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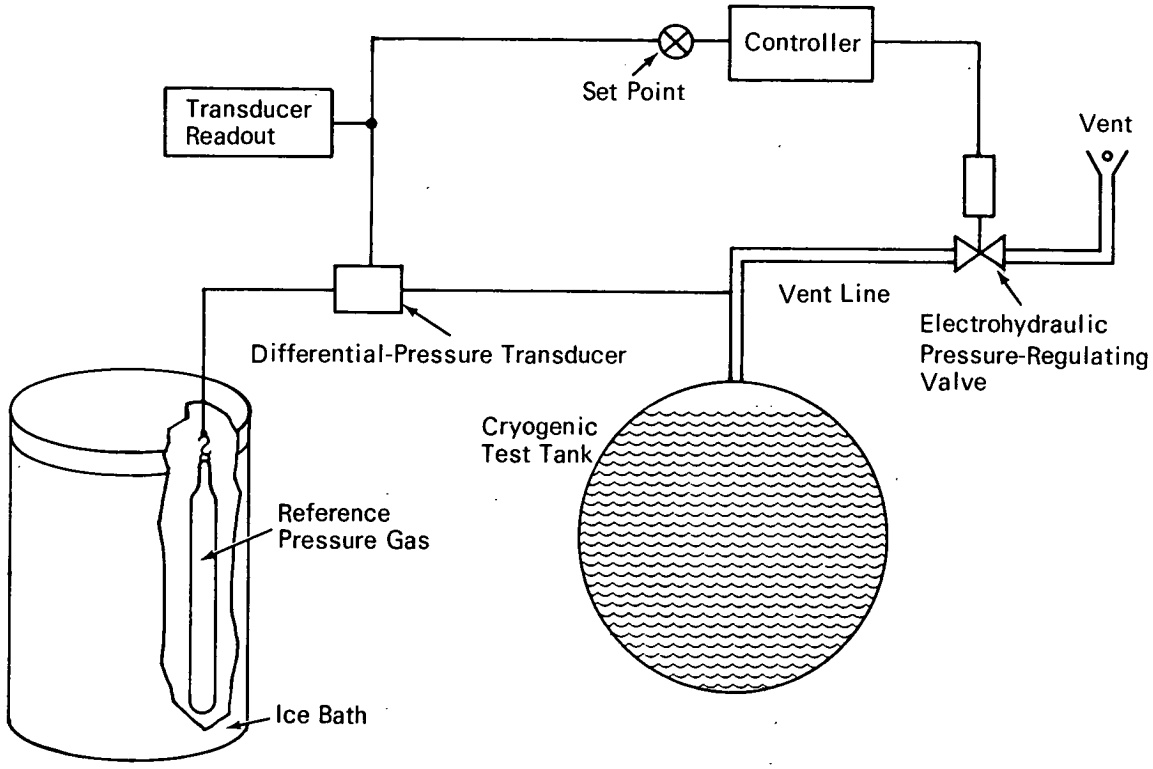
NASA TECH BRIEF

Lewis Research Center

System Accurately Controls Pressure in Cryogenic Tanks

The problem:

One way of determining the effectiveness of insulation on cryogenic-liquid tanks is to measure the quantity of vapor boiled off by the heat leaking into the tanks. To ensure that the boiloff (vented vapor) is due only to the heat leak, the cryogenic fluid in the tank must be kept at a constant temperature. This requirement can be met by maintaining the tank pressure at a known constant value. Small variations in tank pressure commonly occur when conventional methods (e.g., bubbling the vented vapor through a mercury column) are used for pressure control. These small pressure variations introduce relatively large errors in the heat leak calculations. A much more accurate pressure control is required.



The solution:

A high-resolution differential pressure transducer is used to sense very small positive or negative pressure variations in the cryogenic tank relative to an absolute reference pressure. The smallest variation which can be sensed is approximately

(continued on reverse)

± 0.0013 N/m^2 ($\pm 1 \times 10^{-5}$ mm Hg). The electrical output of the transducer is fed to a pressure regulating valve in the vent line, thereby controlling the pressure in the cryogenic tank. Pressure in a typical system has been held at $1.17 \times 10^5 \pm 1.38$ N/m^2 (17 ± 0.0002 psia).

How it's done:

A schematic of a typical control system is shown in the figure. One side of the differential-pressure transducer is connected to a fixed volume of gas maintained at constant temperature by an ice bath in order to provide a constant reference pressure. The other side of the transducer is connected to the vent line of the cryogenic test tank. The electrical output signal from the transducer is fed to a control unit for an electrohydraulic pressure regulating valve in the vent line. To achieve the desired fine control of the tank pressure, this valve must be carefully sized to handle the boiloff gas flow rates expected from the test tank. The valve controller is given a set point, and this results in controlling the tank pressure to a constant value with respect to the reference pressure.

Notes:

1. In addition to measuring insulation effectiveness, the system should be useful in calibrating instruments where the working fluid must be maintained at a closely controlled temperature, or in processes requiring very fine pressure control.
2. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B71-10118

Patent status:

No patent action is contemplated by NASA.

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