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STRESS CORROSION BEHAVIOR OF ALUMINUM ALLOY X7002-T6 IN A MARINE ATMOSPHERE

By

W. F. Gerhold

To

Materials Division
Air Systems Command
Department of the Navy
Project Number RRMA 2131

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References: (a) NBS Report No. 7855, "The Stress Corrosion Behavior of Aluminum Alloy X7002-T6", dated April 25, 1963.

(b) Bureau of Naval Weapons letter RRMA-22: RS/41 dated 20 April 1965.

Introduction: Evaluation of the stress corrosion behavior of an X7002-T6 aluminum alloy plate sample, Reference (a), indicated that the sample had been improperly heat treated. Accordingly, re-evaluation of the alloy using specimens obtained from properly heat treated material was recommended.

Material: An X7002 aluminum alloy plate sample, 18 in. long x 9 in. wide x 1 3/4 in. thick, and reported to be in the -T6 temper, was submitted under reference (b). Reference (b) requested that the stress corrosion behavior in the short transverse direction be determined for this sample in artificial laboratory and marine environments.

Tests: Specimens in the form of sub-size flat tensile bars and "C" rings were cut from the plate in the short transverse direction. The tensile bars were machined to an over-all 1.75 in. length by 0.6875 in. width and to a reduced section 0.125 in. thickness by 0.1875 in. width.

Mechanical properties of the alloy as determined by NBS and as reported by the Reynolds Metals Company were as follows:

	Ultimate Tensile Strength, Ksi	Yield Strength, Ksi	% Elongation
NBS (a)	72.6	(b)	(b)
Reynolds Metals Company	66.6	56.0 (c)	6.6

(a) Average of 3 specimens.
(b) Not determined because of specimen configuration and specimen size.
(c) This value used in stress corrosion tests.

Three of each type of NBS specimen prestressed to 75% of the alloy yield strength (42 Ksi) and three "C" ring specimens prestressed to 50% of the alloy yield strength (28 Ksi) were exposed in the marine atmosphere at Kure Beach, North Carolina. The exposure stresses and the times to failure were calculated to be as follows:

Specimen Type	Exposure Stress % of Yield Strength	Stress, Ksi (a)	Days to Failure (b)
Tensile bar	75	42	5, 12 (2)
"C" ring	75	42	9 (3)
"C" ring	50	28	13 (3)

(a) Calculated from yield strength value supplied by Reynolds Metals Company.
(b) Numbers in parenthesis denote number of specimens that failed after time shown.

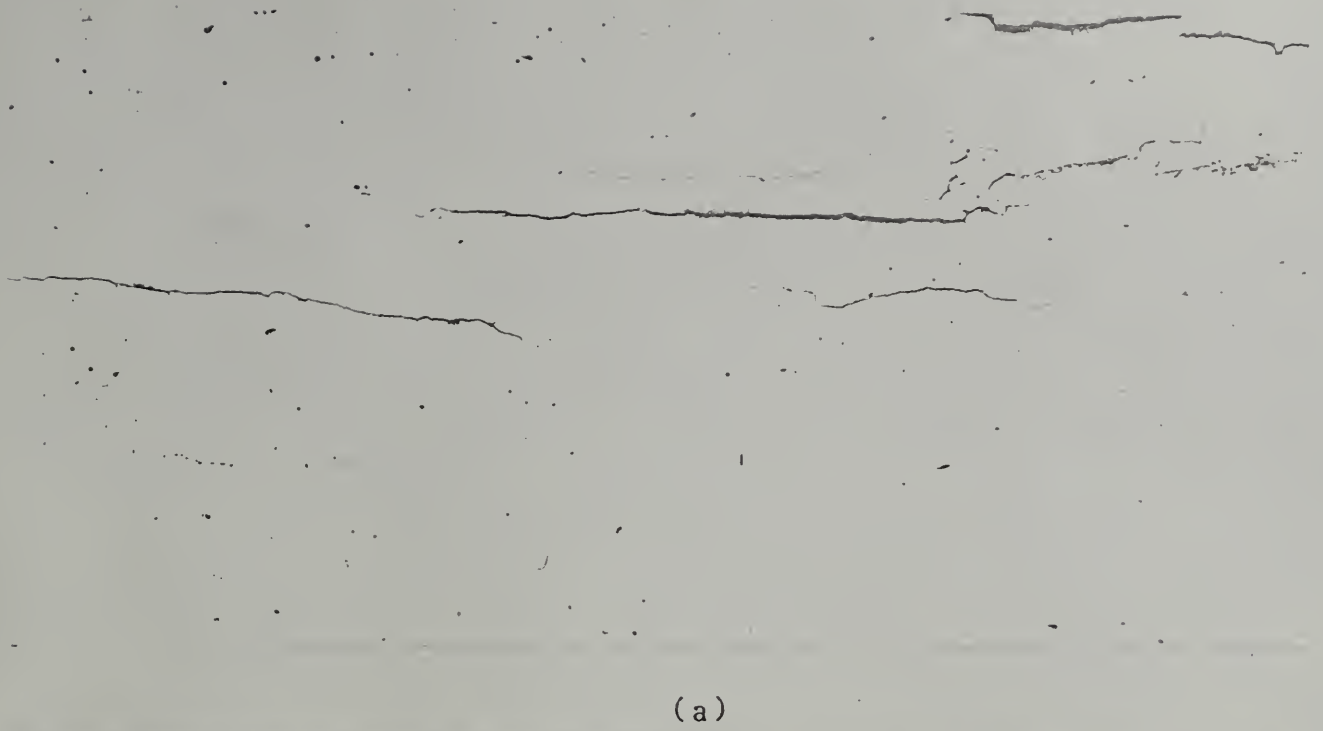
In view of the rapid failures occurring in the marine atmosphere environment it was agreed, after discussion with RRMA-22, that the laboratory tests would not be conducted.

Metallographic examination of sections cut from the failed specimens revealed the presence of secondary cracks adjacent to the main fracture, Figure 1a. These cracks were intergranular and branching in nature, Figure 1b.

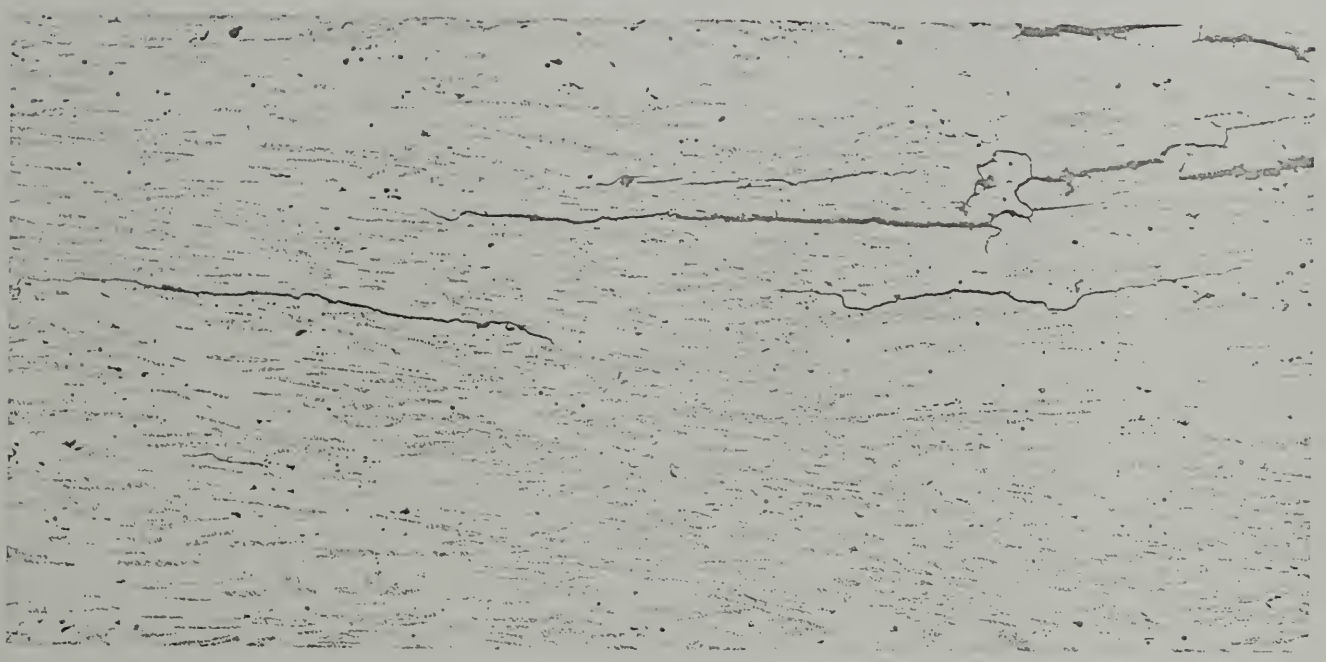
Conclusions: The results obtained from tests conducted in a marine atmosphere environment on aluminum alloy X7002-T6 specimens indicate that the alloy has poor resistance to stress corrosion cracking in the short transverse direction.

"C" ring specimens stressed at 50 and 75% of the reported alloy yield strength failed after exposure of 13 and 9 days, respectively. Flat tensile bars stressed at 75% of the reported alloy yield strength failed after exposures of from 5 to 12 days.

Metallographic examination revealed that in each instance failure was due to stress corrosion cracking.



(a)



(b)

Figure 1. Secondary cracks observed on failed "C" ring specimen stressed at 75% of the alloy yield strength. Note that cracks are intergranular and braching in nature.

(a) Unetched. X 100.
(b) Etched with Keller's reagent. X 100.