Appendix F

Letters from Boeing and McDonnell Douglas to NTSB on Raychem Wiring
July 18, 1995 and July 20, 1995

- Boeing states they do not have safety concerns with the wires, page 2.

- Boeing notes high wire-to-wire abrasion in some Poly-X wiring, but does not blame the wire specifically. Minor deterioration on Stilan in tests noted. page 2.

- Boeing mentions there was no procedure for DOD to notify Boeing of problems not on Boeing aircraft, page 3.

- McDonnell Douglas states it believes the wires are suitable, page 2.


- McDonnell Douglas notes Poly-X insulation failure due to overstamping, causing a fire, but does not blame the wire specifically, page 2.
July 18, 1995
B-U01B-15311-ASI

Mr. Greg Phillips
National Transportation Safety Board
490 L'Enfant Plaza East, SW
Washington, D.C. 20594

Subject: Inquiry Regarding the Use of Certain Raychem Manufactured Wires on Boeing Commercial Airplanes

Reference: Your letter to John Purvis dated 17 Mar 95, same subject

Dear Mr. Phillips:

In the reference letter you asked Boeing to provide information concerning the use of certain Raychem manufactured wires on Boeing airplanes. The letter describes Mr. Edward B. Block's belief that the insulation materials for "Poly-X, Raychem 55 and Stilan" wires break down in the presence of water, hydraulic fluid and deicing fluid and may result in stray or spurious signals emitted from the insulation cracks. He also reportedly states that this breakdown may cause stray signals to adversely affect aircraft spoilers and autopilots. Finally, he reports that the U.S. Department of Defense ordered the removal and replacement of "Poly-X, Raychem 55 and Stilan" wires installed on Grumman F-14 aircraft because of known deficiencies.

Before we reply to your specific questions, we would like to provide some background information. Before wires can be purchased for use in Boeing commercial airplanes they must be "qualified" to Boeing material specifications. These Boeing material specifications are similar in nature to the Military Specifications (Mil Specs) that govern electrical wires and cables, however, they typically contain additional performance and manufacturing handling requirements. We qualify new wire products to the Boeing material specifications by testing them in our own facilities. The specifications are revised to address in-service problems, should they arise, and to incorporate improvements that become available.

Boeing monitors and corrects in-service problems reported by our customers, the FAA and foreign regulatory agencies, our suppliers, component manufacturers, other airplane manufacturers, etc. If we hear of problems from any of these, or other, sources that we do not already understand, we research the reported problem in our laboratories to determine if it could affect the airplanes we make. Our intent is to study and address any significant problems before changes are required by regulatory authorities.
The Raychem "Poly-X, Raychem 55 and Stilan" wires have all been "qualified" and have been used with good success in Boeing airplanes. We have not experienced the problems Mr. Block alleges and we do not have safety concerns with these wires.

Your specific requests for information and our replies follow:

Q1) 'Any known adverse characteristics related to age deterioration of "Poly-X, Raychem 55, or Stilan" wire used in aircraft manufactured by Boeing. Also provide the details of any known deterioration of these wires that are related to the presence of water, hydraulic fluid, [or] deicing fluid.'

A1) We are aware of reports of radial cracks on Poly-X wires in some military airplane applications. However, we have not received reports of unusual or accelerated deterioration of insulation on these wires on Boeing commercial airplanes.

In the early 70's, we experienced high wire-to-wire abrasion in some Poly-X wiring installed in high vibration areas of the 747 airplane. This in-service problem was corrected by changing clamping locations, wire routing and installation procedures. We applied what we had learned from studying this situation to the design and manufacturer procedures used on later airplanes. We do not attribute this higher than expected abrasion to deficiencies in the wires and it did not result in any safety concerns.

The Poly-X wires were replaced by Stilan wires in production as a product improvement. We found in the laboratory that the Stilan wires are susceptible to deterioration with prolonged exposure to certain alcohols. This has not lead to in-service problems because the exposure times necessary to cause deterioration are much greater than that experienced in service.

Q2) 'Any known or suspected failure of "Poly-X, Stilan, and Raychem 55" wire that resulted in an adverse effect to the safety of flight of a Boeing commercial transport category aircraft.'

A2) We are not aware of, nor do we suspect, any failure of Poly-X, Stilan or Raychem 55 wire that resulted in an adverse effect to the safety of flight of a Boeing commercial transport category airplane. (This excludes cases of wire chaffing as the result of improper installation or maintenance practices, or wires damaged as the result of explosion, intense fire, etc.)

Q3) "Any design changes made to Boeing commercial transport category aircraft in response to electrical wire design deficiencies identified by the Department of Defence or other government agency (other than the FAA)."
A3) We are not aware of any requirement or procedure for the DOD to notify us of problems experienced on aircraft not manufactured by Boeing. However, as explained below, there are many sources of information from which we are able to learn of reported wire problems.

For example, in the mid 1980's the resistance to moisture and the arc resistance of wire and cable insulated with Kapton (Polyimide) insulation was the subject of much debate, particularly within the Military. (These wire were not manufactured by Raychem.) We investigated the situation by analysis of the Kapton insulated wire in the fleet and by analysis of many laboratory tests. Although the in-service performance of Kapton insulated wire was extremely good, there was need for improvement. This lead to the development of a new Boeing specification for wire that is now common use. It is not possible to identify the DOD or any other single source of the information which led to Boeing taking this action.

Q4) "Any program, policy, or procedure that Boeing has in place to review material defects or discrepancies that may be identified by another aircraft manufacturer."

A4) It is Boeing's policy to monitor problems reported by our customers, the FAA and foreign regulatory agencies, our suppliers, component manufacturers, other airplane manufacturers, and others. There is also frequent interchange of information as the result of our membership in national technical committees and contact with counterparts in other airplane manufacturers. The aircraft wire and cable community is relatively small and it is relatively easy to keep up to date on the problems reported by others.

We should also point out with regard to Mr. Block's reported suggestion that an insulation breakdown may cause stray signals to adversely affect airplane systems, that even if insulation is deteriorated, it does not necessarily follow that a stray signal will adversely affect the safety of the airplane. Airplane system redundancy and wire/wire bundle separation, minimize the possibility of a wire anomaly, from causing a safety problem.

If The Boeing Company can be of further service, please do not hesitate to call.

Very truly yours,

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Mr. Gregory J. Phillips  
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National Transportation Safety Board  
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Subject: Raychem Electrical Wire

Reference: NTSB letter dated 17 March 1995 to Steve Lund  
of Douglas Aircraft Company from Greg Phillips

Dear Mr. Phillips:

Representatives of Douglas Aircraft Company (DAC) and McDonnell Douglas Aerospace (MDA) have reviewed the subject letter and applicable files involving the versions of “Poly-X, Stilan, and Raychem 55A” electrical wiring manufactured by Raychem Corporation and used in DAC commercial transport category aircraft. DAC installed “Poly-X” wire only on early production DC-10 aircraft.

In response to the four questions in your letter, DAC offers the following information:

1. DAC is not aware of adverse characteristics related to “age deterioration” of the versions of “Poly-X, Raychem 55A and Stilan” wire utilized on DAC commercial transport aircraft. In addition, DAC is not aware of any deterioration of these wires related to the presence of water, hydraulic fluid and/or deicing fluid.

During the first six months of 1978, DAC became aware of instances of “Poly-X” wire insulation wear damage caused by wire chafing in high vibration areas of DC-10 aircraft. Many of the wires were associated with the flight guidance system and some were autoland critical wires. DAC issued DC-10 Alert Service Bulletin A24-99 to inspect and test these wires, DC-10 Service Bulletin 24-99 to replace the “Poly-X” wire with an approved alternate wire (Stilan, Raychem 55A or Kapton) and DC-10 Service Bulletin 24-98 to revise bundle supports and clamping in high vibration areas. In addition, the FAA issued Airworthiness Directive 79-05-01.
During 1976, DAC became aware of a DC-10 wheelwell wire bundle failure involving “Poly-X” wire. The failure occurred on the ground after the wheelwell had been washed. DAC determined that the most probable cause was wire insulation failure due to overstamping of the wire identification in combination with the highly conductive cleaning solution which resulted in subsequent arcing. This particular failure could occur with any electrical wiring and is not peculiar to wire manufactured by the Raychem Corporation. DAC All Operator Letter (AOL) 10-1065 was issued to advise operators of this occurrence.

2. DAC is not aware of any known or suspected failure of “Poly-X, Stilan, or Raychem 55A” which resulted in an adverse effect to the safety of flight of a DAC commercial transport category aircraft.

3. No design changes have been made to any DAC commercial transport category aircraft in response to electrical wire design deficiencies identified by the Department of Defense or other government agency (other than the FAA).

4. With regard to any program, policy or procedure that DAC has in place to review material defects or discrepancies that may be identified by another manufacturer, DAC states that in addition to informal industry-wide channels, DAC participates in the Government Industry Data Exchange Program (GIDEP) and industry associations.

In summary, DAC believes that the versions of “Poly-X, Stilan, and Raychem 55A” wire used by DAC on commercial transport category aircraft are suitable general purpose wires provided that the wiring is properly handled, installed and maintained throughout the service life of the aircraft.

For your convenience, I have enclosed copies of the following documents:

1. DC-10 Service Bulletins A24-99, 24-99 and 24-98; AD 79-05-01; and AOL’s 10-1073 and 10-1073A which relate to wire chafing in high vibrations areas.
2. AOL 10-1065 which relates to the wheelwell wire bundle failure.

3. AOL's 10-1288, 10-1407, 9-1478, 9-1478A, 8-949, 10-1724 and 10-1724A which relate to general purpose wire replacement programs on DAC commercial transport category aircraft.

Please do not hesitate to contact me if you have any questions or desire additional information.

Very truly yours,

[Signature]

Larry L. Fogg
Senior Principal Specialist
Design Assurance & Safety

LLF:bew
Enclosures - Noted