April 1970

Brief 70-10162

NASA TECH BRIEF

Effects of High Pressure Hydrogen on Metals

Failures of large, welded hydrogen storage vessels at and below design pressures of 5000 to 6000 psi have occurred with enough frequency to bring attention to the embrittlement of metals by high-pressure hydrogen at ambient temperatures. Previously, notched steel specimens tested in tension in the presence of high-pressure hydrogen exhibited a considerable decrease in fracture strength. This decrease was more pronounced in cases with sharper notches and steels of higher strength levels.

Thirty-five alloys have been investigated for their susceptibility to high-pressure hydrogen environment embrittlement at ambient temperature. In 10,000 psi hydrogen the ranking in order of decreasing embrittlement was: (1) high-strength steels and nickel-base alloys; (2) moderate- and low-strength iron-base alloys, pure nickel, and titanium alloys; (3) nonstable AISI type 300 stainless steels, beryllium-copper, and commercially pure titanium; and, (4) aluminum alloys, pure copper, and the stable AISI type 300 stainless steels.

The degree of hydrogen environment embrittlement was found to increase with increasing pressure, while low-alloy steels were reduced considerably in notch strength by 1,000- and 10,000-psi hydrogen environments.

Notes:

1. Results of this investigation will be useful in the design of hydrogen storage vessels for both industrial and aerospace use.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B70-10162

Patent status:

No patent action is contemplated by NASA.

Source: R. J. Walter and W. T. Chandler of
North American Rockwell Corp
under contract to
Marshall Space Flight Center
(MFS-18612)

Category 04