May 1968

Brief 68-10153

NASA TECH BRIEF

Study of Crack Initiation Phenomena Associated with Stress Corrosion of Aluminum Alloys

The initiation and development of stress-corrosion cracks in heavy plate of 2219 and 7075 alloys have been investigated. Heavy plate of X7375 (7075 without Cr) has also been used for specific structural comparisons. Corrosion and stress-corrosion tests in a pH 1 NaCl–$AlCl_3$–HCl solution have been made, using metallographically polished unstressed specimens, and special tuning-fork specimens, the most highly stressed regions of which were metallographically polished and masked just prior to exposure.

The majority of the work has been concerned with the effect of metallurgical structure. In all crack-susceptible materials, intergranular corrosion and stress-corrosion cracking started and progressed in boundary regions. With 2219 alloy, this path followed the boundaries of the recrystallized grains, whereas in 7075 alloy, it followed the boundaries of fragment clusters, which were the boundaries of "former" grains. Cracks formed on boundaries oriented perpendicularly to the stressing direction, with the result that boundary orientation and directionality of structure proved of the utmost importance. In 7075 alloy, which had an unrecrystallized structure, cracks developed and propagated rapidly under short transverse stress because the structure was highly elongated in the rolling direction, which oriented the boundaries perpendicular to the stress. A similar situation prevailed in 2219 alloy because of the directionality of the recrystallized structure and the presence of series of favorably oriented boundaries perpendicular to the short transverse stress.

The investigation revealed no other microstructural feature that influenced crack initiation or propagation. The constituent particles, zones, and precipitates within grains had no direct effect because they were not located where cracking occurred. Boundary precipitate particles also had no direct effect associated with cracking. Microstructural features, such as zones, and precipitate particles, may have an indirect effect on crack initiation because their formation and development will influence the localized electrochemical relationships at boundaries.

Note:

Inquiries concerning this study may be directed to:
Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B68-10153

Patent status:

No patent action is contemplated by NASA.

Source: M. S. Hunter
of Aluminum Company of America
under contract to
Marshall Space Flight Center
(MFS-14283)

Category 03