

Deadweight Tester / Pressure Balance Pneumatic, Accuracy up to ±0.008% o.r.

LDW-P

Rel. 20160706

Applications:

- Primary standard for defining the pressure scale in a range up to 100 bar, 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 ±0.008% of reading.
- Factory calibration certificate as standard, traceable to National Standards, DKD-/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 DKD/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 10 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. Correspondignly, 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 m/s²) although, for fixed location usage, they can be adjusted to a customerspecified local gravity.

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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. 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.

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, againgst 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.



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 10 bar / 150 psi With integrated pressure generation through inlet pressure pump and spindle pump
- Basement for Vaccum and ranges >= 20 bar up to 100 bar / 1500 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: http://www.lr-cal.net/dwt-corrections.zip



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Set of masses for the LR-Cal LDW-P

The mass set is supplied in a wooden carrying case 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^2) although, for fixed location usage, they can be adjusted to a customer-specified local gravity.

Pressure range	ext	ext. supply integrated pressure genration ext. pressure supply					pply						
pressure unit "bar"	-0	.031	C	0.032	0	.210	0	.450	0.4100				
	Pieces	nom.pressure per piece	Pieces	' nom.pressure , per piece	Pieces	nom.pressure per piece	Pieces	nom.pressure per piece	Pieces	nom.pressure per piece	NO.	TE.	
Distan	1	[bar]	1	[bar]	1	[bar]	1	[bar]	1	[bar]		1 6. 1 - 11 h	
Piston	T	0.03	1	0.03	1	0.2	1	0.4	1	0.4	IT US	sed with	vacuum
Aluminium nlate	-	0.07	1	0.10	1	0.05	1	0.25	1	0.25	pist	on, in ev	/ery case an
Masses 4 kg	-	-	-	-	-	-	-	-	-	-	exte	ernal va	source
Masses 2 kg		-	-	-		-	-	-	5	10	(
Masses 1 kg		-	9	0.2	9	1	9	5	9	5	(e.g	. LK-Cai	LPP 40 or
Masses 0.5 kg	8	0.1	1	0.1	1	0.5	1	2.5	1	2.5	LR-	Cal 2941	.) is needed,
Masses 0.25 kg	1	0.05	-	-	-	-	-	-	-	-	as v	vell as h	asement
Masses 0.2 kg	-	-	1	0.04	1	0.2	1	1	1	1	u 5 v	· · · ·	
Masses 0.12 kg	-	-	1	0.024	1	0.12	1	0.6	1	0.6	ver	sion wite	ch port for
Masses 0.1 kg	2	0.02	1	0.02	1	0.1	1	0.5	1	0.5	exte	ernal pre	essure supply.
Masses 0.07 kg	-	-	1	0.014	1	0.07	1	0.35	1	0.35		•	
Masses 0.05 kg	1	0.01	1	0.01	1	0.05	1	0.25	1	0.25			
Pressure range	ex	t. supply	inte	grated press	ure g	generation	۱	ext	ernal	pressure s	suppl	У	
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Specifications LR-Cal LDW-P

Measuring range	bar 1)	-0,031	0,032	0,210	0,450	0,4100			
Required weights	kg	5	10	10	10	20			
Smallest step	bar 2)	0.01	0.01	0.05	0.25	0.25			
Nominal cross-sectional									
area of the piston	cm²	5	5	1	0.2	0.2			
Measuring range	psi 1)	-0,43514	0,43530	2,9150	5,8500	5,81000	5,81500		
Required weights	kg	5	10	10	7	13	20		
Smallest step	psi 2)	0.1	0.2	1	5	5	5		
Nominal cross-sectional									
area of the piston	cm²	5	5	1	0.2	0.2	0.2		
Accuracy 3)	% MV.	0,015 / optic	onal: 0,008	(% of meas	sured value	e)			
Version		· · ·	·			•			
for ranges up to 10 bar	with integ	rated pressure	generation,	ranges up t	o 10 bar				
for ranges above 10 bar	for externa	al pressure sou	irce, ranges a	above 10 ba	r, and Vacu	um			
Connections / Media									
Connection piston-cylinder unit	M30 x 2 m	ale thread / o	otional: Quic	k-connecto	r				
Pressure port for test item	Quick-fit 1	/2" BSP femal	e rotating, in	serts chang	eable				
Pressure transmission medium	clean dry r	non-corrosive	gases (e.g. ai	r or nitroge	n)				
External pressure port	6 mm SWA	AGELOK ® tube	fitting, max.	. 110% of th	e assigned	measuring			
	range; onl	y for version "	external pres	sure source	" and Vaccu	um –			
Material									
Piston	Tungsten (Carbide							
Cylinder	Tungsten (Carbide							
Weight set (masses)	Stainless s	teel 1.4305 an	d aluminium	, non-magn	etic				
Piping in instrument base	Version "integr. pressure gen.": Polyurethane hose 4 x 0.75 mm								
	Version "fe	or extern. pres	sure source"	: Stainless s	teel 1.4571	L, 3 x 1 mm			
Operating condition		·							
Operating temperature	°C	1828							
Weight									
Base unit		18,0 (19,0 wit	h optional qu	uick-connec	tor)				
Piston-cylinder system	kg	1,5							
		(5,7 incl. bell j	ar and alu.pl	ate, in optio	onal carryin	g case)			
BAR vacuum mass set	kg	13,1 (incl. pist	on-cylinder u	unit in carry	ing case)				
BAR basic mass set	kg	16,2 (incl. car	rying case)						
BAR mass set extension	kg	14,0 (incl. car	rying case)						
PSI vacuum mass set	kg	13,0 (incl. pist	on-cylinder u	unit in carry	ing case)				
PSI basic mass set	kg	12,5 (incl. car	rying case)						
PSI mass set extension 1	kg	11,0 (incl. car	rying case)						
PSI mass set extension 2	kg	18,5 (incl. car	rying case) o	nly for rang	e 1.500 psi				
Dimension									
Base unit	mm	W 400 x D 37	5 x H 265						
Carrying case for									
basic mass set	mm	W 400 x D 31	0 x H 310						
Carrying case for									
mass set extension	mm	W 215 x D 31	D x H 310						
Optional carrying case									
for piston-cylinder unit	mm	W 300 x D 26	5 x H 205						
Certificate									
Calibration	Factory ce	rtificate, trace	able (Option	al: DKD/DAI	<ks certifica<="" td=""><td>tion)</td><td></td></ks>	tion)			

1) Theoretical starting value; corresponds to the pressure value generated by the piston (by its own weight). To optimise the operating characteristics more weights should be loaded.

2) The lowest pressure change value that is reached based on the standard weight set. A fine weight set is also available for lower values.3) The accuracy is in reference to the measurement value, from 10% of the measurement range. A fixed error is considered in the lower

area in reference to 10% of the area.
4) Measurement uncertainty assuming reference conditions (room temperature 20°C, air pressure 1013 mbar, relative humidity 40%). Corrections may be required.



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LDW-P

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 >10 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



Plan view



Ausführung (bis 10 bar) mit integrierter Druckversorgung Ansicht von oben







Connection for the test item



- (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.)

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Scope of supply

- Instrument base with adjustable feet
- Priming pump (only versions max. 10 bar)
- Pressure input for external pressure source (only versions > 10 bar)
- 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 wooden carrying case
- Mass set extension in wooden carrying case (if required for pressure range)
- Mass set manufactured to standard gravity (9.80665 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-H 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



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.



Set of adapters

Options

- •Systems with increased accuracy to 0.008%
- Piston adapter with quick-connect
- Storage suit case for piston-cylinder systems
- Mass set manufactured to local gravity
- DKD/DAkkS calibration certificate



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



Separator (without diaphragm), max. 1000 bar

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
	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 LR-Cal LDW-P 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 ±0.015% or ±0.006% of measured value

Model LR-Cal LDW-HK

Hydraulic (compact design)

Ranges	from 1120 to 101,200 bar	2
	from 101,600 to 10016,000 psi	

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

Model LR-Cal CPB5000-HP

High pressure, hydraulic

Ranges	from 252,500 to 255,000 bar					
	from 35040,000 to 35070,000 psi					

Accuracy ±0.025% or ±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 ±0.015% or ±0.008% of measured value





