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Low Temperature Uses of Helium

This brief technical paper describes ways in which helium, with its particularly unique properties, is utilized by NASA.

NASA's largest use of helium is for purging and pressurizing cryogenic rocket propellants. The boiling point of helium is the lowest of all the elements. Helium can therefore exist as a gas in temperature and pressure equilibrium with any cryogenic fluid (e.g., liquid hydrogen, oxygen, or nitrogen); hence its use as a pressurizing agent for cryogenic rocket propellants. Helium could likewise be used to maintain pressure in liquid methane fuel tanks.

Many of the purposes for which NASA uses helium are the same as those of industry: welding, atmosphere control, leak detection, and refrigeration. A 6-foot diameter by 10-foot tall space chamber is cooled by helium to simultaneously produce a temperature of 4.2°K and a vacuum of less than 10^{-13} torr.

Helium provides the lowest possible liquid-bath temperature. It is used to cool other materials to low temperature ranges where unusual phenomena occur. It is also used this way to produce superconductivity—the state of zero electrical resistance—in certain

materials, and to maintain superconductivity in devices such as superconducting magnets. Helium itself exhibits very unusual properties at temperatures below 2.17°K, including: virtually zero viscosity, extraordinary thermal conductivity, the ability to flow up and over container walls, and a peculiar heat-seeking effect. These superfluid effects are already used in superconducting magnets and may become important in very low temperature refrigeration applications.

Note:

Requests for further information may be directed to:

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No patent action is contemplated by NASA.

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