June 1970

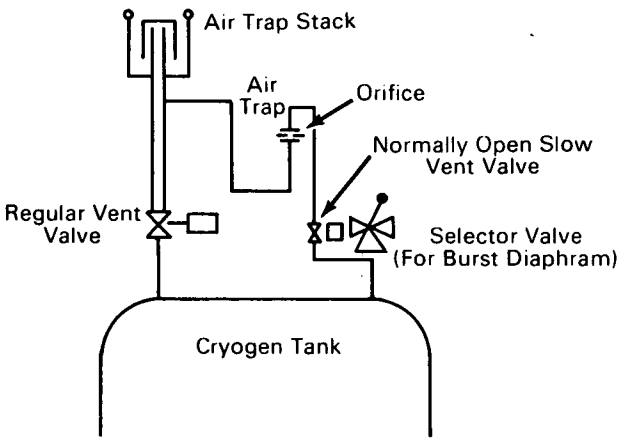
Brief 70-10122

NASA TECH BRIEF

Control of Equilibrium Pressure-Temperature Conditions in Cryogenic Storage

The problem:

The bulk temperature of any cryogenic liquid in storage is directly related to the pressure at which it is allowed to boil. For very cold cryogens, such as liquid hydrogen, a small increase in the containment pressure results in a significant increase in the bulk temperature with a corresponding decrease in fluid density, thus lowering the total mass of cryogen which can be stored in the container.



The solution:

A metered vent has been developed to control the pressure within a liquid hydrogen tank. The size of the vent is chosen to permit a gas flow which corresponds to the boil-off rate necessary to maintain the desired bulk temperature of the liquid hydrogen.

How it's done:

A slow-vent system is added to the normal venting provisions of the cryogenic storage tank, a large spring-loaded valve and a burst diaphragm. The slow-vent is a normally open valve in series with a metering orifice, placed in parallel with the normal vent valve. The metering orifice is sized for choked flow at the gas evolution rate that corresponds to the heat leakage into the liquid hydrogen from the environment. With well-insulated containers and ducting, the rate can be very low, while with uninsulated feed tanks, a much higher rate is experienced. The slow-vent valve maintains a positive pressure of a few inches of water in the tank. For any particular application, precise adjustment of this pressure, and consequently the bulk temperature of the liquid hydrogen, can be obtained experimentally by varying the size of the orifice.

This technique is equally applicable to other cryogens, and can be expected to reduce substantially the conventional loss rates in equipment currently controlled by spring-loaded vent valves. It provides a ready means for maintaining bulk temperatures at closely controlled levels, as well as minimizing storage losses. Also, the technique provides an economical means of restoring bulk temperature to the required level after transfer or transportation.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B70-10122

Patent status:

No patent action is contemplated by NASA.

Source: W. Ford and J. Voss of
North American Rockwell Corporation
under contract to
Marshall Space Flight Center
(MFS-18115)

Category 03