NATIONAL BUREAU OF STANDARDS REPORT

10 137

Progress Report on the

STRESS-CORROSION BEHAVIOR OF DIE FORGED ALUMINUM ALLOY 7175-T736

To
Materials Division
Naval Air Systems Command
Department of the Navy

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards [1] was established by an act of Congress March 3, 1901. Today, in addition to serving as the Nation's central measurement laboratory, the Bureau is a principal focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. To this end the Bureau conducts research and provides central national services in four broad program areas. These are: (1) basic measurements and standards, (2) materials measurements and standards, (3) technological measurements and standards, and (4) transfer of technology.

The Bureau comprises the Institute for Basic Standards, the Institute for Materials Research, the Institute for Applied Technology, the Center for Radiation Research, the Center for Computer Sciences and Technology, and the Office for Information Programs.

THE INSTITUTE FOR BASIC STANDARDS provides the central basis within the United States of a complete and consistent system of physical measurement; coordinates that system with measurement systems of other nations; and furnishes essential services leading to accurate and uniform physical measurements throughout the Nation's scientific community, industry, and commerce. The Institute consists of an Office of Measurement Services and the following technical divisions:

Applied Mathematics—Electricity—Metrology—Mechanics—Heat—Atomic and Molecular Physics—Radio Physics [2]—Radio Engineering [2]—Time and Frequency [2]—Astrophysics [2]—Cryogenics.[2]

THE INSTITUTE FOR MATERIALS RESEARCH conducts materials research leading to improved methods of measurement standards, and data on the properties of well-characterized materials needed by industry, commerce, educational institutions, and Government; develops, produces, and distributes standard reference materials; relates the physical and chemical properties of materials to their behavior and their interaction with their environments; and provides advisory and research services to other Government agencies. The Institute consists of an Office of Standard Reference Materials and the following divisions:

Analytical Chemistry—Polymers—Metallurgy—Inorganic Materials—Physical Chemistry.

THE INSTITUTE FOR APPLIED TECHNOLOGY provides technical services to promote the use of available technology and to facilitate technological innovation in industry and Government; cooperates with public and private organizations in the development of technological standards, and test methodologies; and provides advisory and research services for Federal, state, and local government agencies. The Institute consists of the following technical divisions and offices:

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THE CENTER FOR RADIATION RESEARCH engages in research, measurement, and application of radiation to the solution of Bureau mission problems and the problems of other agencies and institutions. The Center consists of the following divisions:

Reactor Radiation—Linac Radiation—Nuclear Radiation—Applied Radiation.

THE CENTER FOR COMPUTER SCIENCES AND TECHNOLOGY conducts research and provides technical services designed to aid Government agencies in the selection, acquisition, and effective use of automatic data processing equipment; and serves as the principal focus for the development of Federal standards for automatic data processing equipment, techniques, and computer languages. The Center consists of the following offices and divisions:

Information Processing Standards—Computer Information — Computer Services — Systems Development—Information Processing Technology.

THE OFFICE FOR INFORMATION PROGRAMS promotes optimum dissemination and accessibility of scientific information generated within NBS and other agencies of the Federal government; promotes the development of the National Standard Reference Data System and a system of information analysis centers dealing with the broader aspects of the National Measurement System, and provides appropriate services to ensure that the NBS staff has optimum accessibility to the scientific information of the world. The Office consists of the following organizational units:

Office of Standard Reference Data—Clearinghouse for Federal Scientific and Technical Information [4]—Office of Technical Information and Publications—Library—Office of Public Information—Office of International Relations.

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.
[2] Located at Boulder, Colorado 80302.
[4] Located at 5285 Port Royal Road, Springfield, Virginia 22151.

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STRESS–CORROSION BEHAVIOR OF DIE FORGED ALUMINUM ALLOY 7175–T736

By
W. F. Gerhold
Engineering Metallurgy Section

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Reference: (a) Naval Air Systems Command letter, AIR-52031A: RS/53 dated August 16, 1968

Introduction: A new Alcoa die forged aluminum alloy designated 7175 has been reported to have good stress-corrosion cracking resistance when heat treated to the -T736 condition. Reference (a) requested that NBS conduct tests to determine the stress corrosion behavior of this alloy in artificial laboratory and marine environments. This report contains the results obtained from tests conducted in the artificial laboratory environments only.

Material: A die forged 7175-T736 aluminum alloy section (Die No. 9112) approximately 36 in. long was submitted for test by the vendor. Specimens in the form of flat tensile bars were machined from this section so that their principal axes were in the transverse direction with respect to the direction of working of the forging. The specimens were approximately 3 in. long by 0.75 in. wide by 0.125 in. thick.

Tensile Properties: The results of tests conducted by NBS to determine the tensile properties of the die forged 7175-T736 aluminum alloy are given in Table 1.

Table 1. Transverse tensile properties[(a)] of die forged 7175-T736 aluminum alloy

Tensile Strength, ksi	76.5
Yield Strength (0.2% offset), ksi	68.3
Elongation in 1 inch, percent	11.0

(a) Average of three specimens.

Stress-Corrosion Tests: Stress-corrosion tests were conducted in artificial laboratory environments. A system of weights and levers was used to obtain the desired stress.

The specimens were encased in polyethylene cells which were used to contain the corroding media. The specimens were immersed intermittently in the corrodent, once in every 45 minutes, by pumping the corrodent into the cell and then allowing it to drain back into a reservoir. Two corroding solutions were used; one a IN sodium chloride solution containing 10 ml of hydrogen peroxide (30%) per liter of solution and the other a straight 3.5% sodium chloride solution. Specimens were exposed in both environments at stresses equivalent to 75% of the yield strength of the alloy as determined by NBS. The percent loss in tensile strength was determined for each specimen to give an indication of the extent of corrosion. These determinations, shown in Table 2, revealed that the corrosion rate of the stressed specimens exposed in the more aggressive $NaCl-H_2O_2$ solution was higher than that for stressed specimens exposed in the 3.5% NaCl solution. The corrosion rates were similar for unstressed specimens exposed in both environments.

Conclusions: The results obtained from stress-corrosion tests conducted in artificial laboratory environments on die forged 7175-T36 aluminum alloy indicate that the alloy has good resistance to stress-corrosion cracking.

There were no stress-corrosion failures after approximately 61 days exposure in either the $NaCl-H_2O_2$ or 3.5% NaCl environments.

The corrosion rate, for specimens stressed at 75% of the yield strength of the alloy, was higher in the $NaCl-H_2O_2$ environment than in the 3.5% NaCl environment. The corrosion rate for unstressed specimens was similar in both environments.

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Table 2. Results obtained from stress-corrosion tests conducted in artificial laboratory environments.

Environment	Exposure Stress, % of Yield Strength	Exposure Stress, ksi	Days Exposed[a]	Percent Loss in Tensile Strength
3.5% NaCl	75	51.4	61 NF	17
	75	50.9	62 NF	6
	75	50.9	61 NF	12
			Avg.	12
	0	-	62 NF	5
	0	-	62 NF	7
	0	-	62 NF	6
			Avg.	6
$NaCl-H_2O_2$	75	51.4	61 NF	19
	75	50.9	61 NF	7
	75	50.9	61 NF	22
			Avg.	16
	0	-	61 NF	5
	0	-	61 NF	7
	0	-	61 NF	3
			Avg.	5

(a) NF indicates no failure after exposure for the number of days shown.


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