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NASA TECH BRIEF

Marshall Space Flight Center

Helium Leak Measurements Using CO_2 as a Carrier

The problem:

Present methods to accurately detect the presence and level of gas leakage often incur long delays in detection.

The solution:

Leak detection is accomplished by using a helium mass spectrometer leak-detector and, by combining several known procedures, omits those defects in present techniques that result in delay of detection.

How it's done:

The improved leak-detection technique combines carbon dioxide purging, cryogenic separating helium accumulation, and the use of carbon dioxide as a carrier gas.

Helium leak-detector sensitivity using the specimen evacuation technique is better than 1×10^{-9} std. cm^3/sec. The difficulty in locating leaks using this technique occurs when the specimen is a large volume-low conductance system such as the plumbing of a typical cryogenic shroud used in vacuum chambers. The controlling factor for locating leaks in such a system is the system time-constant rather than the leak-detector sensitivity.

The specimen pressurization technique, i.e., sniffing technique, is used as an attempt to circumvent the time constant effect. This method reduces the effective leak-detector sensitivity to 1×10^{-6} std. cm^3/sec. at best. When using the sniffing technique, the controlling factor becomes the effective sensitivity rather than the system time-constant.

This study deals with the development of a technique that retains the basic leak-detector sensitivity while circumventing the specimen time-constant. The technique uses CO_2 as a carrier gas. The leak-detector liquid nitrogen trap is used as a cryogenic pump for the carrier gas. The permissible throughput of the leak-detector is a nominal 5×10^{-4} std. cm^3/sec. for air. The leak-detector throughput using CO_2 may be maintained at 10^{-1} std. cm^3/sec. without compromising the leak-detector ionization chamber vacuum level.

A continuous CO_2 purge is maintained through the specimen. Helium is introduced into the specimen at a rate of 2.7×10^{-8} std. cm^3/sec. The leak-detector response is recorded and compared to the response when no CO_2 purge is used. The helium leak is valved off, and the "cleanup" rates with and without the CO_2 purge are recorded. Using the CO_2 purge, the response rate shows a significant increase without loss in the effective sensitivity.

Notes:

1. Information concerning this innovation may be of interest to manufacturers and users of pressure vessels, cryogenic hardware, or vacuum hardware.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Marshall Space Flight Center
   Code A&TS-TU
   Huntsville, Alabama 35812
   Reference: B72-10354

Patent status:

No patent action is contemplated by NASA.

Source: B. C. Moore and R. G. Camarillo of
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