Gasometer 1000ml

40461.00

Operating Instructions

1 PURPOSE AND CHARACTERISTIC PROPERTIES

The gasometer is used for measuring and storing gas volumes up to 1000 ml.
In contrast to the well-known “Müller Bell” in which only gases saturated by water vapour can be stored due to the bell being closed off with water, with this device it is possible to measure and store gases in the dry state, achieving substantially higher accuracy when working quantitatively with gases.
Owing to its large storage capacity, its complete sealing and the large, clearly marked scale, the device has special advantages when used in demonstration experiments, often replacing the previously used gas syringe.
Using the elastic scale it is possible to calibrate this device for direct measurement of standard volumes. Here, when conducting quantitative experiments with gases, there is no need for the continual conversion of given or required gas quantities to standard volumes. The device is fitted with two oppositely located scales, so that the stored gas volume can be read from two sides.
The device is not suitable for the storage of corrosive gases such as chlorine or hydrogen chloride, because these would corrode the metal parts.

2. DESCRIPTION

A glass cylinder is located vertically on a base-plate. It is 395mm high and has an outside diameter of 75mm. A ring marking on the cylinder exactly marks a level of 1000 ml.
A channel, which leads from a tube nipple to the interior of the cylinder, acts as the inlet and outlet channel.
A flat, movable piston with a piston rod, which passes centrally through the cover of the glass cylinder, is located in the cylinder.
A plate at the upper end of the piston rod can be used if necessary to accommodate weights to increase the pressure when emptying the gasometer. Commercial weights of 200 g and 500 g can be placed on the plate.
Further details about the piston can be found in Section 3.
Two elastic strip scales are stretched between the base-plate and the cover of the device. In the base position these strip scales are set such that their 1000ml markings (10 x 100 ml) exactly cover the ring marks on the cylinder; the divisions on the scale then correspond to a volume of 10ml. The edge of the lower piston disc is used as the reading mark on the piston.

3 SETTING THE OPTIMUM PISTON SEALING

The glass tubes used for the gasometers exhibit slight production tolerances in the internal diameter. For this reason the piston is fitted with an adjustable seal: The piston consists of two metal discs and the distance between them can be changed using a knurled screw (above, on the piston rod). The silicon-rubber sealing ring positioned between the two discs can be pressed outwards to a variable extent, matching it to the internal diameter of the glass cylinder.
The procedure below is followed during adjustment:

1. The piston is pushed down to the bottom of the gasometer.

2. The sealing ring is pressed out so far by turning the knurled nut until its edge just meets the inside cylinder wall on all its circumference.

3. Now a few drops of high quality, clean lubricating oil (multi-range oils for car engines are very suitable) are placed on the inside wall of the gasometer by holding it at an angle and inserting a pipette through the air hole in the cover. The oil drops are allowed for run down to the sealing ring.

4. When the drops reach the piston sealing ring, the oil is distributed over the complete sealing edge by rotating the piston on the piston rod.

5. The gasometer is then placed upright and the piston pulled up slowly to the 1000 ml mark so that the oil forms a thin layer over the internal wall of the cylinder.

6. The piston is now pushed slowly into the cylinder again and a check is made of whether the sealing edge keeps in contact with the cylinder wall at each point. If a region is found where this is not the case, the knurled nut is tightened by turning it slowly until the sealing edge contacts the cylinder wall over all this region.

7. Once the piston has been set, it is pushed up and down a number of times and then the tube nipple is held closed with the thumb and a mass of 500 g (commercial weight) is placed on the plate on the upper end of the piston rod. Small amounts of air, about 50 ml, can be vented off by briefly releasing the nipple opening.
   With a piston that is correctly adjusted, the piston movement over the whole range of the gasometer should stop immediately when the nipple is blocked again with the thumb. This can be easily checked using the scale graduations. If necessary, the knurled screw can be readjusted to give better sealing at places where the piston drops slowly despite the nipple being blocked.

8. Measurement of the gas pressure required for filling the gasometer: A U-tube manometer (e.g. Manometer 03090.00), half filled with water, is connected via a T-piece to the gasometer. The weight plate should be unloaded at this point.
   Air is then slowly forced into the apparatus through a tube which is also connected to the T-piece (e.g. blow air in using the mouth). The filling pressure required is read off the manometer. During the complete filling of the gasometer the pressure varies slightly. However, it should not where possible be above 20 mbar (= 20 cm water gauge). If it increases above this level, then the piston lubrication should be improved or the pressure of the sealing ring reduced slightly. The gasometer adjustment should be such that the gasometer can be filled with the a gauge pressure that is as <u>low as possible</u> – with complete sealing.

4 SCALE CALIBRATION

The device is fitted with two elastic scales, each of which are linearly subdivided by 100 graduations. To calibrate a scale, the two relevant knurled screws on the cover are loosened while holding the upper end of the strip scale. The length of the scale can now be varied by altering the tension. Once the required scale length has been obtained (cf. 4.1 and 4.2), the strip scale is fixed by tightening both knurled screws.

Important

Over-extension of the strip scales should be avoided. The strips can be stretched properly as described until graduation 8 (corresponding to 800 ml) matches the ring mark on the glass cylinder (cf. Section 4.2). After terminating this type of measurement, the scale should not be left for an unnecessarily long period of time in the stretched state, but should instead be returned to its original state (according to Section 4.1).

4.1 Calibration for the measurement of the actual volume of the enclosed quantity of gas

The scale length is set such that graduation 10 matches the ring mark on the glass cylinder corresponding to 1000 ml. The gasometer scale is then calibrated for the measurement of the real volume of the enclosed quantity of gas.

4.2 Calibration for the direct measurement of the standard volume of the enclosed quantity of gas

The standard volume of a quantity of gas is the volume occupied by the gas quantity at 0°C and a pressure of 1013mbar. When working quantitatively with gases, it is necessary to convert the gas volume V_T used or obtained in certain reactions from the prevailing conditions (temperature T, pressure p_T) to normal conditions (T_0 = 273 K, p_0 = 1013 mbar). The standard volume V_0 is given by the general gas equation:

$$V_0 = \frac{p_T \; V_T}{T} \cdot \frac{T_0}{p_0}$$

This conversion is unnecessary when using the Gasometer 40461.00 if the elastic scale is set such that the standard volume of the stored gas quantity is indicated instead of the actual volume. Calibration is made in two steps. In the first step the standard volume V_0 of a quantity of gas is calculated which would occupy a volume of V_T = 1000 ml, filling the gasometer to the ring mark:

$$V_0 = \frac{p_T}{T} \cdot \frac{1000 \cdot 273}{1013} \cdot \frac{\text{ml} \cdot \text{K}}{\text{mbar}}$$

In the second step the two elastic scales are adjusted such that the 1000 ml calibration mark on the cylinder is covered by the scale value of V_0. Prepared in this way, the gasometer is calibrated for direct reading of the standard volume for the enclosed quantity of gas.

Example

Taking the temperature in the working space as 21 °C, the absolute temperature is T = 294K. The air pressure would be 990mbar. Then a gas quantity occupying a volume of 1000ml under these conditions would have a standard volume of

$$V_0 = \frac{990}{294} \cdot \frac{1000 \cdot 273}{1013} \text{ ml} = 907 \text{ ml}$$

The scale is now adjusted such that the scale value “907ml” matches the ring mark on the glass cylinder (cf. Section 2). Now, providing the ambient temperature and pressure do not change, the standard volume of the enclosed quantity of gas can be read off directly.

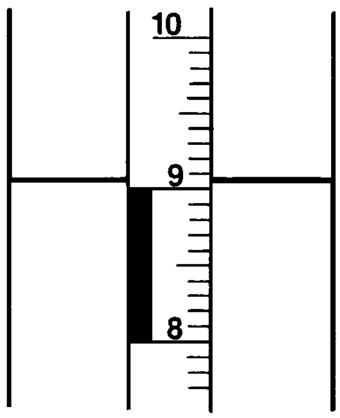

Fig. 2

5. NOTES ON THE CARE OF THE GASOMETER

The gasometer needs almost no maintenance. Once properly adjusted, it will remain ready for use over a long period. However, each time before use the piston should be moved up and down 2 or 3 times to completely redistribute the oil on the internal wall.

If the lubrication is no longer sufficient due to dust or other contamination, then the gasometer can be rinsed with a little petrol and then readjusted in the described manner.