

Vacuum Encyclopedia Article

Vacuum

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Vacuum

Vacuum is a term that describes conditions where the **pressure** is lower than that of the atmosphere. A sealed container is said to be "under vacuum" in this case whereas it is "pressurized" when the pressure is higher than atmosphere. In a vacuum, it becomes necessary to define pressure microscopically. This means that the pressure, or **force** per unit area, is determined by the number of collisions between the atoms or molecules present and the walls of the container.

The first experiments involving vacuum date back to 1644 when **Evangelista Torricelli** worked with columns of mercury, leading to the first barometer (a device for measuring pressure). The famous experiment of **Otto von Guericke** in 1654 demonstrated the astounding force of vacuum when he evacuated the volume formed by a pair of joined hemispheres and attached each end to a team of horses that were unable to pull the hemispheres apart.

In order to create a vacuum, some kind of pump is needed. Simple mechanical pumps create a pressure difference, or suction force, which can be sufficient to pump water, for example. The most common use of vacuum, the vacuum cleaner, is simply a chamber and hose which are continuously evacuated by a fan. More sophisticated vacuum pumps must be sealed to prevent air from leaking back into the pumping volume too quickly. These pumps increase in complexity as better vacuum is needed. Pumps can generally be grouped into two categories: dynamic pumps, using mechanical or turbo-molecular action, and static pumps, using electrical ionization or low **temperature** (cryogenic) condensation.

Vacuum is important for research and industry, especially for manufacturing. Many industrial processes require vacuum either to be efficient or to be possible at all. Vacuum can be used for the prevention of chemical reactions, such as clotting in blood plasma or the removal of water in the process of freeze drying. Vacuum is also necessary for the prevention of particle collisions with background gas, in a television picture tube for example. For the fabrication of integrated **electronics**, it is very important to avoid impurities on a microscopic scale. It is only with excellent vacuum that such conditions can be obtained.