Lectromec LECTROGRAM©

July 2005 Newsletter

A Resource for your Wire Maintenance Program

The amount of wiring on a civil aircraft has increased in recent decades such that today's typical aircraft has hundreds of miles of wire connecting all of its subsystems. The increase in the amount of wire on an aircraft, coupled with weight concerns, has lead to progressively thinner and lighter insulation materials. Wires used on today's aircraft are 70% lighter and occupy 20% of the space of their 1950's counterparts. When considering that the insulation on today's wires can be as thin as three human hairs, we should realize that modern aircraft wiring is a fragile, yet critical component of the overall aircraft electrical interconnect system.

Each insulation material has advantages and disadvantages that make it perform well under some circumstances and unacceptably in others. Some wires are especially resistant to fire, others are resistant to chafing. Before selecting a type of wire to install on an aircraft, one should understand the properties of the insulating material and the environmental conditions to which the wire is exposed.

Not all wires are the same

Additionally, identifying types of wire can be extraordinarily difficult because wires come in a variety of colors and may not have any identifying markings. It is also difficult to identify wire based on the type of aircraft in which it is found and even experts on the subject are often unable to identify wire types with only a visual inspection. We have presented two types of wire and summarized their properties to illustrate the wide range of advantages and disadvantages to different types of insulation.

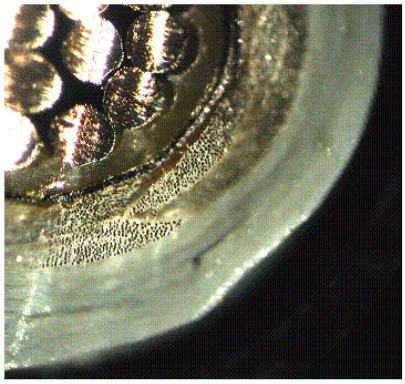
Aromatic Polyimide

✔ **Trade names**:
Kapton™, Apical™

✔ **Identification codes**:
BMS 13-51, MIL-W-81381/7 through /14 and /17 through /21, DMS 7007, and others

✔ **Aircraft used in**:
- Space Shuttle
- Airbus
- B727
- B737
- DC-10
- F-14
- F-16
- P-3

(Not all-inclusive)



Cross Section Photo of BMS 13-51

✔ **Advantages:**
- Lightweight, typically 4.6lbs./1,000 ft.(6.8 kg/km)(20 AWG)
- Good abrasion and cut-through resistance
- Passes standard low temperature chemical flame tests.
- Excellent thermal and electrical properties.

✔ **Disadvantages:**
- Will crack or delaminate when it ages
- Prone to wet and dry arc tracking
- Will deteriorate when exposed to heat or stress
- The only insulation type mentioned by the Federal Aviation Administration (FAA) as not to be mixed with other insulation types because of its propensity to cut through softer insulations.

✔ **Overall**: Widely used in commercial, aerospace and military vehicles because of its light-weight and resistance to abrasion. Not found on new aircraft as much because of its propensity to sustain high temperature electrical arcs. Note: the preceding information applies only to the H-film build seen in the left column photo. The DuPont Oasis ™ insulation will be addressed in a future Lectrogram.

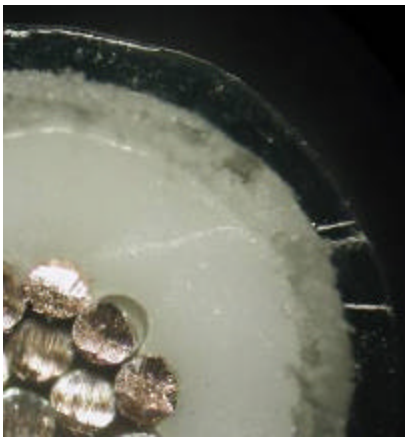
Polyvinyl Chloride (Constructed with Nylon topcoat)

✔ **Trade name:** Quad 4™

✔ **Identification codes**: BMS 13-13, MIL-W-5086/1 and /2

✔ **Aircraft used in**:
- B707
- B727
- B737
- DC-8
- DC-9
- KC-135
- A-10
- C-130

(Not all-inclusive)



Cross Section Photo of Quad 4™

✔ **Advantages**:
- Good resistance to chafing (thicker insulation)

✔ **Disadvantages**:
- Loss of dimension and weight over time
- Discolors with moderate heating.
- Produces harmful gasses and smoke when it burns
- Comparatively low temperature rating measured against aromatic polyimide
- Heavy, about 6.8 pounds/1,000 ft (10 kg/km) (20 AWG)

✔ **Overall**: Will not pass the FAA's 60º flame test. Gasses from burning are extremely harmful if inhaled. Although this wire does not meet current standards, it is still found on some older aircraft.

It is not just insulation that protects wires, but also a trained maintenance staff. When maintaining or replacing wires, it is vitally important to understand their properties. The wrong wire placed in the wrong environment can significantly impact aircraft airworthiness. Proper electrical systems maintenance and care can both improve aircraft readiness and help retain the resale value of your aircraft.

For more information on these and other wire types, and their implications for safety, contact Lectromec.

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Lectromec is a full-service firm specializing in safety assessments of aircraft and space systems wiring; our specialty is in understanding the electrical and physical properties of wire insulation and the ill effects of damaged wiring.

Lectromec's safety evaluations run the gamut of the vehicle life cycle. With our Risk Assessment Tool, Lectromec experts can assess the safety of a wiring system in new production aircraft to help avoid problems and costs associated with in-service failures. Similarly, Lectromec can evaluate the safety of wiring and bundles associated with a Supplemental Type Certificate (STC) installation or modification before they are added to the existing wire system. Lectromec offers specific guidance regarding the routing and placement of wiring to minimize the chance of failures caused by inadequate routing practices, collocation of wiring with other systems (such as hydraulics or thermal acoustic insulation blanketing), or by other conditions that may affect system reliability.

Lectromec WIDAS Test Jigs

The goals of such analyses are to avoid design-induced failures and to maximize trouble-free service life of wiring.

Additionally, Lectromec conducts laboratory assessments of existing wire installations to predict the remaining life of existing wire systems. This information is critical to any program of selective wire replacement. Lectromec maintains a Wet/Dry Arc Tracking Station, an Accelerated Aging Test Apparatus, Hi-Pot Station, DelTest™ Station, Humidity Chambers and other facilities. With our range of testing methods and expertise, Lectromec can help assure maximum life for existing wiring, minimize the potential for electrical arcing, and guide selective replacement of wiring to assure continued safety.

Lectromechanical Design Company has worked closely with a number of government agencies and private corporations to provide guidance in wiring reliability and risk assessment. We have assisted the National Transportation Safety Board (NTSB) in accident investigations where wiring may have been a factor, the Federal Aviation Administration (FAA) in its zonal assessments of wiring in high-time commercial transports, and made various military assessments of the safety and potential service life extensions of aircraft wiring.

For objective, quantifiable analyses of wiring, its service life under different conditions, its routing in various zones of the aircraft, and its resistance to arcing, Lectromec stands ready to assist. Remember, the more reliable the wiring, the less down time for trouble-shooting and repair of wiring related faults. We can help prevent such failures through improvements in the design phase and, subsequently, through improved programs of wire husbandry in service.

WIRE IDENTIFICATION

As was discussed on the front side of this newsletter, the identification of aircraft wiring is extraordinarily difficult. If you are unsure about the wire used on your airplanes, please contact Lectromec. We can assist you in identifying the wire and can offer advice as to its condition and impact on the reliability of the aircraft electrical system on your airplane.

We will be happy to receive your inquires from 9:00 am to 6:00 pm EST. Or you may contact either

Michael Traskos: Mtraskos@Lectromec.org
Or
Micah McCutchan: Mmccutchan@Lectromec.org

Please contact us if you would like more information on our services or would like to discuss your wiring needs.