**AEROJET-GENERAL CORPORATION**

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**AZUSA PLANT**

4 October 1963

Subject: Informal Monthly Report on the Investigation of Stress-Corrosion Cracking of High-Strength Steels, Covering the Period 1 August through 31 August 1963, Report No. L0414-02-2

To: U.S. Army Ordnance Corps
Frankford Arsenal
Philadelphia, Pennsylvania

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Reference: Contract DA-04-495-ORD-3069, Modification No. 4

This is the twenty-sixth in a series of monthly informal progress reports submitted in partial fulfillment of the contract. It constitutes the second monthly report on the second 1-year continuation of the original 2-year program. This report was written by R. B. Setterlund, who was supervised by A. Rubin.

I. OBJECTIVES

A. To study the stress-corrosion characteristics of 18%-nickel maraging steel with respect to compositional variation.

B. To study the effect of environmental temperature on the rate of stress-corrosion cracking in three alloys: 18%-nickel maraging steel, a low-alloy martensitic steel, and a hot-worked die steel.

C. To study the electropotential changes occurring in 18%-nickel maraging steel during stress-corrosion exposure, and the effect of applied potential.

D. To evaluate the effectiveness and applicability of surface protection on 18%-nickel maraging steel in preventing stress-corrosion cracking.

II. WORK PROGRESS

A. COMPOSITIONAL VARIATION

Orders were placed for four heats of maraging steel to be used in determining the effect of compositional variation. Only one heat, Vascomax 300

(Vanadium Alloys Steel Company), has arrived to date. This material is now in the process of having its mechanical properties evaluated. Two other heats are scheduled to be shipped within 1 week. These steels are Vascomax 250 (Vanadium Alloys Steel Company) and Marvac 18 (Latrobe Steel Company). The remaining heat, RSM 200 (Republic Steel Company), will be shipped within 1 month.

Stress-corrosion tests will be conducted on the above material using beam specimens stressed elastically to 75% of yield strength, as well as plastically deformed U-bend specimens. Three replicate tests will be conducted for each test condition. Tests will be conducted in distilled water, 3% NaCl solution, high humidity air and seacoast atmospheric exposure. Center-notched specimens will be employed to obtain fracture toughness values and to determine the tendency of stress-corrosion cracks to propagate in the presence of an existing crack. These tests will be conducted at various loads in the salt-water environment only.

B. ENVIRONMENTAL TEMPERATURE EFFECT

Samples of the above four heats of maraging steel, along with specimens of Vascojet 1000 and Ladish D6AC, will be exposed to a distilled-water environment at 70, 120 and 160°F. These data will show the temperature dependence - and possibly the energy of activation - of the stress-corrosion process.

C. ELECTROCHEMICAL CHANGES

Preliminary experiments have been started to establish procedures for the portion of the testing in which measurement will be made of electrochemical changes occurring during stress-corrosion exposure. (These experiments were conducted using material left over from the previous year's work.)

A center-notched specimen of 18%-nickel maraging steel (Group I-4) was coated with mask-off lacquer except for the area of the fatigue crack. An agar-agar salt bridge with a capillary tip contacting the specimen at the crack tip, was connected to a standard calomel half-cell. The potential of the specimen crack was continuously recorded as the specimen was loaded. After each application of load, an abrupt anodic shift in potential was noted. A plot of "potential against load" was found to yield a straight line. During further stressed exposure (to a 3% salt solution) at constant load, occasional random anodic potential shifts were recorded, indicating initiation of stress-corrosion cracking. The test was stopped when solution leakage was noted from the salt bridge. With certain improvements in technique now being developed, this test method promises to yield important basic data on the stress-corrosion cracking process.

D. SURFACE PROTECTION

The two protective coatings found to be most effective in preventing stress-corrosion cracking of H-11 steel will be evaluated for applicability in protecting 18%-nickel maraging steel. The coatings selected, based on the previous year's work, are CAT-A-LAC 454-1-1, a chromate-inhibited epoxy; and Magna Laminar X-500, a polyurethane-type coating.

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