



EUROPEAN AVIATION SAFETY AGENCY
AGENCE EUROPÉENNE DE LA SÉCURITÉ AÉRIENNE
EUROPÄISCHE AGENTUR FÜR FLUGSICHERHEIT

Occurrences

Standard parts in critical installations

Industry meeting

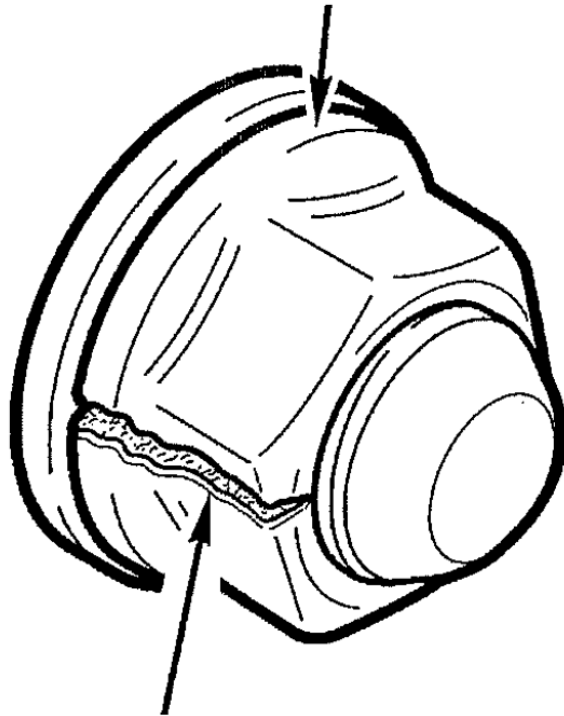
3 June 2014

Your safety is our mission.

- **Significant occurrences**
large aeroplane, rotorcraft, others
- **Defects observed**
manufacturing, hydrogen embrittlement
- **Occurrence analysis**
size, origin, frequency

Self locking nuts MS21042 / NAS1291

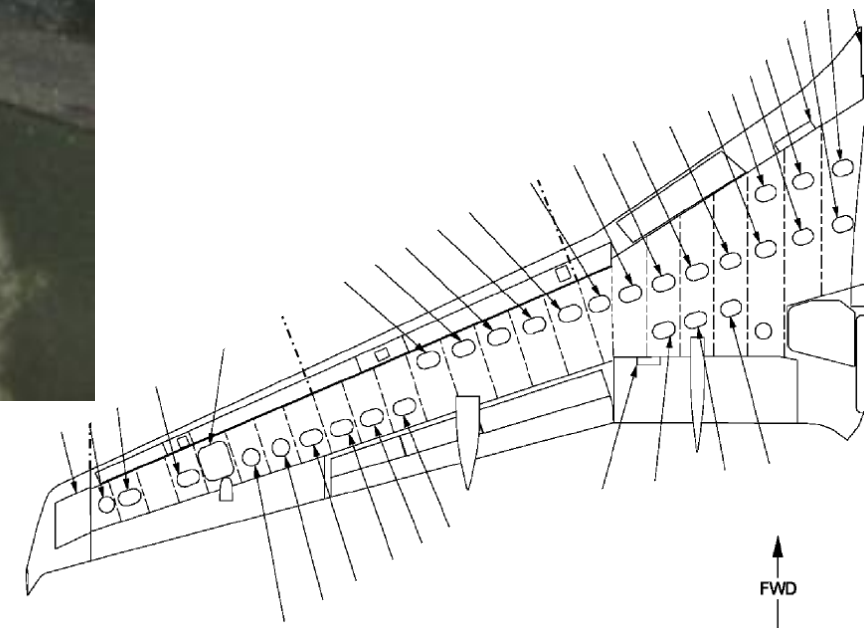
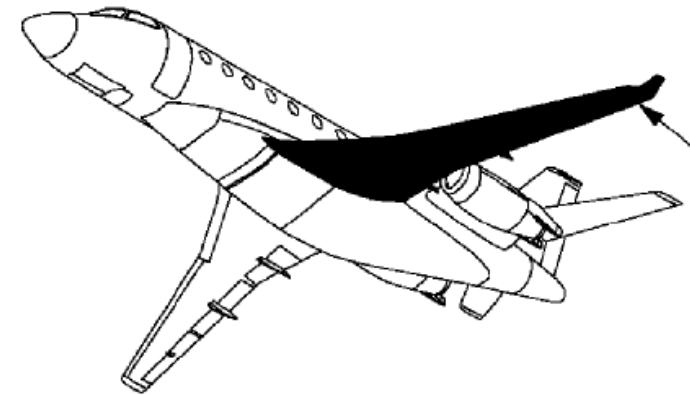
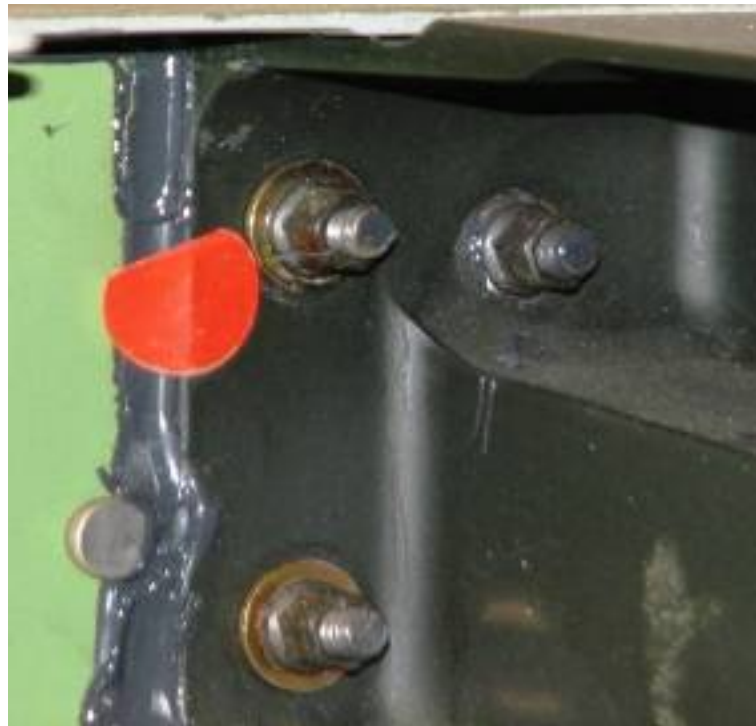
MS21042L-series Nut



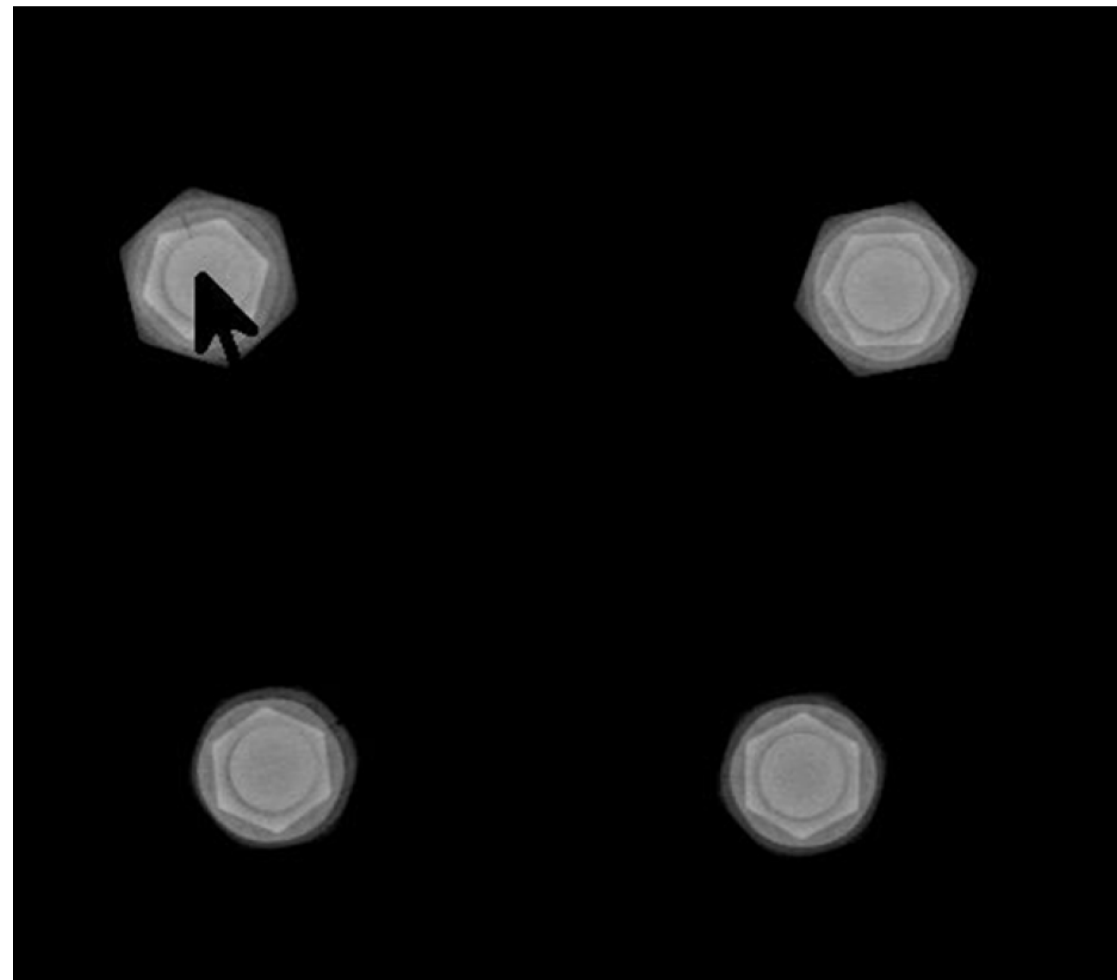
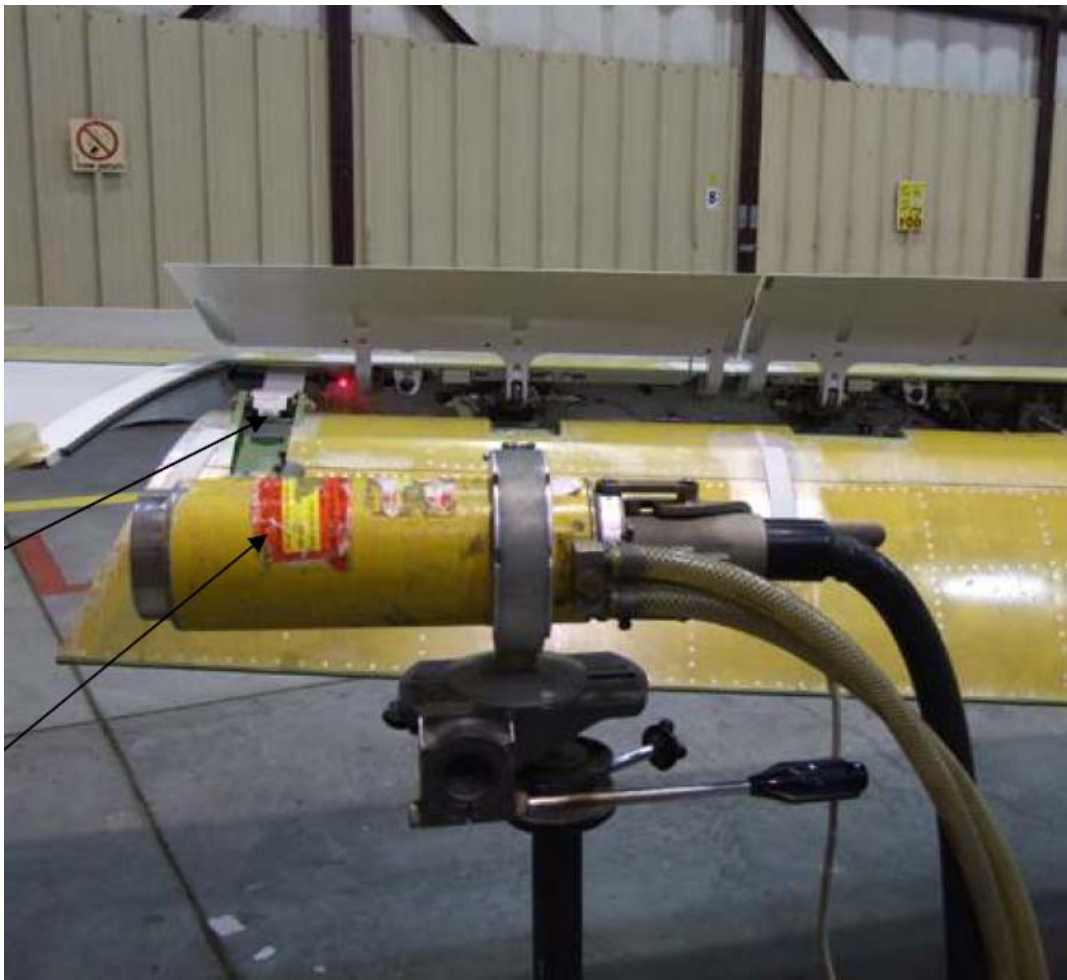
Any crack, if present, would be parallel with nut axis.



AD mandating inspection of wings, wheel wells and vertical stabilizer



X-ray inspection:





IFTB due to flaps jammed

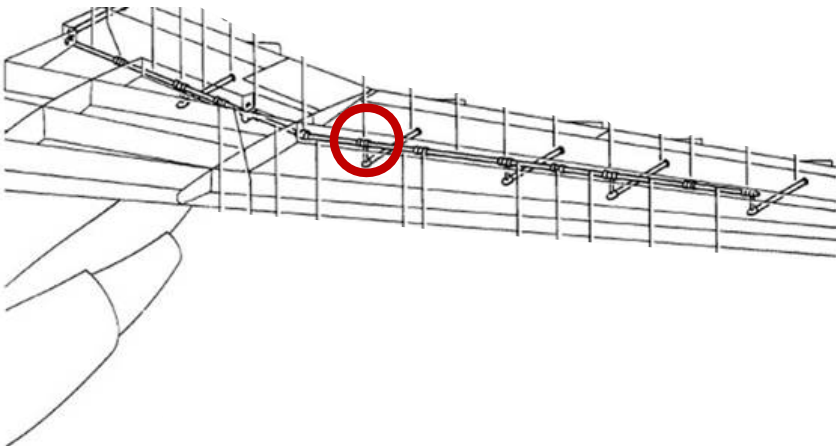


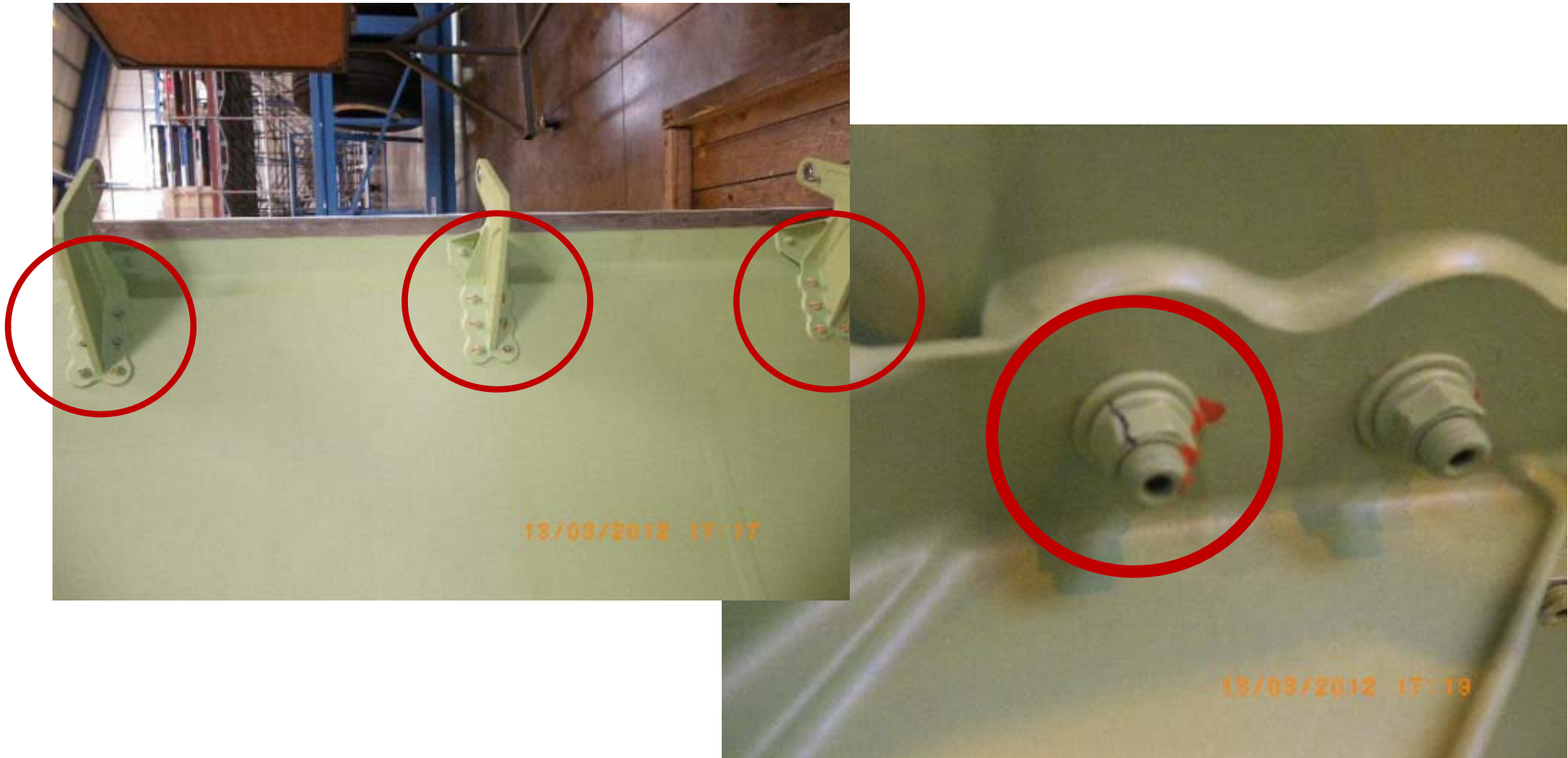
Redundancy is no mitigation



Occurrences – Large Aeroplane

IFTB due to flaps jammed





11 self-locking nuts cracked

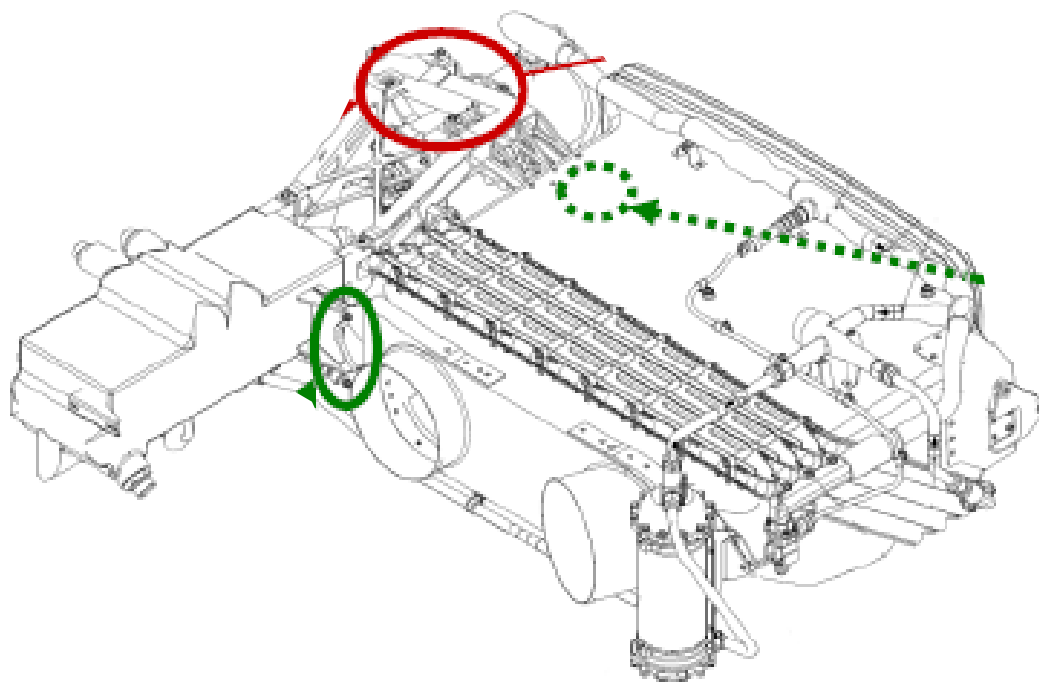


Occurrences – Large Aeroplane





Air conditioning compressor



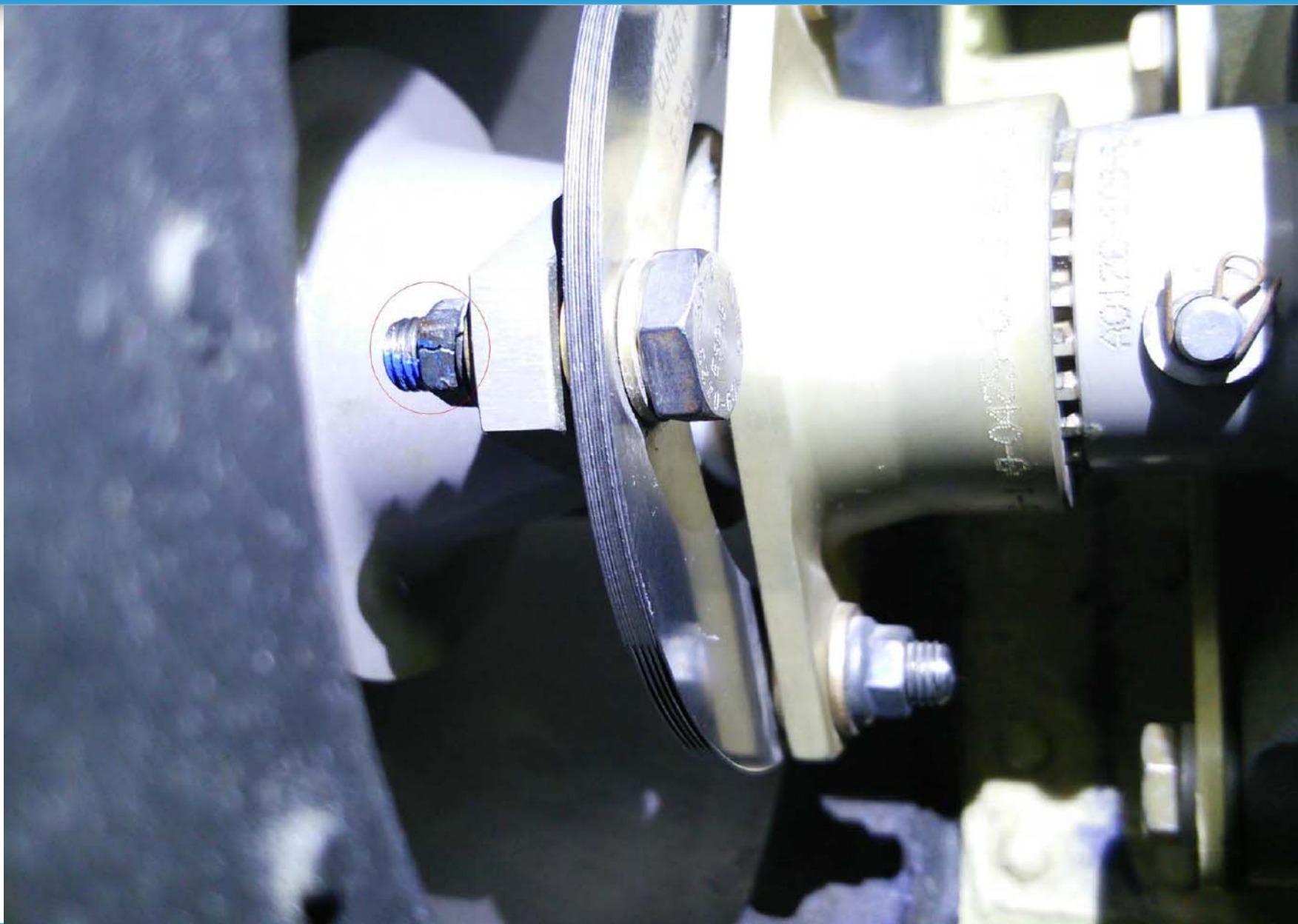


Occurrences - Rotorcraft





Occurrences - Rotorcraft



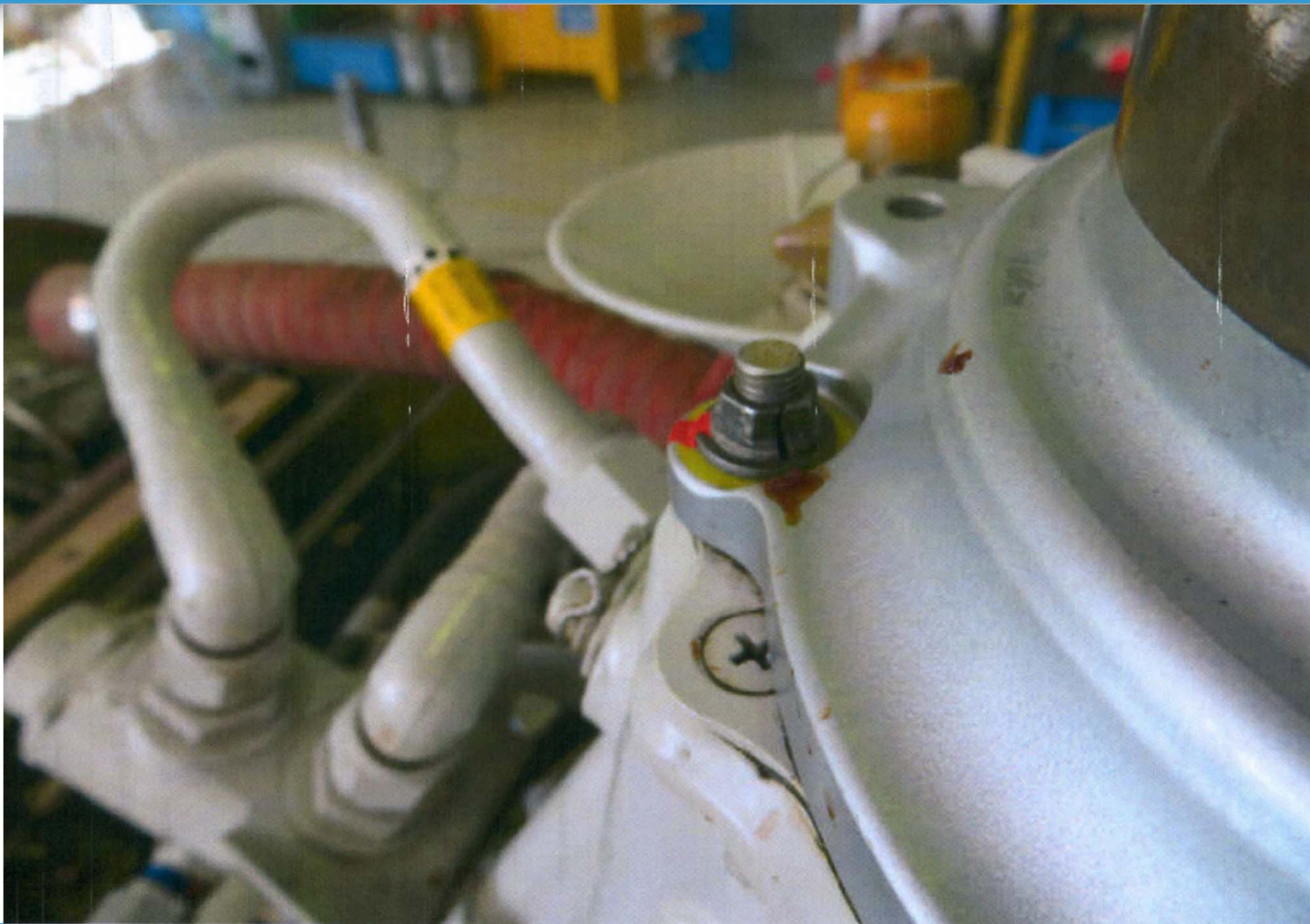


Occurrences - Rotorcraft





Occurrences - Rotorcraft



MS21042 nuts used extensively on certain rotorcraft



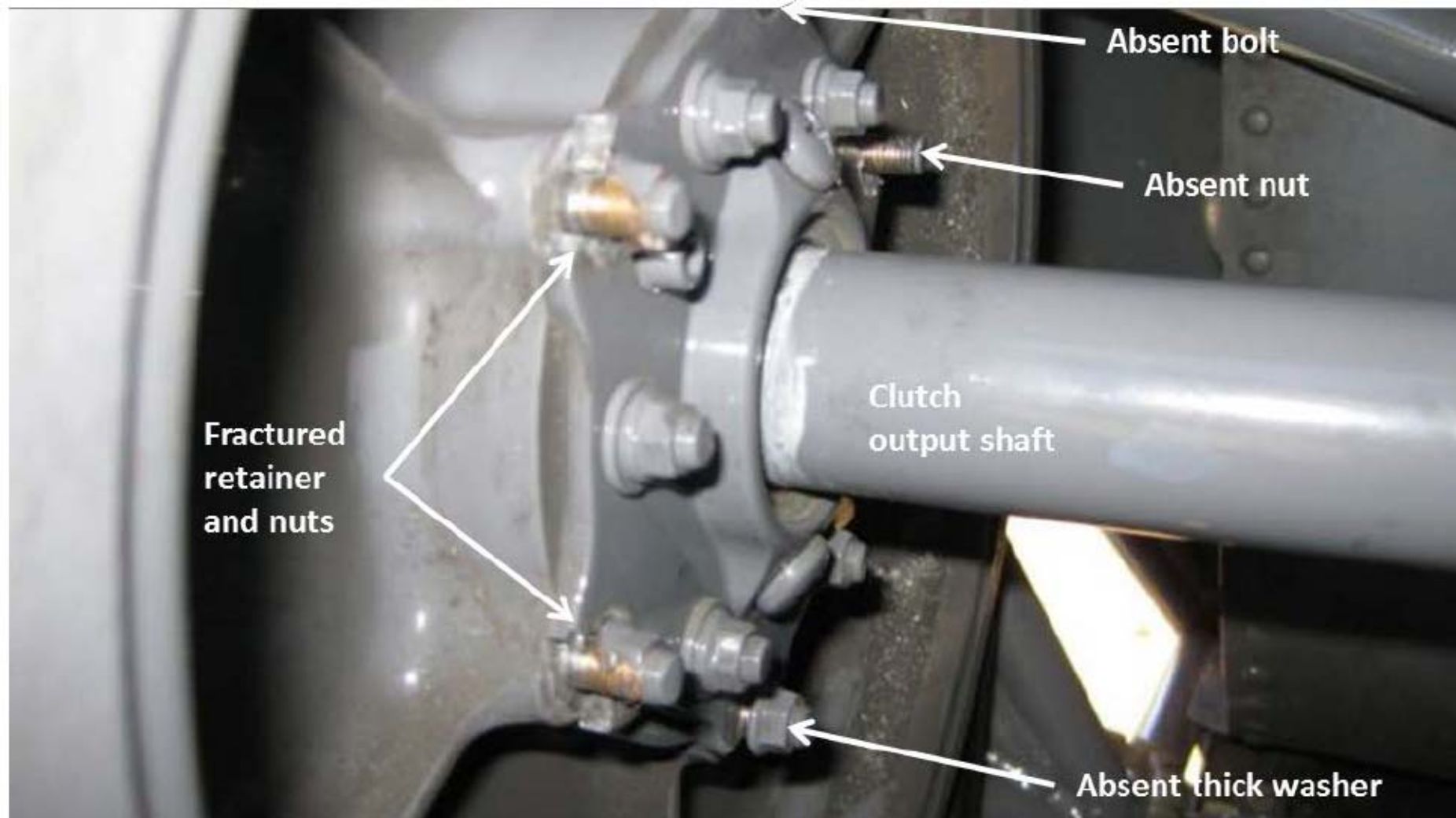


Occurrences – Rotorcraft



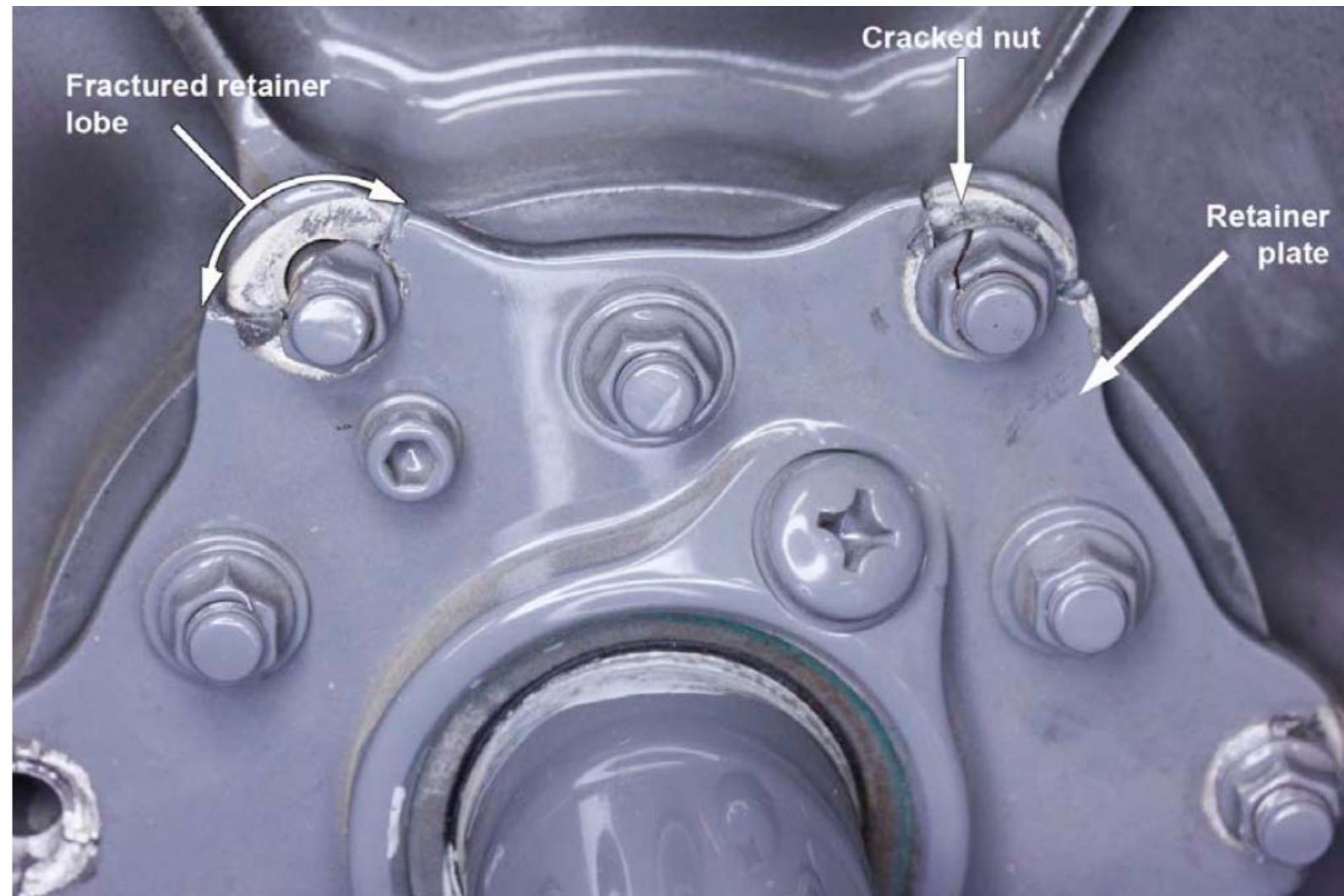


ATSB AO 2011-135





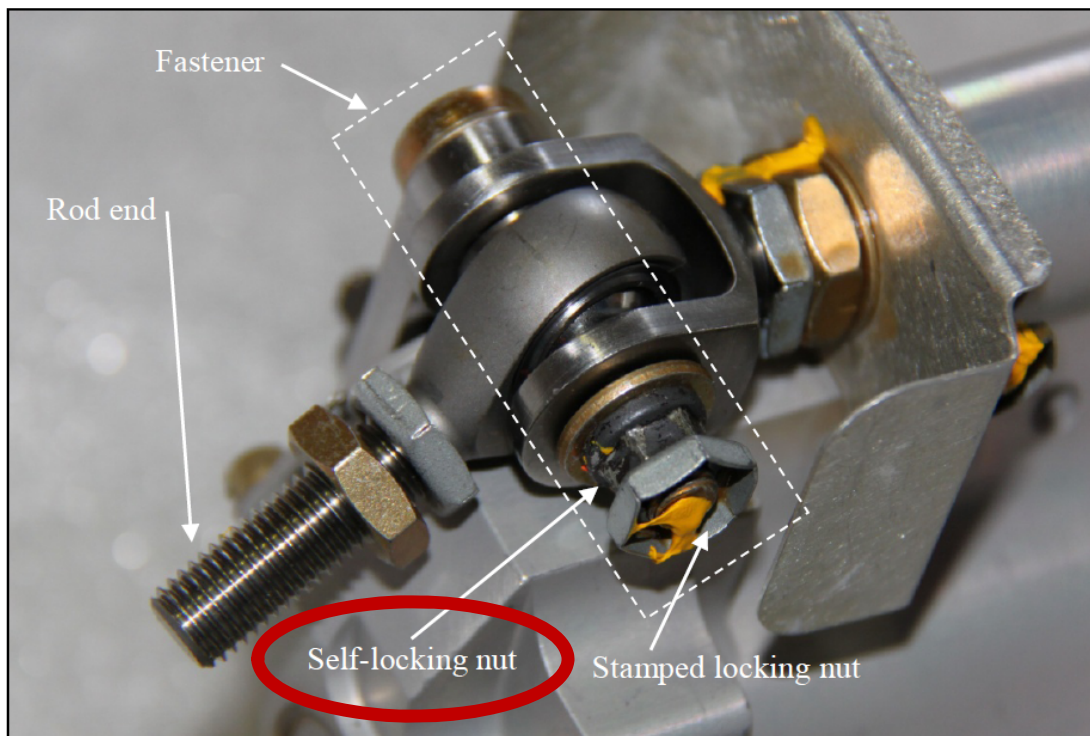
Five of the nuts had either cracked or fractured





ATSB AO 2011-016

Figure 8: Lower flight control push-pull tube rod end



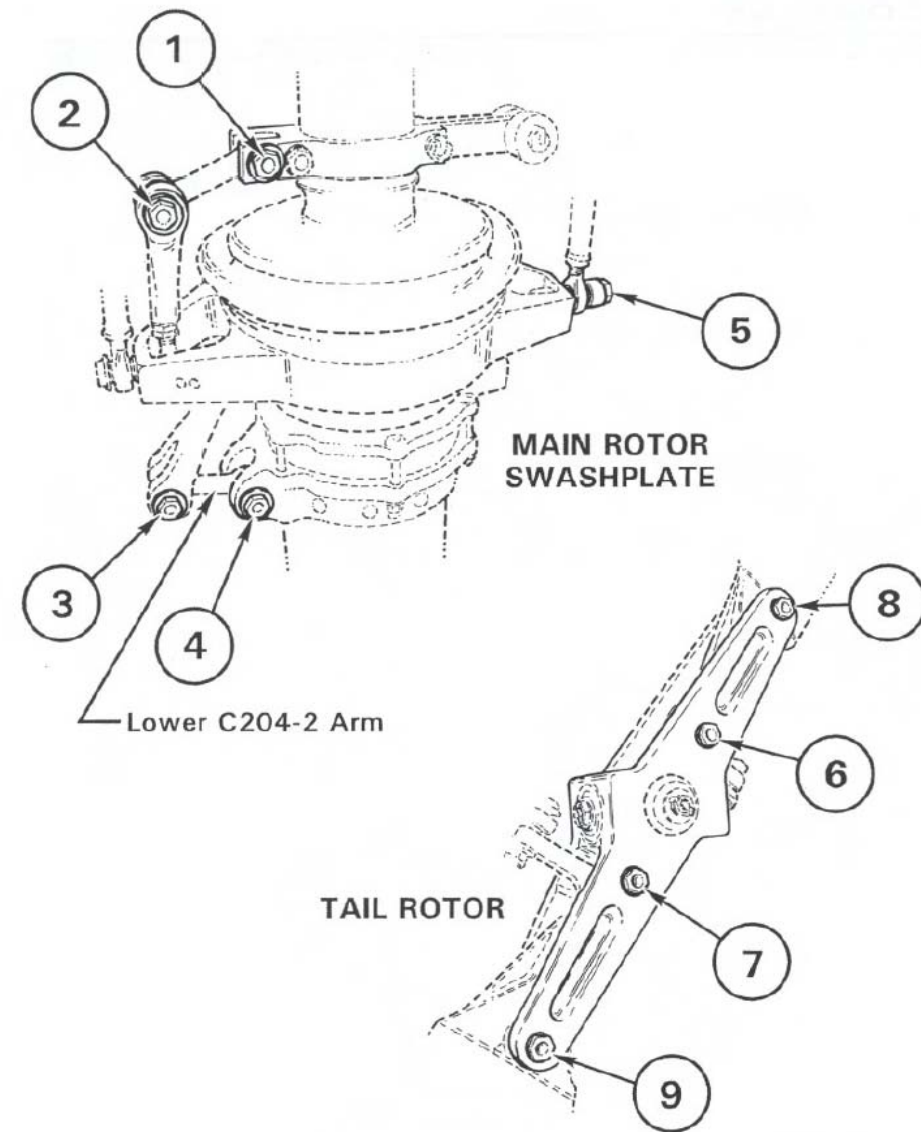
**2 fatalities,
1 severely burned**



- The absence of physical damage or defect on the detached bolt, combined with the testing conducted by the Australian Transport Safety Bureau (ATSB), identified that the fastener likely failed as a result of its incorrect assembly, or a material defect that affected the serviceability of the retaining nuts, or a combination of both.
- There was no evidence that the fastener had been incorrectly assembled or tampered with by any of the organisations that had handled the servo.



- **FAA AD 2003-24-51**
- Prompted by a report of the failure of the bolt that secures parts of the main rotor swashplate and attaches the tail rotor blade. An examination revealed that the bolt failed due to hydrogen embrittlement.



SUSPECT NAS6605-31 BOLTS



Ignition coils



Cracked during thermal cycling



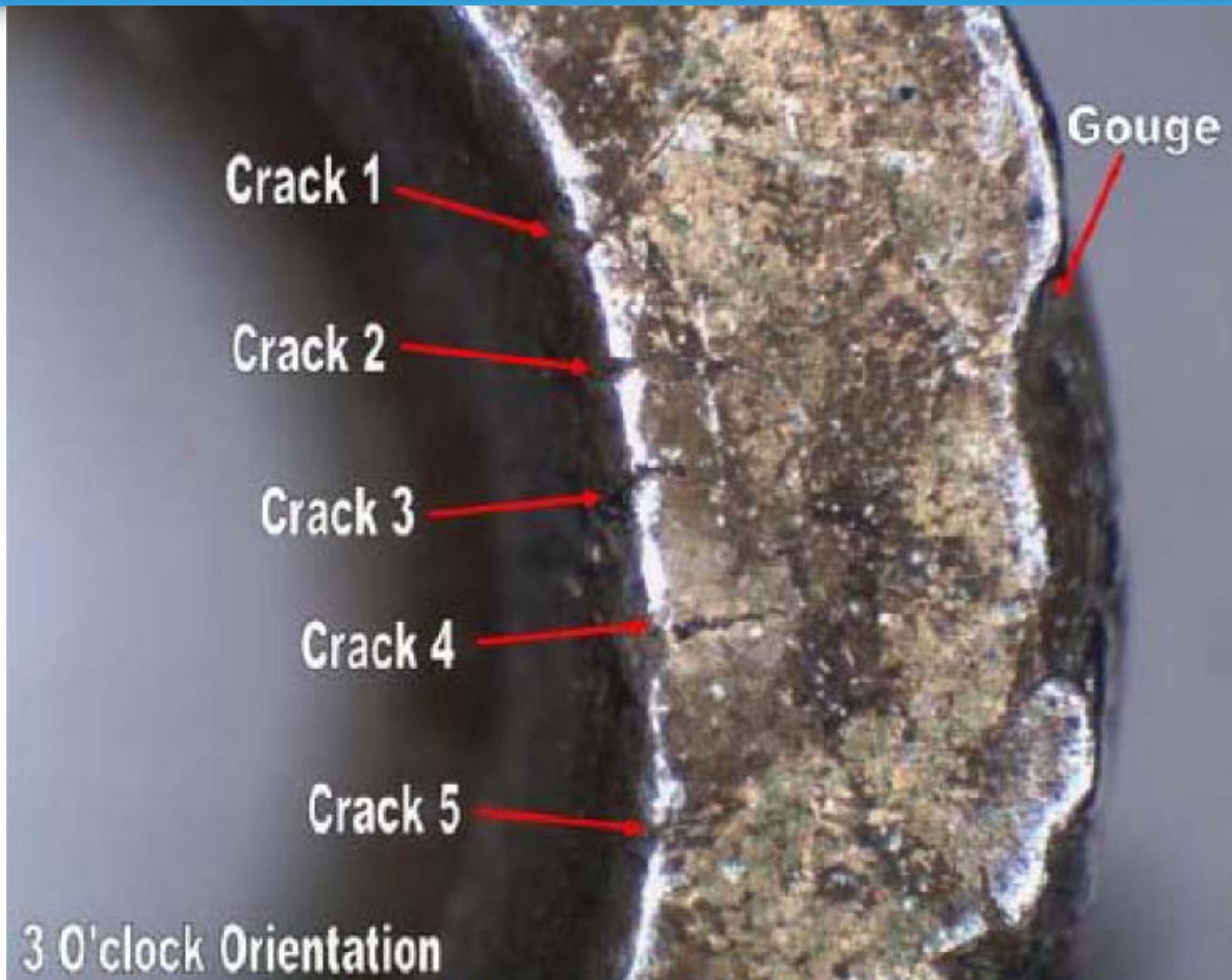
- **TCCA CASA 2013-04**
- Failure of self-locking nuts in certain applications could ultimately lead to a catastrophic event.



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Defects observed - surface



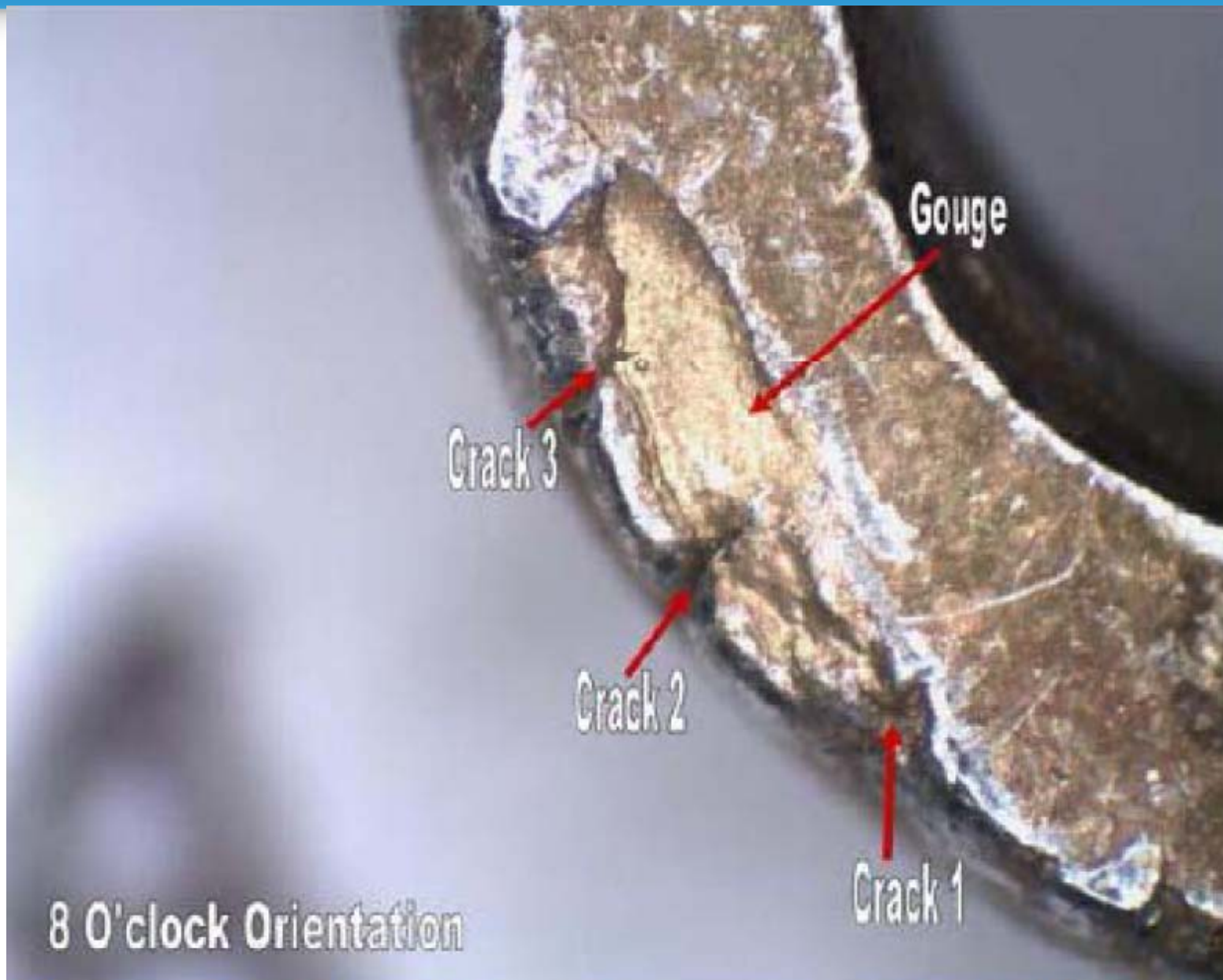


Defects observed - surface





Defects observed - surface

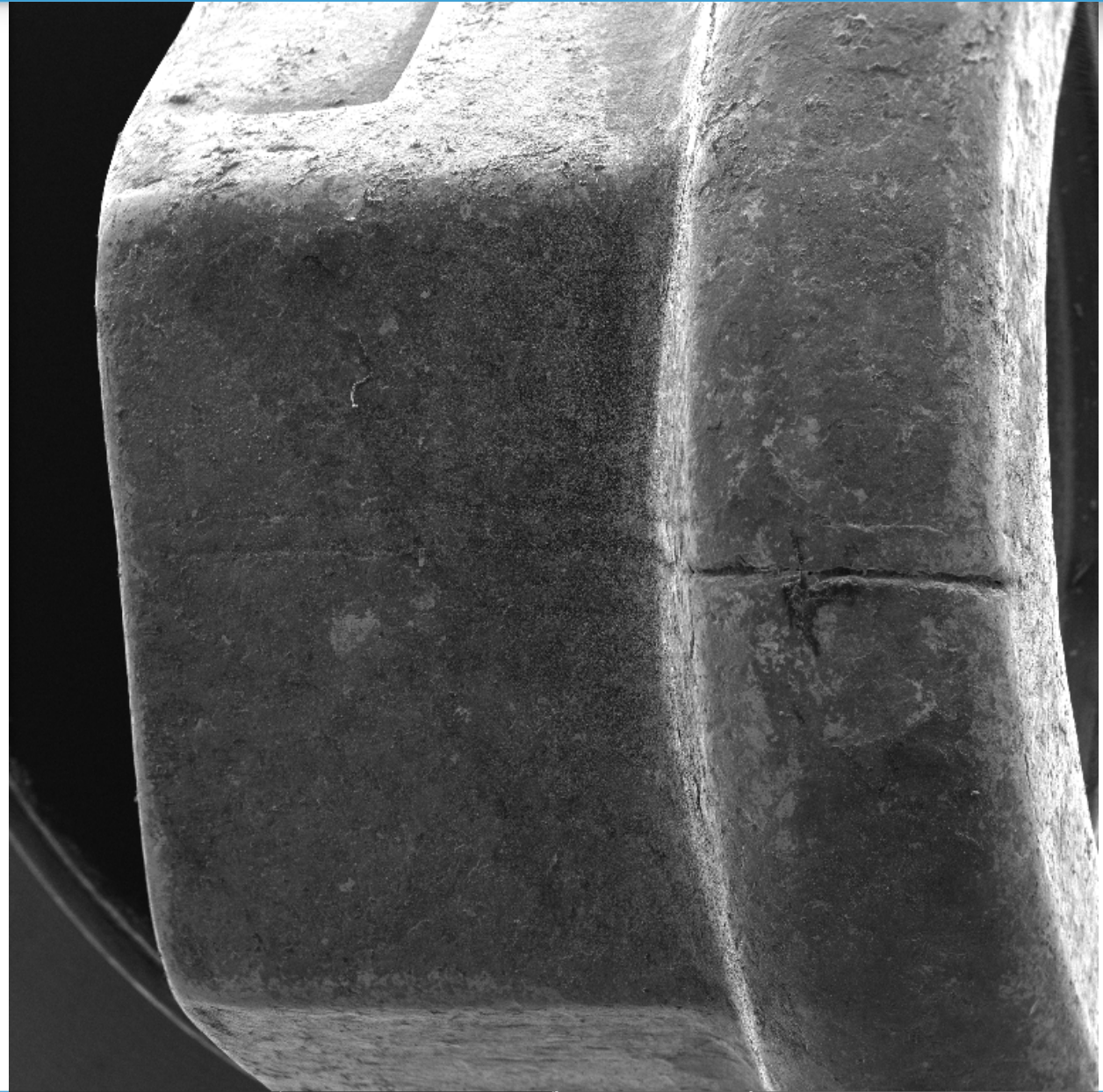




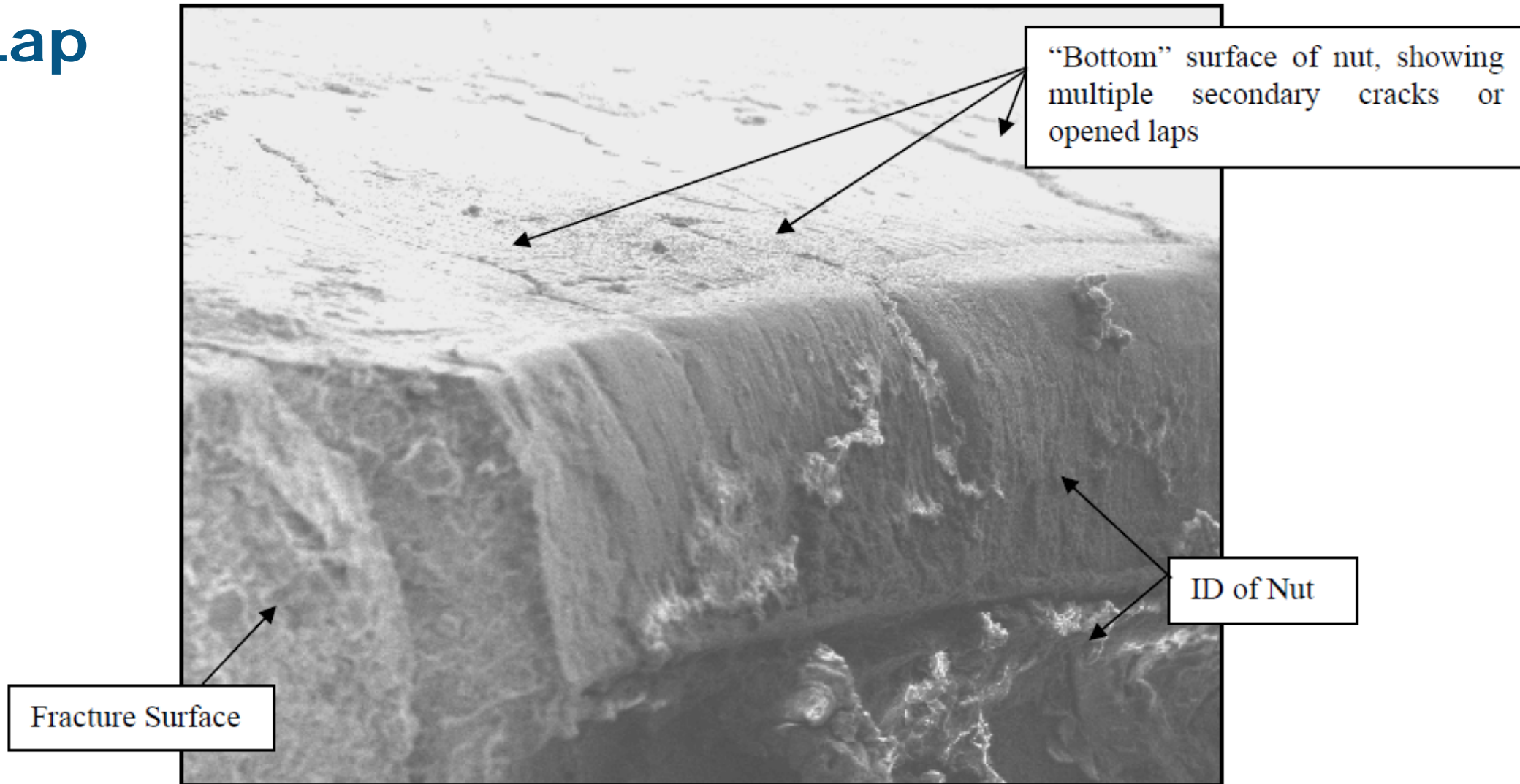
Defects observed - surface



Seam



Lap



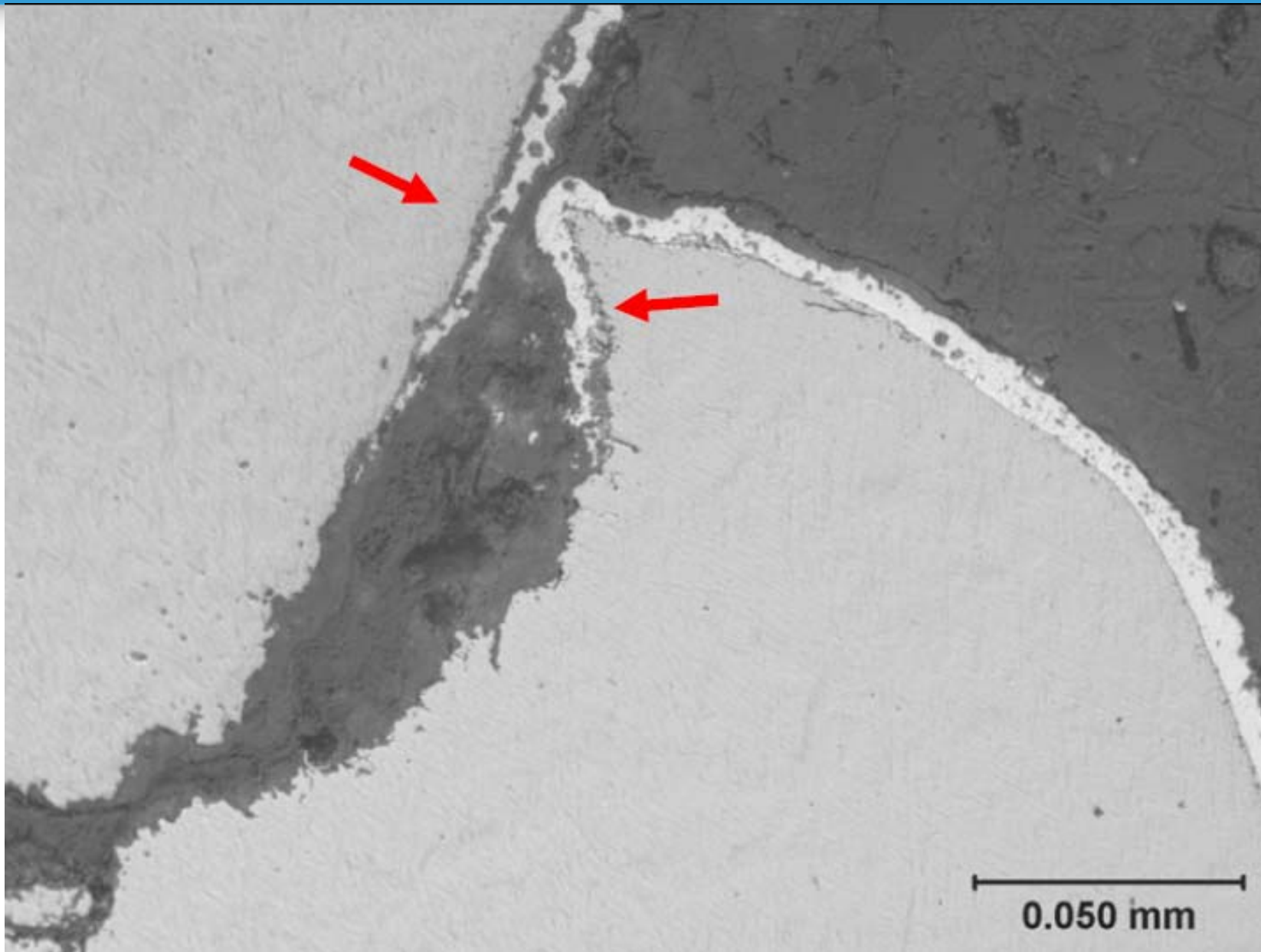
- **micro-crack**
- **fold**



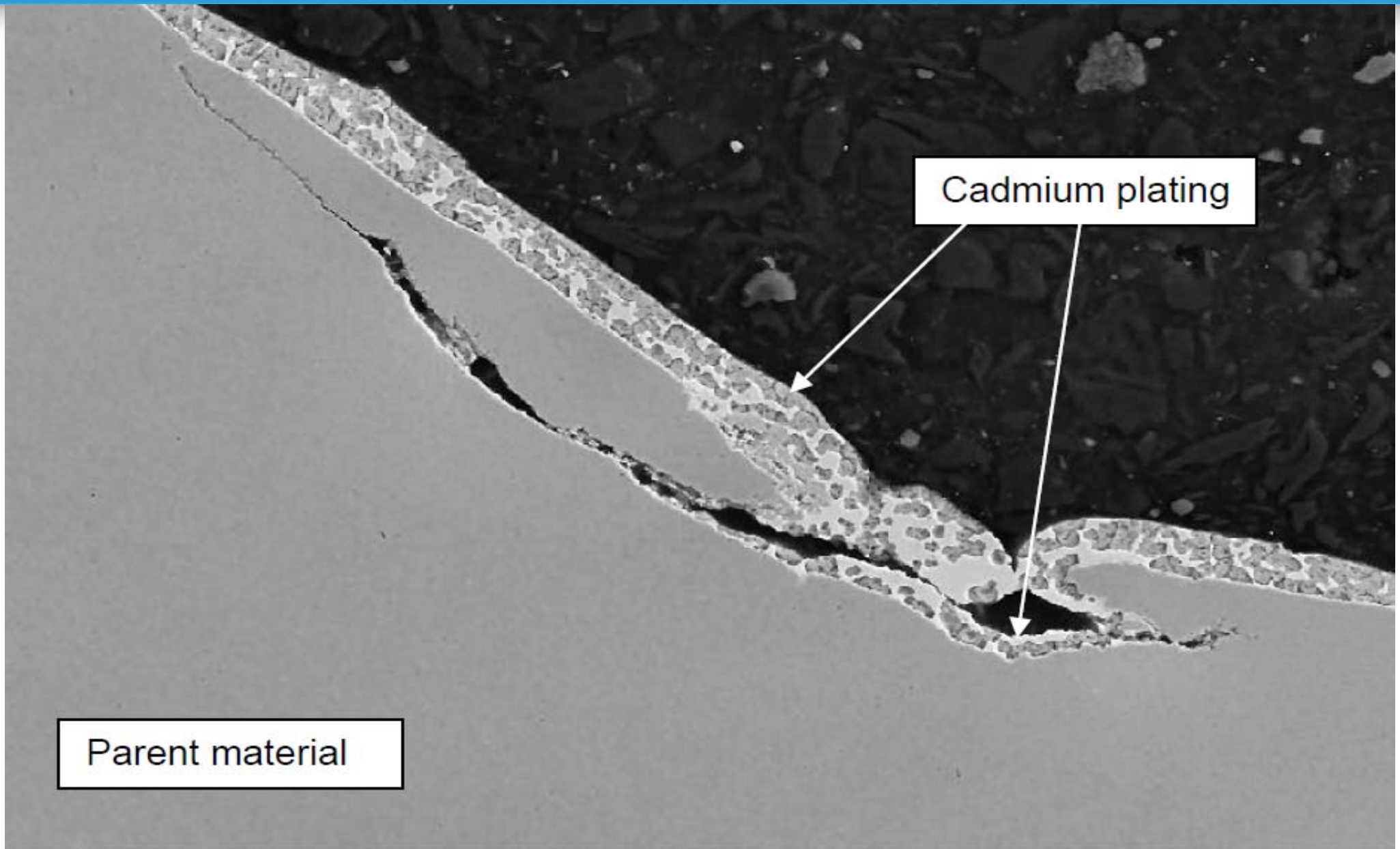
Defects observed - manufacturing



Defects observed - plating

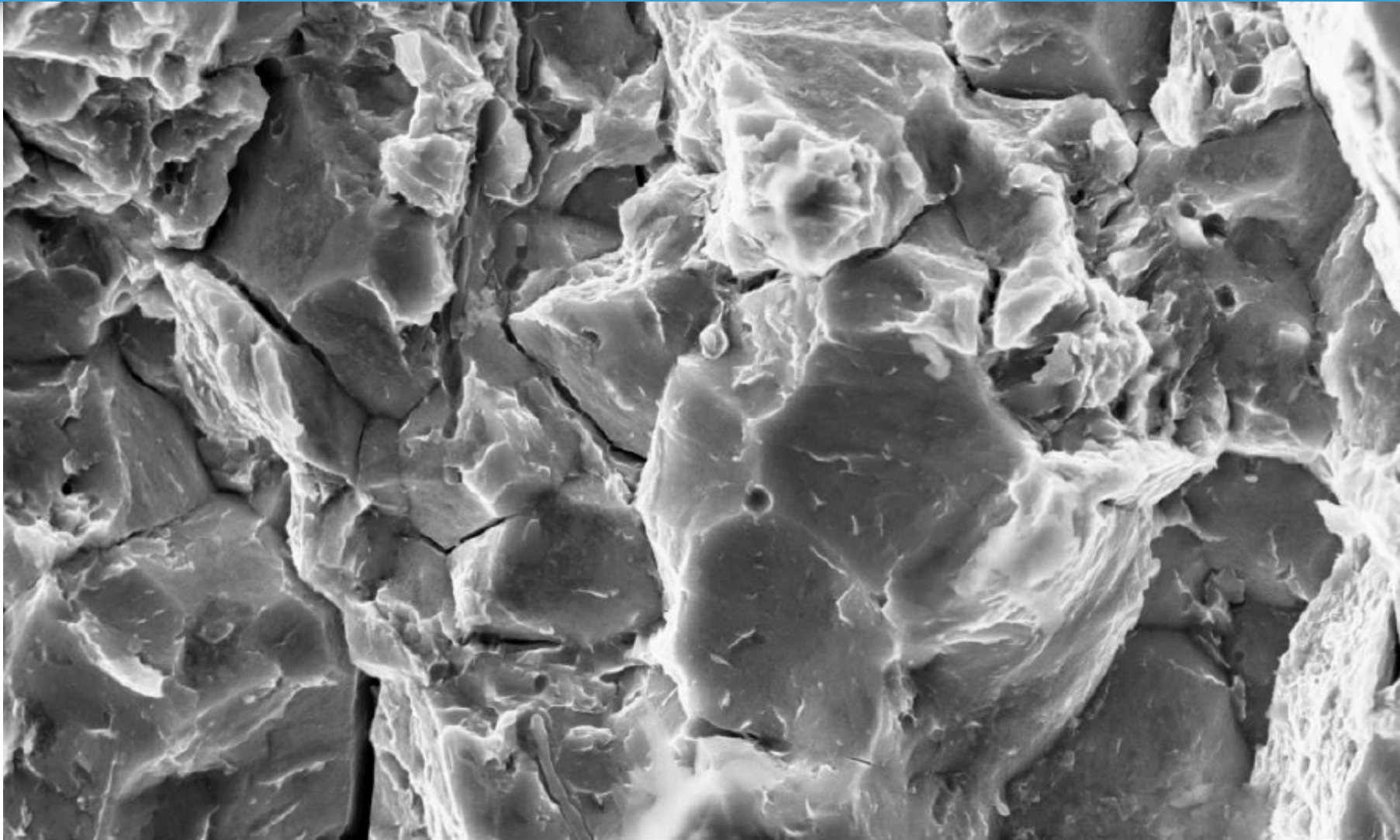


Defects observed - plating





Defects observed - metallurgy



Hydrogen embrittlement



- **Chemical composition**
 - NASM21042 lists 7 approved alloys
 - Do not match any of the approved alloys

Element	%
Carbon	0.43
Manganese	0.69
Phosphorus	0.018
Sulfur	0.007
Silicon*	*Insufficient sample to test
Copper	0.02
Nickel	0.42
Chromium	0.40
Molybdenum	0.18

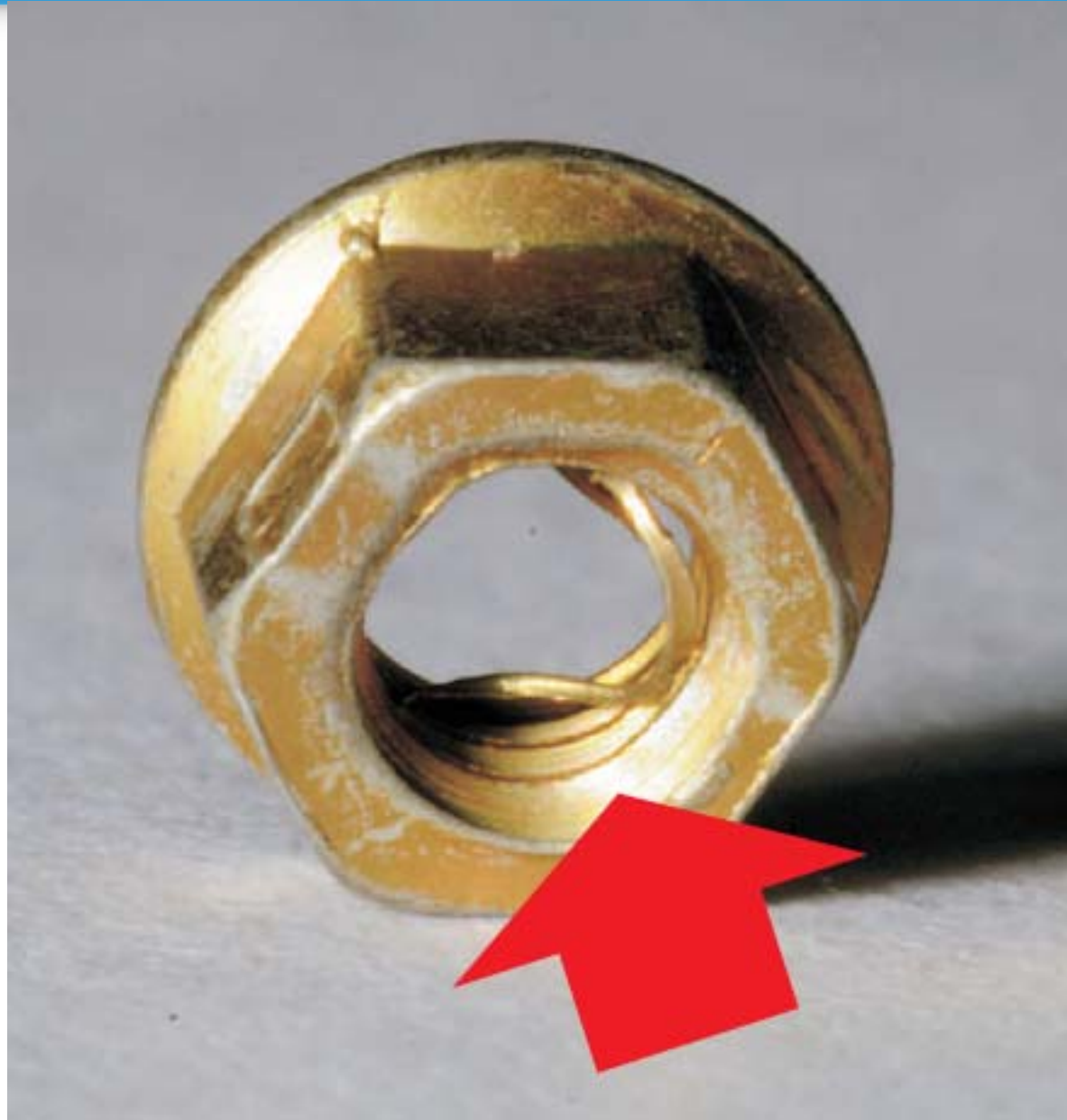


Some occurrences on aluminium nuts





Defects observed - geometry





Defects observed - geometry





Defects observed - geometry





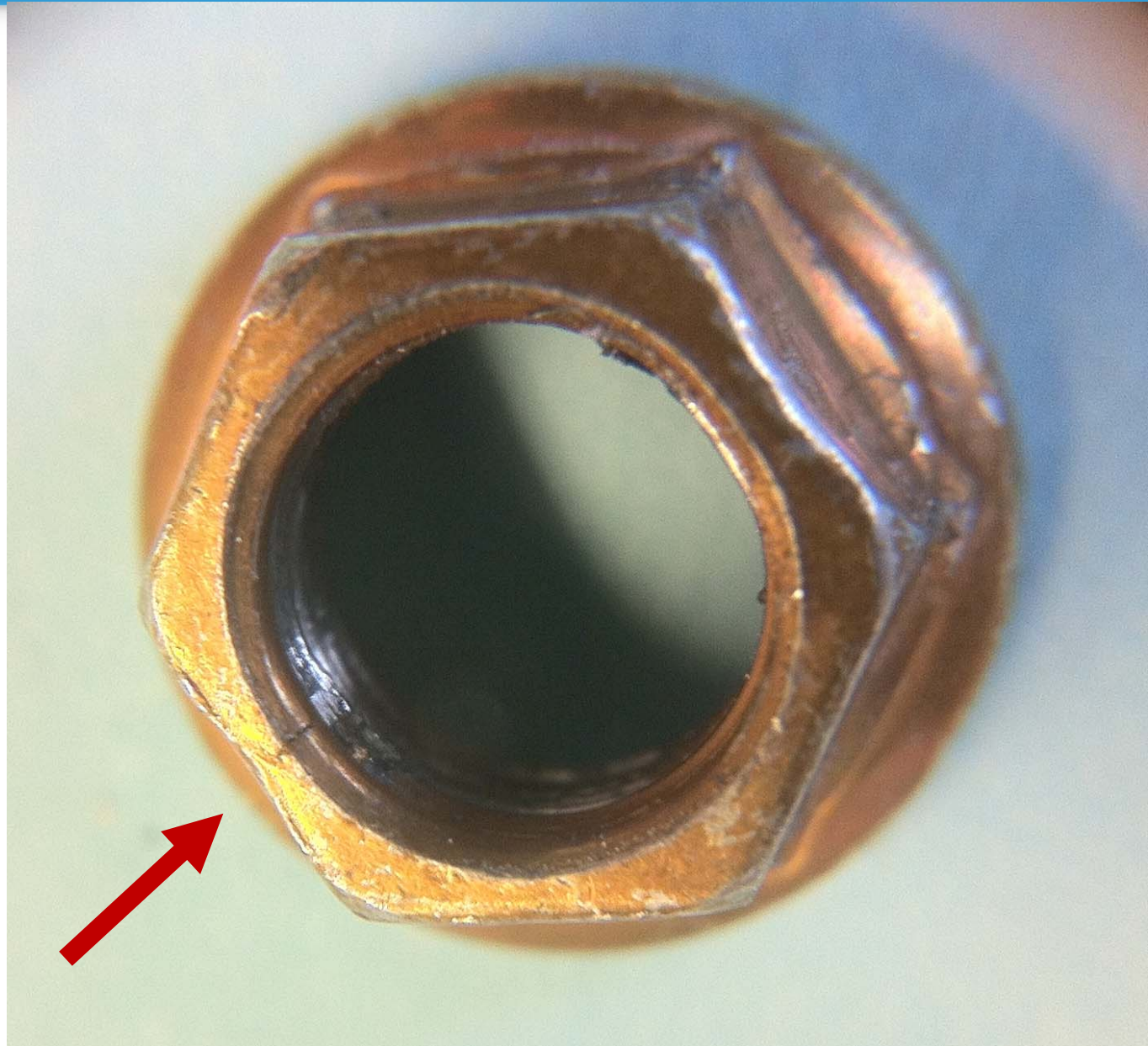
Defects observed - geometry





Defects observed - geometry

**Large portion of
a new batch
already cracked**





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Analysis - classification

- **Visual:** obvious surface or geometry defects, e.g. Figure 1 and 2 of the SIB.
- **No lock:** nuts lacking locking torque.
- **Cracked:** as illustrated by Figure 3 of the SIB.
- **Multiple:** as determined by metallurgical analyses.
- **Magnetic:** nut being non-magnetic when it should be and vice-versa.
- **Missing:** nut missing from aircraft.

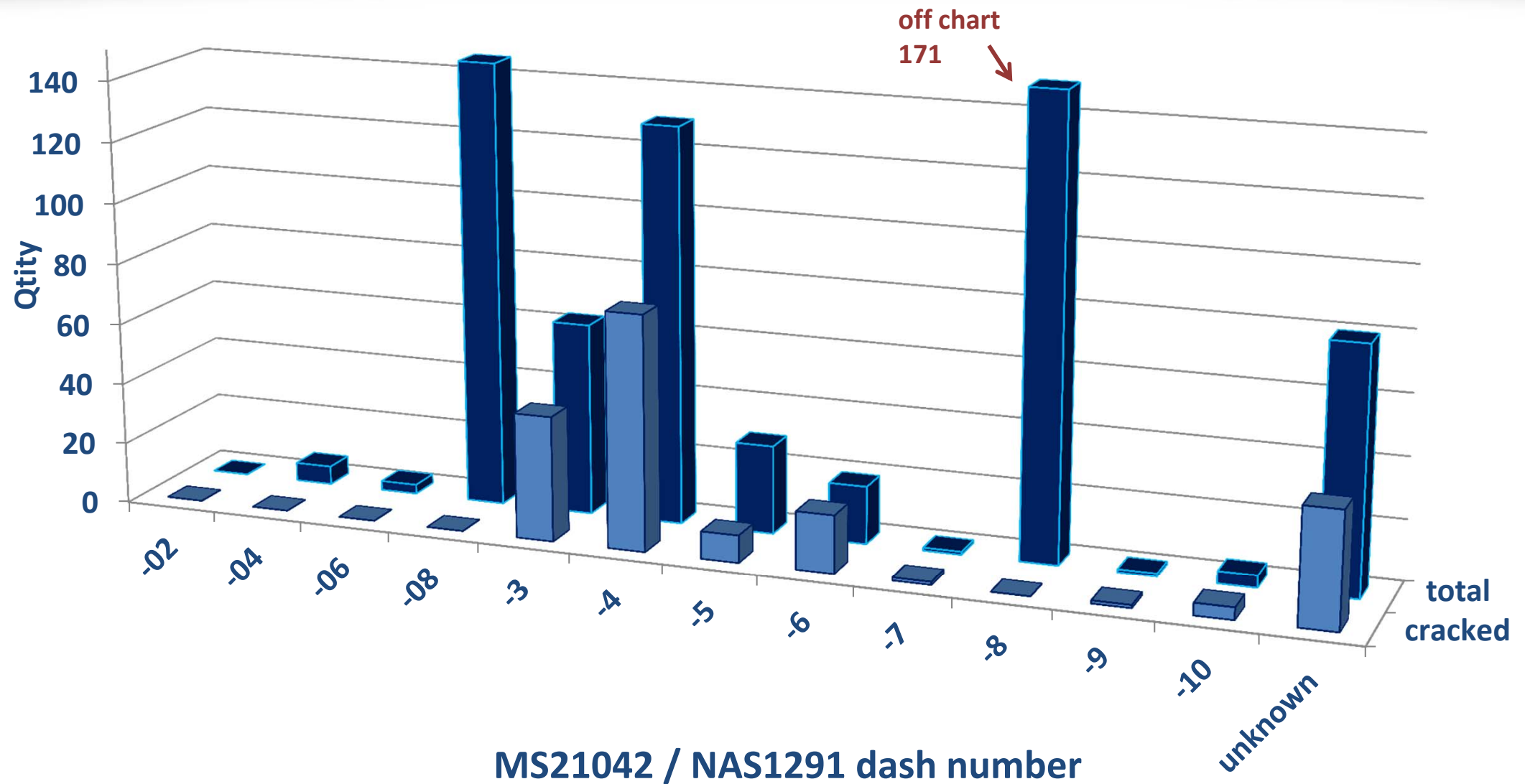


Analysis - classification

	Large Airplane	General Aviation	Rotorcraft	Engine/ Props	ETSO	stock	total
visual						554	554
no lock	22	1		170			193
cracked	276	28	86	3	3	25	421
multiple						16	16
magnetic						20	20
missing	12		8				20
total	310	29	94	173	3	615	1224

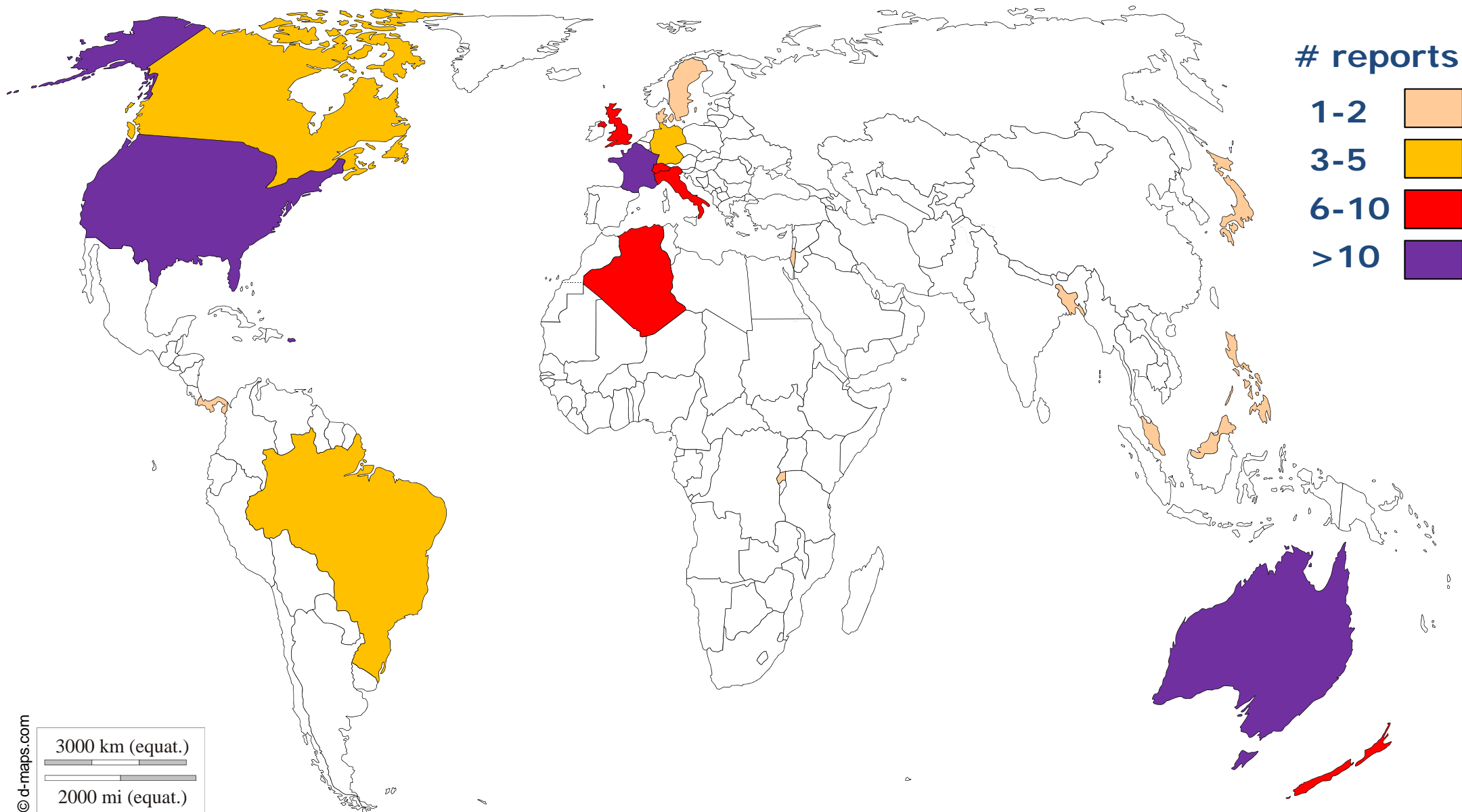


Analysis - sizes



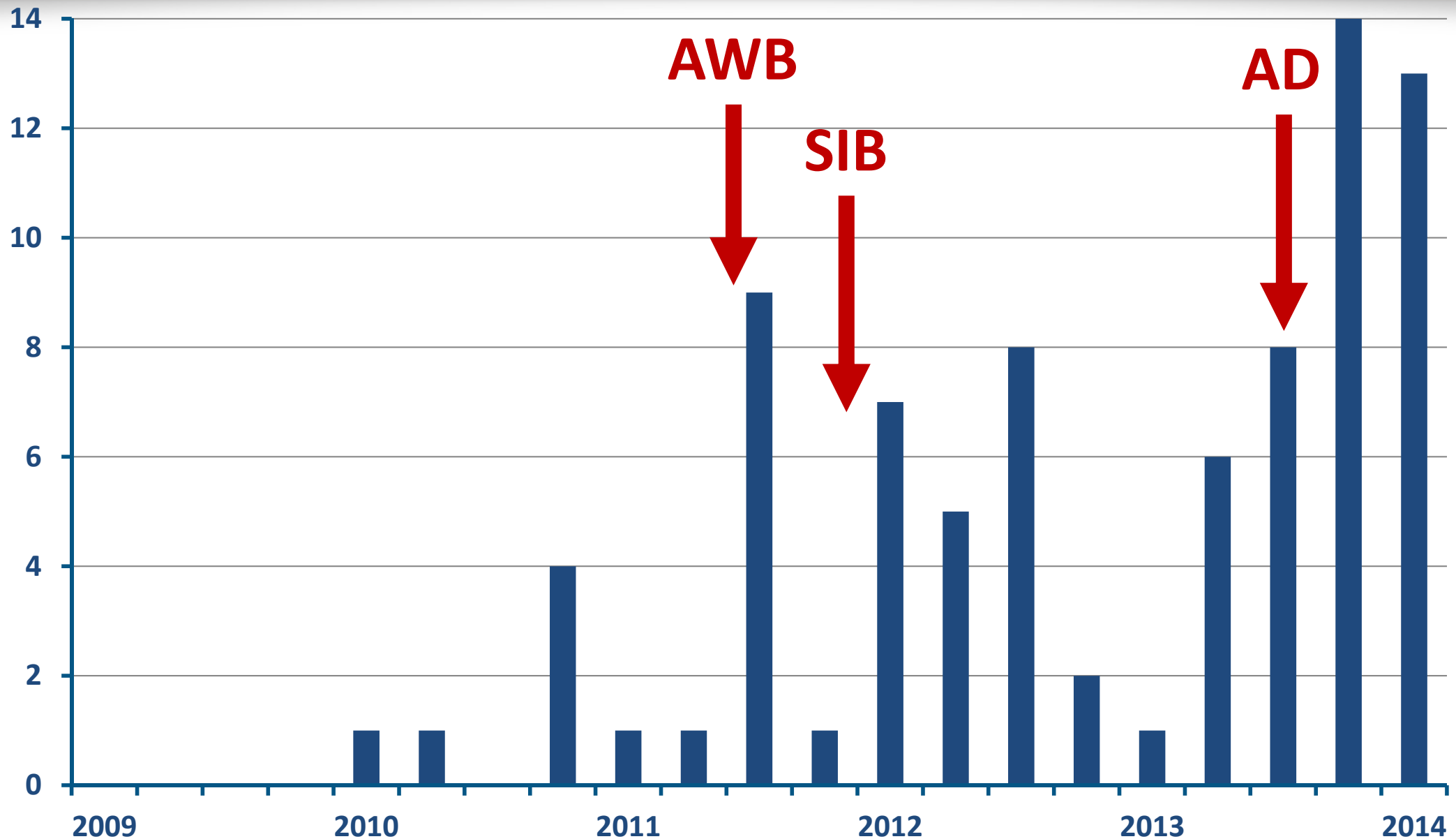


Analysis – origin of reports



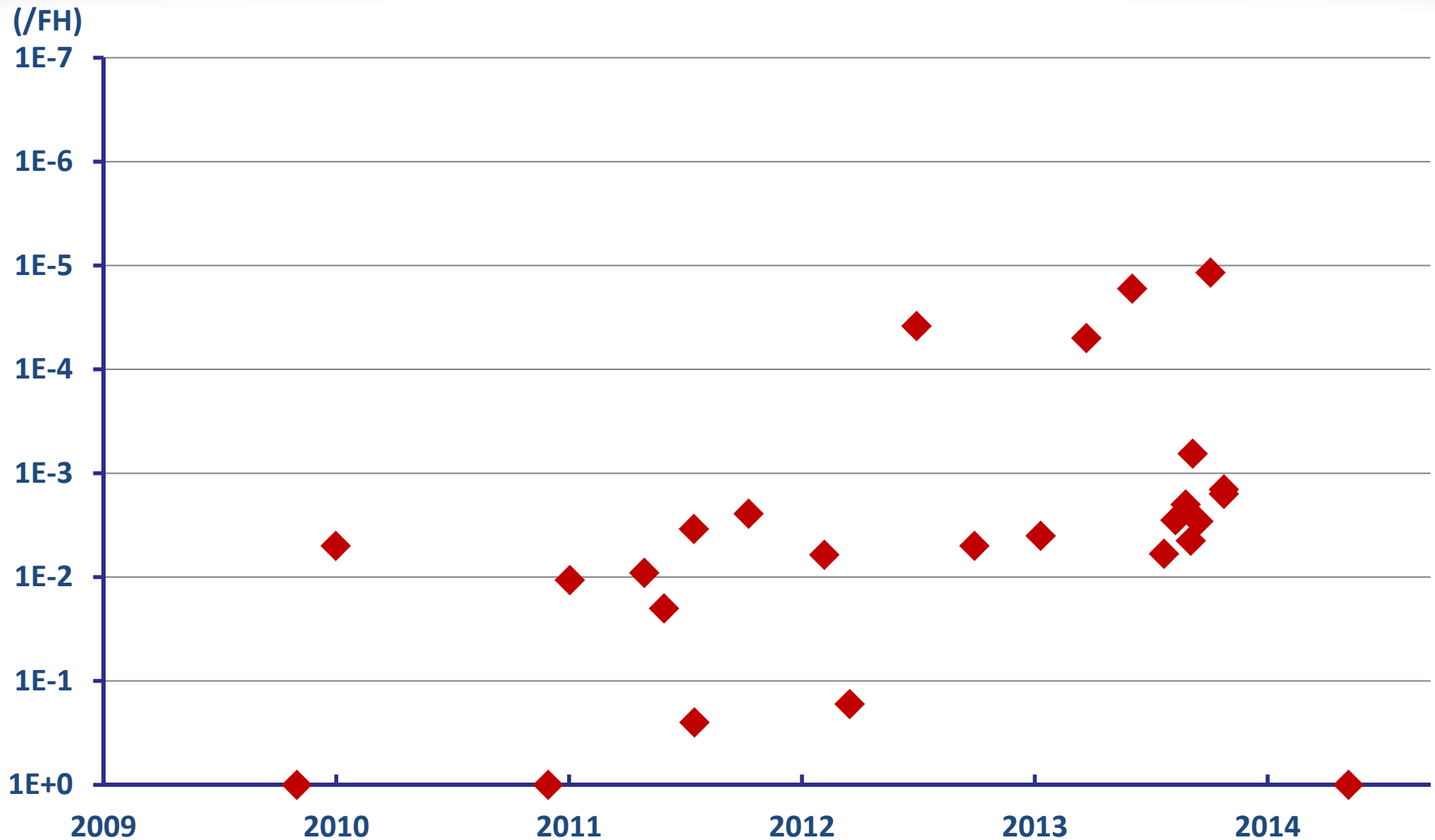


Analysis – frequency of reports



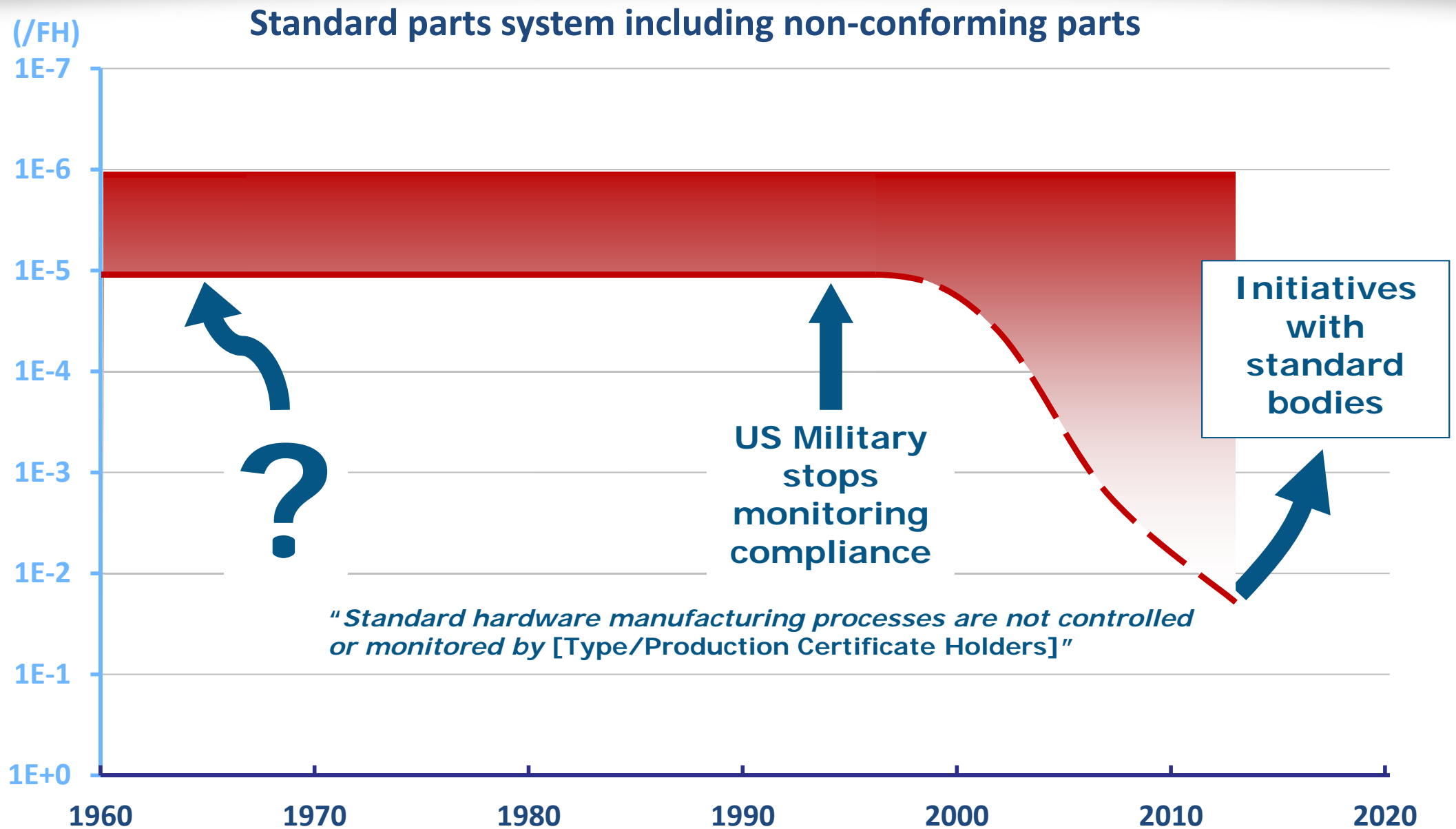


Analysis – failure rates



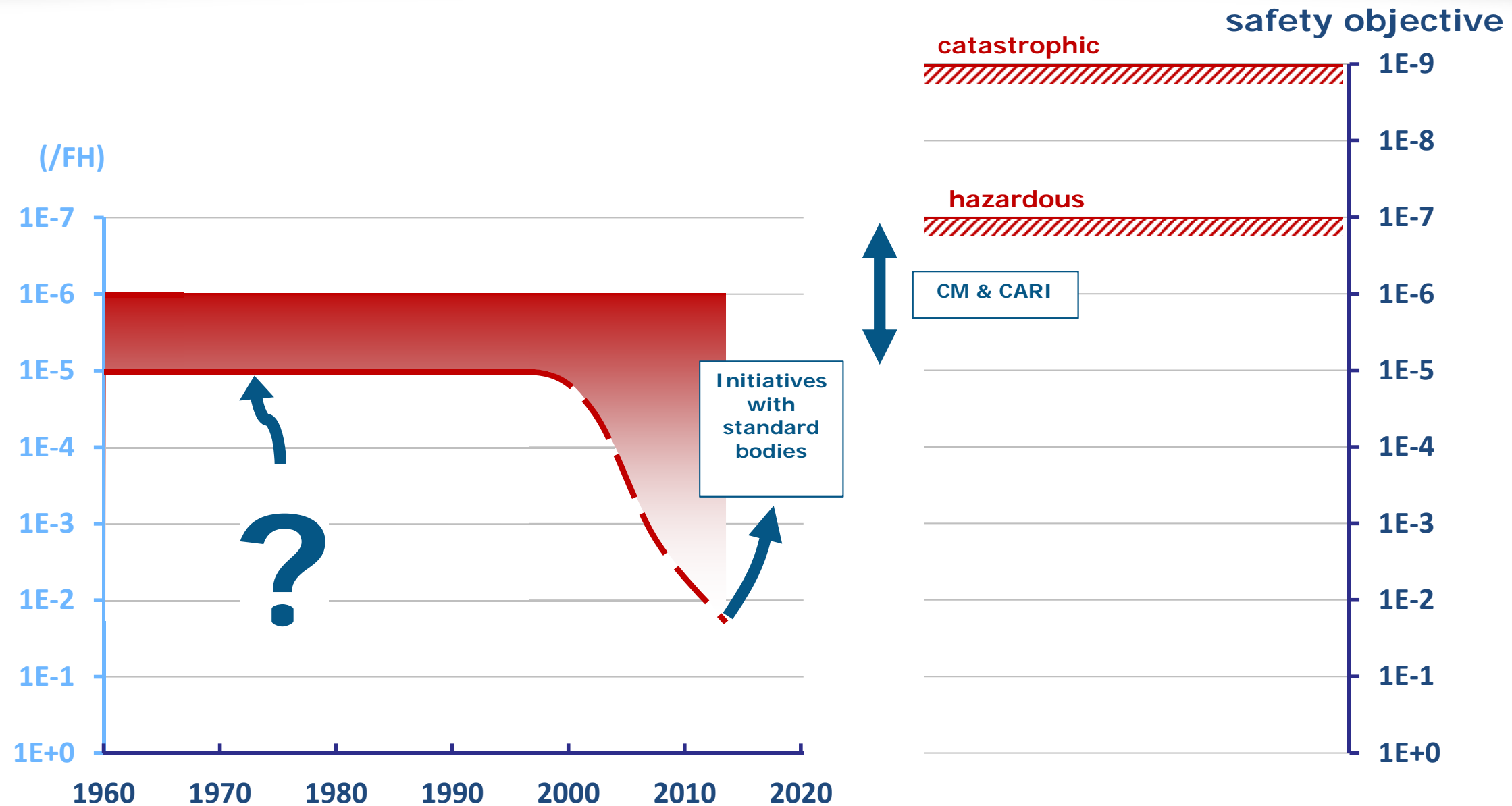


Standard parts – in critical installations





Standard parts – in critical installations





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