



UK MOD DSTL EWIS CONDITION SURVEY PROGRAMME

Aircraft Airworthiness & Sustainment Conference

Brisbane, Australia

6th July 2018

EWIS CONDITION SURVEY (CS)

- The Defence Science & Technology Laboratory (dstl) has set up an EWIS Cradle to Grave (C2G) programme, managed, coordinated and carried out by CableConnect Solutions (CCS) Ltd.
- A major element of this programme is the provision of an EWIS CS on in-service platforms.
- Scope for 2 platforms per aircraft type.
- Project Teams can use the evidence generated from the EWIS CS to support Continuing Airworthiness and Ageing Aircraft Audits.
- Programme currently **98%** complete.

WHAT IS AN EWISCS?

- A non intrusive visual examination carried out as far as practicable in order to determine the current condition of the EWIS.
- Performed during an appropriate servicing that affords the best access to EWIS.
- The inspection is expected to identify degradation due to wear, vibration, moisture, contamination, damage, excessive heat, ageing etc.



STANDARDS

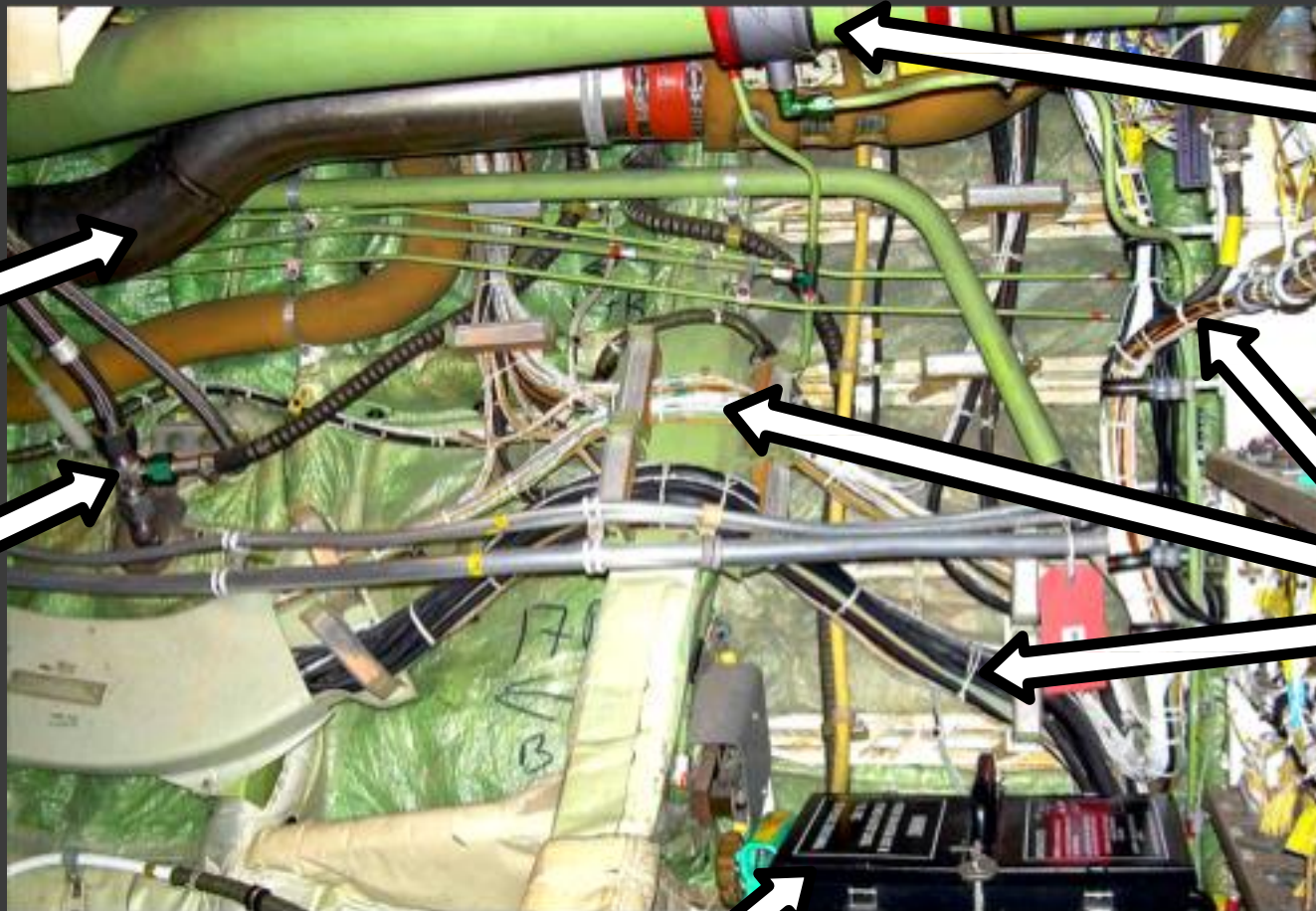
- EWIS CS use DESIGN & BUILD standards as the assessment criteria.
- Standards can be aircraft type specific or more universally recognized standards such as:
 - AS50881 Wiring Aerospace Vehicles
 - EN3197 Design and installation of aircraft electrical and optical interconnection systems (European)
 - Def Stan 00-970 Design and Airworthiness Requirements for Service Aircraft. (UK MoD)
- Other information, general guidance and best practices can also be utilised found in:
 - Maintenance documents
 - AP101A-0005-1 Aircraft Wiring Standards and Practices

TECHNIQUES

- A hands on 'Look and Feel' approach is required.
- Flashlight and mirror used to provide an adequate view of all surfaces.
- Magnifier (x10) used to assess suspected wire damage.
- NO requirement to disconnect or remove components.
- NO requirement to remove paint or sealant.



COMPLEX ZONE



FUEL
LINE

HOT AIR

OXYGEN

LOOMS

BATTERY

MAIN CONSIDERATIONS

- Wire, cable, loom damage
- Clearance
- Adequate protection
- Minimum bend radius
- Contamination
- Moisture ingress
- Corrosion
- Heat damage
- Repairs



TOOLS

The following tools are used:

- Flashlight
- Mini Flashlight
- Head Flashlight
- Flexible Mirror
- Standard Mirror
- X10 Magnifier
- Ruler



TAGGING

- Used to easily locate the observation.
 - Tied as close to observation as possible
 - Aids recovery
 - Uniquely identified

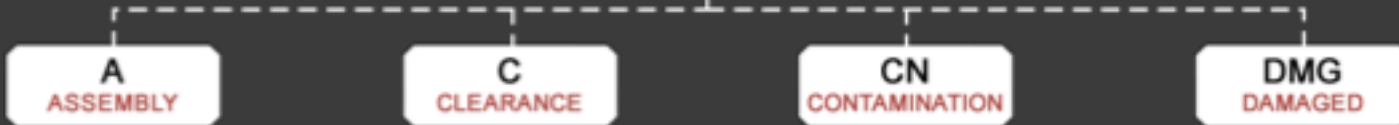


SEVERITY LEVEL

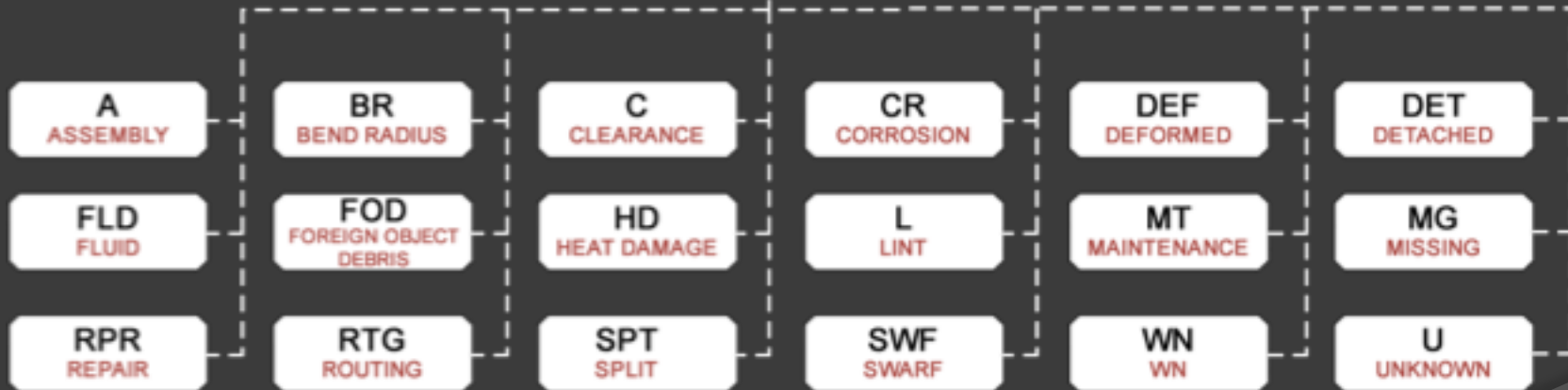
- CCS apply a purely subjective classification of severity to each observation raised. These are defined by CCS as:
 - Severity Level 1 - An observation that is considered to be an immediate airworthiness issue.
 - Severity Level 2 - An observation which has the potential to become an airworthiness issue, or was typical of a number of issues, which when taken together, could become an airworthiness issue.
 - Severity Level 3 - An observation which did not appear to meet the required standard, but which was considered unlikely to become an immediate airworthiness issue.

KEYWORD CODES

MAJOR KEYWORD CODES



MINOR KEYWORD CODES



DATABASE & SENTENCING

Where			What									
Entry No	Date	Zone	Tag No	Major Keyword Code	Minor Keyword Code	Observation	CCS Recommendations	Sev	Hyperlink Observation Zoom ed In	Hyperlink Observation Zoomed Out	Sentencing Decision	PT Communication
1	12-Oct	350	CCS3/001	CN	A	Cable protection AFT wall contaminated. Protection unravelling, no longer fit for purpose.	Replace.	2		View Image	Replace tape, clean loom.	N

- Provides a unique identifier for each observation found.
 - Aids recovery of observations.
 - Database provided, with all images to the project team and maintenance organisation.
- Sentencing allows the maintenance organisation to assess observations.
 - Ideally carried out daily.
 - Involving CCS, PT LOA holder or delegated representative, Maintenance Manager, Technical Support (AEDIT), Aircraft Team Chief, Av Trade Manager, Team Av representative as appropriate.

AIRCRAFT SURVEYED

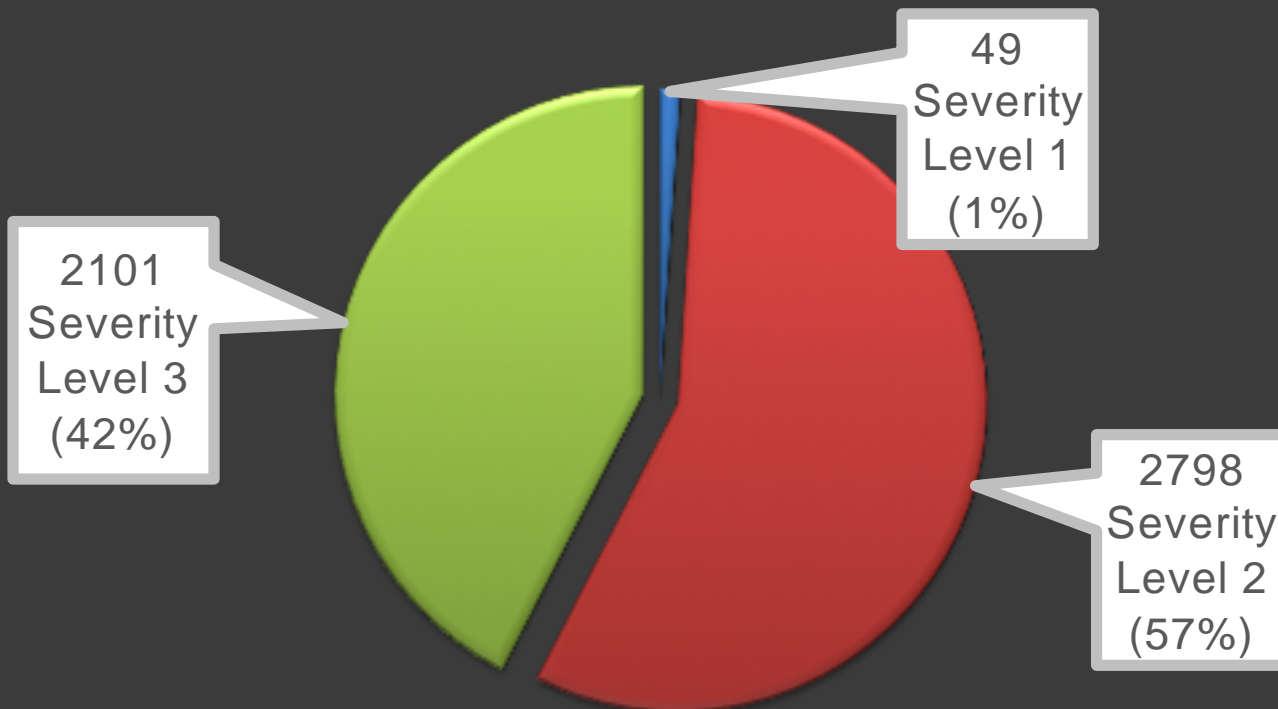
- Viking x 7
- Vigilant x 6
- Sentinel x 2
- Hawk T1 (Black) x 3
- Hawk T1 (Red) x 1
- Hawk T2 x 1
- Puma II x 2
- Chinook x 1
- Spitfire x 2
- Islander x 2
- Defender x 2
- Apache x 2
- Gazelle x 4
- BAE 146 x 3
- Hercules C130J x 2
- C17 (Partial)
- Merlin x 2

AIRCRAFT REMAINING



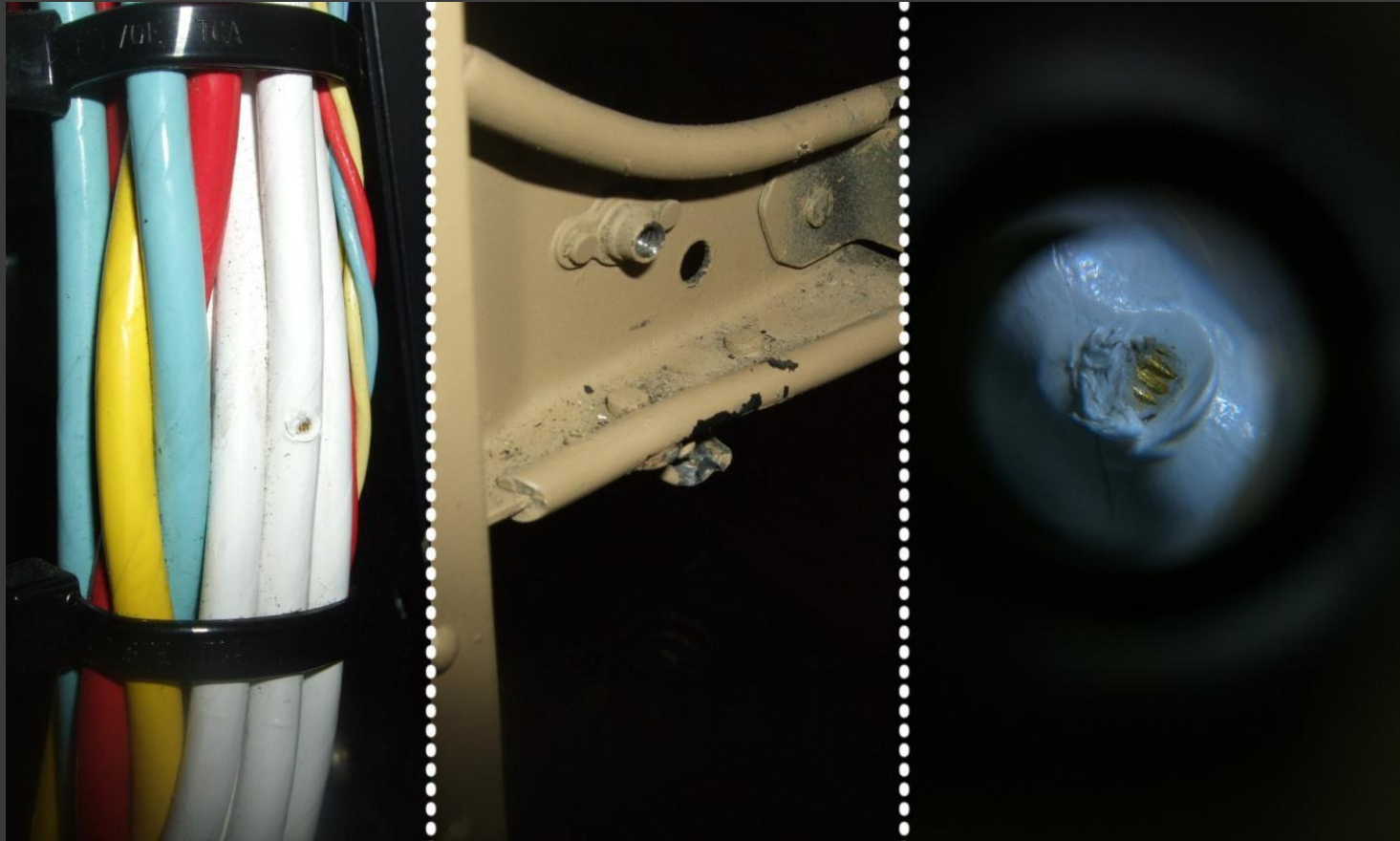
- Chinook x 1

FINDINGS



- 42 Aircraft Surveyed
- 4948 Observations Raised

LEVEL 1 EXAMPLES



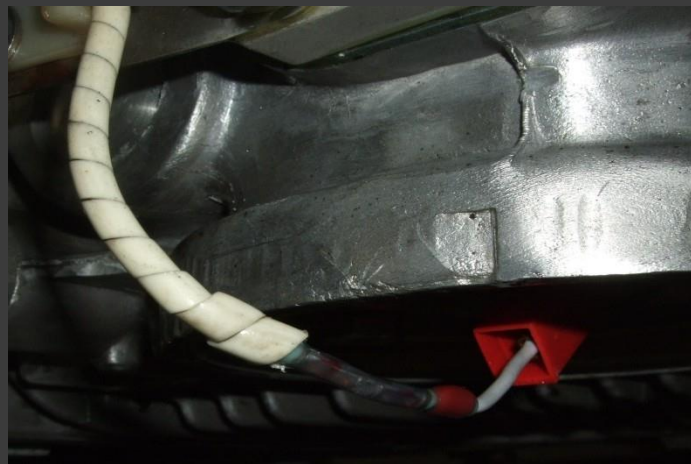
Wire chafe on metal receptacle – through to conductor



Chafe damage to power feeder cables

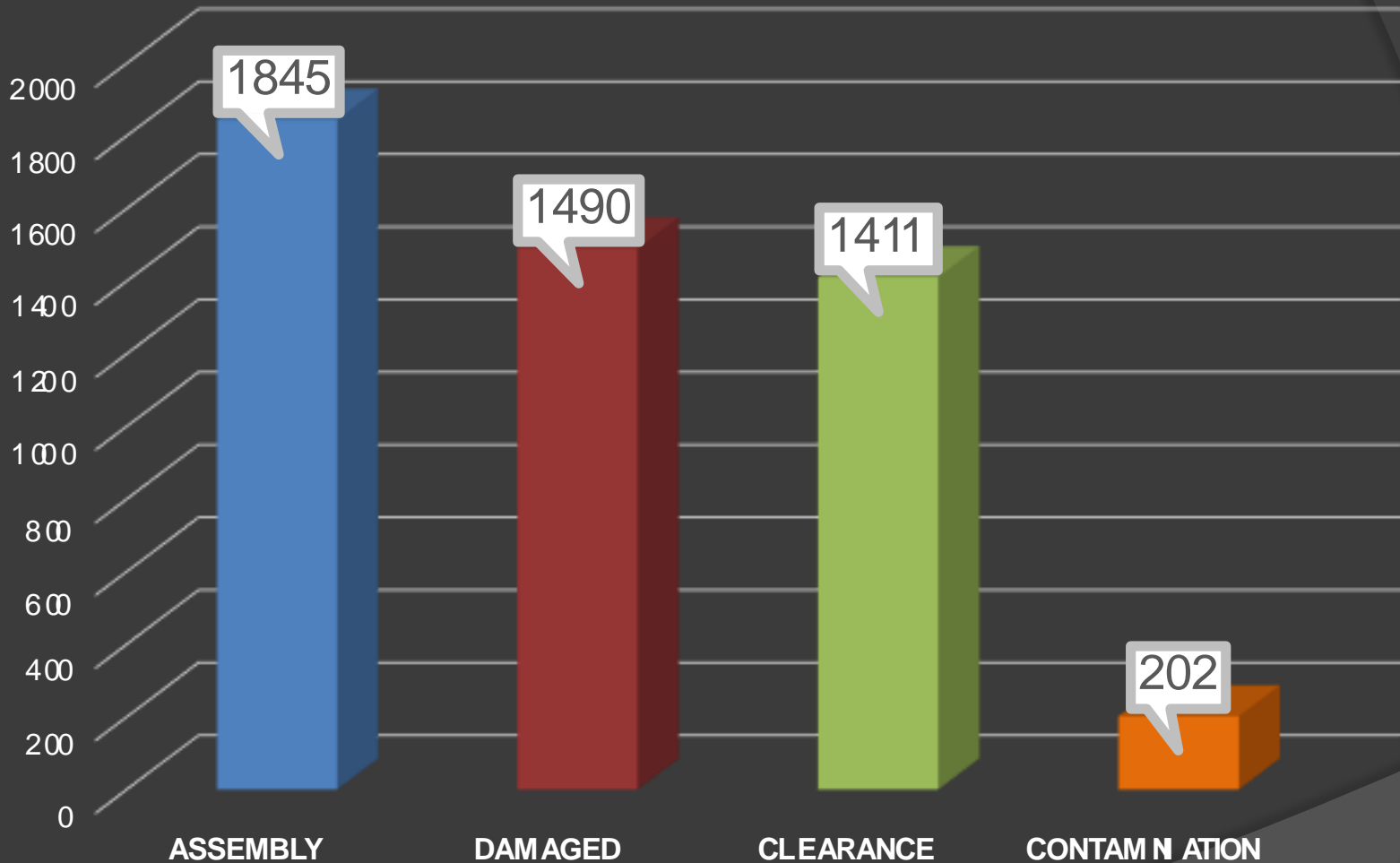


Wire damaged through to core



Inline splice in fire zone

MAJOR KEYWORD CODES



CLEARANCE

- Clearance and Damage categories are closely linked.

- Clearance related observations account for **43%** of overall total.

- Clearance related observations account for **55%** of Severity Level 1 observations.

CLEARANCE



CAUSES

- Poor routing
- Incorrect P-clip and support positioning
- Poor design





Loom in Position



Loom Retracted from Tray



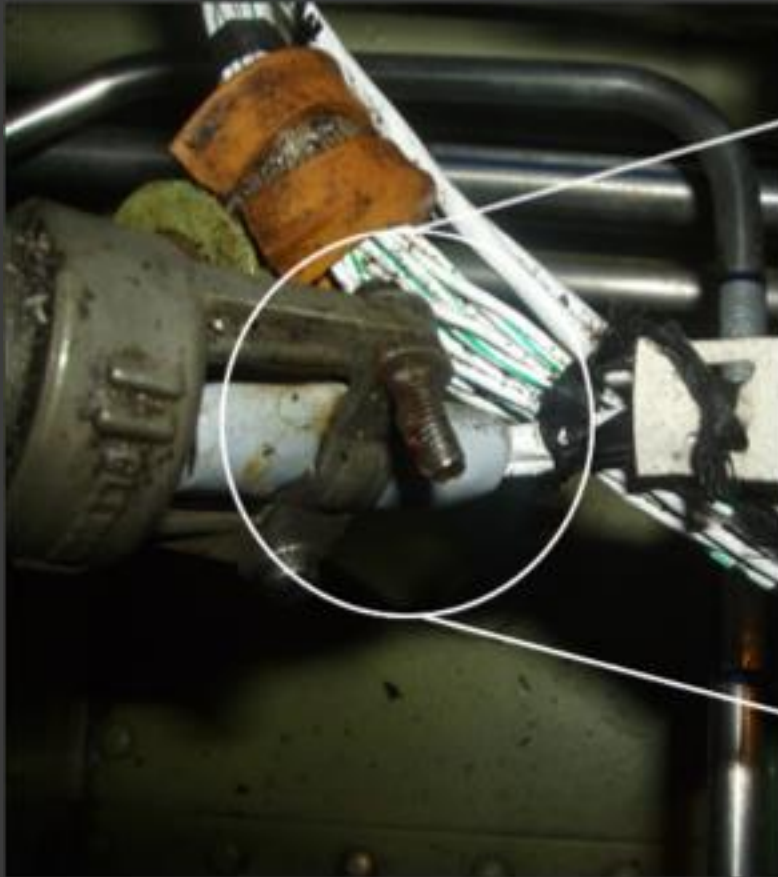
Self Tapping Screw for Cockpit Footwell Kick Plate



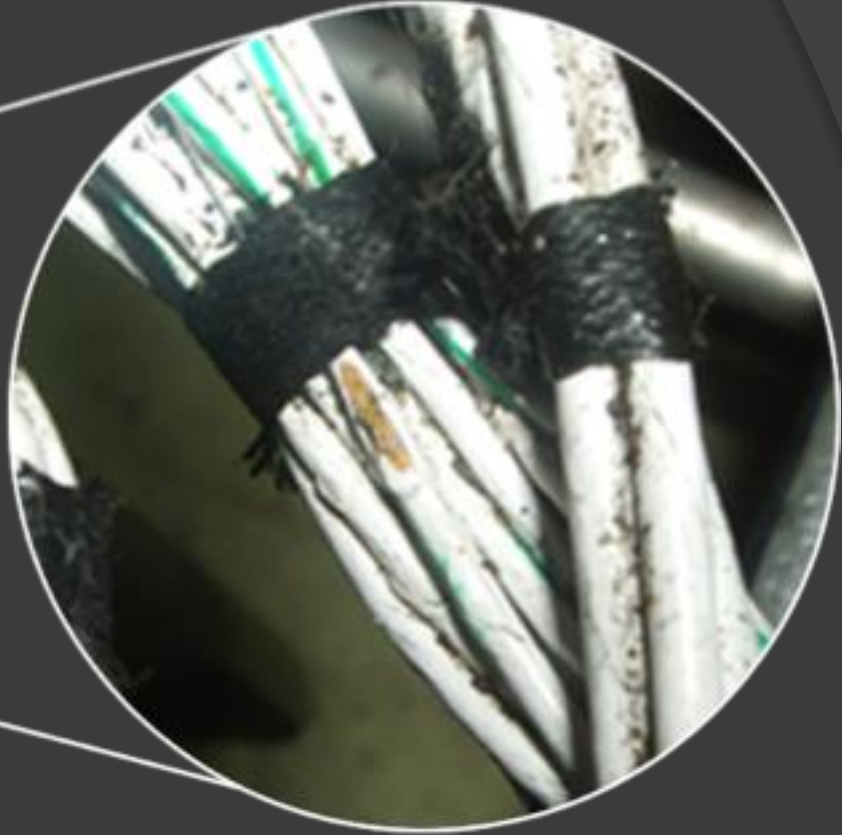
Drill mark in Pitot Static Pipe

WIRE CHAFING

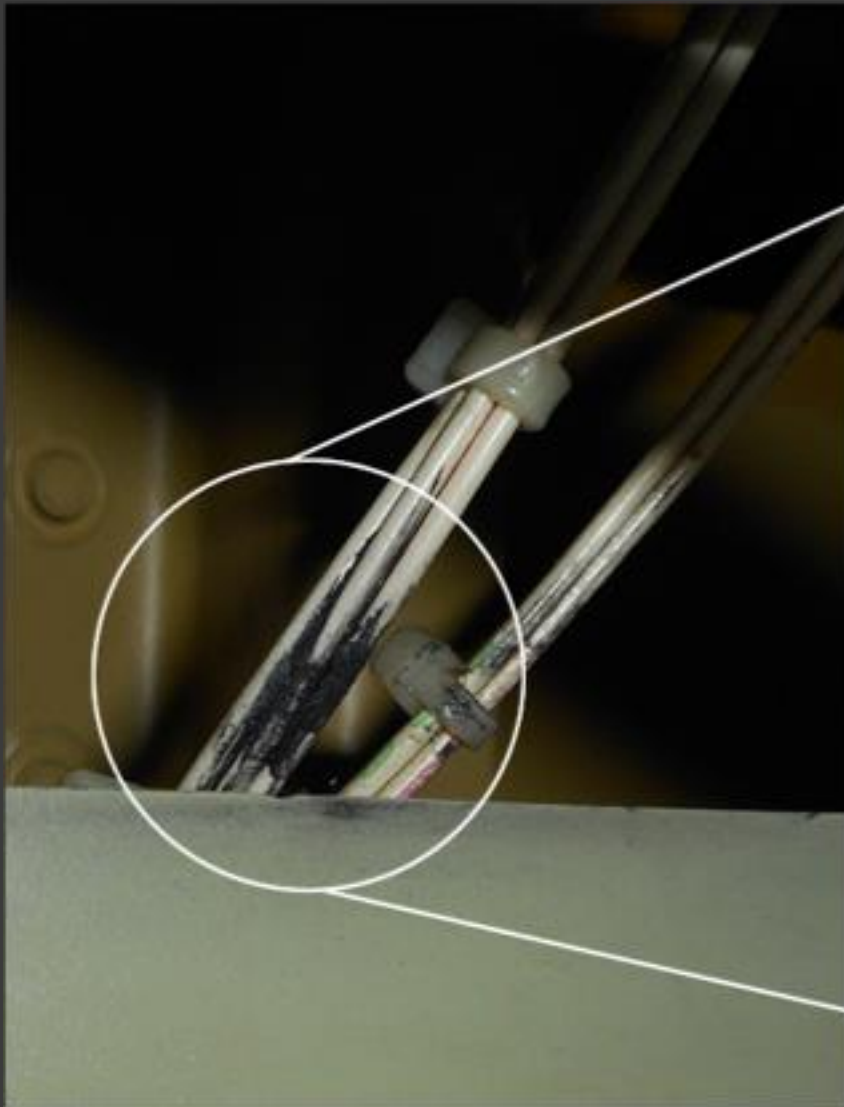
- Insufficient clearance will lead to chafing.
- Checks are required where wire is routed near structure, EWIS and Mechanical components.
- Examine where wire moves/flexes when doors are opened /closed, passes over or near hinged areas, turns or bends near components.
- Use a mirror and sufficient light to follow cable runs to examine all surface areas.



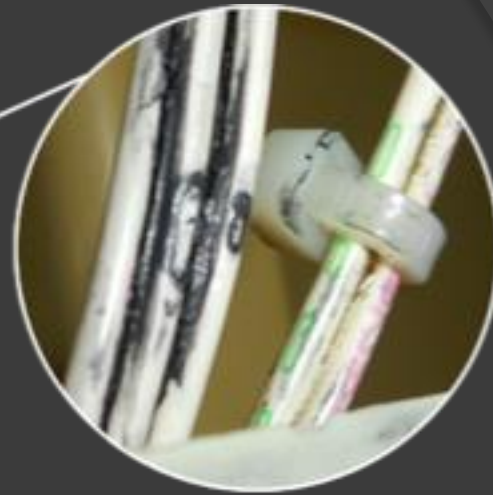
Loom against connector



Wire chafed through to core.



Cables Chafing Against Frame



Cables Cleaned - 2 Cables Chafed to Core

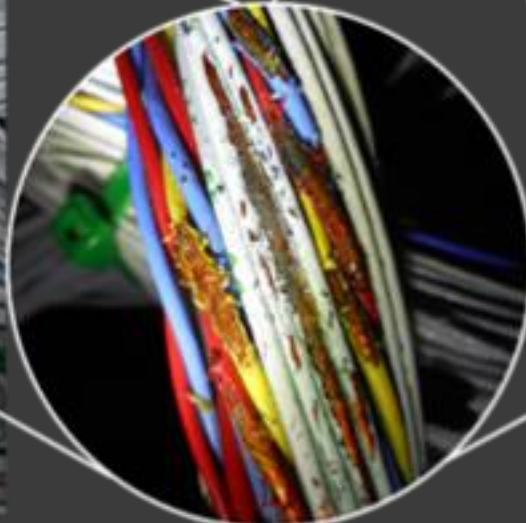


Arc Damage to Rear of Frame - Seen through Mirror



Loom as found

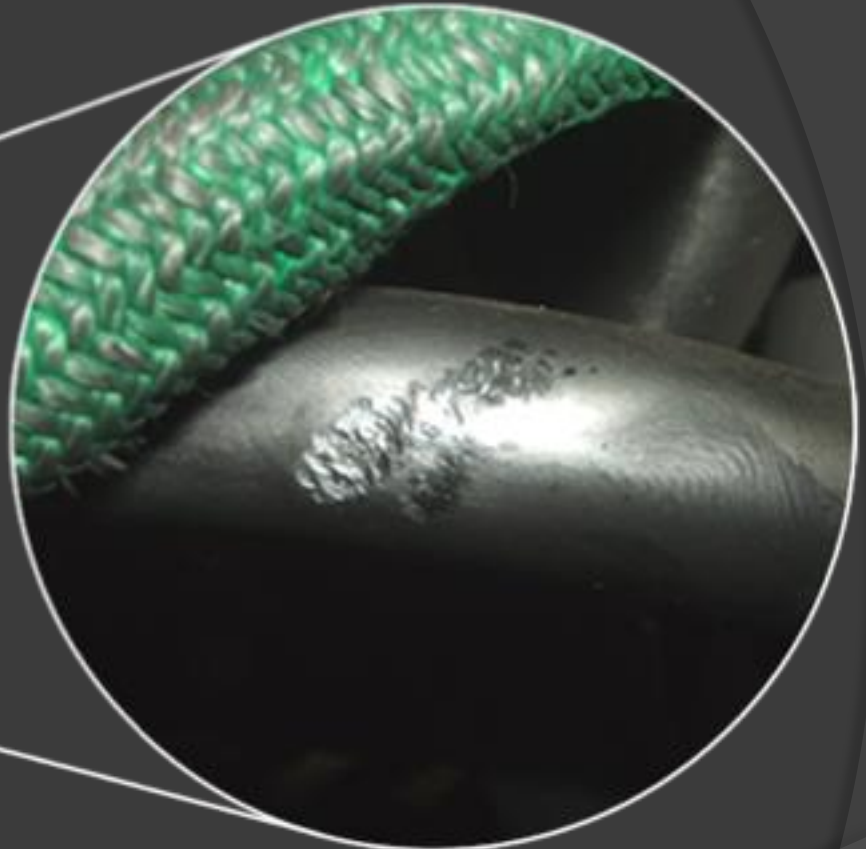
Signs of Arcing
(Seen Through x10 Magnifier)



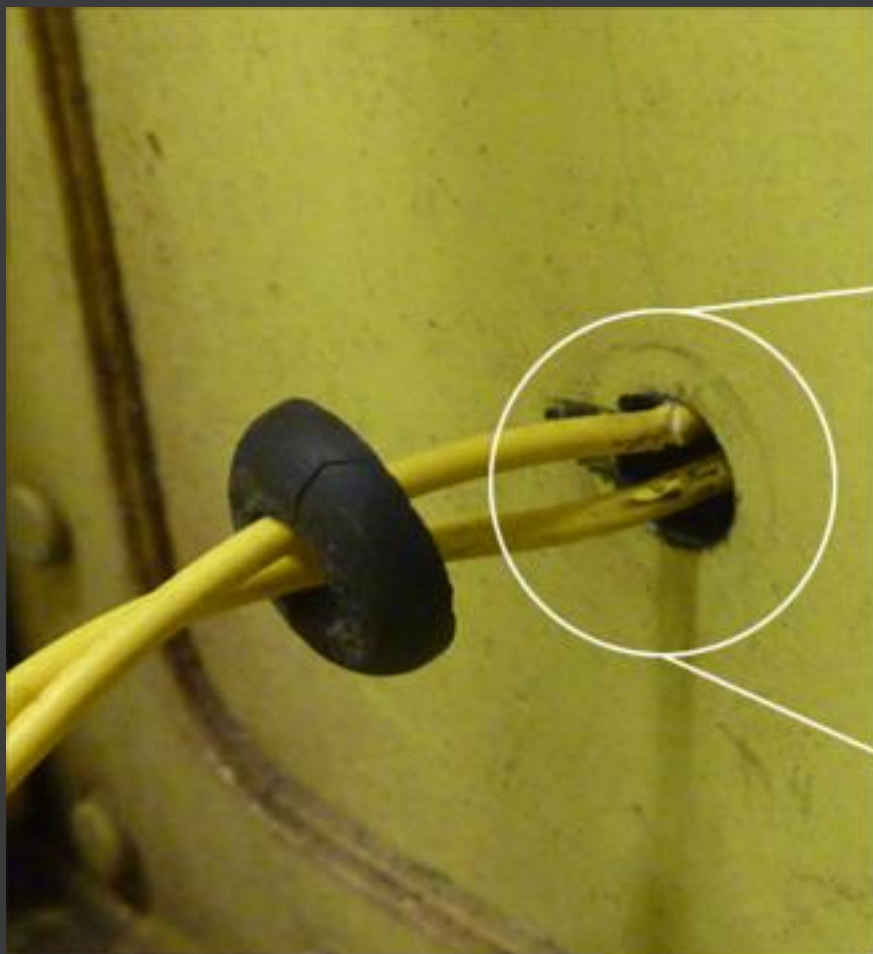
Extensive Damage to Loom -
Likely Chafe on Control Unit



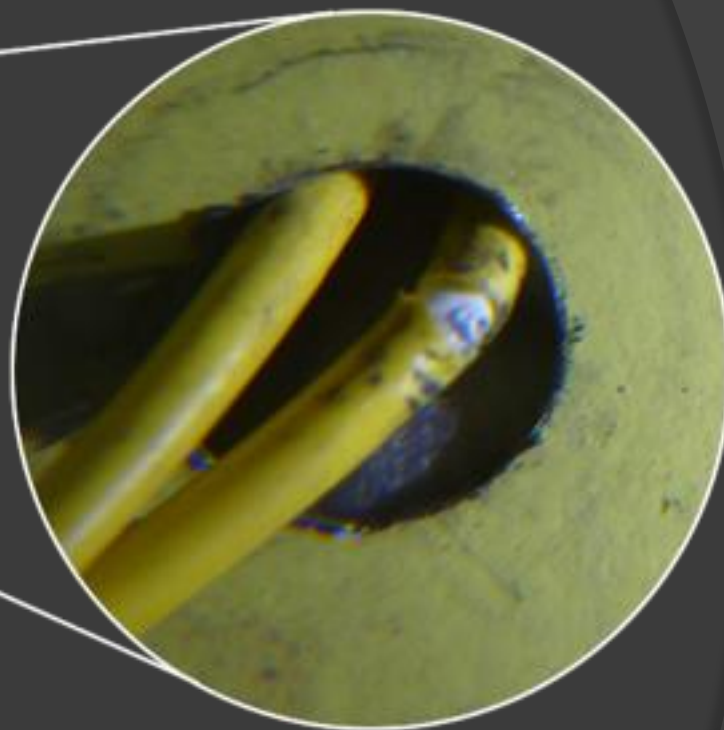
Nomex Loom against Fuel Pipe



Damage to Fuel Pipe



Grommet found detached



Wire chafed through to core

WIRE INSULATION DAMAGE

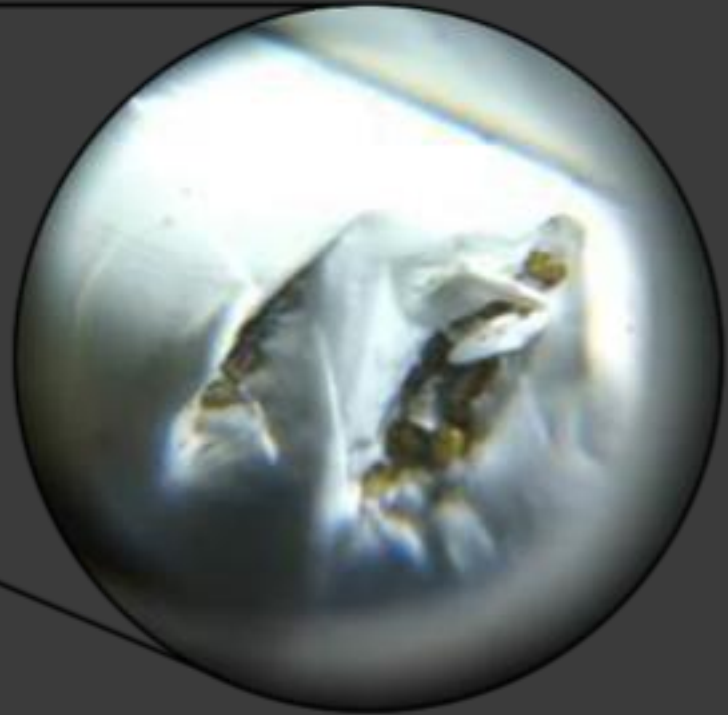
- Examine for: cracking or peeling, circular cracking, heat damage, fluid/moisture effects (swelling, blistering or cracking), crushing and mechanical damage caused by installation or removal of equipment, crew movement or moving cargo.
- Examine for loose or frayed wiring, cable shields or braided metal jackets.

CAUSES

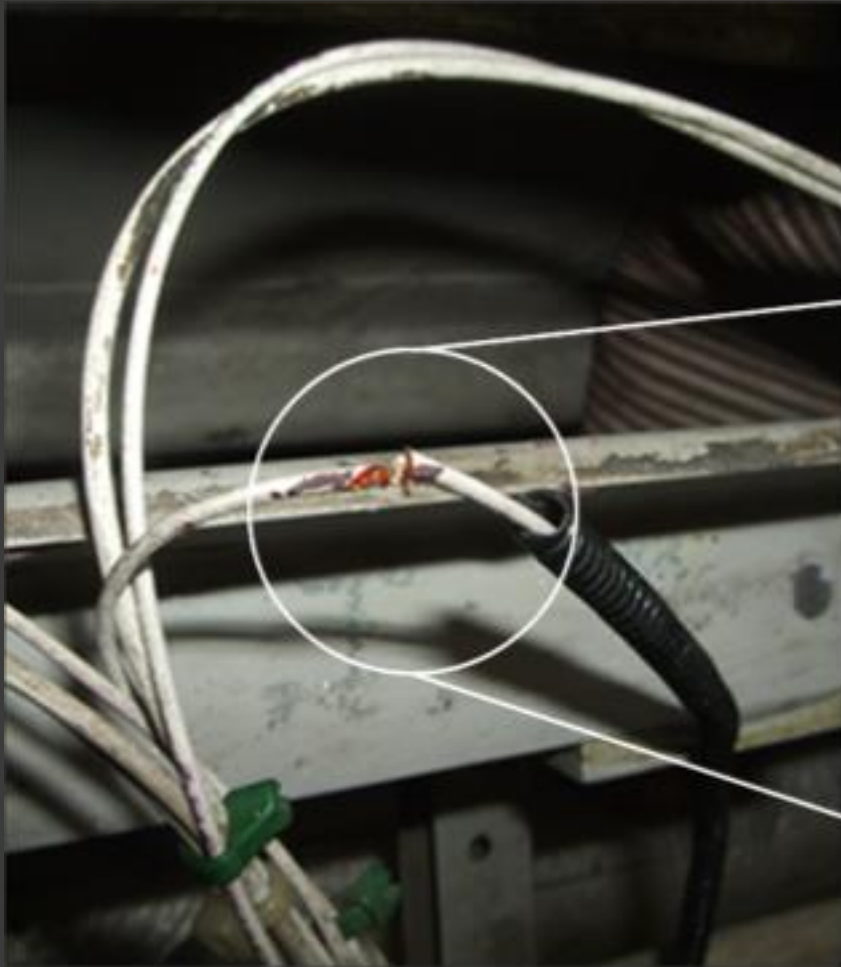
- Stress
- Excessive bend radius
- Movement due to maintenance
- Hydrolysis, ingress of moisture
- Hot stamp marking, creating stress point
- Chafing



Suspected Tooling Damage



Damage Through to Core - Seen Through x 10 Magnifier



Damaged Cable Found



Cable Through to Conductors

ASSEMBLY

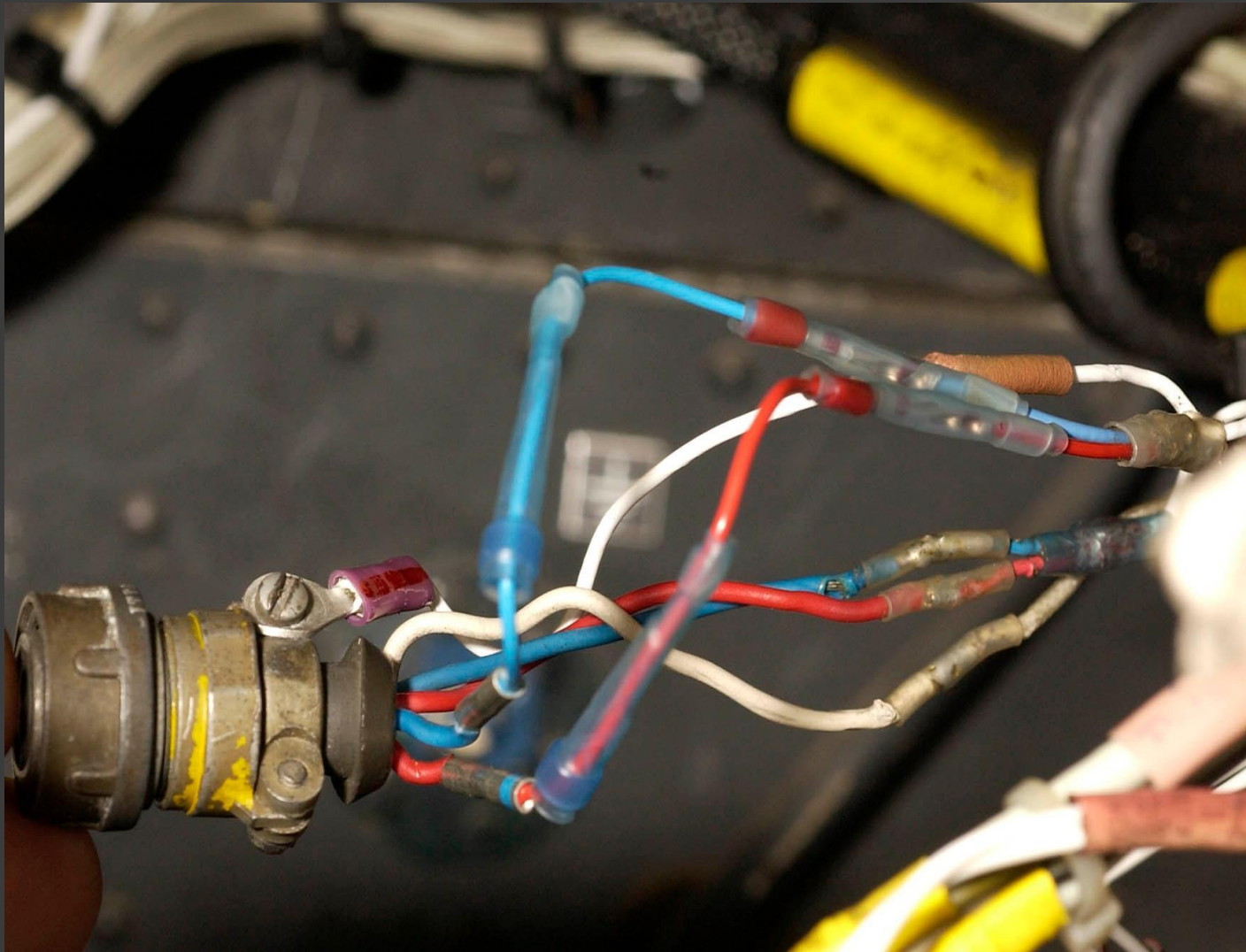
- Loose or missing fixings
- Bolts/screws not in safety (min 1 ½ thread) or bottomed out.
- Poorly fitted protection.
- Properly locked and mounted connectors and accessories.
- Correct termination.
- Poor loom support.
- Wire Bend Radius



Cable protection tape incorporating support pipe/bracket.



Guitar String



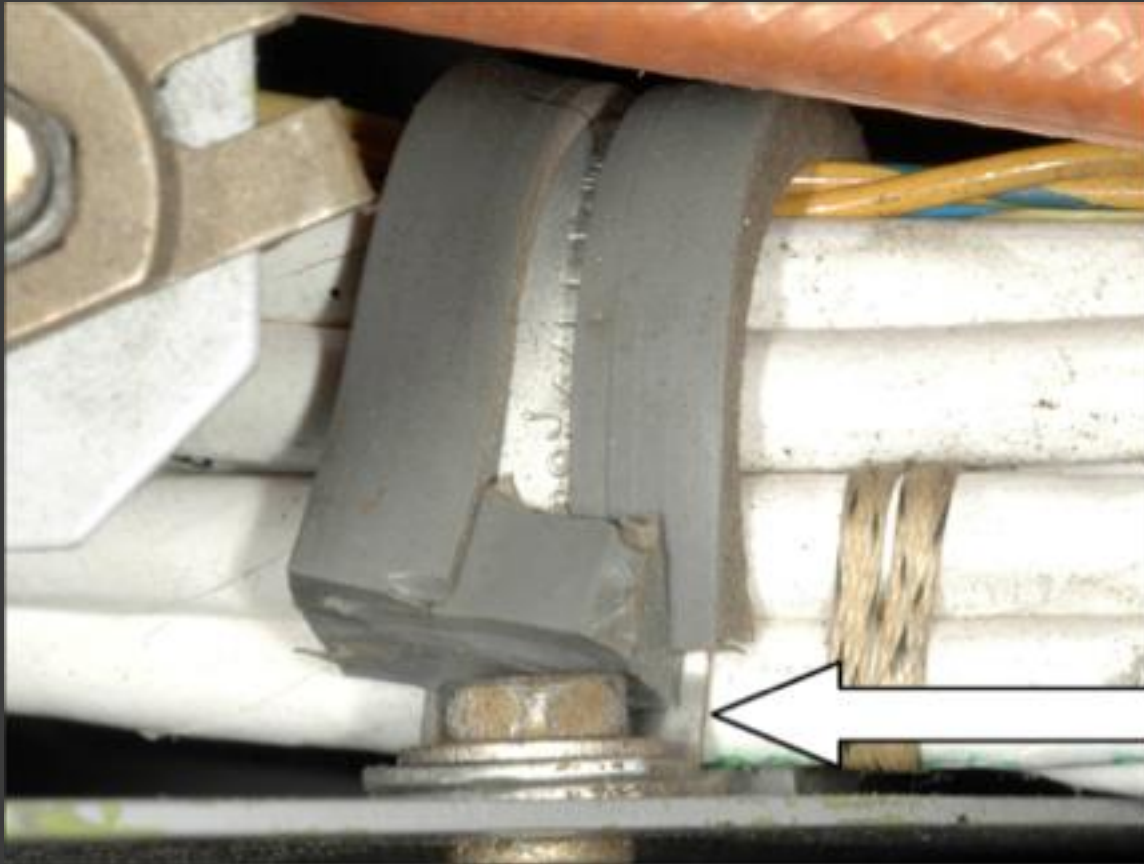
Words fail?

SUPPORTS

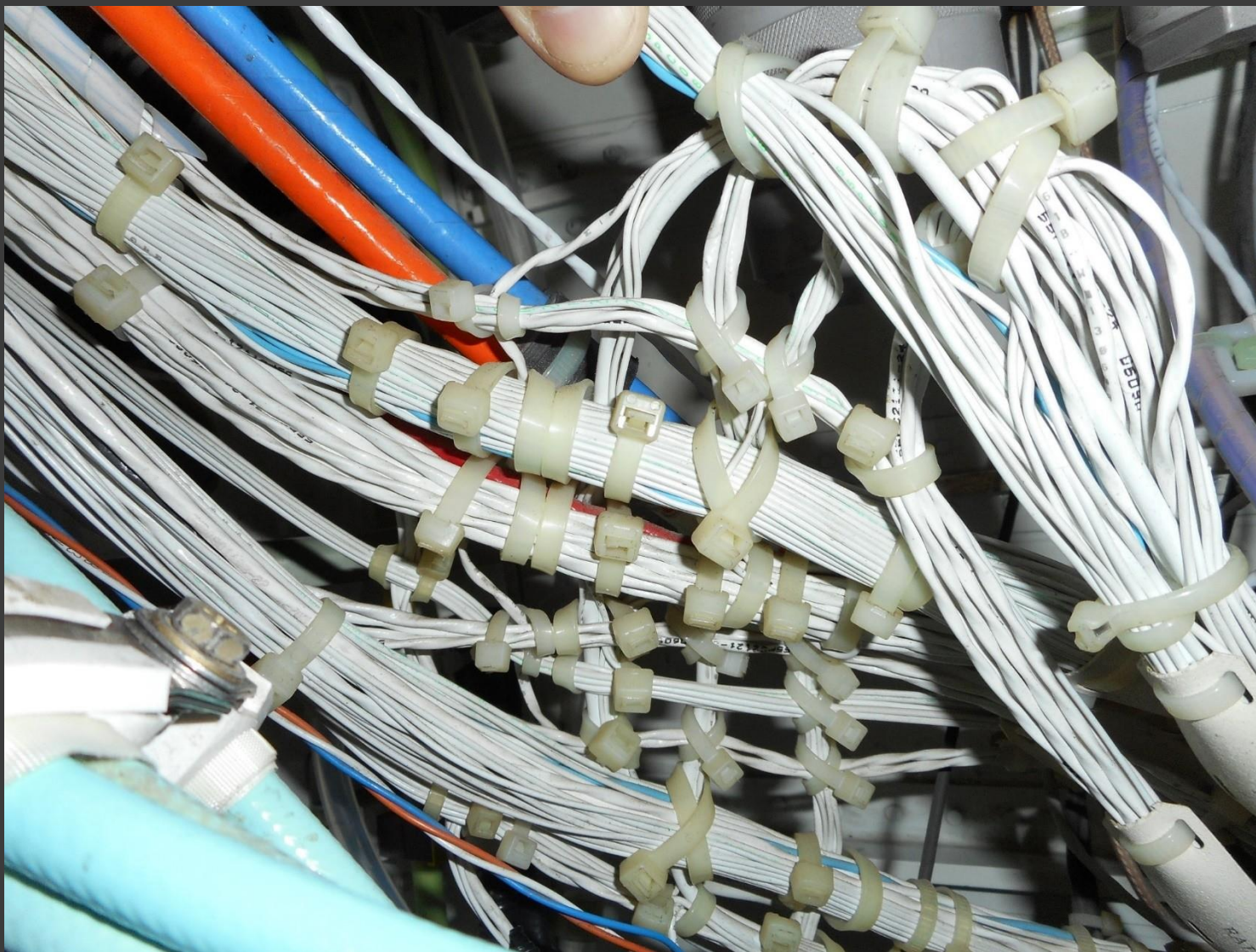
Incorrectly fitted or degraded P-clips, brackets, clamps, lacing tape and cable ties will lead to damage to wiring.

CAUSES:

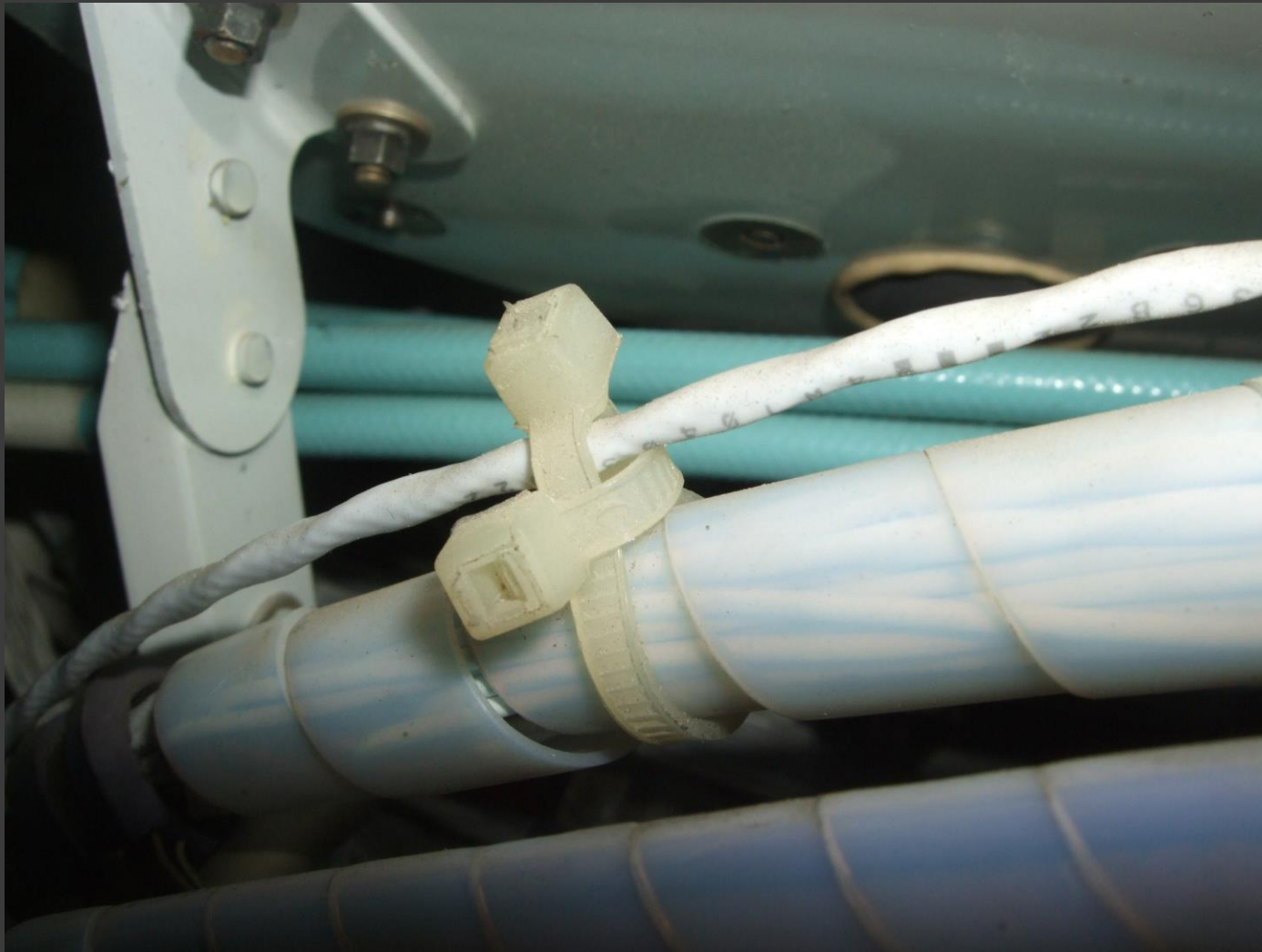
- Wiring incorrectly supported and insecure.
- Incorrect type fitted, i.e non wedge.
- Incorrect size.
- Insufficient filler material.
- Loose, broken or deteriorated cushion clamps.
- Loose or damaged clamp stand offs and support brackets.
- Incorrect clamp for the environment in which fitted.
- Internally serrated cable tie.
(Check the Aircraft Support Policy Statement)



P-clip Metal in
Contact With
Cables - P-clip too
small



Interesting use of cable ties



Cable ties used as spacers – Not tested for this use

PROTECTION

- Should be inspected to ensure it is still providing sufficient protection.
- Clearance should always be preferred to the addition of protection.
- Correct protection should be applied for the environment.
- Installation guidance provided in AP101A-0005-1.



Kevlar Wrap fitted against an oxygen pipe.

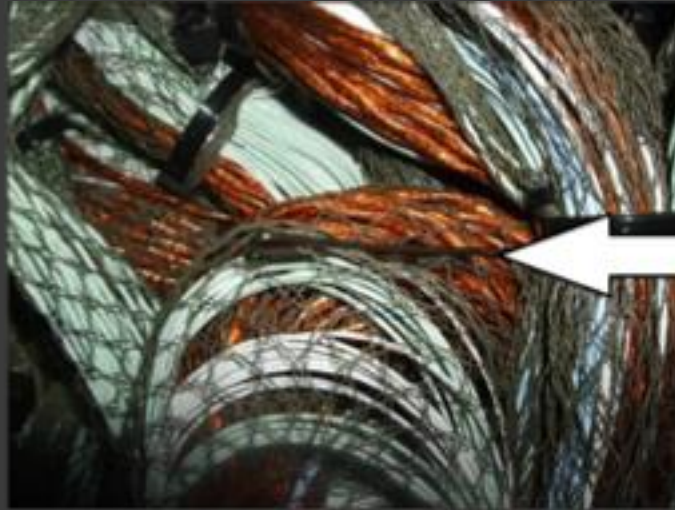
CORROSION

- Many forms of corrosion can occur depending upon the types of metal and the environment in which they are placed.
- Left untreated corrosion on electrical connectors will continue to spread to adjacent surfaces and into the connector itself causing failure.





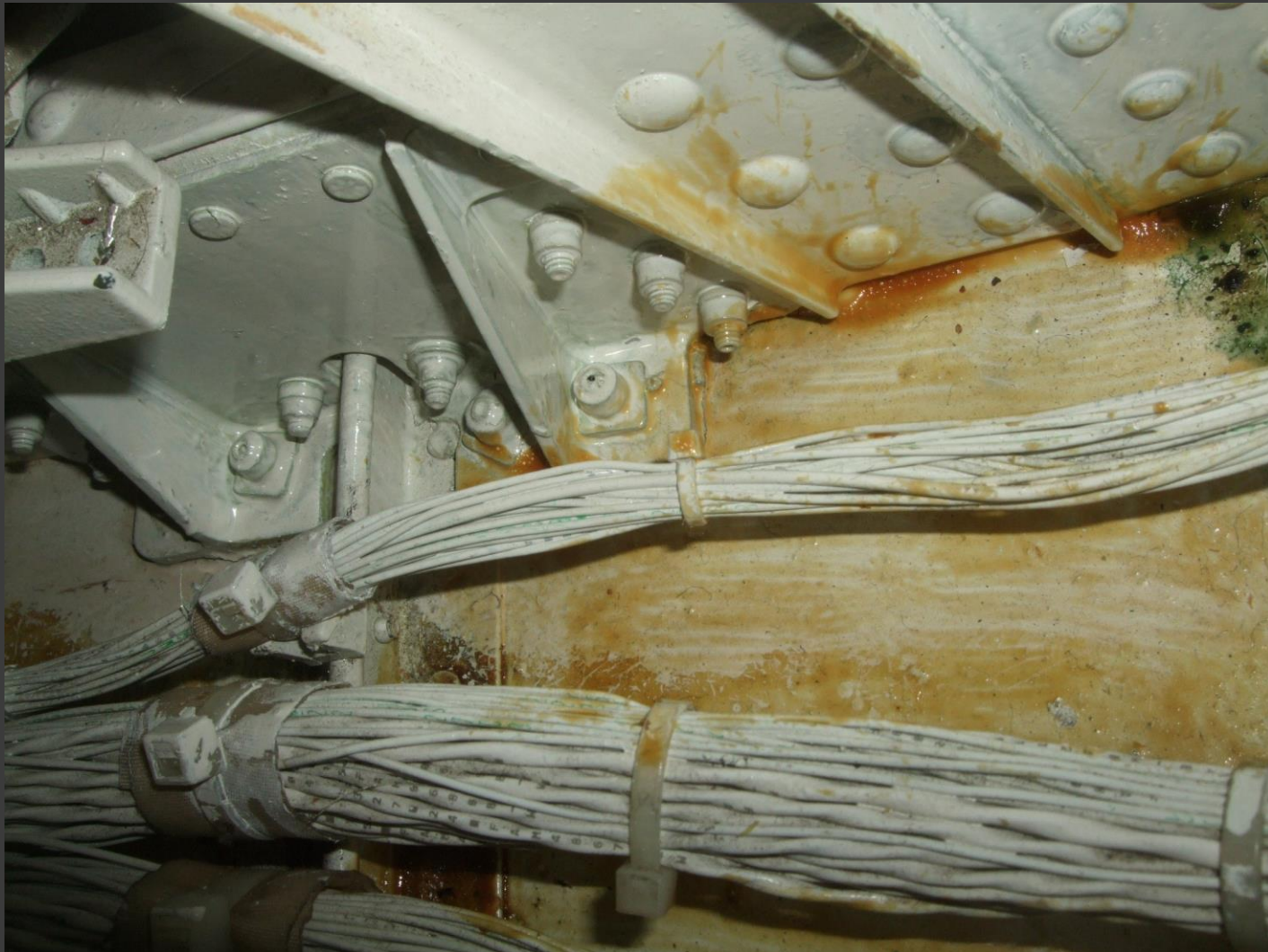
CONTAMINATION

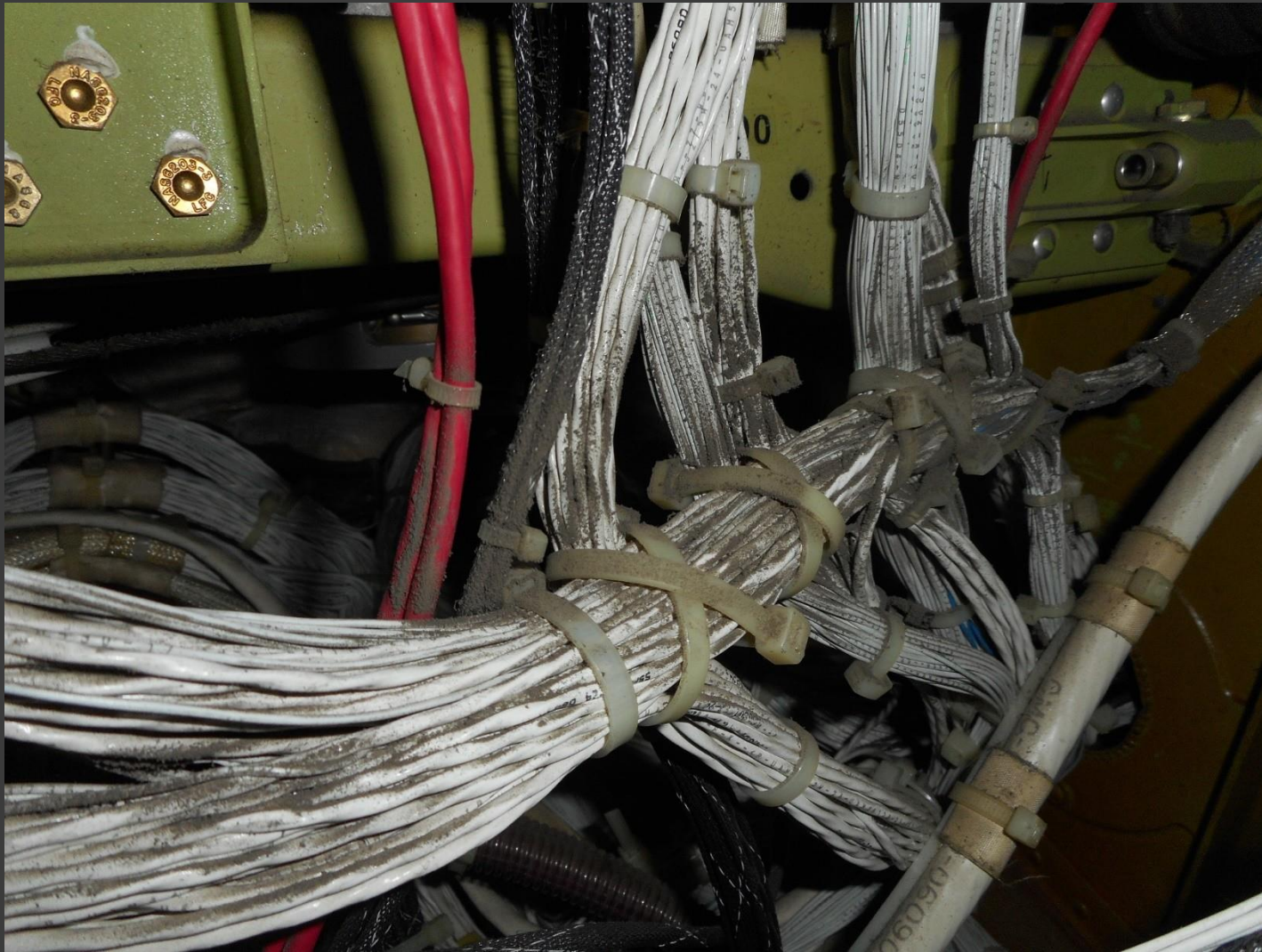


Metal
Hairclip



- Water, Fuel, Hyd oil, Grease
- Paint overspray
- Sealant
- Swarf
- FOD, Dirt, Lint
- Blanking, Stowage









If contamination is left, it can cause damage to EWIS

GENERAL OBSERVATIONS

- The condition of the general airframe wire, where installed correctly, is deemed to be in good condition across most platforms.
- The observations found during the survey are mainly down to incorrect installation, poor maintenance, or incorrect standards and procedures being applied.
- There is vast array of cable ties fitted across the fleet of MOD aircraft.
- The introduction of additional EWIS due to modifications is causing strain on the support devices fitted to the aircraft. The additional EWIS is also a common cause of the insufficient clearance seen across aircraft.
- The incorrect capping and stowing of connectors is common across aircraft.

GENERAL OBSERVATIONS

- There are very few FOD observations raised across the platforms. This is encouraging as it shows that the MOD/Industries education and awareness campaigns regarding FOD are working and best practices are being adhered to.
- Lack of appropriate documentation sets to assist the maintainers is evident throughout most platforms.
- A number of unrecognised separation methods are being used.
- Poorly installed additional protection is common.
- Incorrect protection types for application are being installed.
- A number of aircraft were not built to the standards set out by the DO.

OUTCOMES

- A report for each aircraft has been produced detailing the condition of the airframe at the time of survey.
- Where numerous aircraft from the same fleet were surveyed, a comparison report was also produced.
- The reports contain findings, conclusions and recommendations on best practices to manage platforms EWIS moving forward.
- The survey reports, database and images have been used as:
 - Evidence to be included in Ageing Aircraft Audits
 - Training aids
 - Policy reviews
 - Maintenance practices improvements
 - Guidance to improve aircraft document sets

OUTCOMES

- A number of platforms are looking at putting a programme of independent surveys in place to achieve the following:
 - 2+ aircraft surveyed per year over a number of years
 - Monitor the standard of the platforms EWIS
 - Assess if the changes to policy, maintenance practices, training etc are being effective
 - Further enhance the Ageing Aircraft Audit package
 - Further improve aircraft document sets

QUESTIONS?