil lubricated.

The masses are stacked on the piston-cylinder system apart from the 25 bar/400 psi 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 overall 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 usage. As a standard all instrument bases are equipped with a G 1 female thread as connection for the piston-cylinder system.



Piston-cylinder system model CPS3500

Tables of masses

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

Should the instrument not be operated under reference conditions (ambient temperature $20 \text{ }^\circ\text{C}/68 \text{ }^\circ\text{F}$, atmospheric pressure $1,013 \text{ mbar}/14.69 \text{ psi}$, relative humidity 40%), the relevant corrections must be made, for example with the CPU6000 CalibratorUnit, see page 8.

The disc weights are manufactured, as standard, to the standard gravity (9.80665 m/s^2) although they can be adjusted for any local gravity.

Measuring range [bar] ¹⁾	0.015 ... 1		0.1 ... 7		0.2 ... 25		1 ... 70		1 ... 120	
	Quan- tity	Nominal pressure per piece	Quan- tity	Nominal pressure per piece	Quan- tity	Nominal pressure per piece	Quan- tity	Nominal pressure per piece	Quan- tity	Nominal pressure per piece
Piston and make-up weight	1	0.015	1	0.1	1	0.2	1	1	1	1
Standard mass set	1	0.005	1	0.4	1	0.3	2	1	2	1
	3	0.02	2	0.5	1	4.5	5	10	1	18
	2	0.01	5	1	3	5	1	9	4	20
	6	0.05	2	0.2	2	2	2	4	1	10
	6	0.1	1	0.1	1	1	1	2	2	4
	-	-	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 [psi] ¹⁾	1 ... 100		3 ... 400		15 ... 1,000		10 ... 1,600	
	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece	Quantity	Nominal pressure per piece
Piston and make-up weight	1	1	1	3	1	10	1	10
Standard mass set	1	4	1	7	2	10	2	10
	2	5	1	90	1	180	1	180
	5	10	2	100	3	200	6	200
	2	2	1	50	1	100	1	100
	1	1	2	20	2	40	2	40
	1	0.5	1	10	1	20	1	20
	-	-	1	5	1	5	1	5
Set of fine increment masses (optional)	2	0.2	2	2	1	0.4	1	0.4
	1	0.1	1	1	1	0.2	1	0.2
	1	0.05	1	0.5	1	0.1	1	0.1
	-	-	2	0.2	2	0.04	2	0.04
	-	-	1	0.1	1	0.02	1	0.02

Measuring range [kPa] ¹⁾	1.5 ... 100		10 ... 700		20 ... 2,500		100 ... 7,000		100 ... 12,000	
	Quan- tity	Nominal pressure per piece	Quan- tity	Nominal pressure per piece	Quan- tity	Nominal pressure per piece	Quan- tity	Nominal pressure per piece	Quan- tity	Nominal pressure per piece
Piston and make-up weight	1	1.5	1	10	1	20	1	100	1	100
Standard mass set	1	0.5	1	40	1	30	2	100	2	100
	3	2	2	50	1	450	5	1,000	1	1,800
	2	1	5	100	3	500	1	900	4	2,000
	6	5	2	20	2	200	2	400	1	1,000
	6	10	1	10	1	100	1	200	2	400
	-	-	1	5	1	50	1	50	1	200
	-	-	-	-	-	-	-	-	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" and "mm. water" also available on request.

Specifications

Model CPB3500

Piston-cylinder systems

Measuring range ²⁾	bar	0.015 ... 1	0.1 ... 7	0.2 ... 25	1 ... 70	1 ... 120
Required masses	kg	3.3	22.5	21	29	49.5
Smallest step ³⁾ (standard mass set)	bar	0.005	0.05	0.3	0.5	0.5
Smallest step ⁴⁾ (set of fine increment masses)	bar	-	0.005	0.01	0.02	0.02
Nominal effective area of the piston	in ²	1/2	1/2	1/8	1/16	1/16
Measuring range ²⁾	psi	-	1 ... 100	3 ... 400	15 ... 1,000	10 ... 1,600
Required masses	kg	-	22.6	22.4	26.9	45.5
Smallest step ³⁾ (standard mass set)	psi	-	0.5	5	5	5
Smallest step ⁴⁾ (set of fine increment masses)	psi	-	0.05	0.1	0.2	0.2
Nominal effective area of the piston	in ²	-	1/2	1/8	1/16	1/16
Measuring range ²⁾	kPa	1.5 ... 100	10 ... 700	20 ... 2,500	100 ... 7,000	100 ... 12,000
Required masses	kg	3.3	22.5	21	29	49.5
Smallest step ³⁾ (standard mass set)	kPa	0.5	5	30	50	50
Smallest step ⁴⁾ (set of fine increment masses)	kPa	-	0.5	1	2	2
Nominal effective area of the piston	in ²	1/2	1/2	1/8	1/16	1/16

Accuracies

Standard ⁵⁾	% of reading	0.015	0.015	0.015	0.015	0.015
Premium ⁶⁾	% of reading	0.008	0.006	0.006	0.006	0.006

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	kg / lb	0.5 / 1.1	1 / 2.2	1 / 2.2	2 / 4.4	2 / 4.4
bar mass set incl. mass carrier	kg / lb	4 / 8.8	23 / 50.8	24 / 53.0	32 / 70.7	53 / 117
lb/in ² mass set incl. mass carrier	kg / lb	4 / 8.8	23 / 50.8	24 / 53.0	30 / 66.3	49 / 108
kPa mass set incl. mass carrier	kg / lb	4 / 8.8	23 / 50.8	24 / 53.0	32 / 70.7	53 / 117
Storage case for mass set (optional, 2 pieces required)	kg / lb	5.8 / 1.1				

Dimensions

Storage case for mass set (optional)		400 x 310 x 310 mm (W x H x D) and 215 x 310 x 310 mm (W x H x D) 15.8 x 12.2 x 12.2 inch (B x H x T) and 8.5 x 12.2 x 12.2 inch (B x H x T)				
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- 2) 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 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 set of class M1 or F1 trim masses is available.
- 5) The accuracy is in reference to the measurement value, from 10 % of the measurement range to compensate for effects of gravity, temperature and actual area of piston unit. Standard accuracy without any corrections for 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 x 1/4 NPT (female) adapter in scope of supply

Pressure transmission medium

Base	Pneumatic based on clean, dry and non-corrosive gases (e.g. air or nitrogen)
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Weight

Base	12 kg / 26.5 lb
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Permissible ambient conditions

Operating temperature	10 ... 30 °C / 50 ... 86 °F
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Dimensions

Base	510 x 490 x 300 mm / 20.1 x 19.3 x 11.8 inch (W x D x H), for details, see technical drawings
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Certificates

Certificate

Calibration	Standard: Calibration certificate Option: UKAS calibration certificate (area and mass calibration)
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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 inch.

The overall weight is dependent on the measuring range.

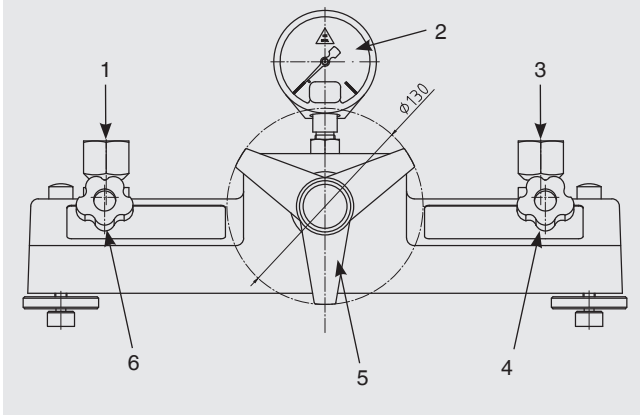
Version in bar Range	Weight in kg	
	net	gross
0.015 ... 1 bar	14	35
0.1 ... 7 bar	34	55
0.2 ... 25 bar	32	53
1 ... 70 bar	36	57
1 ... 120 bar	62	83

Version in psi Range	Weight in kg	
	net	gross
1 ... 100 psi	34	55
3 ... 400 psi	34	55
15 ... 1,000 psi	36	57
10 ... 1,600 psi	58	79

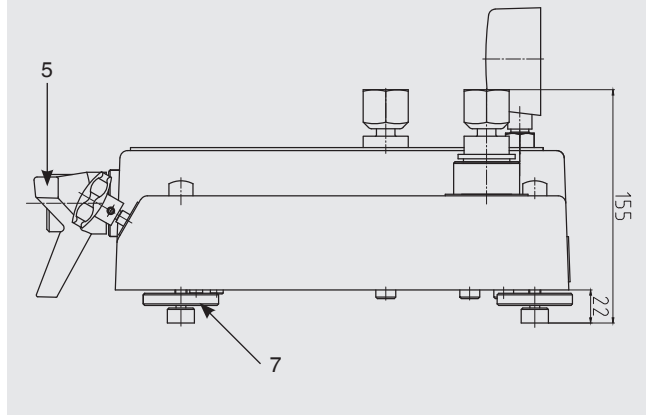
Version in kPa Range	Weight in kg	
	net	gross
1.5 ... 100 kPa	14	35
10 ... 700 kPa	34	55
20 ... 2,500 kPa	32	53
100 ... 7,000 kPa	36	57
100 ... 12,000 kPa	62	83

Dimensions in mm

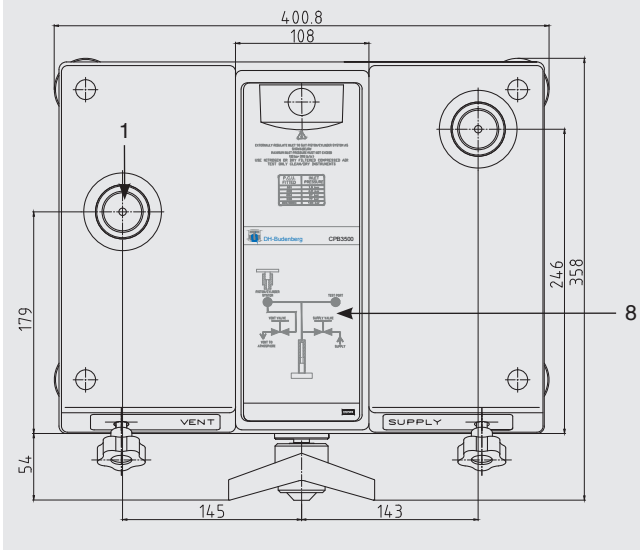
Front view



Side view

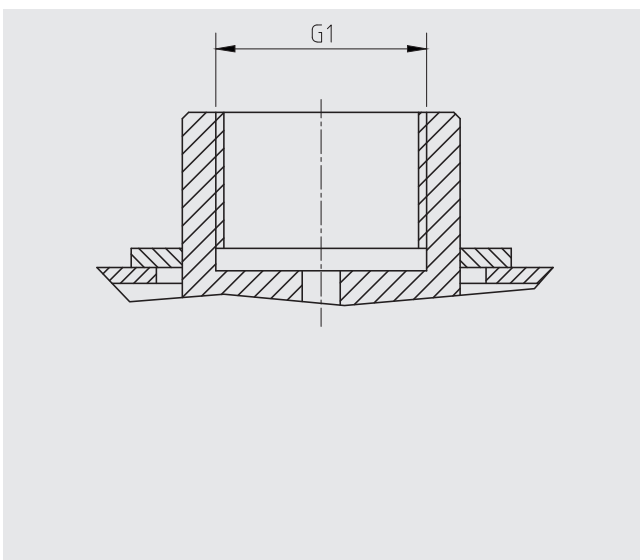


Top view

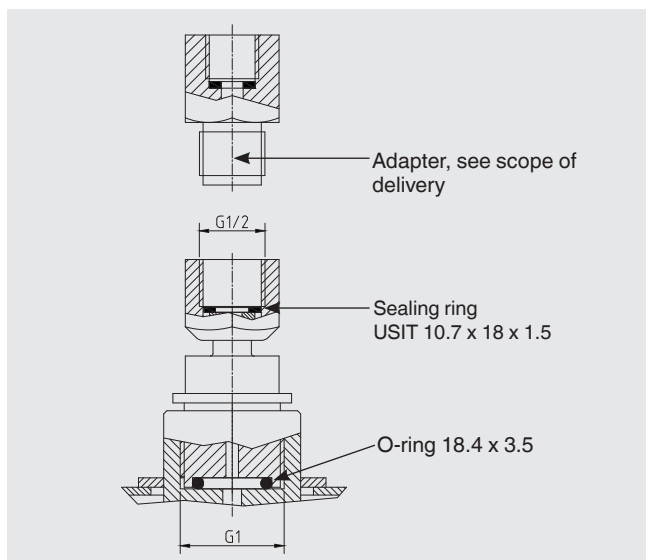


- (1) Connector for piston-cylinder system
- (2) Pressure gauge
- (3) Test item connection
- (4) Inlet valve
- (5) Volume adjuster with star handle
- (6) Outlet valve
- (7) Rotatable feet
- (8) Pressure generation control schematic

Standard connection piston-cylinder system



Test item connection



Accessories

Pneumatic/hydraulic separator

For calibrating low-pressure hydraulic instruments with gas air/liquid separator is used. It can also be used to protect the pressure balance from contamination.

Set of adapters

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

- Set of adapters (BSP): G 1/8, G 1/4, G 3/8, G 1/2
- Set of adapters (NPT): 1/8 NPT, 1/4 NPT, 3/8 NPT and 1/2 NPT
- Set of adapters (Metric): M12 x 1.5, M20 x 1.5

Vacuum adapter

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

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.

The separator (without diaphragm) has been specially conceived for measuring instruments where the filling medium should not come into contact with the pressure balance. It is typically used with hydraulic pressure balances for the calibration of instruments with the test media water as well as with pneumatic pressure balances (only with external pressure supply) for the calibration of instruments with the test media water or oil.



Pneumatic/hydraulic separator, model 35



Vacuum adapter

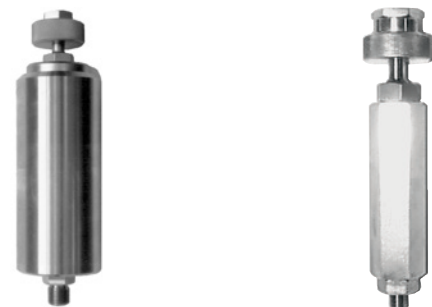


Fig. left: Separator
Fig. right: dirt trap

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 CPB-CAL (iPad® app) and/or 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 air 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 fulfills the function of a digital multimeter and power supply unit when electronic pressure transmitters must be calibrated.

Typical application

CPB-CAL iPad® app

The iPad® application calculates the mass loads for pressure balances (dead-weight testers) or the reference pressure while taking the measured parameters from the CPU6000 into account. The conversion can be carried out in all common pressure units. As an additional parameter, the local gravity can be specified for location-independent measurements.

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 disc weights 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 online available XML file.

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.

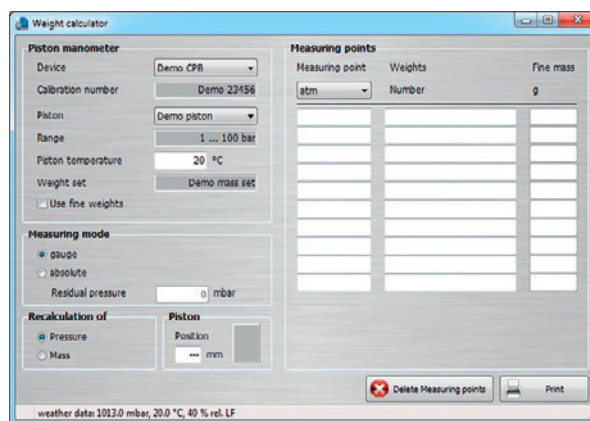
For details of the WIKA-CAL calibration software see data sheet CT 95.10.



CPU6000 series and iPad® app CPB-CAL



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



WIKA-CAL PC software - Weight calculator

Scope of delivery

- Instrument base with ABS cover
- Piston-cylinder system
- Mass set manufactured to standard gravity (9.80665 m/s²)
- Operating instructions in English
- Factory calibration certificate
- 1 x 500 ml bottle of oil (for 70 and 120 bar range only)
- Standard tool roll containing:
 - 1 - Hexagon wrench key 2 mm A/F
 - 1 - Hexagon wrench key 3 mm A/F
 - 2 - 30 mm A/F open ended spanners
 - 1 - Spirit level
 - 4 - Level plates
 - 1 - Bag of seals
 - 1 - G ½ B connection for test item
 - 1 - Pointer punch
 - 1 - Pointer remover
 - 1 - Inlet manifold adaptor
 - 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

Options

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

Ordering information

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

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We reserve the right to make modifications to the specifications and materials.

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Accessories

Adapter and connections

- Adapter set "BSP" for test item connection G ½ B male on G ⅛, G ¼, G ⅜ and G ½ female
- Adapter set "NPT" for test item connection G ½ B male on ⅛ NPT, ¼ NPT, ⅜ NPT and ½ NPT female
- Adapter set "metric" for test item connection G ½ B male on M12 x 1.5 and M20 x 1.5 female
- Vacuum adapter (for measuring ranges 1 bar and 100 kPa only)
- Test item connection G 1 male to G ½ female, rotating
- Dual test item connection G 1 male to 2 x G ½ female, rotating (Model 27)

Fine increment masses

- Fine increment masses in bar
- Fine increment masses in psi
- Fine increment masses in kPa

Fluids

- Hydraulic fluid based on VG22 mineral oil in plastic bottle, content 0.5 litre

Dirt trap, separator

- Dirt trap, -1 ... +1,000 bar, volume 0.2 litres
- Dirt trap, -1 ... +1,000 bar, volume 0.03 litres
- Separator 0 ... 35 bar (model 35)
- Separator (without diaphragm), max. 1,000 bar

Storage

- Storage case for CPB3500 instrument base
- Two storage boxes for mass set

Tools

- Sealing and maintenance set for instrument base
- Tool set consisting of open-ended spanner, BSP adapters, replacement seals, pointer remover and pointer punch

