

Applications:

- Primary standard for defining the pressure scale in a range up to 1200 bar hydraulic
- 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 0.025% of measured value
- Factory calibration includes traceability to national standards, as standard; with UKAS-calibration possible as an option
- High long-term stability with recommended recalibration cycle every five years
- Masses manufactured from stainless steel, can be adjusted to local gravity
- Compact dimensions

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

Pressure balances / Deadweight 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 of five years (recommended in accordance with the German Calibration Service DKD/DAkks).

The deadweight 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 pure mechanical measuring principle, the model **LR-Cal LDW-HK** 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 **LR-Cal LDW-HK** 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 m/s^2), though they can be adjusted to a specific location and also DKD/DAkks calibrated.

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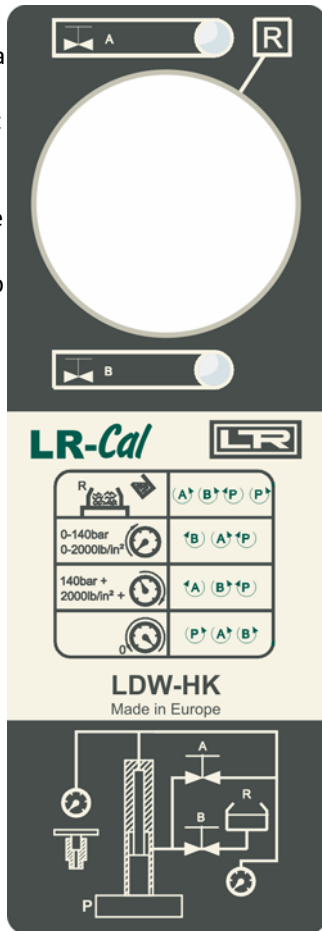
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Easy operation

The integrated dual-area spindle pump enables rapid priming of the test system and smooth pressure generation up to 1200 bar. At the same time, the precise 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 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.

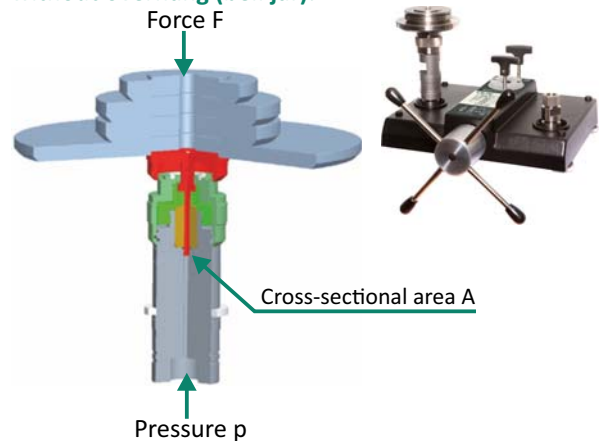


The piston-cylinder system

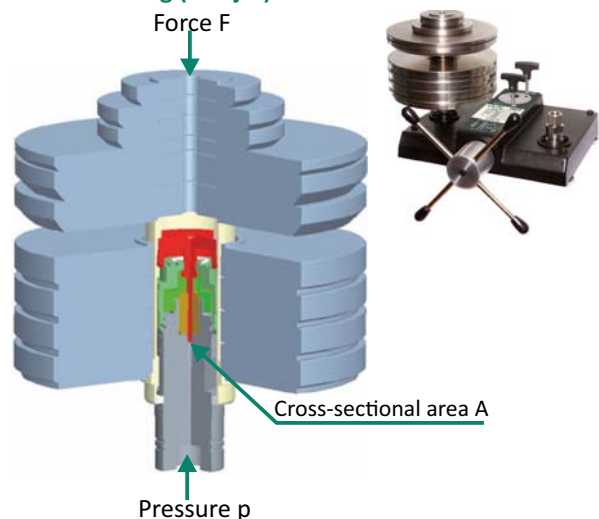
The piston and cylinder of the **LR-Cal** LDW-HK are manufactured from tungsten carbide. This pairing of materials, in comparison to other materials, has very low pressure and temperature coefficients of expansion, which results in a very good linearity for the cross-sectional area and a very high accuracy.

Piston and cylinder are very well protected, against contact, impacts or contamination from outside, in a solid stainless steel housing. 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 mass removal under pressure.

Piston-cylinder system with masses, without overhang (bell jar):



Piston-cylinder system with masses, with overhang (bell jar):



Compact instrument design

The **LR-Cal** LDW-HK deadweight tester 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 housing and the low weight associated with these, the **LR-Cal** LDW-HK pressure balance is also particularly suited to on-site applications.

The masses are stacked on an overhang (bell jar), which sits on the piston shaft. The construction of the overhang (bell jar) provides a very low centre of gravity for the stacked weights, which minimises both the side thrust on the piston-cylinder system and the friction. For smaller starting pressures, the masses can also be stacked directly onto the piston shaft, without using the overhang (bell jar).

The overall design of the piston-cylinder unit and the very precise manufacturing of both the piston and the cylinder, ensures 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.

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 1013 mbar, relative humidity 40%), the relevant corrections must be made.

The masses are manufactured, as standard, to the standard gravity (9.80665 m/s²) although they can be adjusted for any particular location.

| Measuring range [bar] | 1...120 | | 2,5...300 | | 5...700 | | 10...1,200 | |
|---|---------|----------------------------|-----------|----------------------------|---------|----------------------------|------------|----------------------------|
| | Qty. | nom.pressure per pc. [bar] | Qty. | nom.pressure per pc. [bar] | Qty. | nom. ressure per pc. [bar] | Qty. | nom.pressure per pc. [bar] |
| Piston and make-up weight | 1 | 1 | 1 | 2,5 | 1 | 5 | 1 | 10 |
| Piston, overhang (bell jar) and overhang make-up weight | 1 | 20 | 1 | 50 | 1 | 100 | 1 | 200 |
| Masses (stackable on bell jar) | 3 | 20 | 3 | 50 | 4 | 100 | 3 | 200 |
| Masses (stackable on piston) | 1 | 20 | 1 | 50 | 1 | 100 | 1 | 200 |
| | 1 | 10 | 1 | 25 | 1 | 50 | 1 | 100 |
| | 2 | 4 | 2 | 10 | 2 | 20 | 2 | 40 |
| | 1 | 2 | 1 | 5 | 1 | 10 | 1 | 20 |
| | 1 | 1 | 1 | 2,5 | 1 | 5 | 1 | 10 |

| Measuring range [psi] | 10...1,600 | | 25...4,000 | | 50...10,000 | | 100...16,000 | |
|---|------------|----------------------------|------------|----------------------------|-------------|----------------------------|--------------|----------------------------|
| | Qty. | nom.pressure per pc. [psi] | Qty. | nom.pressure per pc. [psi] | Qty. | nom.pressure per pc. [psi] | Qty. | nom.pressure per pc. [psi] |
| Piston and make-up weight | 1 | 10 | 1 | 25 | 1 | 50 | 1 | 100 |
| Piston, overhang (bell jar) and overhang make-up weight | 1 | 190 | 1 | 475 | 1 | 950 | 1 | 1900 |
| Masses (stackable on bell jar) | 5 | 200 | 5 | 500 | 7 | 1000 | 5 | 2000 |
| Masses (stackable on piston) | 1 | 200 | 1 | 500 | 1 | 1000 | 1 | 2000 |
| | 1 | 100 | 1 | 250 | 1 | 500 | 1 | 1000 |
| | 2 | 40 | 2 | 100 | 2 | 200 | 2 | 400 |
| | 1 | 20 | 1 | 50 | 1 | 100 | 1 | 200 |
| | 1 | 10 | 1 | 25 | 1 | 50 | 1 | 100 |

Scope of delivery:

- Base
- Dual-area spindle pump for filling, pressure generation and fine pressure adjustment
- Piston connection with 3/4" BSP male thread
- Test item connection with 1/2" BSP female thread, loose union connection
- Adapter set for test item connection, 1/2" male to 1/4" BSP female and 3/8" BSP female threads
- Piston-cylinder system with overhang (bell jar)
- Set of masses manufactured to standard gravity (9.80665 m/s²)
- Operating fluid (special mineral oil VG22) 0.5 l
- Tool and maintenance set
- Operating instructions in German and English language
- Factory calibration certificate (traceable)

Options:

- System with increased accuracy to 0.025% of measured value
- Set of masses manufactured to local gravity
- Storage case for base, mass set and the piston-cylinder system
- DKD/DAkkS calibration certificate

Specifications model LR-Cal/ LDW-HK piston-cylinder systems:

| Measuring range "bar" 1) | [bar] | 1...120 | 2,5...300 | 5...700 | 10...1200 |
|--|--|-----------------------|-----------|------------|-------------|
| Required masses | [kg] | 41 | 50 | 58 | 50 |
| Smallest step 2) (standard mass set) | [bar] | 1 | 2,5 | 5 | 10 |
| Nominal cross-sectional piston area | [inch ²] | 1/16 | 1/40 | 1/80 | 1/160 |
| Measuring range "psi" 1) | [psi] | 10...1600 | 25...4000 | 50...10000 | 100...16000 |
| Required masses | [kg] | 38 | 47 | 58 | 47 |
| Smallest step 2) (standard mass set) | [psi] | 10 | 25 | 50 | 100 |
| Nominal cross-sectional piston area | [inch ²] | 1/16 | 1/40 | 1/80 | 1/160 |
| Accuracies | | | | | |
| Standard 3) | [% v.Mw.] | 0.05 | | | |
| Option 3) | [% v.Mw.] | 0.025 | | | |
| Pressure transmission medium | Hydraulic fluid mineral oil VG22 (0.5 l included in scope of delivery) | | | | |
| Material | | | | | |
| Piston | Tungsten carbide | | | | |
| Cylinder | Tungsten carbide | | | | |
| Mass set | Stainless steel, non-magnetic | | | | |
| Weight | | | | | |
| Piston-/Cylinder-System | [kg] | 2.4 | | | |
| "bar" set of masses incl. overhang | [kg] | 41.5 | 50.5 | 58.5 | 50.5 |
| "psi" set of masses incl. overhang | [kg] | 47,5 | 47.5 | 58.5 | 47.5 |
| Carrying case for set of masses (optional, 2 pieces required) | [kg] | 5.8 | | | |
| Dimensions | | | | | |
| Carrying case for set of masses (opt.) | [mm] | W 400 x D 310 x H 310 | | | |

- 1) 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 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 available as option/accessory.
- 3) The accuracy from 10% to the measuring range is based on the measured value. In the lower range, a fixed error based on 10% of the range applies.
Measurement uncertainty assuming reference conditions (ambient temperature 20°C, air pressure 1013 mbar, relative humidity 40%). For operation without an Intelligent Calibration Module **LR-Cal IKM** the corrections must be made (manually) if required.

Specifications model LR-Cal/ LDW-HK base unit:

Connection for piston-cylinder system: 3/4" BSP male

Test item connection: 1/2" BSP female thread, loose union connection, incl. adapter set to 1/4" BSP and 3/8" BSP female threads

Material Wetted Parts: Austenitic stainless steel, high tensile brass, nitrile rubber

Pressure transmission medium: Hydraulic fluid VG22 based on mineral oil (0.5 l included in scope of delivery)

Reservoir volume: 170 cm³

Base weight: 13.5 kg; **Optional storage case weight:** 8.5 kg

Permissible operating temperature: 18...28°C

Dimensions of the base: W 401 x D 397 x H 155 mm, for details see drawings on page 5

Approvals and certificates:

CE conformity: Pressure equipment directive 97/23/EC (Module A)

Certificate of Calibration: 3.1 calibration certificate (traceable); optional: UKAS-certificate of calibration

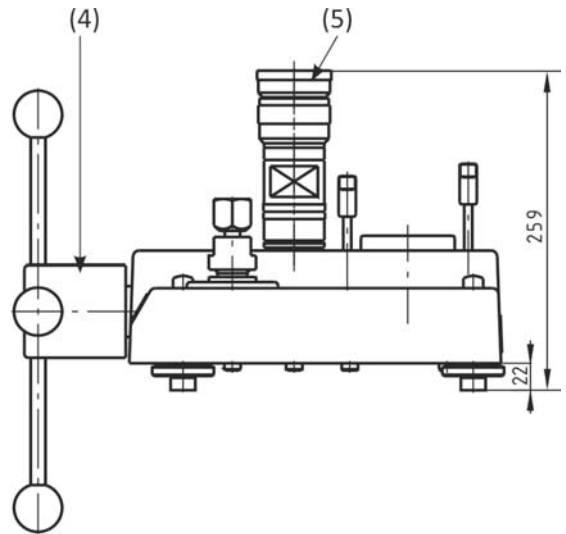
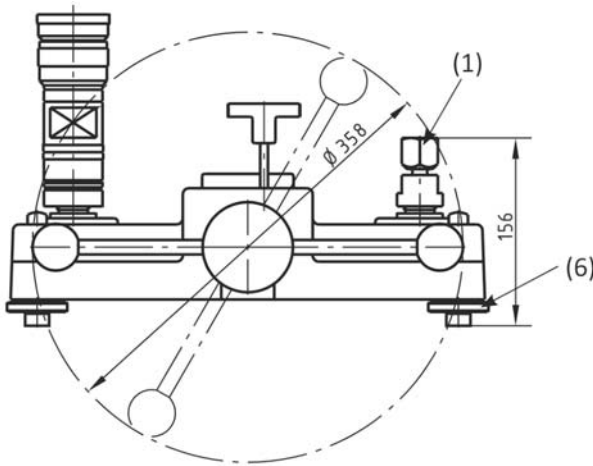
Transport dimensions for complete instrument:

The complete instrument, in its standard version and standard scope of delivery, consists of three packages on a single pallet.
The dimensions are 1,200 x 800 x 500 mm.

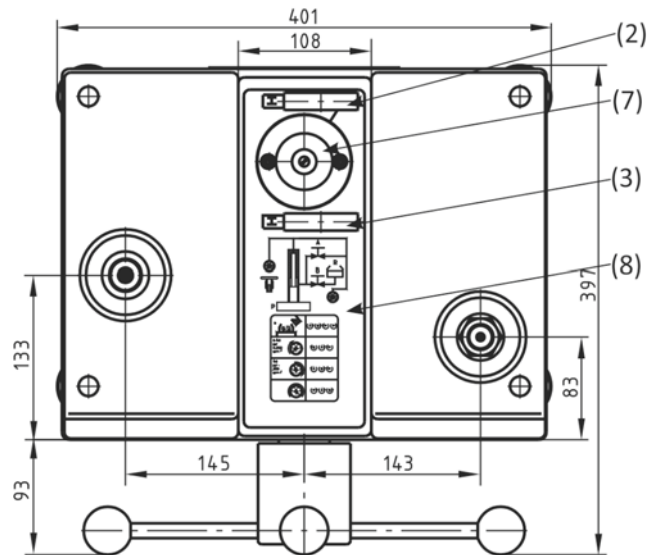
The overall weight is as follows (independent from pressure range):

- „bar“ pressure ranges: net 71 kgs / gross 89 kgs
- „psi“ pressure ranges: net 71 kgs / gross 89 kgs

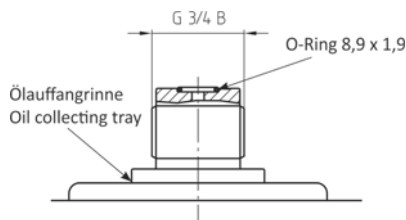
Dimensions in mm (without masses):



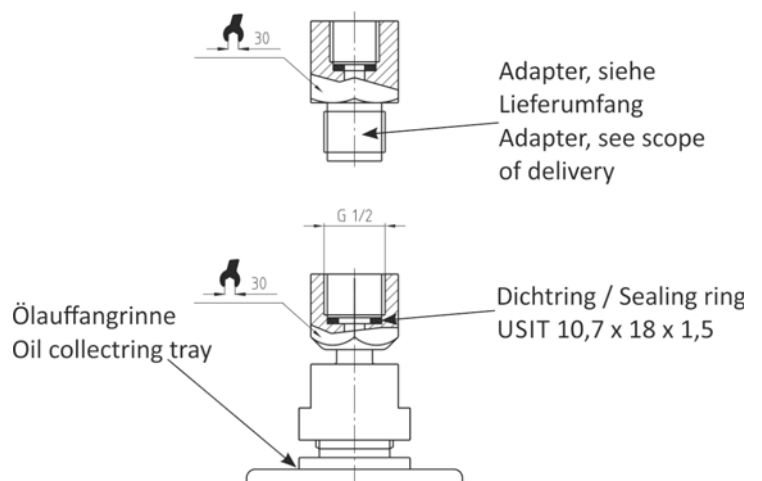
- (1) Test item connection
- (2) High-pressure shut-off valve
- (3) Low-pressure shut-off valve
- (4) Dual-area pump with star handle
- (5) Piston-cylinder system
- (6) Rotatable feet
- (7) Reservoir with scewed sealing plug
- (8) Pressure generation control schematic



Standard connection piston-cylinder system:



Test item connection:



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



Angle connector 90°



Gauge adapter
3/4" BSP female
to 1/2" BSP female

Test connections

With the existing standard test item connection, test items with radial bottom connection can be mounted. For units with axial rear connection, a 90° angle connector is available. With a 3/4" BSP female to 1/2" BSP female, free-running connector, which can be mounted in place of the piston-cylinder system on the piston connector, the **LR-Cal LDW-HK** instrument base can be used as a pressure comparison test pump.

Separators

The separators (with diaphragm) 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
(with diaphragm)
700 bar



Separator
(with diaphragm)
1200 bar

Order-Codes (Accessories):

| Order-Code | Description |
|------------------|--|
| LDW-FMS-F1 | Set of trim masses (1 mg up to 50 g), class F1 |
| LDW-FMS-M1 | Set of trim masses (1 mg up to 50 g), class M1 |
| LDW-HK-KOFFER-MS | Set of 2 carrying cases for set of masses |
| LDW-HK-KOFFER-BM | Storage case for LR-Cal LDW-HK instrument base |
| LDW-ADAPTER-BSP | BSP adapter set for test item connector: 1/2" BSP male to 1/8", 1/4", 3/8" and 1/2" BSP female |
| LDW-ADAPTER-NPT | NPT adapter set for test item connector: 1/2" BSP male to 1/8", 1/4", 3/8" and 1/2" NPT female |
| LDW-ADAPTER-M | Metric adapter set for test item connector: 1/2" BSP male to M12 x 1.5 and M20 x 1.5 female |
| LDW-PAS-G12 | Test item connection, 3/4" BSP female to 1/2" BSP female, loose union |
| CPB5000-WA90 | 90° angle connection, for test items with back mounting connection |
| LDW-TV-M-0700 | Separator (to separate 2 liquid media by a diaphragm), max. 700 bar |
| LDW-TV-M-1200 | Separator (to separate 2 liquid media by a diaphragm), max. 1200 bar |
| LDW-HK-R-SET | Sealing set for LR-Cal LDW-HK instrument base |
| CPB5000-FLUID | Operating fluid 1 l, max. 4000 bar |
| LDW-HK-W-SET | Spare: Tool set consists of open-ended spanner, BSP adapter, replacement seals, pointer removal device and pointer press-on tool |

Further LR-Cal deadweight testers / pressure balances:

Model LR-Cal LDW-P

Pneumatic

Ranges from -0.03...-1 to +0.4...+100 bar
from -0.435...-14 to +5,8...+1500 psi

Accuracy $\pm 0.015\%$ resp. $\pm 0.008\%$ of m.v.



Model LR-Cal LDW-H

Hydraulic

Single piston models

Ranges from 1...120 to 2...300 bar
from 10...1600 to 30...4000 psi

Dual piston models

Ranges from 1...60 / 10...700 bar to
1...60 / 20...1400 bar
from 10...800 / 100...10000 psi to
10...800 / 200...20000 psi

Accuracy $\pm 0.015\%$ resp. $\pm 0.006\%$ of m.v.



Model LR-Cal CPB5000-HP

High pressure, hydraulic

Ranges from 25...2500 to 25...5000 bar
from 350...40.000 to 350...70000 psi

Accuracy $\pm 0.025\%$ resp. $\pm 0.02\%$ of m.v.



Model 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...1000 bar
from 2.9...1000 to 29...14500 psi

Accuracy $\pm 0.015\%$ resp. $\pm 0.008\%$ of m.v.

[m.v. = measured value]



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