



National Transportation Safety Board

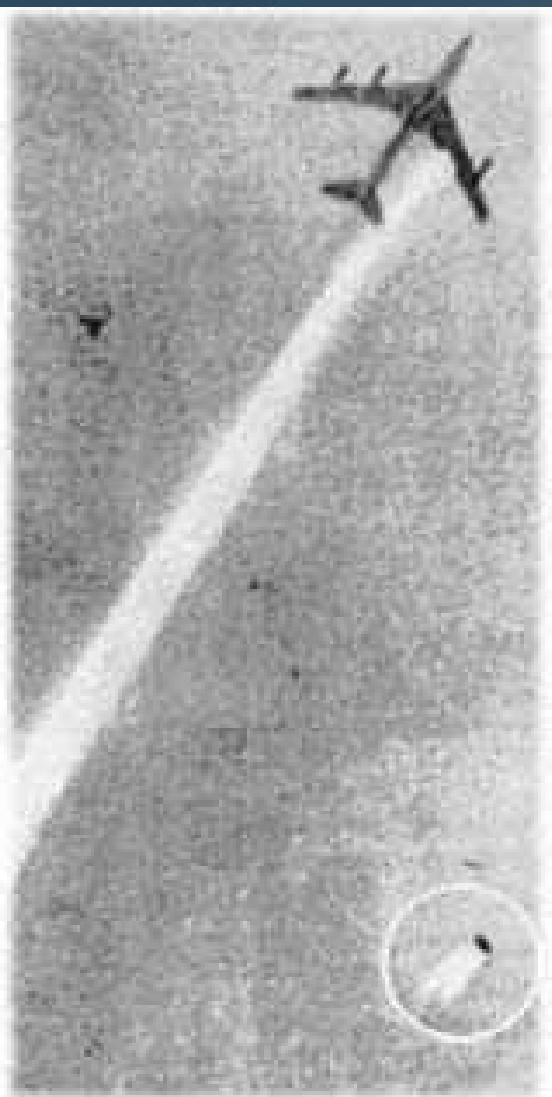
Robert L. Swaim

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Fire Issues

October 23, 2001

The Safety Board has investigated aircraft fires since inception on April 1, 1967



BOAC 707 uncontained engine failure results in in-flight fire, engine separation, then fuel ignition during emergency landing. Five fatalities. April 8, 1968

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Accident Investigations Result in Recommended Changes and Research

June 2, 1983, Air Canada DC-9 in-flight fire led to recommended changes.



December 1, 1984, Controlled Impact Demonstration Test



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Accident Investigations Can Lead to Sweeping Changes (Legacy Events)

TWA flight 800, July 17, 1996:



Fuel Tank Protection
Aging Systems (Mainly Wire-Related)

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ValuJet 592 as a Legacy Event



- ValuJet Safety Issues Included:
- Minimization of the Hazards Posed by Fires in Class D Cargo Compartments;
- Equipment, Training, and Procedures for Addressing In-Flight Smoke and Fire;

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Recommendations Remain Pertinent

Varig Airlines B-707, July 11, 1973, near Paris, France.

Crashed after fire began in an aft lavatory and safety recommendations resulted in:

- Lavatory Smoke Detectors,
- Walk-around oxygen bottles,
- Organization of a Government /Industry task force. FAA organization of SAFER in May 1988, further addressed cabin interior materials.

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Accident Investigations Can Result in Less Visible Improvements

- Other ValuJet Safety Issues Included:
 - Oversight of Contract Maintenance Facilities by Operator & FAA;
 - FAA Oversight;
 - And Lap Child Accounting.



Incident Investigations May Result In Recommended Changes

Safety Recommendations (A-91-70 through -72) were issued that the FAA should:

- Require quality control & inspection procedures for wire installations.
- Notify FAA personnel and operators about fire hazards posed by accumulations and other debris.
- Require that maintenance manuals be amended to ensure thorough inspection & cleaning.

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Not All Recommendations Are Implemented

TWA 800 Resulted in Similar Recommendations

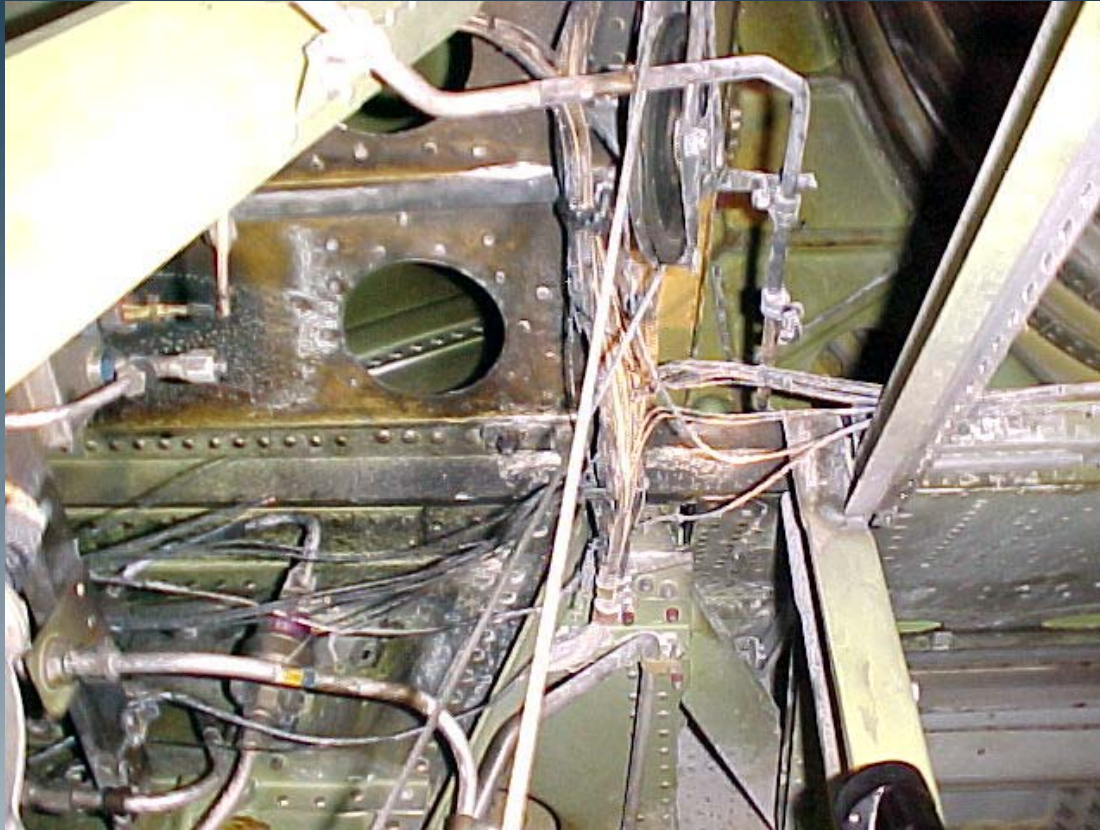


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FIRE EVENTS CONTINUE

Most are little-known



May 2001 Fire in 727 Air-stair Area Resulted in All-Base Operators Message & Fleet Inspections

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NTSB Records Are Available

- NTSB Official Accident Data Base
 - Nine Part 121 Records
- NTSB Web-Site (www.nts.gov)
 - 5,938 Total Records (includes GA)
 - Includes Both Accidents and Incidents
 - May be Sorted
 - Records Need To Be Checked Before Use

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Accident and Incident Study

Encouraged

FTW83LA093

January 16, 1983, Bay City, Texas

DC-3

The Guatemalan registered aircraft collided with the ground while dropping bales of marijuana on a beach. According to witnesses, while the aircraft was making low passes...the propeller struck the beach...The crew unsuccessfully attempted to set the aircraft on **fire**.

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Records Must Be Individually Verified!

No evidence of **fire** was found...

Cessna 185 engine compartment **fire** originated
by over-use of primer ...

Post-crash **fire** had consumed...

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NTSB Issues & Recommendations

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Prevention

Response

Retain Control

Hardening,

Automated Responses,

Crew Responses

Evacuation



RESPONSE ISSUES

Horizon Air, DHC-8, April 15, 1988, Seattle, WA

The fire itself may affect continued control, hardening against damage, and responses to the event:

The right nacelle had an in-flight fire, due to improperly reinstalled fuel filter cover. Directional control could not be maintained during landing.

Investigation found that fire & explosion opened engine access panels, reducing effectiveness of fire suppression system and allowing other systems to be damaged.

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Further NTSB Presentations on Response Issues

Crew Response to In-Flight Fires

Cindy Keegan

Evacuation Slide/Raft Reliability

Jason Fedok

Evacuation Study

Dr. Debbie Bruce

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Prevention

Deny Fuel &/or Oxygen -

Fuel Tank Recommendations

Aging Aircraft Recommendations

Prevent Ignition -

Maintenance and Aging Aircraft Efforts

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Research and Recommendations to Deny Fuel &/or Oxygen

Safety Recommendations A-96-174 & -175 begin:

Require the development and implementation of design or operational changes that will preclude the operation of transport-category airplanes with explosive fuel/air mixture in fuel tanks

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A fuel tank...philosophy that relies solely on the elimination of all ignition sources ... is fundamentally flawed because experience has demonstrated that all possible ignition sources cannot be predicted and reliably eliminated.

NTSB Finding 20

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Operating transport-category airplanes with flammable fuel/air mixtures in fuel tanks presents an avoidable risk of explosion.

NTSB Finding 21

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Research and Recommendations to Deny Fuel &/or Oxygen

Following Safety Recommendations A-96-174 & -175:

Two FAA ARACs created:

Largest population of each represented vested parties.

Both wrote that inerting was too expensive.

Further concentration on ignition-prevention.

A-96-174/-175 remain in NTSB

“Top 10” recommendations list.

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Fuel Tank Explosions Continue

Thai 737 Fuel Tank Explosion of March 3, 2001



No evidence of bomb.

Fuel pump testing about to begin.

Electrical and fuel quantity systems still under investigation

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Research and Recommendations to Deny Fuel &/or Oxygen (Airframe)

FAA goal of non-flammable interiors.

NTSB documented thick lint accumulations in 1991 and 1998.

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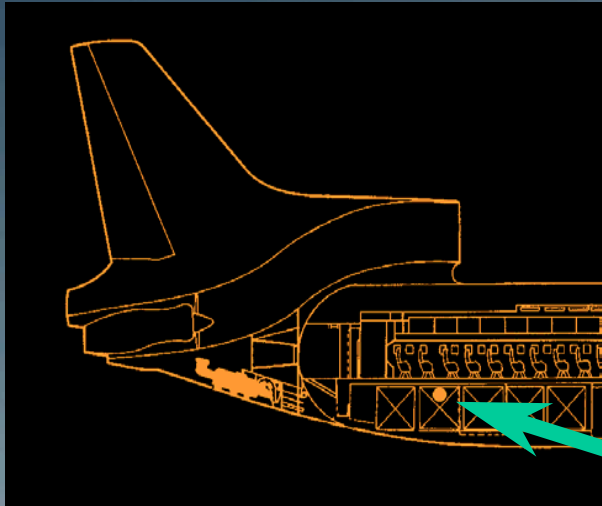
L-1011 In-Flight Fire of March 17, 1991

2 INCHES OF LINT
ON CABLES

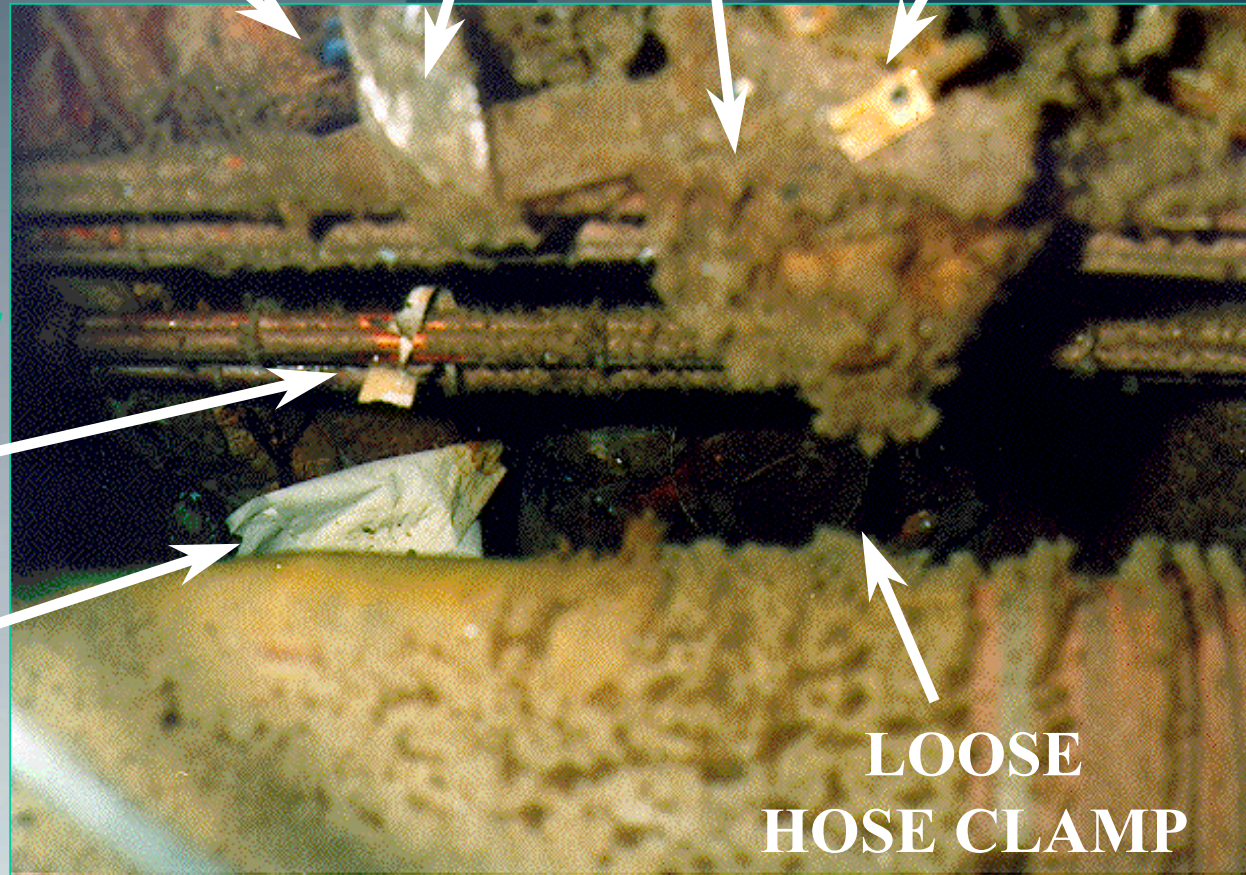
HYDRAULIC
"B-NUT"

PLASTIC
WRAPPER

NUTPLATE



FOIL WRAPPER
IN GEN. CABLES



PAPER

LOOSE
HOSE CLAMP

Research and Recommendations to Deny Fuel &/or Oxygen (Airframe)

NTSB investigation documented that FAA efforts in response to 1991 recommendations had not been effective.

Enhanced Airworthiness Plan for Aircraft Systems (EAPAS) calls for additional effort in cleaning.

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Research and Recommendations to Deny Ignition

Fuel Tank Ignitions

Fire in Pressure Vessel

Aging Aircraft (mostly wire-related)

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Research and Recommendations to Deny Ignition (Fuel Tank)

Following Safety Recommendations A-96-174 & -
175 came:

*Special Federal Aviation Regulation (SFAR)
New Regulations and Guidance Material,
Fuel Tank Design Reviews,
Fuel Tank Inspection and Maintenance Programs,
Transient Suppression Devices,
Review of Static / Lightning Protection in Tanks,
and other changes.*

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Research and Recommendations to Deny Ignition (Airframe)

Electrical causes lead airframe ignitions,
such as:

Chafed wires,

Overheated wires

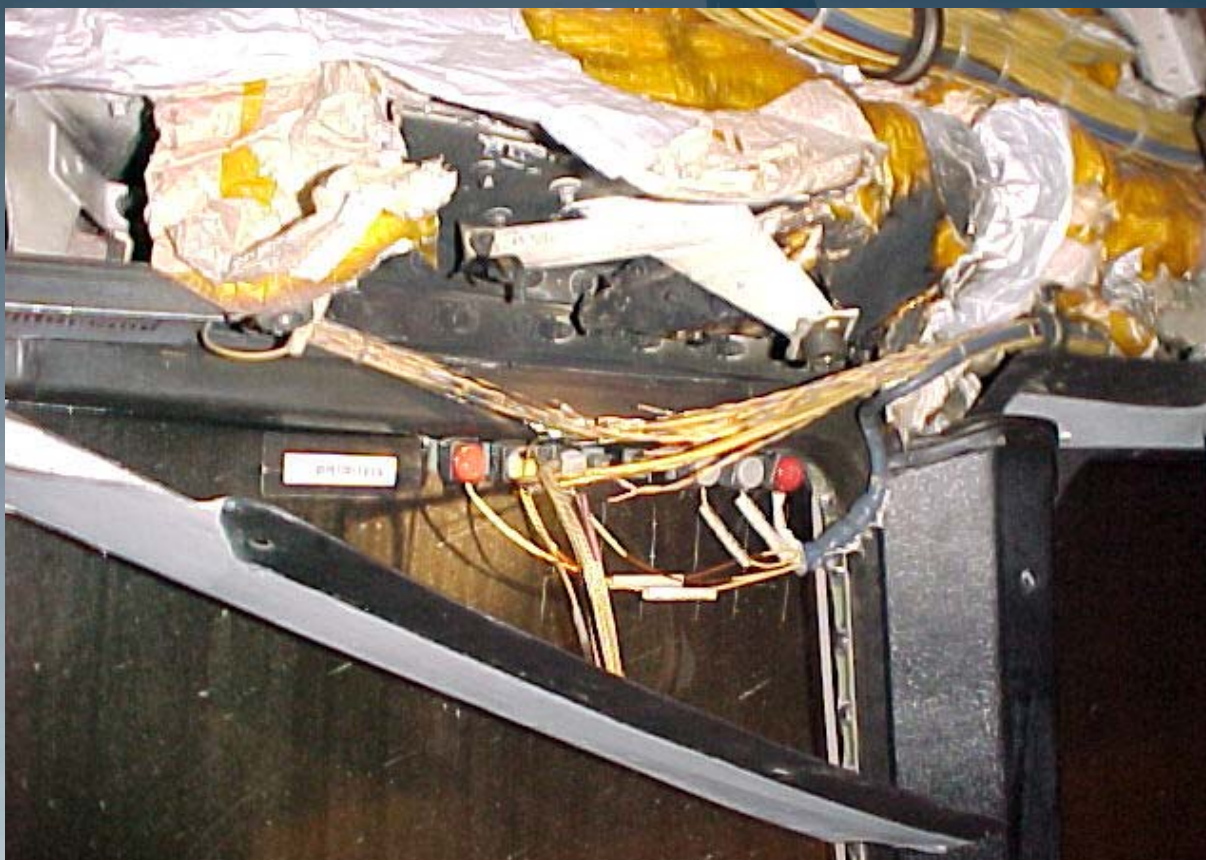
Degraded splices and connectors

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Most Fires Are Non-fatal

December 2000, LOCKHEED L-1011-385. Wire fire above
First Officer Window.



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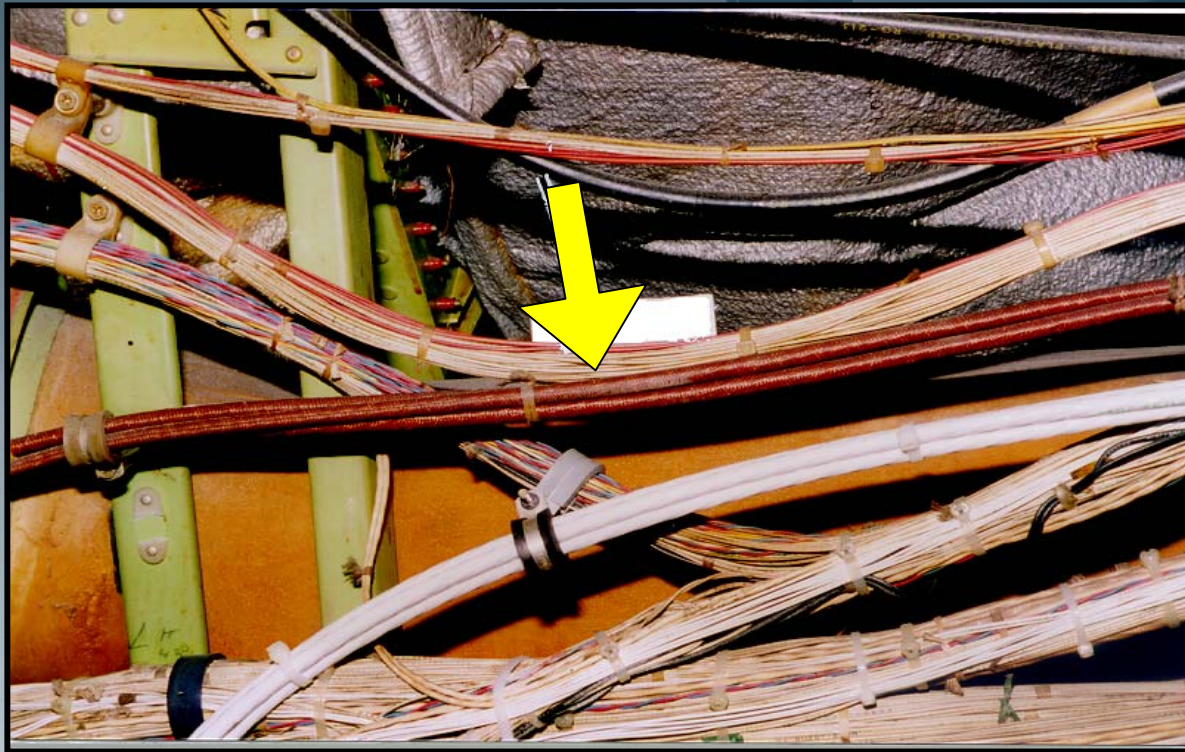
TWA 800 Investigation Revealed Potential Age-Related Problems That Could Lead to Ignition of Flammable Materials

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Potential Problems Found During TWA 800 Investigation Into Aging Aircraft

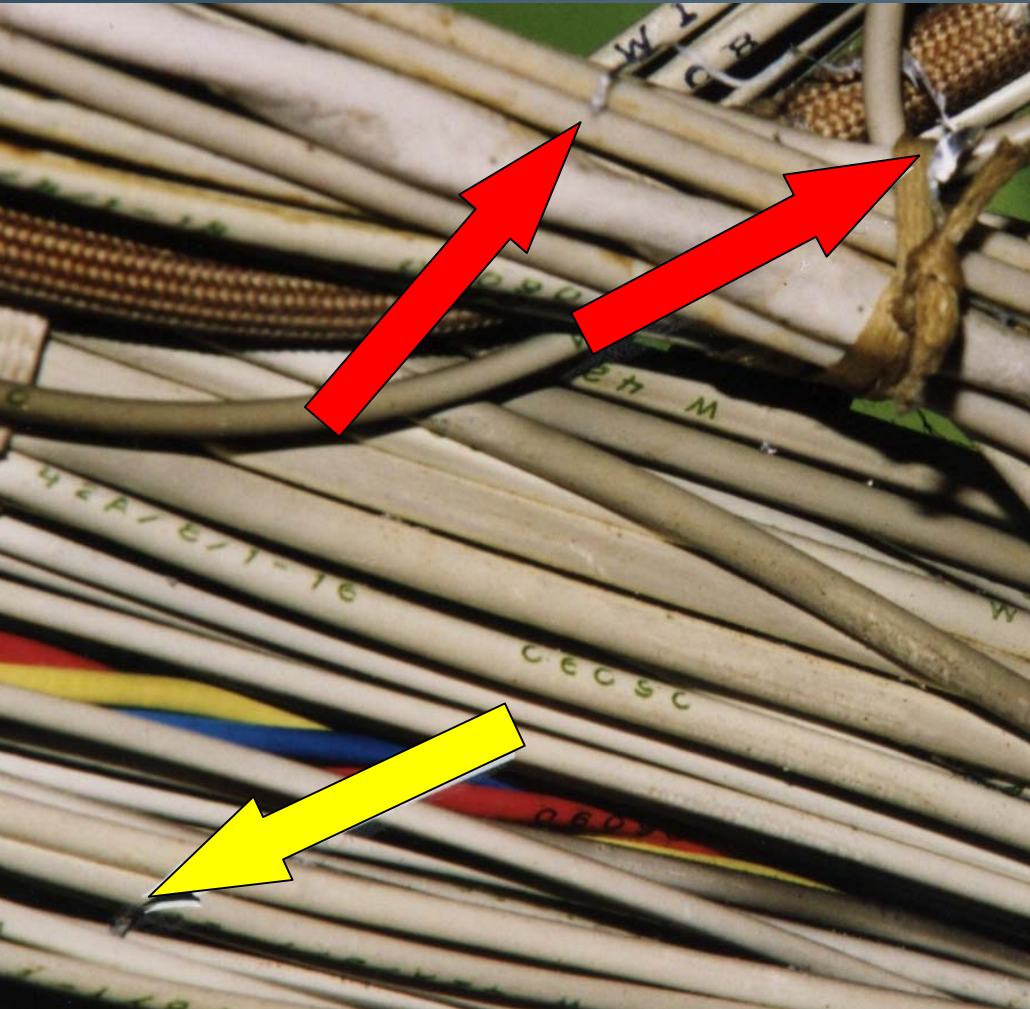
Chafe of Fuel & Galley Power Wires (747)



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Potential Problems Found During TWA 800 Investigation Into Aging Aircraft



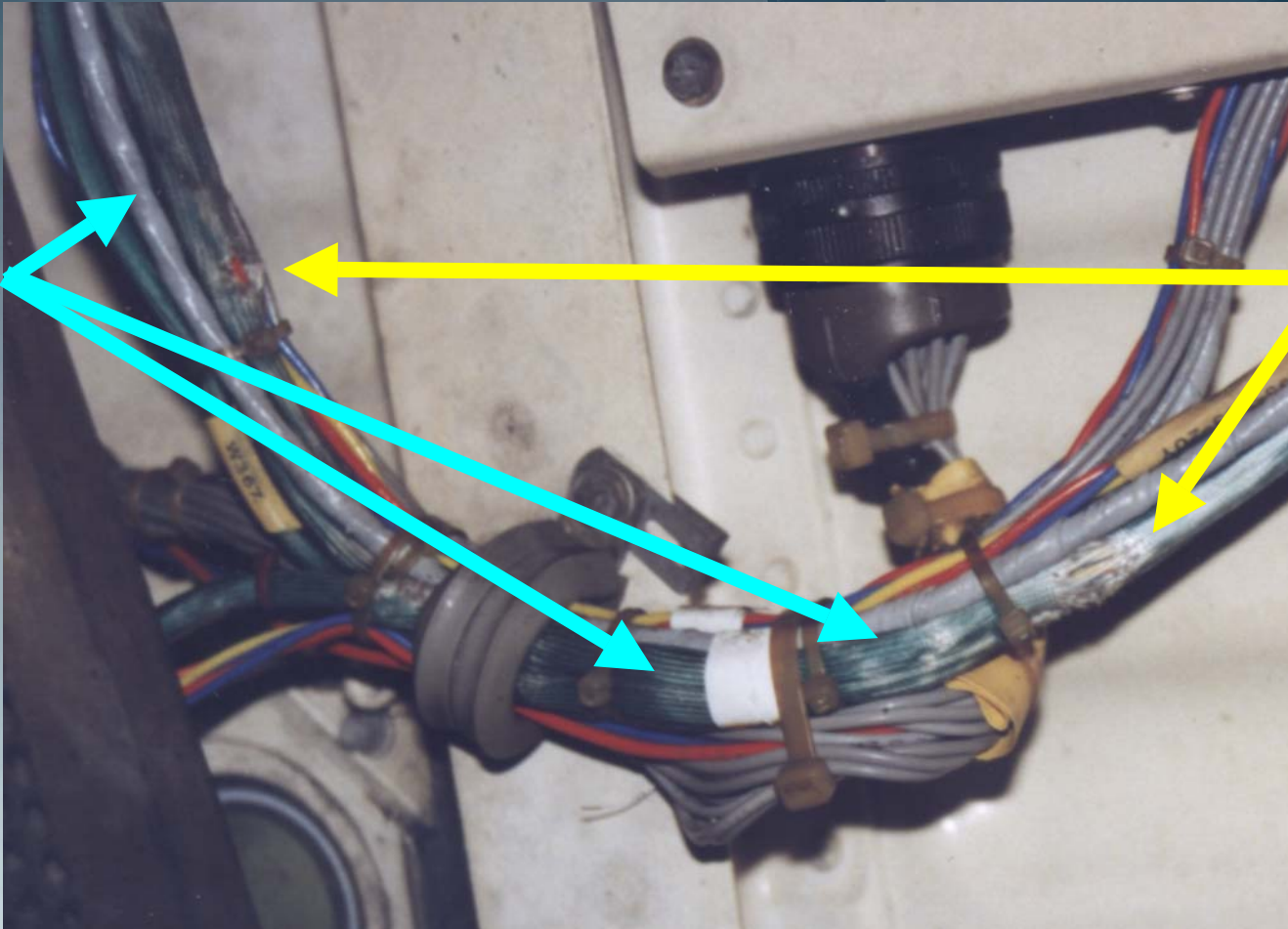
Shavings On Top
Of Wires And Coming
Through Bundle (747)

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Potential Problems Found During TWA 800 Investigation Into Aging Aircraft Lavatory Fluid Stains (737)

Blue
Lavatory
Fluid
Stains



Damaged
Wire
Sleeves





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FAA EAPAS Plan Addresses Potential Cleanliness (Fuel) and Ignition Issues

Research scheduled to take years.

Implementation not yet known.

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Ignition Sources May be Unrecognized



Gasoline carried in overhead luggage.
Uni Air MD-90 cabin fire at Hualian, Taiwan,
on August 24, 1999.

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Any Fire May be High-Risk



DCA96MA054, VALUJET AIRLINES DC-9, May 11, 1996,
Everglades, Florida, about 10 minutes after take off.

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SUMMARY

Certification Standards, Safety Equipment, Procedures, and Training Have Been Developed As A Result of Prior Investigations.

Most Events Are Non-fatal, but Low-probability Events Can Have High Risk.

Data Exists, But May Be Difficult to Extract and Must Be Carefully Analyzed.

Safety Recommendations Remain Pertinent

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<http://www.nts.gov>