

# NASA TECH BRIEF



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Division, NASA, Code UT, Washington, D.C. 20546.

## 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) non-stable 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

MASS TECH CENTER

