

**Applications:**

- Primary standard for defining the pressure scale in a range up to 120 bar (1,600 psi), pneumatic.
- Reference instrument for testing, adjusting and calibrating pressure measuring instruments in factories and calibration laboratories.
- Self-contained, complete system also suitable for on-site measurements/calibrations.

**Special features:**

- Total uncertainty of measurement down to  $\pm 0.008\%$  of reading.
- Factory calibration certificate as standard, traceable to National Standards, DAkkS calibration certificate available as an option.
- High long-term stability with a recommended recalibration cycle of 5 years.
- Masses manufactured from stainless steel and aluminium, local gravity adjustment possible at not additional charge.
- Optional a quick-change system for piston-cylinder unit available, enables fast and secure exchange of the piston-cylinder system in order to change the measuring range.

**Description:****Proven primary standard**

Pressure balances are the most accurate instruments for the calibration of electronic or mechanical pressure measuring instruments. The direct measurement of pressure ( $P = F/A$ ) and the use of high-quality materials, result in small measurement uncertainties and an excellent long-term stability of five years (Recommendation in accordance with the German Calibration Service DAkkS). For these reasons pressure balances / deadweight testers have already been used in the calibration laboratories of industry, national institutes and research laboratories for many years.

**Self-contained operation**

Due to the integrated pressure generation (for ranges up to 7 bar) and the purely mechanical measuring principle, the **LR-Cal LDW-P** deadweight tester is ideally suited to on-site use as well as service and maintenance purposes.

**Basic principle**

Pressure is defined as the quotient of force and area. Correspondingly, the core of the **LR-Cal LDW-P** deadweight tester is a very precisely-manufactured piston-cylinder system, which is loaded with masses in order to generate the individual test points.

The weight applied is proportional to the desired pressure and accomplished by using optimally graduated weights. These weights are manufactured to standard gravity ( $9.80665 \text{ m/s}^2$ ) although, for fixed location usage, they can be adjusted to a customer-specified local gravity.

**Easy operation**

Depending on the instrument range the pressure is set via an integrated pump or via an external pressure supply by the use of control valves. For fine adjustment a very precisely adjustable spindle pump with a precision spindle running only within the pump body is mounted.

**Piston-cylinder system**

Both the piston and cylinder are manufactured from Tungsten Carbide. Compared to other materials, Tungsten Carbide has very small pressure and thermal expansion coefficients, which results in a very good linearity of the effective cross-sectional area of the piston and high measurement accuracy.

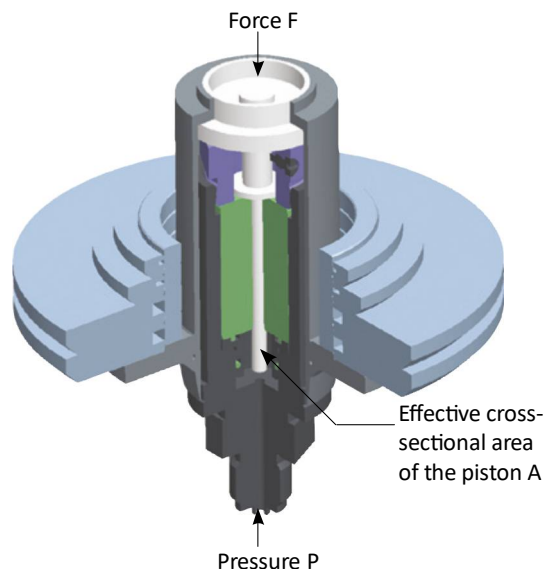
Piston and cylinder are very well protected in a solid stainless steel housing, against contact, impacts or contamination from outside. In addition, overpressure protection is integrated, which prevents the piston from being forced out vertically and avoids damage to the piston cylinder system in the event of weight removal under pressure.

The weight discs are stacked on a bell jar which is fitted to the piston skirt. Due to the construction of the bell jar, the centre of gravity for the stacked weights is very low, which minimises both the side thrust on the piston-cylinder system and the friction. For relatively low starting pressures, a lighter aluminium plate can be used instead of the bell jar.

The overall design of the piston-cylinder unit 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 5 years.

The standard connection for the piston-cylinder system is an M30 x 2 male thread. A quick-connect system, for easy measuring range changes without tools, is available as an option.

As soon as the measuring system reaches equilibrium, there is a balance of forces between pressure and mass applied. The excellent quality of the system ensures that this pressure remains stable over several minutes, so that the device under test can be calibrated or time-consuming adjustments can be carried out without any problems.

**High performance instrument base LR-Cal LDW-P**

The instrument base is supplied in two different versions, depending on the measurement range of the deadweight tester:

- Basement for ranges up to 7 bar / 100 psi  
With integrated pressure generation through inlet pressure pump and spindle pump
- Basement for Vacuum and ranges  $\geq 25$  bar up to 120 bar / 1,600 psi  
With connection for external pressure supply or vacuum, incl. inlet vent.

**GRATIS - FREE OF CHARGE:**

Download Link für a MS Excel sheet for calculation of corrections (e.g. air density, piston temperature) and masses/pressure calculation:

<https://www.druck-temperatur.de/images/software/dwt-corrections.zip>

### Set of masses for the LR-Cal LDW-P

The mass set is supplied in rigid carrying cases with foams. Here included are the masses shown in below tables, manufactured in stainless steel (non-magnetic). The weight discs are optimally graduated. For smaller graduation an incremental weight set is recommended, see accessories.



### Tables of masses

The following tables show the number of weights per measuring range, within a weight set, with their nominal mass values and the resulting nominal pressures. Should you not operate the device under reference conditions (ambient temperature 20°C, air pressure 1013 mbar, relative humidity 40%), corrections must be considered, if necessary.

There weights are manufactured to standard gravity (9.80665 m/s<sup>2</sup>) although, for fixed location usage, they can be adjusted to a customer-specified local gravity (no extra charge, order-code [LDW-P-GRAV](#)).

Measuring range [bar]	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]
<b>Piston and make-up weight</b>	1	0.015	1	0.015	1	0.1	1	0.2	1	1	1	1
<b>Standard mass set</b>	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
<b>Optional set of fine increment masses order-code <a href="#">LDW-P-FMS</a></b>	-	-	-	-	-	-	-	-	-	-	1	0.5
	-	-	-	-	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
<b>Optional set of fine increment masses order-code <a href="#">LDW-P-FMS</a></b>	-	-	-	-	-	-	1	0.01	1	0.02	1	0.02
Measuring range [PSI]	0.2...15		0.2...30		1...100		3...400		15...1,000		10...1,600	
	Quantity	Nominal pressure per piece [PSI]	Quantity	Nominal pressure per piece [PSI]	Quantity	Nominal pressure per piece [PSI]	Quantity	Nominal pressure per piece [PSI]	Quantity	Nominal pressure per piece [PSI]	Quantity	Nominal pressure per piece [PSI]
<b>Piston and make-up weight</b>	1	0.2	1	0.2	1	1	1	3	1	10	1	10
<b>Standard mass set</b>	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	-	-	-	-	-	-	-	-
<b>Optional set of fine increment masses order-code <a href="#">LDW-P-FMS</a></b>	-	-	-	-	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

## Order-Codes

**LR-Cal LDW-P - Pneumatisch, für kleine Drücke, mit integrierter Druckerzeugung.**

Kolben-/Zylinder-System mit Gabelschlüssel auswechselbar. Inkl. Massensatz und Werks-Kalibrierschein

**LR-Cal LDW-P - pneumatic, for small pressures, with integrated manual pressure source.**

Piston-/Cylinder-unit changeable with flat spanner. Incl. mass set and traceable factory Certificate of Calibration

Prüflingsanschluss G 1/2

Pressure port for test item: 1/2" BSPF

**Genauigkeit  $\pm 0,015\%$  v. Messwert**Uncertainty  $\pm 0.015\%$  of measured value**Genauigkeit  $\pm 0,008\%$  vom Messw.**Uncertainty  $\pm 0.008\%$  measured value

Prüfbereich Range	Druckeinheit Pressure Unit	Artikel-Nummer Order Code	Artikel-Nummer Order Code
0,015 ... 1	bar	LDW-P-B-00001-G015	LDW-P-B-00001-G008
0,015 ... 2	bar	LDW-P-B-00002-G015	LDW-P-B-00002-G008
0,1 ... 7	bar	LDW-P-B-00007-G015	LDW-P-B-00007-G008
0,2 ... 15	PSI	LDW-P-P-00015-G015	LDW-P-P-00015-G008
0,2 ... 30	PSI	LDW-P-P-00030-G015	LDW-P-P-00030-G008
1 ... 100	PSI	LDW-P-P-00100-G015	LDW-P-P-00100-G008

**Zusätzliche Kolben-/Zylinder-Systeme (PNEUMATISCH) zu o.g. Modellen mit integrierter Druckerzeugung**

Additional piston-/cylinder-units for above mentioned PNEUMATIC models with integrated manual pressure source

0,015 ... 1	bar	LDW-PK-B-00001-G015	LDW-PK-B-00001-G008
0,015 ... 2	bar	LDW-PK-B-00002-G015	LDW-PK-B-00002-G008
0,1 ... 7	bar	LDW-PK-B-00007-G015	LDW-PK-B-00007-G008
0,2 ... 15	PSI	LDW-PK-P-00015-G015	LDW-PK-P-00015-G008
0,2 ... 30	PSI	LDW-PK-P-00030-G015	LDW-PK-P-00030-G008
1 ... 100	PSI	LDW-PK-P-00100-G015	LDW-PK-P-00100-G008

**LR-Cal LDW-P - Pneumatisch, für Vakuum oder größere Drücke, mit Anschluss für ext. Druck- bzw. Vakuum-Versorgung**

Kolben-/Zylinder-System mit Gabelschlüssel auswechselbar. Inkl. Massensatz und Werks-Kalibrierschein

**LR-Cal LDW-P - pneumatic, for vacuum or higher pressures, with connector for external pressure/vacuum source.**

Piston-/Cylinder-unit changeable with flat spanner. Incl. mass set and traceable factory Certificate of Calibration

-1 ... -0,015	bar (Vakuum)	LDW-P-B-00000-G015	LDW-P-B-00000-G008
0,2 ... 25	bar	LDW-P-B-00025-G015	LDW-P-B-00025-G008
1 ... 70	bar	LDW-P-B-00070-G015	LDW-P-B-00070-G008
1 ... 120	bar	LDW-P-B-00120-G015	LDW-P-B-00120-G008
-15 ... -0,2	PSI	LDW-P-P-00000-G015	LDW-P-P-00000-G008
3 ... 400	PSI	LDW-P-P-00400-G015	LDW-P-P-00400-G008
15 ... 1000	PSI	LDW-P-P-01000-G015	LDW-P-P-01000-G008
10 ... 1600	PSI	LDW-P-P-01600-G015	LDW-P-P-01600-G008

**Zusätzliche Kolben-/Zylinder-Systeme (PNEUMATISCH) zu o.g. Modellen mit Anschluss für ext. Druck-/Vakuum-Quelle**

Additional piston-/cylinder-units for above mentioned PNEUMATIC models with connector for external pressure/vacuum source

-1 ... -0,015	bar	LDW-PK-B-00000-G015	LDW-PK-B-00000-G008
0,2 ... 25	bar	LDW-PK-B-00025-G015	LDW-PK-B-00025-G008
1 ... 70	bar	LDW-PK-B-00070-G015	LDW-PK-B-00070-G008
1 ... 120	bar	LDW-PK-B-00120-G015	LDW-PK-B-00120-G008
-15 ... -0,2	PSI	LDW-PK-P-00000-G015	LDW-PK-P-00000-G008
3 ... 400	PSI	LDW-PK-P-00400-G015	LDW-PK-P-00400-G008
15 ... 1000	PSI	LDW-PK-P-01000-G015	LDW-PK-P-01000-G008
10 ... 1600	PSI	LDW-PK-P-01600-G015	LDW-PK-P-01600-G008



The above mentioned vacuum ranges -1...-0.015 bar and -15...-0.2 PSI are realised with a vacuum adapter.

This vacuum ranges are possible only with basement version with connector for external pressure/vacuum source and with a suitable vacuum pump.

## Specification LR-Cal/ LDW-P

## Piston-cylinder systems

Measuring range [bar] 1)	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 2) (Standard mass set)	0.005 bar	0.005 bar	0.05 bar	0.3 bar	0.5 bar	0.5 bar
Smallest step 3) (optional increment masses)	-	-	0.005 bar	0.01 bar	0.02 bar	0.02 bar
Nominal effective area of the piston	1/2 in <sup>2</sup>	1/2 in <sup>2</sup>	1/2 in <sup>2</sup>	1/8 in <sup>2</sup>	1/16 in <sup>2</sup>	1/16 in <sup>2</sup>
Measuring range [PSI] 1)	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 2) (Standard mass set)	0.05 PSI	0.005 PSI	0.5 PSI	5 PSI	5 PSI	5 PSI
Smallest step 3) (optional increment masses)	-	-	0.05 PSI	0.1 PSI	0.2 PSI	0.2 PSI
Nominal effective area of the piston	1/2 in <sup>2</sup>	1/2 in <sup>2</sup>	1/2 in <sup>2</sup>	1/8 in <sup>2</sup>	1/16 in <sup>2</sup>	1/16 in <sup>2</sup>

## Accuracies

Standard 4)	0.015% of reading				
Premium 5)	0.008% of reading	0.006% of reading		0.008% of reading	

## Material

Piston	High-chromium steel	Tungsten carbide	High-chromium steel
Cylinder	High-alloy heat treatable stainless steel	Tungsten carbide	Bronze
Mass set	Stainless steel, non-magnetic		

Measuring range [bar]	0.015...1	0.015...2	0.1...7	0.2...25	1...70	1...120
Measuring range [PSI]	0.2...15	0.2...30	1...100	3...400	15...1,000	10...1,600

## Weights

Piston-cylinder system	0.5 kg 1.1 lbs	0.5 kg 1.1 lbs	1 kg 2.2 lbs	1 kg 2.2 lbs	2 kg 4.4 lbs	2 kg 4.4 lbs
mass set [bar] incl.	4 kg	7.6 kg	23 kg	24 kg	32 kg	53 kg
mass carrier	8.8 lbs	16.8 lbs	50.8 lbs	53.0 lbs	70.7 lbs	117 lbs
mass set [PSI] incl.	4 kg	7.6 kg	23 kg	24 kg	30 kg	49 kg
mass carrier	8.8 lbs	16.8 lbs	50.8 lbs	53.0 lbs	66.3 lbs	108 lbs
Storage case for mass set (max. 2 pcs., included)	1 pc.: 5.8 kg 1 pc.: 12.8 lbs		2 pcs.: 5.8 kg each 2 pcs.: 12.8 lbs each			

## Dimensions (W x H x D)

Storage case for mass set	300 x 265 x 205 mm 11.8 x 10.4 x 8.1 in 6)	400 x 310 x 310 mm + 215 x 310 x 310 mm 15.8 x 12.2 x 12.2 in + 8.5 x 12.2 x 12.2 in
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- 1) Theoretical starting value. Corresponds to the pressure value generated by the piston or the piston or the piston and its make-up weight (by their own weight). To optimize the operating characteristics more masses should be loaded.
- 2) The smallest pressure range value that can be achieved based on the standard mass set.
- 3) The smallest pressure change value that can be achieved based on the optional set of fine increment masses (order-code [LDW-P-FMS](#)). For further reductions, an accessory of class M1 or F1 set of fine increment masses is available (order-code [LDW-FMS-F1](#) or [LDW-FMS-M1](#))
- 4) The accuracy is in reference to the measured value, from 10% of the measuring range to compensate for actual area of piston unit. Standard accuracy without any corrections for the actual area down to 0.02% (0.03% of reading below 10% of range). For the range 0.015...1 bar the accuracy below 10% of the range is 0.04% of reading.
- 5) Available as high-accuracy class deadweight testers for area and mass.
- 6) Piston and mass set can be supplied in a flight box.

## Basement LR-Cal LDW-P

## Base version

Pneumatic, low pressure	up to max. 7 bar (100 psi), with internal pressure generation
Pneumatic, high pressure + vacuum	up to max. 120 bar (1,600 psi) and vacuum, for external supply (pressure and vacuum)

## Pressure transmission medium

Pneumatic	Clean, dry, non-corrosive gases (e.g. air or nitrogen)
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## Connections

Connection for piston-cylinder system	Standard: M20 x 2 female thread Option: Quick release connector (order-code <a href="#">LDW-P-CT</a> together with <a href="#">LDW-PKZ-CT</a> )
Test item connection	Quick connector 1/2" BSP female thread, freely rotating, changeable Option: further threaded inserts, see accessories
External pressure connection	6 mm SWAGELOK® threaded pipe connection, max. 100% of assigned measuring range (only basement version for external supply)

## Material

Piping in base	low pressure version: plastic tubing from polyurethane, 4 x 0.75 mm high pressure + vacuum version: stainless steel 1.4571, 3 x 1 mm
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## Weight

with standard conn.	18.0 kg / 39.8 lbs
with optional quick release conn.	19.0 kg / 42.0 lbs

## Permissible ambient conditions

Operating temperature	18...28°C / 64...82°F
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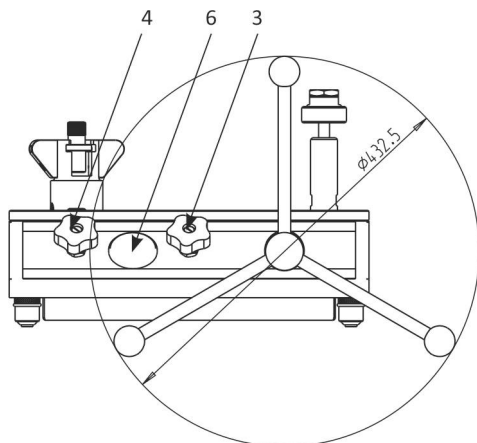
## Dimensions (W x H x D)

Base	401 x 375 x 265 mm / 15.8 x 14.8 x 10.4 in
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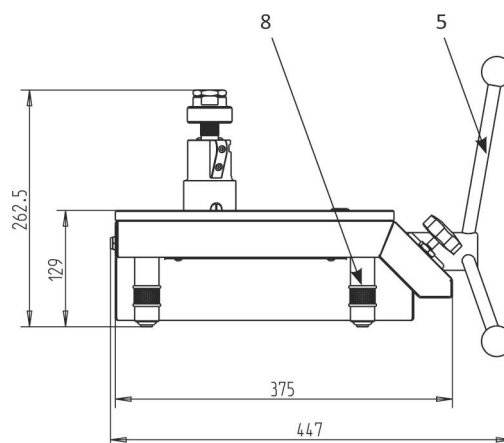
### Dimensions (mm) LR-Cal LDW-P

The drawing shows a base version **LR-Cal LDW-P** for external power supply (vacuum range or pressure ranges  $>7$  bar), with optional quick-connect for the piston-cylinder system. The version with integrated pressure generation differs only in the arrangement of the control elements, and not dimensionally.

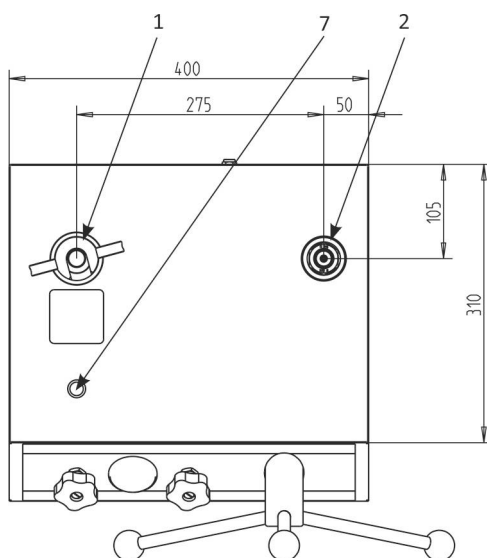
Front view



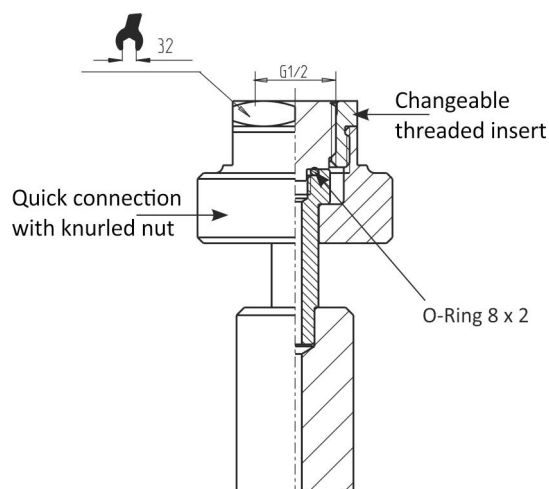
Side view



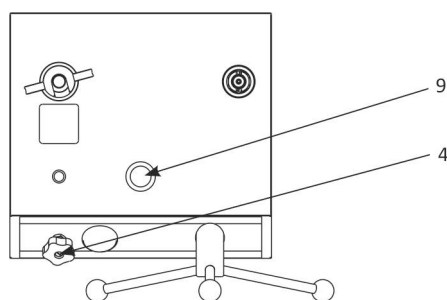
Plan view



Connection for the test item



Version (up to 7 bar) with integrated pressure source (pump)  
Plan view



- (1) Adapter piston-cylinder system
- (2) Adapter test item
- (3) Inlet-valve (only version for external power supply)
- (4) Outlet-valve
- (5) Spindle pump with star handle, removable
- (6) Analogue pressure gauge (for visual control purposes)
- (7) Water level (for adjusting the basement)
- (8) Rotating feet (for adjusting the basement)
- (9) Priming pump (only version with integr. pressure gener.)

**Scope of supply**

- Instrument base with adjustable feet
- Priming pump (only versions max. 7 bar)
- Pressure input for external pressure source (only versions > 7 bar and vacuum)
- Spindle pump for pressure generation / fine adjustment
- Piston adapter with M30 x 2 female thread
- Piston-cylinder system with bell jar
- Basic mass set in rigid carrying cases
- Mass set manufactured to standard gravity ( $9.80665 \text{ m/s}^2$ )
- Operating manual in German and English
- Factory calibration certificate

**Accessories****Trim-mass sets M1 and F1**

The weights included in the **LR-Cal LDW-P** standard mass set or fine increment weights 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 M1 / F1



90° angle connection

**Separators**

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



Separator (without diaphragm), max. 1000 bar



Set of adapters

**Connector for test items with back connection**

For test items with back connection mounting, a 90° angle connection is available

**Set of adapters for test item connection**

As a standard, the pressure balance is equipped with a quick connector for connecting the test item. For this purpose, various threaded adapters, which can be easily changed, are available. Additionally the sets of adapters include spare-O-rings and a spanner with SW32 flats and SW14 flats, for changing the adapters.

Order-Code	Description / Execution
LDW-FMS-F1	Trimm-masses (1 mg up to 50 g), class F1
LDW-FMS-M1	Trimm-masses (1 mg up to 50 g), class M1
CPB5000-ADS	Set of adapters for test item, in a case, with threaded inserts 1/4" BSP, 3/8", BSP, 1/2" NPT 1/4" NPT and M20 x 1.5 for fitting to the knurled nut of the test item connection
CPB5000-ADS-NPT	Set of adapters for test item, in a case, with threaded inserts 1/8" NPT, 1/4" NPT, 3/8" NPT and 1/2" NPT for fitting to the knurled nut of the test item connection
CPB5000-WA90	Angle connection 90°, for test items with back mounting connection
CPB5000-TV-1000	Purifier, max. 1000 bar
CPB5000-R-SET	Only for version with input for external pressure supply
CPB5000-R-SET	Set of o-rings consisting of 5 spare 8 x 2 and 5 spare 4 x 2.2
CPB5000-PN-RS	Cleaning set for <b>LR-Cal LDW-P</b> piston-cylinder systems

**Further LR-Cal Deadweight Tester / Pressure Balances:**
**Model LR-Cal LDW-H**

Hydraulic

Single Piston

 Ranges                from 1...120 to 2...300 bar  
                           from 10...1.600 to 30...4.000 psi

Double Piston

 Ranges                from 1...60 / 10...700 bar to  
                           1...60 / 20...1.400 bar  
                           from 10...800 / 100...10.000 psi to  
                           10...800 / 200...20.000 psi

 Accuracy             $\pm 0.015\%$  or  $\pm 0.006\%$  of measured value

**Model LR-Cal LDW-HK**

Hydraulic (compact design)

 Ranges                from 1...120 to 10...1,200 bar  
                           from 10...1,600 to 100...16,000 psi

 Accuracy             $\pm 0.05\%$  or  $\pm 0.025\%$  of measured value

**Model LR-Cal CPB5000-HP**

High pressure, hydraulic

 Ranges                from 25...4,000 to 25...5,000 bar  
                           from 365...60,000 to 365...70,000 psi

 Accuracy             $\pm 0.025\%$  or  $\pm 0.02\%$  of measured value

**Modell LR-Cal CPB5600-DP**

Differential pressure, pneumatic

 Ranges                from 0.03...2 to 0.4...100 bar  
                           from 0.435...30 to 5.8...1500 psi

Differential pressure, hydraulic

 Ranges                from 0.2...60 to 2...1,000 bar  
                           from 2.9...1,000 to 29...14,500 psi

 Accuracy             $\pm 0.015\%$  or  $\pm 0.008\%$  of measured value

**GRATIS - FREE OF CHARGE:**

Download Link für a MS Excel sheet for calculation of corrections (e.g. air density, piston temperature) and masses/pressure calculation:

<https://www.druck-temperatur.de/images/software/dwt-corrections.zip>