New Materials for the Repair of Polyimide Electrical Wire Insulation

Wire/Cable Inspection and Repair

Two viable polyimide backbone materials have been identified that will allow the repair of polyimide electrical wire insulation found on the Space Shuttle and other aging aircraft. This identification is the outcome of ongoing efforts to assess the viability of using such polyimides and polyimide precursors (polyamic acids [PAAs]) as repair materials for aging polyimide electrical wire insulation. These repair materials were selected because they match the chemical makeup of the underlying wire insulation as closely as possible. This similarity allows for maximum compatibility, coupled with the outstanding physical properties of polyimides. The two polyimide backbone materials allow the polymer to be extremely flexible and to melt at low temperatures. A polymer chain end capping group that allows the polymer to crosslink into a nonflowable repair upon curing at around 200 ºC was also identified. The table highlights two repair materials prepared from each of the two backbone materials identified. Two films, one from each backbone, are soft, flexible films suitable for manually wrapping damaged wire. The other two are stiffer, more rigid films to be formed into "sleeves" that can easily be slipped onto a wire. Both of the wire repair materials achieved excellent results. Figure 1 shows that the repairs (on 12-gauge polyimide insulated wire) are small and compact, exhibiting excellent flexibility. Methods have also been established to repair electrical wire insulation based on fluoropolymers (polytetrafluoroethylene materials [Figure 2]). In addition, a heater was developed to melt and flow the materials, which enables the curing process required for repairs. A portable soldering iron was modified with a custom head designed to accommodate a wire wrapped with repair film. Figure 3 shows the wire holders that were modified for repairing wires.

Characteristics of repair materials prepared from two viable polyimide backbone materials.

Polymer	Type	Film Forming Ability	Wire Repair Results	Comments
A-1	Imide	Excellent	Good	Soft for wrapping; very good on voltage breakdown
A-2	Imide	Excellent	Good	Stiff for sleeve type repair
B-1	Imide	Excellent	Good	Soft for wrapping; v. good adhesion
B-2	Imide	Excellent	Good	Stiff for sleeves

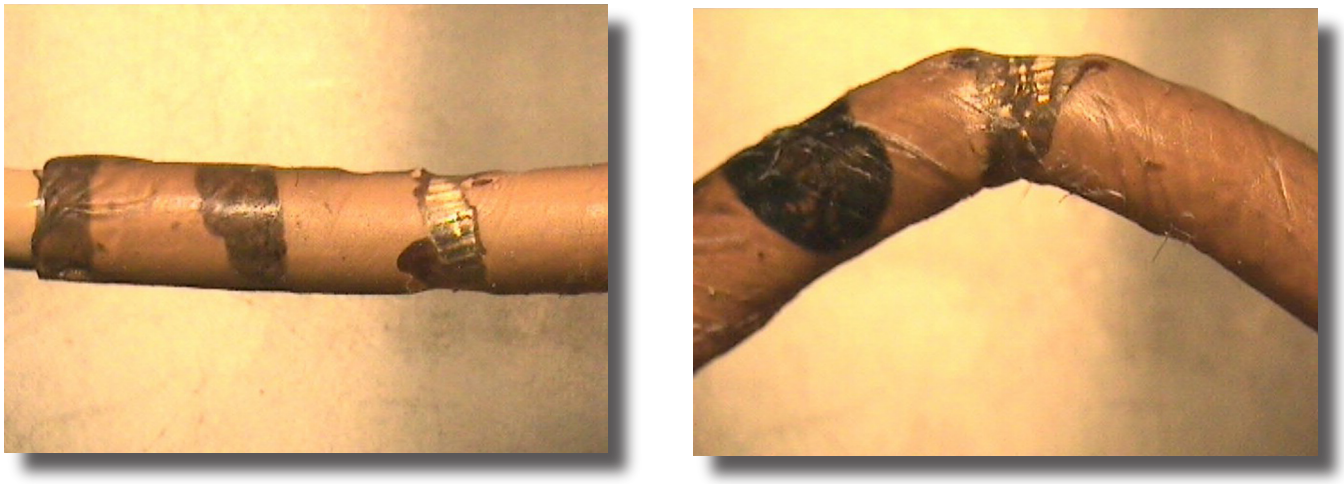

Figure 1. Small, compact repairs on 12-gauge insulated wires exhibit excellent flexibility.

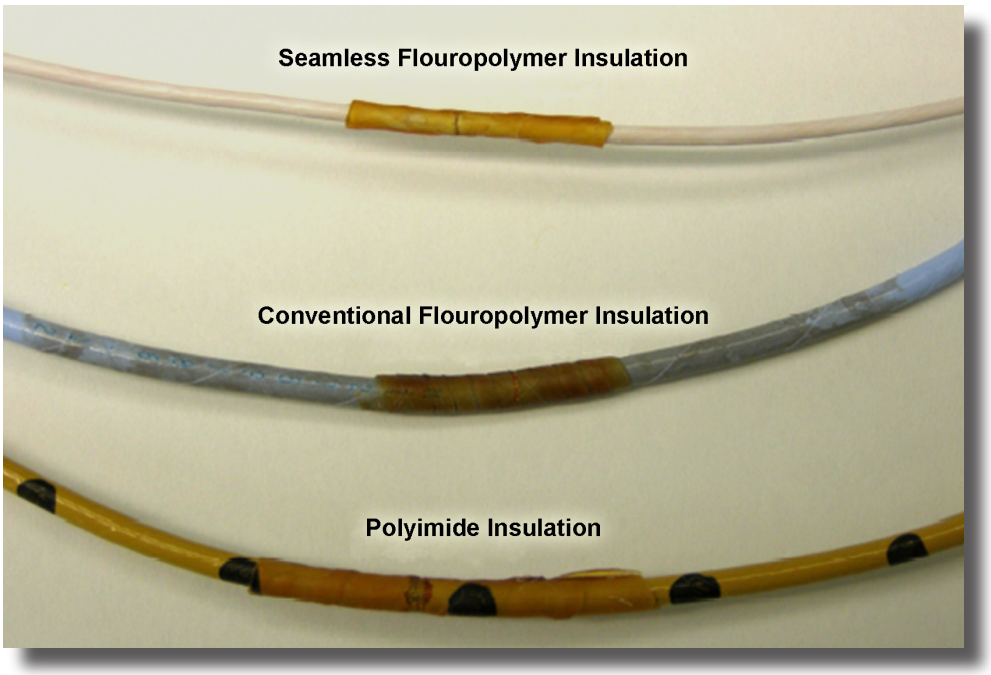

Figure 2. Repairs to various types of wire insulation materials.

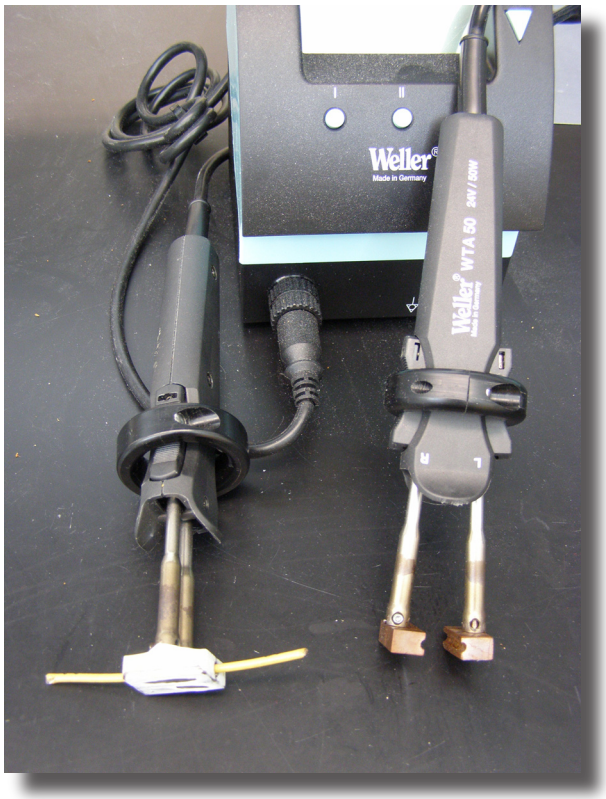

Figure 3. Wire holders modified for repairing wires.

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