

Full automatic pressure standard Model CPB8000



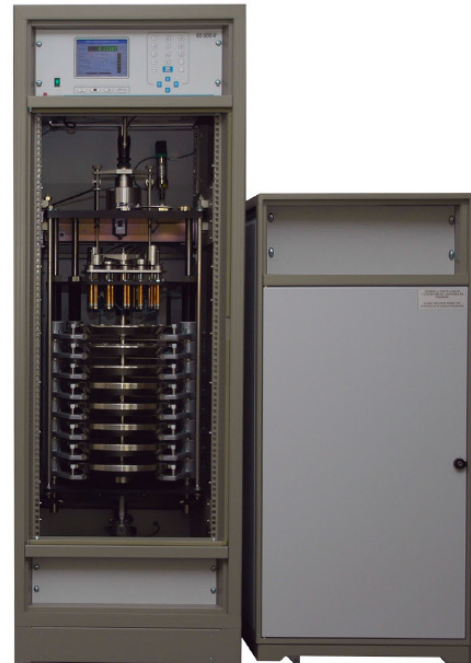
Desgranges & Huot WIKA Data Sheet CPB8000 04/2012

Applications

- Combining automation with high level primary pressure standard
- A powerful solution to test & calibrate high specifications sensors
- Automatic calibration & verification of pressure instruments
- Large volume calibrations

Special Features

- Accuracy down to 20 ppm of the reading
- Available up to 1000 bar pneumatic and 5000 bar hydraulic.
- Automatic 100 kg mass loading system with resolution down to 0.1 g
- Automatic pressure generation



Model CPB8000 automatic pressure balance

Description

Fundamental primary standards

The CPB8000 automatic pressure balance is **high accuracy** fundamental pressure standard that define the derived unit of pressure directly from the fundamental units of mass, length and time following the formula :

$$P = F / A$$

The direct measurement of the pressure with an automatic balance; combined to the know-how of Desgranges & Huot guarantees **the best metrological specifications on the market**: high quality piston/cylinder units (high floating time, long term stability), protection and smooth handling of the mass set.

Large volume calibration

CPB8000 has been designed to provide the best available metrological specifications but also to reply to industry expectations. Providing a high MTBF, the CPB8000 pressure generation system can also generate and regulate with large volume under test.

Automation & Metrology

The servo controlled variable volume pressure generator combined to the built-in optical detection used to measure the piston position offer fine and reliable pressure regulation. The mass set protected in a cabinet is handled carefully providing the highest stability. Finally the pressure is automatically fully corrected taking in account all ambient parameters.

Our models

CPB8000 is available in 4 versions: pneumatic / hydraulic pressure, with/without the trim mass set handling system (down to 10 mg). A large range of piston cylinder assemblies is available to best meet your specific requirements.

AUTOMATIC PRESSURE STANDARD AND GENERATION SYSTEM



The complete CPB8000 pressure standard consists of four inter-connected systems mounted into two separate standard rack enclosures.

The Electronic Interface (1)

The PC based Electronic module is used to control mass loading, piston position, pressure generation and displays current system status.

The Pressure Standard (2)

It consists of the mass set, mounting post for the Piston & Cylinder and the interchangeable Tungsten carbide Piston & Cylinder assembly. Hydraulic operation requires the model CPB8000-HX and for gas model CPB8000-PX is used.

The Pneumatic Module (3)

It contains several solenoids which operate the pneumatic cylinders to control the loading of the masses.

Pressure Generation System (4)

The automatic system uses a servo controlled variable volume. As an option a pre-filling system is available, this allows the standard to work with larger volumes. A manual system is available as an alternative.

THE ELECTRONIC CONTROL SYSTEM

The CPB8000 pressure standard can be controlled and monitored in two ways:

- By using the in-built electronic control module and his keypad.
- By using External computer and software via IEEE488 (SCPI protocol)

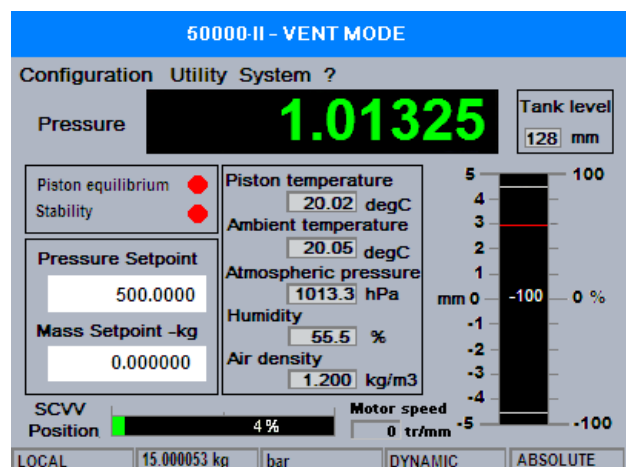
The computer driven controller carries out all monitoring, control functions and does all metrological corrections for factors of influence, the pressure displayed is therefore the true pressure.

The unit consists of an internal computer, a TFT screen with a wide viewing angle and a 23 key keypad. It controls the generation of pressure and the loading of masses. The user can input the target pressure, the computer will then determine the value of masses required taking into account all factors of influence or alternatively the user can input directly the value of mass to be loaded. The system can operate in one of 10 standard pressure units or a user defined unit.

The system includes an EMM (Environmental Monitoring Module) which has sensors for ambient temperature, humidity and air pressure which are used to determine the air density and carry out corrections for air buoyancy effects. The temperature of the piston & cylinder assembly is also measured and appropriate corrections completed.

The TFT screen displays all critical parameters, including: True Pressure, Piston Equilibrium Status, Piston Stability Zone, Pressure Set Point, Mass Set Point, Calculated True Mass, and Pressure Unit in use plus graphical display of Variable Volume Position and most importantly Piston Position.

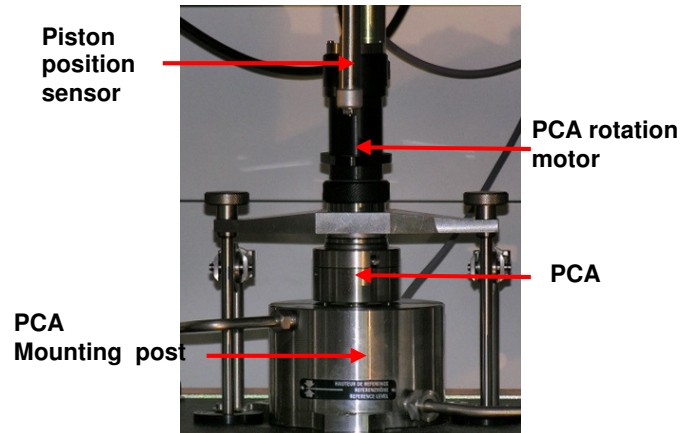
The unit can operate in absolute pressure mode with the addition of an optional DPM Barometric sensor connected to an RS232 port, this provides high accuracy absolute pressure measurement at pressures above ambient.



THE PISTON CYLINDER, HEART OF THE SYSTEM

All Type CPB8000 piston-cylinders and masses are built around a nominal mass to pressure conversion coefficient, **Kn**. The nominal effective area of each piston-cylinder size is such that, under standard conditions, the piston loaded with 1 kg of mass floats at a whole number pressure value such as 100 psi or 2 MPa. All mass values, including the mass of the piston are adjusted to be a whole number or fraction of the kilogram. The nominal pressure defined by any Type CPB8000 standard is calculated as $Kn \times$ the mass loaded in kg. Corrections are applied to Kn to calculate the pressure defined within the accuracy tolerance of the Type CPB8000 standard used. The **PCA (Piston / Cylinder Assembly)** is the heart of the pressure balance. These are manufactured in tungsten carbide and are honed and lapped to provide critical geometry better than 0.1 μm . There is 13 sizes of PCA available to cover range from 0.2 MPa to 500 MPa. Depending of the diameter of the piston, they are mounted in four types of mounting post.

PCAs are interchangeable within the same type of mounting post and can be exchanged very easily in less than one minute. The mounting post also holds the RTD temperature probe.



THE MASS LOADING MECHANISM AND THE MASS SET

The mass set of the CPB8000 HR for high resolution is unique in the world. Made in AISI316 austenitic, non magnetic stainless steel, it is composed of several masses multiple or sub-multiple of the kilogramme and in binary progression. The smallest one is **0.1 g** and the bigger one is **16384 g**. This unique design allows the machine to load any mass value between 2 kg (the starting point of the machine) and 100 kg by step of 0.1 g, this give a mechanical resolution of **1 ppm**. A special option is also available with smallest mass down to 0.01 g and achieves a resolution of **0.1 ppm** !

The mass set of the CPB8000 LR, low resolution is a simplified version with a resolution of 1 kg only.

Each mass is loaded / unloaded onto the piston with an individual actuator. The complete sequence to load or unload a mass value is done within 10 seconds. Each mass is calibrated and adjusted with a tolerance down to 10 ppm of his nominal value and all values are stored in the electronic rack for the calculation. The main masses (from 2048 g up to 16384 g) are loaded / unloaded with three arms linked to a pneumatic actuator. All movement are user adjustable.

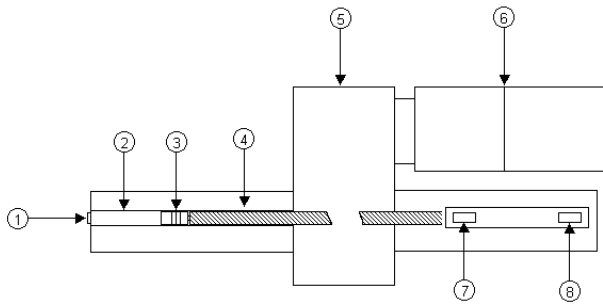


The small masses (from 0.1 g to 1024 g) are directly loaded / unloaded with a small actuator. The masses from 16 g up to 1024 g are composed of 2 masses of half weight (i.e. 32 g=2 masses of 16 g) and they are physically in opposed position to keep a good centring of the piston and not apply lateral perturbation force.

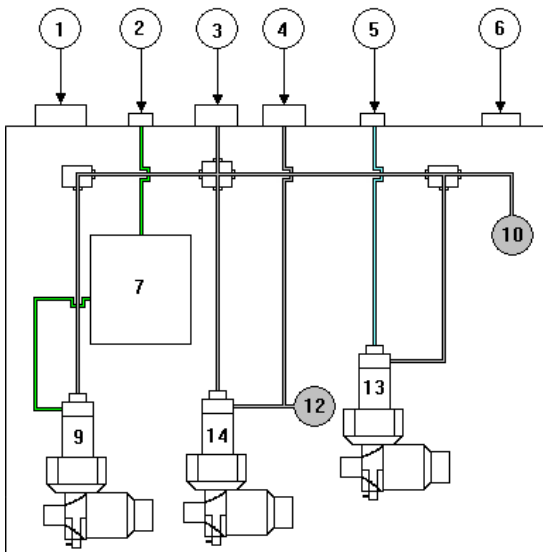
PRESSURE GENERATOR

HYDRAULIC

The pressure generator is constituted by a servo controlled variable volume. A piston (3) move in a chamber to compress the fluid. It is controlled by a brushless motor (6) and his linked to the position of the measuring piston cylinder.



The priming is done by applying the drive air in the oil reservoir or by using a priming rack which enclosed an hydro pneumatic pump and several valves.



This priming rack allows also performing several complete stroke of the variable volume. If the variable volume arrive at the end of his stroke, the circuit under test is then isolated and the variable volume recharged. This feature is useful when the volume under test is large. It is totally managed by the electronic interface of the mass loading rack.

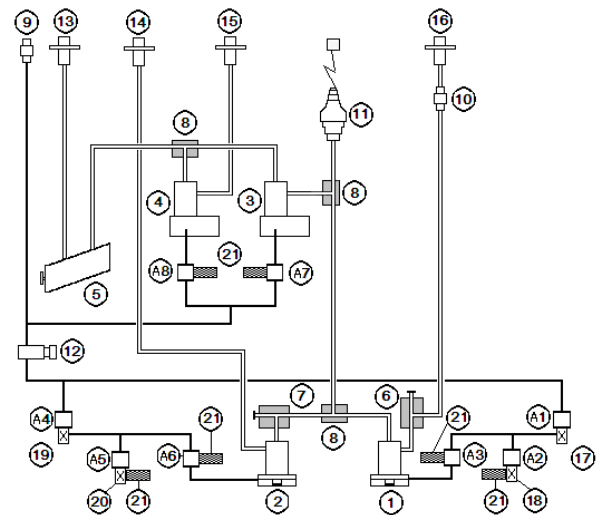
This pressure generator has been developed keeping in mind an easy accessibility by the user if maintenance is required. All sub assembly can be accessed in front by simply opening a door.

PNEUMATIC

The pneumatic gas pressure generator is in fact a pressure controller. It requires an external gas or air pressure source such has a nitrogen cylinder or nitrogen cylinder + gas booster depending of the pressure range. The pressure source must be at least equal to the maximum pressure needed

99 % of the generation is done by using a pressure controller which enclosed several dome valves as well as classical valve.

This pressure controller is fully managed by the software of the CPB8000. Several versions are available up to 1000 bar.



The end of the generation is done by using the same servo controlled variable volume as the hydraulic version.

This controller can work with nitrogen or clean and dry compressed air correctly filtered (0.1 micron recommended).

A special version of this controller is also available with oxygen compatibility.

Specifications CPB8000

Dimension (mm) :	600 x 600 x 1800 (Mass loading rack)	550 x 1250 x 1000 (Pressure generator)
Weight (in kg) :	200 kg (Mass loading rack)	170 kg (Pressure generator)
Drive air supply :	8 to 10 bar	
Power supply :	240 Vac 50-60 Hz (For country using 110 Vac, a power transformer is required)	
Computer connection :	GPIB (SCPI protocol)	
Ranges :	Up to 1000 bar pneumatic CPB8000-PX	Up to 5000 bar in hydraulic CPB8000-HX
Mass set :	100 kg in binary progression. Resolution 1 kg for LR version, 10 mg for HR version	
Material :	AISI316 austenitic, non magnetic stainless steel	
PCA material :	Tungsten Carbide	

Pressure transmission medium		Lubrication medium
CPB8000-PX	Clean and dry air or nitrogen	Drosera™ oil or Krytox™ when oxygen compatibility required
CPB8000-HX	Sebacate	Sebacate

Accuracy

All Desgranges & Huot equipments are delivered with calibration certificate issued by our Cofrac accredited Laboratory.

Accuracy is the result of $\sqrt{(\text{Repeatability}^2 + \text{Resolution}^2 + \text{Linearity}^2 + \text{Hysteresis}^2)}$ and are expressed in % of reading

Typical accuracy of reading (in 1.0E-6 x P (ppm))	PCU KN	Usable Medium
10	0.1 MPa/kg – 1 bar/kg	Gas lubricated / Oil
10	20 psi/kg	Gas lubricated / Oil
10 / 5	0.2 MPa/kg – 2 bar/kg	Gas lubricated / Oil
10 / 5	50 psi/kg	Gas lubricated / Oil
5	0.5 MPa/kg – 5 bar/kg	Gas lubricated / Oil
5	100 psi/kg	Gas lubricated / Oil
10 / 5	1 MPa/kg – 10 bar/kg	Gas lubricated / Oil
10 / 5	200 psi/kg	Gas lubricated / Oil
10	250 psi/kg	Oil only
10	2 MPa/kg – 20 bar/kg	Oil only
10	300 psi/kg	Oil only
15	500 psi/kg	Oil only
15	5 MPa/kg – 50 bar/kg	Oil only



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