

Issued 1992-06
Reaffirmed 2004-08
Revised 2011-06

Superseding AIR4487

(R) Investigation of Silver Plated Conductor Corrosion (Red Plague)

RATIONALE

AIR4487 was initially published in 1992, and contained information available at that time. The document is being updated removing old reference documents which are no longer available and adding new information and reference documents uncovered during recent studies.

1. SCOPE

This SAE Aerospace Information Report (AIR) shall be limited to information about cuprous/cupric oxide corrosion of silver plated conductors. It examines some possible causes and some recommendations to minimize the possibility of its occurrence. It also provides a number of reference documents that describe the corrosion in detail, methods to determine conductor damage, methods to produce the corrosion, and other investigative reports of this phenomena and their conclusions.

1.1 Purpose

This document provides some brief information about silver plated conductor corrosion and a list of reference documents that can be used for more detailed information.

2. REFERENCES

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 ASTM International Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 961 Standard Specification for Silver Coated Copper and Copper Alloy Stranded Conductors for Electronic Space Application

2.2 U. S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-9495, <https://assist.daps.dla.mil/quicksearch/>.

MIL-STD-889B Military Standard Dissimilar Metals

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2011 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

**SAE values your input. To provide feedback
on this Technical Report, please visit
<http://www.sae.org/technical/standards/AIR4487A>**

2.3 Other Publications

"A study of Aging of Silver-Plated Conductors", Raychem Laboratory report No. 5104, January 1988, Neal C. Enault, Robert O. Bremner, and Hans E. Lunk

"Corrosion of Silver-Plated Copper Conductors", B. D. Dunn, A. de Rooij, and D. S. Collins, ESA Journal, 1984, Vol. 8, <http://nepp.nasa.gov/docuploads/97164203-A4FB-479A-A075C918D51DD81E/ESA%20Red%20Plague.pdf>

"Red Plague", P. L. Anthony and O. M. Brown, Materials Protection, Volume 4, No. 3, 8-18, 3-65 <http://nepp.nasa.gov/DocUploads/16F59745-C53E-49B2-AFCDF883CFE54D64/RED%20PLAGUE%20mtrl%20protection%20pub.pdf>

"Determination of the susceptibility of silver-plated copper wire and cable to "red-plague" corrosion" ECSS Secretariat ESA-ESTEC Requirements & Standards Division Noordwijk, The Netherlands <http://esmat.esa.int/ecss-q-st-70-20c.pdf>

"Status of Red Plague Mitigation for the US Army Aviation and Missile Life Cycle Management Command" Alexander P Steel, Robert E. Morris, <http://www.docstoc.com/docs/38758920/Status-of-Red-Plague-Mitigation-for-the-US-Army> or <http://corrdefense.org>

"Red Plague Control Plan" Robert Wm Cooke, <http://ntrs.nasa.gov>

3. GENERAL

3.1 Background

Documented reports of silver plated conductor corrosion (Red Plague) began as early as 1957 with reports of TFE insulated silver plated copper wire, and have continued until the present day. By 1963 the corrosion problem of silver coated wire became important enough for numerous studies and publications to be issued and have continued periodically. The primary issue is that silver plating is more anodic than the copper substrate with respect to the galvanic series (Ref 10). When copper is exposed, a galvanic cell will be created in the presence of water and oxygen resulting in the corrosion of the copper substrate. This can reduce conductivity and damage the structural integrity of the conductor strands.

3.2 Cuprous/Cupric Oxide

Cuprous/cupric oxide (Red Plague) is the result of a galvanic corrosion that occurs at a silver/copper interface in the presence of moisture and oxygen. It may appear as a reddish brown cuprous oxide, or black if it is cupric oxide. This variation in color is due to the different levels of oxygen or moisture which may be available.

4. CASES OF SILVER PLATED CONDUCTOR CORROSION (RED PLAGUE)

4.1 Conductor Processing and Inadequate Silver Plating

Inadequate process controls during silver plating and /or drawing of conductors to size can result in thin, voided, or porous silver that exposes silver/copper interface and presents sites capable of supporting red plague. Conductors which have been manufactured with either exposed copper or porous silver plating are much more likely to develop corrosion since a greater number of silver/copper interfaces will be exposed. Areas of low silver plating thickness are more easily damaged, thus increasing the susceptibility.

4.2 Mechanical Damage

Another cause of silver coated copper corrosion is mechanical damage, which can occur either during conductor manufacture, cable manufacture, cable installation, or during flexing of the cable (particularly shields) in service. Abrasion may expose the copper beneath the silver plating, creating potential sites for the corrosion to begin. Flattened silver coated copper shield strands are the most commonly corroded areas, which is probably due to the thinning of the plating that can occur during the flattening process. Additional abrasion can occur during the braiding process of the shield strands.