



AEROSPACE RECOMMENDED PRACTICE

ARP6167™**REV. A**

Issued	2013-11
Reaffirmed	2019-06
Stabilized	2024-10

Superseding ARP6167

Etching of Fluoropolymer Insulations

RATIONALE

ARP6167A is being stabilized because the processes are considered mature and the committee does not anticipate future technical guidance. Stabilization does not imply the process is unacceptable for applications for which it is designed. Any changes noted by a user which results in a change of guidance will be addressed by a new revision.

STABILIZED NOTICE

This document has been declared "STABILIZED" by SAE AE-8A Electrical Wiring and Fiber Optic Interconnect Systems Installation Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

SAE Executive Standards Committee 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 revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2024 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, or used for text and data mining, AI training, or similar technologies, 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 WEB ADDRESS:

Full document details: SAE ARP6167A

For more information on this standard, visit
<https://www.sae.org/standards/content/ARP6167A/>

**Documents**

Document Sharing Hub

1. SCOPE

This SAE Aerospace Recommended Practice (ARP) describes the etching of fluoropolymer electrical wire insulations to ensure that all facets of the process from the chemistry to the processing, to the storage and handling are well defined.

1.1 Purpose

The purpose of the SAE Aerospace Recommended Practice (ARP) is to provide a standard practice guide for etching of Fluoropolymer electrical wire insulations. The ARP is subject to change to keep pace with experience and technical advances.

2. APPLICABLE DOCUMENTS

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 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 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AIR5717 Mitigating Wire Insulation Damage During Processing and Handling

ARP6400 Recommended Practice for Processing and Handling Wire and Cable with Silver Plated Conductors and Shields

2.2 ASTM 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 D5946-09 Standard Test Method for Treated Films Using Water Contact Angle Measurements

ASTM D2578 Dyne Pens

3. GENERAL

The purpose of chemical etching fluoropolymer wire insulations is to enhance the bonding of materials to their surface. The chemistry of etching is achieved by the abstraction of a fluorine atom from a monomer unit and the formation of a free radical. Beginning with PTFE (C₂F₄) the etching process removes the fluorine from the surface. This etched layer is very thin, only angstroms deep. The etching process then develops double carbon to carbon bonds (C=C), Carbonyl, Carboxyl, Hydroxyl groups and epoxides.

3.1 Etching Quality

The quality of etching as measured by the formation of a boundary layer onto which one can adhere other materials depends on:

- The etching agent.
- The etching conditions, i.e., the temperature, reagent concentration, and contact time.
- The polymer being etched. This process will work with PTFE, FEP, CTFE, ETFE, PVDF, and PFA. It will not work well with irradiated (XLETFE) ETFE insulation.

3.2 Chemistry of Etchants

- Ethylene Glycol Dimethyl Ether or MONOGLYME is the simplest of the three etchants and has the greatest affinity for sodium and is the easiest solvent with which to form the sodium naphthalene complex. The resulting etchant is very sodium rich but also very viscous, sometimes needing to be thinned for particular applications. The closed cup flash point of this solvent is low (30F). It is recommended to store these etchants under refrigeration in order to limit deterioration.
- Diethylene Glycol Dimethyl Ether or DIGLYME while it dissolves less sodium naphthalene in complex than MONOGLYME, has a much higher flash point (134F) and makes an etchant with the viscosity of about water. It is very stable at room temperatures and above and does not exhibit the same spontaneous decomposition as MONOGLYME does at temperatures near and above its flash point.
- Tetraethylene Glycol Dimethyl Ether or TETRAGLYME is the most complex of the three solvents. It has a very high flash point (230F). An etchant made with this solvent yields marginal bond strengths since the complexity of the solvent inhibits release of the active ingredient - sodium - to the etching process.

3.2.1 Chemical Etching Detailed

Different polymers are built of different monomers. For example, PTFE is built by combining many monomer units with the structure CF₂=CF₂ into a single long chain. Each monomer unit is connected to two others, one at each end, except for the two end units, which are called terminal units. If one connects n monomer units to each other one obtains the polymer: [-CF₂-CF₂]_n. In typical polymers, n is very large and may be in the range of 5000 to 100 000. If n is small, i.e., 10 to 2000, the material may behave like a paste and it is often referred to as pre-polymer. Other polymers are built from other monomers, e.g., PVdF is built by combining the monomer Vinylidene di-fluoride, VDF, CH₂=CF₂ to form the polymer PVdF, [-CH₂-CF₂]_n.