Appendix H

National Electrical Manufacturers Association Report on Military Aircraft Wiring
1982

This report followed a NEMA study team visit to Navy repair facilities where they interviewed maintenance specialists and examined aircraft. The document includes:

- severe problems experienced by Poly-X, including frequent splitting (see especially Subsections 5.c, and 7.d, page 4).

- Subsection 1.d on page 5 notes that wire was replaced with the same kind of wire - more Poly-X.

- Problems with Raychem 55 were also discovered (see especially Section 9, page 5) by the team.
FINAL REPORT
OF THE
MILITARY AIRCRAFT SUBCOMMITTEE
OF
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
HIGH TEMPERATURE INSULATED WIRE AND CABLE SECTION

I. BACKGROUND

As a result of a memo (Air-4112C2:RD Ser 1906) issued by the Navy Aircraft Maintenance Branch, NAVAIR-04, dated 27 October 1981, the Military Aircraft Subcommittee was formed to investigate the claims therein (see Exhibit A attached).

II. LOCATION:

Dates & Aircraft Viewed:

<table>
<thead>
<tr>
<th>Location</th>
<th>Dates</th>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego, CA</td>
<td></td>
<td>F14</td>
</tr>
<tr>
<td>NAS - Miramar</td>
<td>June 16, 1982</td>
<td>A6, F14, F4S</td>
</tr>
<tr>
<td>San Diego, CA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAS - Oceana</td>
<td>July 21, 1982</td>
<td></td>
</tr>
<tr>
<td>Oceana, VA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NARF - Norfolk</td>
<td>July 22, 1982</td>
<td>No Aircraft seen due to the Committee not having portable steel tip shoes and prior trip arrangements not effective.</td>
</tr>
<tr>
<td>Norfolk, VA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

III. MEMBERS OF THE COMMITTEE

<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>James Anastasi</td>
<td>Brand-Rex Company</td>
</tr>
<tr>
<td></td>
<td>A Part of Akzoa, Inc.</td>
</tr>
<tr>
<td>Richard Collins</td>
<td>ITT Surfrenant Division</td>
</tr>
<tr>
<td>Robert W. Curren</td>
<td>Champlain Cable Corporation</td>
</tr>
</tbody>
</table>
b. FL4 engine wire exhibited tape wrapped Teflon insulation with spiral splits exposing conductors.

c. Flight-ready aircraft that were wired with Poly-X wires exhibit very frequent radial splits and cracks in every location where observed on F4, A6, E2C and FL4 aircraft. These insulation splits usually expose the conductor and severe conductor corrosion is found. Aircraft are flying with these severely cracked and exposed corroded wires in use.

6. Connector systems were reported to be more severe than wire problems.

a. Wingfold areas, wheelwells, engine bays and other areas where swamp conditions occur evidenced severe connector corrosion. Often complete cable retermination to a new connector or cable splicing to a potted connector is necessary. Wire bundles then become shorter and shorter as corroded connectors are cut off and new connectors put on. Drip loops become shorter or removed altogether, thereby intensifying the corrosion process.

7. Wire maintenance trouble and casualty reporting does not reflect cause of problem or identify type of wire insulation or connector involved. Trouble incident do not provide data to associate either failure rates or failure modes for specific wire types.

a. Although trouble report forms are well formulated, they require a great deal of time to fill in all the necessary information. The F4 "Technical Manual, Aircraft Maintenance" is well indexed and cross referenced, nevertheless it does take several minutes to obtain location identification codes and to cross reference them to proper trouble codes.

b. Code 160, "Broken wire or defective contact/connection", is a common report. Failure mode is indeterminate; it appears it is impossible to determine the problem, cause, or the type of wire insulation involved.

c. Harness bundles often contain several wire types, making identification, by aircraft serial number referral, questionable. Harness and wire bundles have or contain severely cracked Poly-X wire along with unaffected Kapton insulated wire.

d. Associated components, such as shorted connectors and circuit breakers which fail to trip, cause incorrect reports of wire problems.

e. Maintenance and workmanship defects to the wire cannot be viewed subsequent to an electrical incident. Workmanship related causes are not reported at all.
8. "Kapton caused fires" reported by NAVAIR-04 in F6 circuit breaker panels were found and reported to this Committee by NARF-North Island to have been caused by metal panel hole plugs. These plugs had extremely sharp edged, pointed retaining prongs. The wire had been forced into extremely tight bends and jammed against the side panels and plugs. A bulletin was issued directing replacement with an elastomeric plastic plug. A second bulletin was issued for extension of the connector bracket to alleviate the tight bends of the installed wire. These repairs are still underway.

9. NARF- Norfolk stated that Product 55 MIL-W-22759/34 exhibits a serious notch propagation problem and they stated that a nick in the wire insulation eventually created a 360° opening down to the conductor. They stated they have reported this problem to the proper authorities including NAC.

VIII. RECOMMENDATIONS

1. Maintenance personnel at all levels need additional corrective training to improve maintenance adequacy in a currently more demanding environment.

   a. Teach wire type and/or style identification skills. Maintenance personnel are not aware of wire insulation differences.

   b. Casualty reporting should be made more responsive to actual casualty cause. This should be as simple as possible and still accurately reflect the problem.

   c. Include wire and connector type or style in failure reporting.

   d. Current maintenance policy encourages Naval personnel to replace wire with like wire. When Poly-X is replaced, Poly-X is used from the abundant inventory, despite the known tendency for insulation splits and the obsolescence of this wire style.

2. Maintenance procedures for current wiring should be updated and brought into conformance with today's requirements.

   a. Provide proper tools: Squadron level maintenance workers are not provided the proper wire stripping tools for MIL-W-81381 (Kapton) wire. Improper tools lead directly to wire termination and handling problems.

   b. Increase repair technicians awareness of potential problems: Inspection of wire installation and repair is now done by the technician who does the repair. Many misinstalled cables, missing clamps, improperly replaced clamps, tightly stretched cable bundles, inadequate clearance from retracted oversize spinning wheels, lack of drip loops after retermination and other causes lead to direct