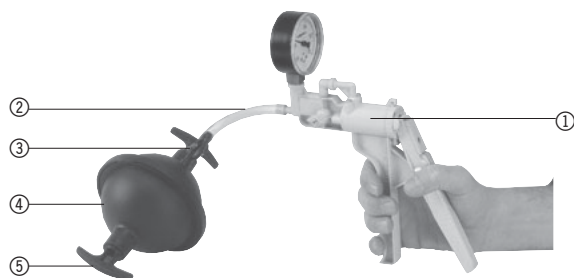


U30010 Magdeburg Hemispheres

Instruction Sheet

7/03 ALF



- ① Vacuum hand-operated pump
- ② Hose
- ③ Stopcock or ventilation valve with hose nipple
- ④ Hemisphere
- ⑤ Handle

The Magdeburg hemispheres are used to demonstrate the effect of atmospheric pressure (historical experiment according to Otto von Guericke).

1. Safety instructions

- Do not try to pry the two evacuated hemispheres apart using tools.
- Do not try to separate the hemispheres using ropes or similar, because when they do separate they can turn into projectiles.
- When ventilating the hemispheres hold on tight to the apparatus so that you can avoid any damage from the hemispheres falling.
- Ample space should be left behind the persons trying to separate the Magdeburg plates.

2. Description, technical data

Two plastic hemispheres with handles and inlaid rubber sealing rings can be joined vacuum tight. One hemisphere is equipped with stopcock or ventilating valve and hose connection. A short hose completes the apparatus.

Vacuum connection:	8 mm
Diameter:	120 mm
Hose length:	110 mm

3. Operating principle

A protective mantle of air called the atmosphere surrounds the earth. The air molecules like all other materi-

als are subject to the force of gravity and thus become concentrated at the earth's surface. The atmospheric pressure, which is exerted by the air mass, is highest at sea level and gradually decreases with increasing distance from the earth's surface. Air pressure like any liquid exerts equal and constant pressure on all sides of an object. In an open object equilibrium always prevails between internal and external pressure. If the internal pressure drops more than the external pressure, the state of equilibrium is reestablished by letting air in. Conversely, if the internal pressure becomes greater than the prevailing external pressure, there is the same tendency to escape. In an enclosed object the force resulting from the difference between the internal and external pressures affects the object's surface either causing it to compress or in the latter case causing the object to explode.

The physicist and mayor of Magdeburg Otto von Guericke was the first to demonstrate the effect of atmospheric pressure. His vacuum experiments commenced around 1650 and reached their zenith in 1654 in a spectacular experiment attended by Kaiser Ferdinand III in the town of Regensburg: the famous Magdeburg hemispheres. To do this von Guericke evacuated the air out of two copper hemispheres of 42 cm diameter and sealed with an oil and wax saturated leather lining. The air pressed the hemispheres together with such force that even 16 horses were unable to pull them apart.

4. Operation

- Before starting the experiment check ensure that the rubber seal ring is correctly situated and that it is undamaged.

- Connect the hemisphere with stopcock to a pump and open the valve.
- Place the second hemisphere on the first one and press the two of together.
- A second person starts the evacuation process.
- After a short time (depending on the pump's pumping power) stop the pump, close the stopcock and loosen the hose connection.
- Demonstrate the effect of atmospheric pressure by

trying to pull the hemispheres apart.

- After completing the experiment ventilate the sphere by opening the valve. Make sure you hold on to the hemispheres to avoid any damage from them falling down.

Additionally required:

1 Vacuum pump (e.g. vacuum hand-operated pump U20500)