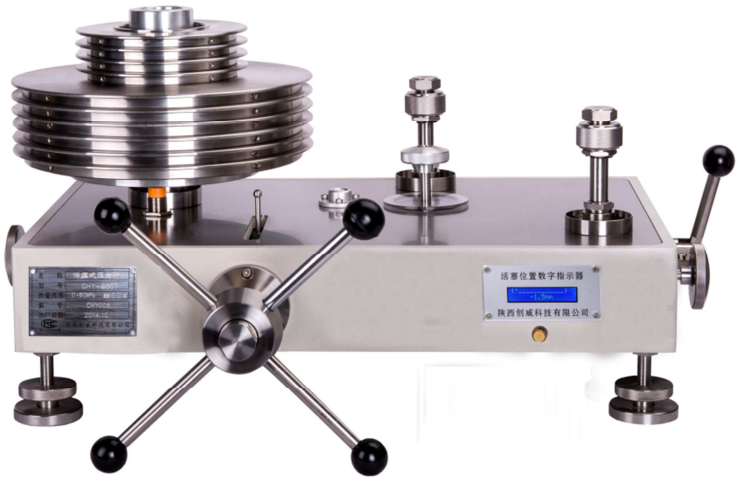
Hydraulic Deadweight Tester

Operating Manual



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Content

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I. Application

The deadweight tester can be used to transmit the pressure value and to measure high-precision instruments.

II. Structural Principle and Features

The deadweight pressure tester (hereinafter referred to as the pressure tester) is based on the working principle of making the force produced by fluid pressure at the lower piston end equivalent to the gravity of weights placed at the upper piston end.

The pressure tester has the following features:

1. Piston system (piston and piston cylinder) is made of tungsten carbide, enjoying low deformation error and additional temperature error, wear-resistant, and keeping the piston system size unchanged for a long time;

2. Equipped with a digital indicator of piston working position, it is convenient to read corresponding values.

if the measurement range is 25MPa or above, the pressure gauge shall use Di (2-ethyl-hexyl) sebacate as the pressure transmitting medium and the viscosity is (20-25) mm^2/s at 20℃, the pressure transmitting medium for domestic general pressure gauge, so the sensitivity is greatly increased; the pressure measurement range is wider and the pressure building system is

precisely machined, easy to use and enjoying reliable seal; the base is made of high-strength aluminum alloy, light, strong and beautiful; and the conduct material is made of 1Cr18Ni9Ti stainless steel tube, rust-resistant, beautiful and reliable.

III. Main Technical Parameters

1. Uncertainty of Measurement

At the ambient temperature of (20±2) ℃ and temperature fluctuation of no more than ±0.5℃, the uncertainty of measurement is as shown in Table 1

Accuracy	Maximum permissible error	
0.005	When the pressure value is below the lower limit of measurement range, it is ±0.005% of lower measurement range.	When the pressure value is within the measurement range, it is ±0.005% of actual measuring pressure.
0.01	When the pressure value is below the lower limit of measurement range, it is ± 0.01% of lower measurement range.	When the pressure value is within the measurement range, it is ± 0.01% of actual measuring pressure.
0.02	When the pressure value is below the lower limit of measurement range, it is ± 0.02% of lower measurement range.	When the pressure value is within the measurement range, it is ± 0.02% of actual measuring pressure.
0.05	When the pressure value is below the lower limit of measurement range, it is ± 0.05% of lower measurement range.	When the pressure value is within the measurement range, it is ± 0.05% of actual measuring pressure.

Table 1

2. Measurement Range and Required Weight and Quantity As shown in Table 2

Type	CW-6T	CW-60T	CW-250T	CW-600T	CW-1000T
Measurement range (MPa)	0.04～0.6	0.1～6	0.5～25	1～60	2～100/1～100
Upper nominal limit (MPa)	0.6	6	25	60	100
Lower nominal limit (MPa)	0.04	0.1	0.5	1	2/1

Upper measurement range (MPa)		0.6	6	25	60	100
Lower measurement range (MPa)		0.04	0.1	0.5	1	2/1
Nominal area of piston (cm2)		1	0.5	0.1	0.05/0.1	0.05
Chassis and piston	Nominal mass (kg)	0.4	0.5	0.5	0.5/1	1/0.5
	Pressure produced (MPa)	0.04	0.1	0.5	1	2/1
Special weight	Nominal mass (kg)	0.1;0.5	0.5;2.5	0.5; 2.5	0.5; 2.5 or 1; 5	0.5;1;2;5
	Pressure produced (MPa)	0.01;0.05	0.1;0.5	0.5 ; 2.5	1 ;5	1;2;4;10
	Quantity (piece)	6;10	4;11	4; 9	4;11	1;2;1;9
Interface thread specification		M20 × 1.5	M20×1.5	M20 × 1.5	M20×1.5	M20×1.5
Total weight, including box (kg)		53	100	80	85 or 115	105
Working medium		The kinematic viscosity of oil mixture of 25# transformer oil and aviation kerosene is 9~12 mm^2/s at 20℃, with the acid value no greater than 0.05mgKOH /g.		The kinematic viscosity of Di (2-ethyl-hexyl) sebacate is 20~25 mm^2/s at 20 ℃, with the acid value no greater than 0.05mgKOH /g.		

Table 2

IV. Mass Calculation Formula of Special Weight, Piston and Its Fittings

When using the piston pressure tester with the measurement limit of 6MPa

or below to measure the pressure value, the mass of special weight, piston and its fittings shall be calculated according to formula (1):

$$m = p \times A' \times \frac{1}{g} \times (1 + \frac{\rho_a}{\rho_m}) \qquad (1)$$

Where:

m - Mass of special weight, piston and its fittings, ***kg****;*

p - Pressure value measured, ***Pa****;*

A' - Effective area of piston pressure gauge to be inspected, $\mathbf{m^2}$;

ρ_a - Ambient air density, its value can be $1.2\,kg/m^3$;

ρ_m - Material density of special weight, piston and its fittings, it can take following value:

ρ carbon steel: 7.8x103kg/m^3 *ρ aluminum: 2.73x103kg/m*^{3}

ρ stainless steel: 7.93x103kg/m^3

ρ tungsten carbide: 14.7x103kg/m^3*;*

g -local gravity acceleration, m/s^2;

When using the piston pressure gauge with the measurement limit of greater than 25MPa (including) to measure the pressure value, the equipped special weights shall be placed according to the sequence number and the mass of special weight, piston and its fittings shall be calculated according to formula (2):

$$m_j = \frac{A_0' p_J}{g}(1 + \frac{\rho_a}{\rho_m})[1 + (2j - 1)\lambda p_j] \qquad (2)$$

m_j - Load the mass of j pieces of weights in order, kg;

p_j - Under the reference temperature and normal acceleration of gravity, the pressure produced after loading j pieces of weights, Pa or (MPa);

A_0' - Effective area of piston pressure gauge to be inspected under zero pressure and reference temperature, m^2;

g - Acceleration of gravity of the using site, m/s^2;

ρ_a - Ambient air density, may take 1.2 kg/m^3 ;

ρ_m - Density of weight material, may take ρ carbon steel: 7.8x103kg/m^3; *ρ carbon steel: 7.8x103kg/m^3; ρ aluminum: 2.73x103kg/m^3 ρ stainless steel: 7.93x103kg/m^3; ρ tungsten carbide: 14.7x103kg/m^3;*

λ - Pressure deformation coefficient of piston and piston cylinder components, Pa^{-1}.

Measurement range (MPa)	λ value
0.5～25	7.42×10^{-13} Pa^{-1}
1～60	0.1 covers an area of 7.42×10-13 Pa-1, and 0.05 covers an area of 7.19×10-13 Pa-1
2～100	7.19×10^{-13} Pa^{-1}
2～160	7.19×10^{-13} Pa^{-1}
5～250	7.09×10^{-13} Pa^{-1}
The deformation error of pressure testers below 25MPa (excluding 25 MPa) can be ignored.	

V. Notice of Use

1. The pressure gauge shall be placed in a strong and vibration-free platform, and the level vial is fixed at the center of pressure gauge with four

leveling nuts.

2. Operating ambient temperature should be at 20±2℃, with the fluctuation of no more than ±0.5℃.

3. For pressure gauges with the pressure transmitting medium of 25MPa, they shall use the oil mixture of 25# transformer oil and aviation kerosene, with the viscosity of (9-12) mm^2/s at 20℃; for those with the pressure transmitting medium greater than 25MPa (including), they shall use Di sebacate, with the viscosity of (20-25) mm^2/s at 20℃. The pressure transmission medium should keep clean and replace regularly.

4. Pay attention to load or unload weights, and try to avoid collide the weight hoist; otherwise, the piston rod will be damaged.

5. The piston should be rotated with two hands to exert force evenly, so as not to damage the piston rod.

6. Before increasing pressure, rotate the piston.

7. The measurement datum line of pressure gauge (lower piston end) shall be on the same level with the measured instrument.

If not and there is a large difference, conduct measuring value correcting (if the measured instrument is a dead weight tester and use the method of initial balance for measurement, this problem can be ignored).

8. Regular instrument calibration according to the relevant regulations.

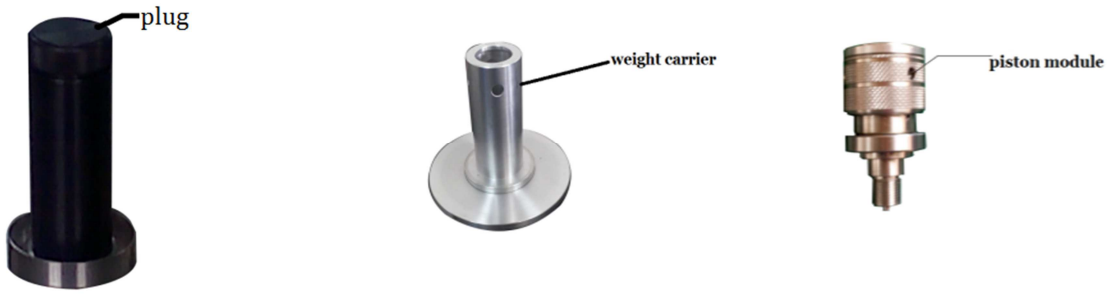
VI. Operation Steps

Tips: Open the valve - rotate the handle counterclockwise

Close the valve - rotate the handle clockwise

1. Installation of Piston System

Tips:1) For piston systems of 25MPa and above, loose the plug, screw in piston module and add a hoist (refer to Figure 1). Pay attention to check that the o-ring at the measurement base shall be centered before installation.



25 MPa /60MPa/100 MPa

Figure 1

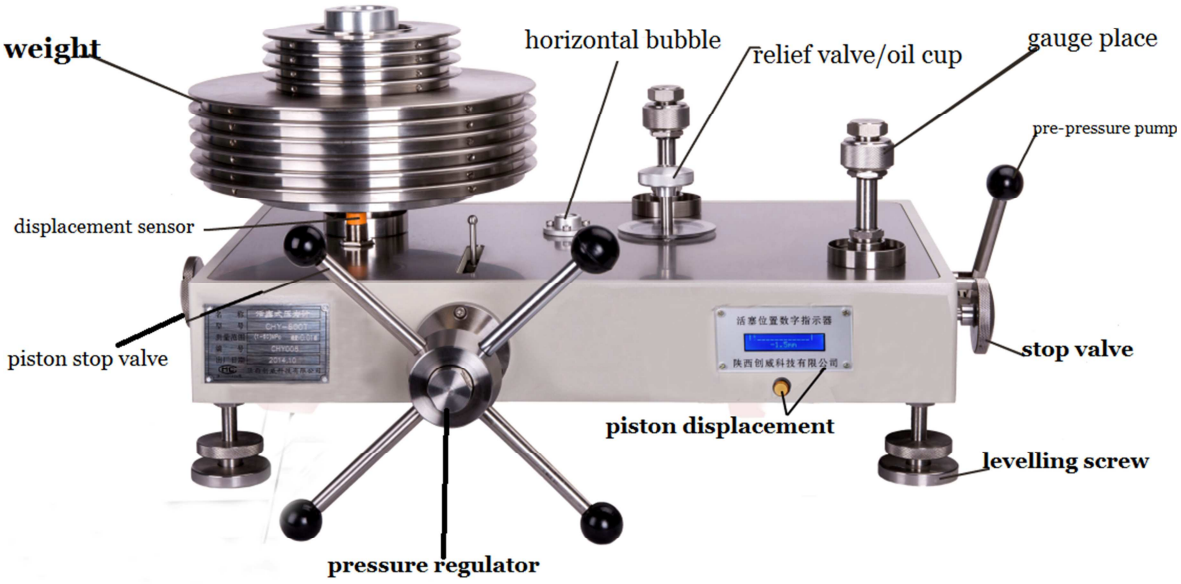
（2）Pour clean medium to oil cup

2. Calibration of Piston Displacement

Make a long press of the displacement calibration button and release when there is "1L" on the LCD display; place the piston at the lowest position and press the button when the digit is stable on the display; when there is "1H" on the LCD display, place the piston at the highest position and press the

button when the digit is stable on the display. Thus the calibration of piston displacement is finished.

3. Measurement (take 60MPa as an example)



25MPa/60MPa/100MPa

a. Open the pressure relief valve and stop valve, exhaust the air inside the cavity with preloading pump and then close the pressure relief valve.

b. Unload the plug at the quick coupling, close the pressure relief valve and pressurize with preloading pump, exhaust the air inside the gauge connecting stand, and connect the pressure tester with the measured instrument.

c. Pressurize with preloading pump; when there is pressure inside the cavity, continue to increase pressure and keep rotating the pressure regulator counterclockwise, and then close the stop valve on the right.

d. Load weights equivalent to the pressure measured on the pressure tester,

and rotate the piston with both hands at a speed about (30-60) r/min; increase the pressure with pressure regulator to lift the piston. When the position indicator approximate value is close to "0.0mm", it will start reading (For measuring the piston area, keep the two pistons at the working position and in balance, then it will start reading).

e. After the first reading, reduce the pressure with pressure regulator to drop the piston to the lowest position; load weights equivalent to the second measurement point on the pressure tester, increase pressure with pressure regulator and read until the positive stroke measurement finishes.

f. During reversal stroke measurement, the pressure regulator is still required to reduce the pressure. Avoid using the pressure relief valve to reduce pressure during operation, especially in high pressure measurement, which may break the piston and damage the pressure tester.

g. After measurement, open the pressure relief valve, stop valve and turn pressure regulator in, close the pressure relief valve, remove the measured instrument and place the plug at the quick coupling.

VII. Common Problems and Solutions

Problem	Cause	Troubleshooting
The pressure gauge is difficult to build pressure	① The stop valve is closed.	Open the stop valve.
	② The pressure relief valve is not closed.	Close the pressure relief valve.
	③ There is no O-ring in the gauge stand.	Install an O-ring.

	④ The calibrated instrument is not tightened.	Tighten the calibrated pressure gauge (the unused gauge connection can be tightened with the plug attached).
	⑤ The medium is too little inside the oil cup.	Add corresponding medium to maintain the volume at 2/3 of the oil cup.
The pressure of pressure gauge is instable	① There is air inside the piping system.	Open all valves, increase pressure with preloading pump until no bubbles overflow from the oil cup.
	② The gauge connecting port leaks oil and the O-ring is worn.	Replace the O-ring equipped with the instrument and tighten the calibrated pressure gauge.
	③ The O-ring under the piston cylinder is not in the groove center.	Remove the piston cylinder with special tool, place the O-ring in the cavity center and install the cylinder.
	④ The pressure gauge is leaking.	Pressurize to the full range for 15-20 min, observe the leakage point, find out the reason and contact us.
The pressure gauge leaks oil	① The O-ring at the gauge connecting port is worn.	Replace the O-ring equipped with the instrument.
	② The hexagonal nut at the valve needle is loose.	Rotate the valve needle for 3-4 rounds counterclockwise and tighten the hexagonal nut with a wrench properly.
	③ The hexagonal gland nut at the pipe joint is loose.	Tighten the gland nut with 12" open spanner.
The piston displacement display is not accurate.	The calibration button is not calibrated.	Calibrate according to step 2 of Section 6 of instruction manual.

VIII. Accessory List

Main machine	**1 set**
Special weight	**1 set (refer to the calibration certificate or factory test record for details)**
Measurement system	**1 set (inside the small aluminum alloy box)**
O-ring	**Outside diameter 12X2.5, 10 pcs in total (for gauge connecting stand and piston cylinder); Outside diameter 9X1.9, 5 pcs in total (for outlet plug and test tube).**

Instruction Manual	**1 copy**
Certificate of approval	**1 copy**
Calibration certificate/factory test record	**1 copy**
Power adaptor	**1**
Digital terminal (chassis)	**1 set (order separately)**
Serial port line	**1 (order separately)**
Power adaptor	**1 (order separately)**
Test lead	**1 set (order separately)**

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