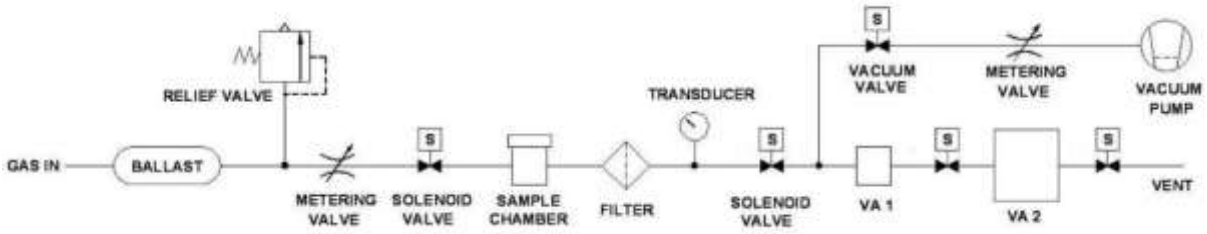
PASCONEXT

Pycnometer

General specifications of pycnometer

A pycnometer or densitometer is a device that measures the density of solids, including metal powders through measuring gas pressure using the first law of Thermodynamics and Archimedes' principle. This device uses helium gas, because helium gas is capable of penetrating the smallest pores between the powder particles, and this in turn increases the device precision. Besides, given that helium is a perfect gas, the laws governing behaviors of perfect gas simplifies the working equations of the device. Thus, using this device, the density of any powders, sponge material and other solids can be measured.



The figure above shows work process and components of the pneumatic circuit of the device. Helium gas enters the chamber containing the sample (V_c) and leaves out of the tank from the other side. Next to the main chamber, the device has an auxiliary chamber to create a pressure drop. Following the placement of the sample in the main chamber and tightening the chamber lid, first to increase the accuracy of the results, all chambers must be cleaned of any impurities and trapped air. To do this, solenoid valves 1 to 4 are opened for one minute and helium gas enters from the tank and exits through the other parts. Thus, the helium gas will be the only gas in the system. This is called purification.

After the purification, and to start the density measurement process, solenoids 2 to 4 are closed and solenoid 1 is opened to allow gas to enter the chamber and leave the pressure of the chamber to reach the desired pressure (target pressure). Immediately after reaching the target pressure (here, 19 psi) solenoid one is also

closed. Having stabilized the chamber pressure, the pressure is read and recorded by the barometer(P_A). Then solenoids 2 and 3 are opened to enter the volume of auxiliary chambers (V_A) into the circuit. Therefore, the system pressure decreases to the P_B pressure. After recording this pressure, the solenoid 4 also opens to start the gas discharge operation. Then, the sample density is accurately declared by four decimal digits using the relationships between pressure and volume for perfect gas. This cycle is repeated for each experiment. For more accurate results, the device conducts the experiment up to three times and records the mean number as the final result.

pycnometer device consists of six main parts, including:

• The body of the device

• Chamber

• (HMI) display

• Printer

• Instrumentation

• Electrical panel

Valves

Safety valve : The safety valve is located immediately after the tank and does not allow the pressure to rise above 25 psi. Usually the gas tank pressure regulator is set slightly higher than the target pressure. Here the target pressure is 19 psi and the pressure regulator is set to 22 psi. But if for any reason the input pressure of the set exceeds 25psi, the safety valve directs the gas out of the circuit.

Solenoid valves : These valves have been used to cut off or connect the gas flow in different parts of the circuit.

Flow control valve : A needle flow control valve controls the amount of flow entering the main chamber. This valve should set so that the set pressure to reach the pressure target in one minute.

Vacuum pump

If necessary, a vacuum pump can be used in the system for purification.

Calibration

After installing the device, the device needs to be calibrated and store the exact numbers V_C and V_A in its memory. The device should be calibrated periodically to get more accurate results

Component	No.	Model
Electric valve	3	Festo
Display	1	Seimens
Transmitter	1	Sensys
plc	1	Seimens
needle valve	2	S-Loc

Advantages of using this pycnometer

• Simple and convenient operation for operator

• Save time due to the high test speed of the device

• No need for a pneumatic device such as an air compressor

• Very simple calibration with minimum time

• High accuracy per test

• Calibration certificate for device performance from reputable authorities