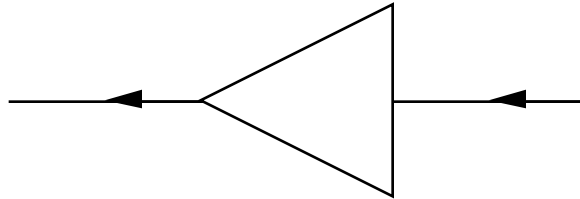


CRYOGENICS PRIMER CONTENTS

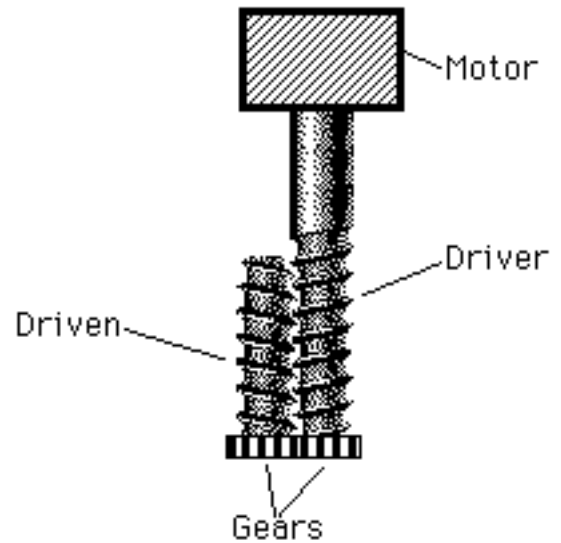
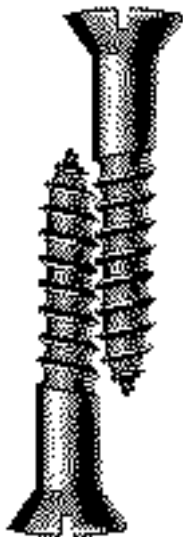
SCREW COMPRESSORS

This is the schematic symbol for a compressor. Notice the orientation of the triangle and the direction of flow through it.



A compressor is a mechanical device that takes in gas at one pressure, generally low, and increases it to a higher pressure. The temperature of the gas increases as the pressure is increased. The compressor can also be considered as a flow device.

There are many types of compressors, reciprocating, centrifugal, diaphragm, and screw. The research department uses either the Mycom or the Sullair screw compressor.



Screw compressors get their name because of the similarity they have with two screws meshed. The gas is compressed as it passes through the meshing screw threads.

GLOSSARY

Absorbed- Gas or vapor which has been taken up by molecular or chemical action.

Adsorbed- Gas or vapor which has condensed on the surface as a layer.

Adsorber- Traps and holds contaminants in the gas system. In the case of the Cryo system, its primary purpose is to remove all trace elements from the helium gas, principally nitrogen. An adsorber is used at the startup of the Cryo system to clean up the system and prevent plugging of the rest of the cryo equipment. For the same reason, an adsorber may be used at any time while the system is up and running if it is suspected that contaminants may be present.

Adsorbent- The material used in an adsorber to hold contaminants. Usual adsorbent is Silica-gel, Alumina, and Charcoal, with Charcoal being that which we use most. Characterized by coarse, high surface to volume ratio.

Atmosphere- A convenient measure of pressure, 1 atmosphere is equal to 14.696 psia. (psia- Pressure/Square Inch Absolute)

Carbon Resistor - A carbon resistor whose temperature sensitivity provides good temperature resolution, especially below 10° Kelvin. Carbon resistors are used in the helium equipment and are signified by the letter "R" in the device name giving the temperature readout. i.e.: BBTR32. Carbon resistors used for this purpose are usually precision resistors at 100u range. They are calibrated by conditioning cards in the relay racks in junction with the device template in the programming.

Cold Box- Usually a low pressure vessel that provides vacuum insulation for the various connections to the heat exchanger.

Compressor- Screw compressor (oil flooded) used to compress helium gas from 1 psig (suction) to ~280 psig (discharge).

Control Dewar- A vacuum jacketed vessel used to store liquid helium and to maintain flow through a refrigerator.

Dry-Wet (Expansion Engines) - A device that removes energy from the helium gas, which results in a drop of temperature and pressure. Normal operating temperatures of a dry engine are approximately 28°K in and 14K out.

Enthalpy- The sum (H) of the internal (U) and PV energy of a fluid of a given pressure and temperature. ($H = U + PV$)

Entropy- The change in Entropy of a system is equal to the heat that it absorbs, divided by the absolute temperature. The Entropy of a substance is a derived thermodynamic quantity.

Heat Exchanger- A device used to transfer heat from one substance to another.

Instruments- Devices that measure pressure, (PI), temperature, (TI), differential pressure indicator, (DPI), and alarms, (PA, TA).

Insulation- A means to reduce heat transfer by material means.

Insulating Vacuum- A vacuum provided for the express purpose of reducing conduction. The purpose is to prevent the absorption of heat into the cryogenic liquids, thus causing excessive flashing to gas or extra work on the refrigeration system.

Jacketed- A descriptive term used to signify cryogenic devices that have vacuum insulation provided. Thus the term Vacuum Jacketed, or more commonly, Jacketed.

J.T.- Abbreviation for the Joule-Thomson expansion valve. The J.T. valve can be used to replace the wet engine if needed, but has a much lower liquefaction rate. The J.T. valve takes high-pressure gas on one side and releases it to the other side to remove energy and lower temperature. At low temperatures, it is able to reduce energy enough to make a liquid and vapor solution.

Kelvin- The temperature scale that is used to signify absolute zero as zero degrees. Normal room temperature is $\sim 300^{\circ}\text{K}$; normal superconducting operation is 4.7°K .

MWP (Maximum Working Pressure)- The maximum pressure a container, (Dewar), should be operated

Pearlite- A finely divided powder used to insulate cryogenic storage devices, (Dewars), when vacuum failure is a serious consideration, or the cost of super insulation would be too high.

Pressure- The force exerted per unit area. Dimensions are pounds per square inch absolute- (**PSIA**), pounds per square inch gauge- (**PSIG**), and pounds per square inch differential (**PSID**).

Quench - A situation where a small generation of heat in a superconducting magnet causes its flow of liquid helium to change to its gaseous state, causing the magnet to lose its superconducting ability.

Refrigeration- The extraction of heat at lower than ambient temperatures. The common name for a cryogenic system is "Refrigerator."

Relief Valve- There are two uses: 1- pressure relief, relieve pressure at M.W.P. + 10%, and 2- thermal, set to relieve at a pressure conveniently above system working pressure but below M.W.P.

Storage Dewar- A vacuum jacketed device used to store cryogenic fluids.

Transfer Line- A vacuum jacketed line used to move cryogenic fluids from one point to another.

Vacuum- Pressures below one atmosphere, 14.696 psia. Units of measurement are inches of mercury- (HG), Millimeters- (mm Hg). The most common reference in speaking about vacuum is Microns-(u Hg), and most common way of writing the form is 10^{x-n} .

Vapor- The gaseous phase of a material that is a solid or a liquid in its standard state at room temperature and atmospheric pressure.

Vaporizer- A device used to cause vaporization, that is, to cause liquid to change into its gas phase. Nitrogen Dewars often have vaporizers that supply pressure to a nitrogen vessel in order to maintain working pressure. Also, the outlet side of a Dewar is used to provide nitrogen gas to experiments or systems that are intended to use Gaseous nitrogen, (GN₂). (Some systems may use liquid nitrogen, these will not have a vaporizer on the outlet side of the Dewar.)

Vapor Pressure- The pressure of the vapor of a liquid or solid at any given temperature at which the vapor and the liquid or solid phases exist in equilibrium.

Viscosity- The resistance to flow. Some cryogenic fluids have a very low viscosity.

V.P.T.- Vapor Pressure Thermometer. Its temperature limits are set by the expected temperature of the cryogenic gas measured. A hydrogen VPT would be used on the outlet of the dry engine. A neon VPT would be used on the inlet of the dry engine. A helium VPT would be used on the wet engine. VPTs are used in numerous locations throughout the cryogenic refrigerator. The VPT gets its name from the type of gas it is charged with. A very tedious calibration must be accomplished on each VPT each time it is charged. Due to its inherent nature, the VPT may lose part of its charge and frequently becomes unreliable. A good practice when using VPT's is to compare several in near locations to estimate their accuracy.

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