

NATIONAL BUREAU OF STANDARDS REPORT

10 138

FAILURE OF HYGROTHERMOMETER THERMAL SHIELD TOP MOUNTING PLATE

for

U. S. Department of Commerce
Environmental Science Services Administration
Weather Bureau
Silver Spring, Md. 20910



U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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The National Bureau of Standards¹ 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 Physics²—Radio Engineering²—Time and Frequency²—Astrophysics²—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:

Engineering Standards—Weights and Measures—Invention and Innovation—Vehicle Systems Research—Product Evaluation—Building Research—Instrument Shops—Measurement Engineering—Electronic Technology—Technical Analysis.

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 Information⁴—Office of Technical Information and Publications—Library—Office of Public Information—Office of International Relations.

¹ Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.

² Located at Boulder, Colorado 80302.

³ Located at 5285 Port Royal Road, Springfield, Virginia 22151.



An Hygrothermometer Thermal Shield Top Mounting Base was received after removal from ET-WBO-Montgomery, Alabama. Examination of the mounting base determined that the failure was by exfoliation corrosion. A photograph of the cross-section of one of the affected areas is shown in Figure 1. Exfoliation is a type of corrosion that progresses approximately parallel to the outer surface of the metal, causing layers of the metal to be elevated by the formation of corrosion products. The alloy of which the mounting base was constructed (2024-T4) is known to be susceptible to exfoliation corrosion in the atmosphere. Failure of some but not all of the top mounting bases in use is most likely caused by variations in heat treatment of these parts. Variations in heat treatment of 2024 can cause drastic changes in its exfoliation resistance. In general, 2024 is not recommended for resistance to exfoliation.

The solution to this problem, is to replace the 2024-T4 with an alloy which is resistant to exfoliation. An alloy which meets the desired corrosion resistance properties ^{is} ~~is~~ 5052-0. This alloy is very resistant to exfoliation, but has lower mechanical properties than the 2024-T4. Alloy 5052-0 has a nominal ultimate tensile strength of 28,000 psi and yield strength of 13,000 psi. Since high mechanical strength is not necessary in the construction of the thermal shield, this alloy should be acceptable.

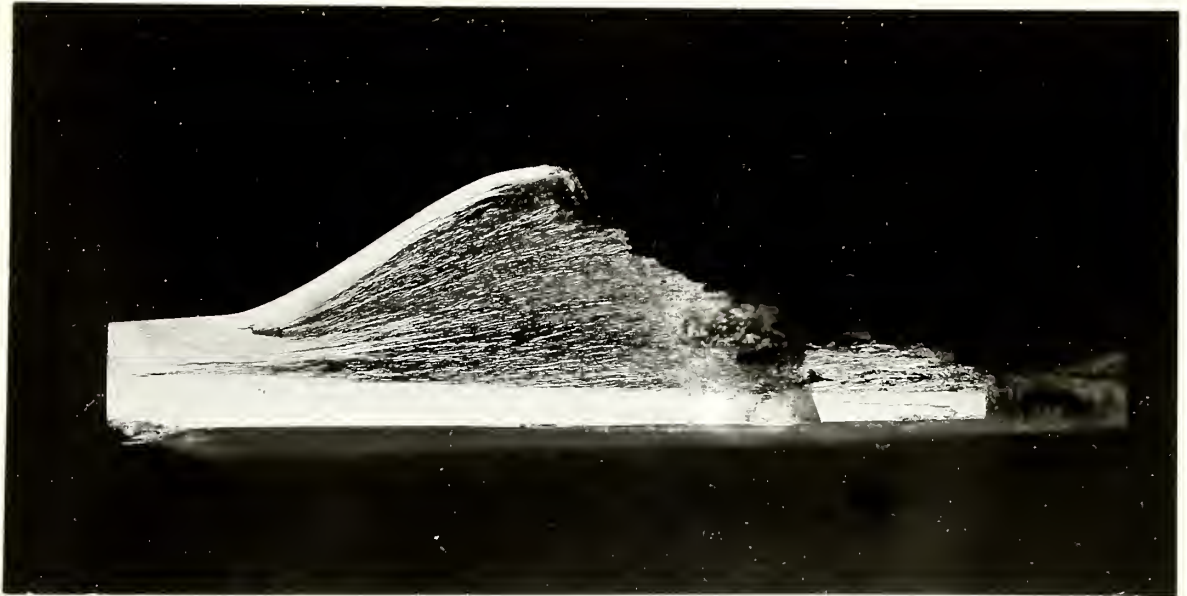


Figure 1. Cross-section of exfoliated 2024-T4 Aluminum Alloy hygrometer thermal shield top mounting plate. X 2

It is, therefore, recommended that the material for construction of the top mounting base be changed to 5052-0 aluminum alloy. It is further recommended that all other parts constructed of wrought alloys also be replaced by 5052-0 in future assemblies. This is especially important for the 2024-T4 mounting plates. The cast parts should be satisfactory as specified in the specifications drawings.

It is also suggested that any brass fasteners be replaced by fasteners less likely to cause galvanic corrosion. Acceptable alternatives are, in order of decreasing desirability: chromium plated, zinc plated (i.e., galvanized), or cadmium plated fasteners.

The above modifications in the design of the thermal shield, along with the anodization process already in use, should correct the exfoliation problem encountered with the top mounting base and prevent future problems with other components of the assembly.

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