

Bell/PHI/NTSB telecon

Tuesday, July 25, 2017 10:00 AM

Bell	Robert Figueroa
PHI	Tom Yakubovich
NTSB	Joe Epperson
NTSB	Van McKenny

Bell Update on work done by their lab.

- x-ray exam of incident blade shows cross-hatched/waffle pattern
 - Indicates that adhesive flow between surfaces was not homogeneous - not enough or uneven pressure applied during curing process
- Similar cross-hatched pattern found on exemplar RBI blades repaired using vacuum curing process, but not as severe as the incident blade.
- Incident blade was repaired using the vacuum curing process.
- FTIR - no silicone mold release found. NTSB lab FTIR exam concurs with the finding.
- DSC to det % cure
 - 74.9% on upper blade surface-leading edge
 - 79.7 % on lower blade surface-leading edge
 - 92% & 100% on lower part of blade - trailing edge
- Thermocouple monitoring identified that the leading side is not getting to the proper temperature for a full cure. The metal erosion strip is acting as a heat sink.
- Broken fibers and resin from end block identified on adhesive surface.
- Blade ends were sealed and immersed in 170° water to check for leaks (bubbles)

Blade A4436 (opposite blade)

- Void identified using tap test
 - Failed lap shear test
 - Void - 1 inch long, 0.1-0.4 in wide.
 - Non bonded area.
- Lap shear on upper side failed (limit 2000 psi)
 - 1037 psi - upper skin
 - 1264 psi - lower skin
 - Found resin rich areas in the block material (weaker bond areas) 8/29

Gear box alignment pins

- Not located when removing support casting from helicopter
- Press fit into gear box

Adhesive

- Adhesive spec research.
 - Recommend pressure 8-12 psi
 - Higher or lower pressure results in porosity and decrease in bond strength
 - Blade repair by RBI done at 28 psi

Safety Actions

NTSB addressed the need to take actions to alert operators to end block crack inspections, review the rotor blade end block repair process, and whether further action such as an AD or SAIB would be needed/beneficial.

Bell Actions

- Operators Safety Noticed - OSN Visual Inspection of T/R blades issued 7.28.2017
- OSN 407-17-21
- OSN 206L-17-52

PHI Actions

- Not accepting repaired T/R blades
- Performing 50 hr tap test
- Rejecting blades with cracks between weights - 8/29
- Daily visual inspection - 8/29

Follow on work

Bell	Leak test A4436- blade sealed & no leak detected 8/29
Bell	measure adhesive thickness - A4436 skin and adhesive bond line thickness. Leading side adhesive thickness (btwn strap & block)0.08- 0.62 max, 0.008 - 0.020 in thickness Flat side of blade -0.007 - 0.044 (1st 2 inches), 0.007-.024 (following 2 inches) Skin thickness - top side 2 - 5 inches from tip 0.0- 0.011 in Skin thickness bottom side 2 -5 in from tip - 0.0 -0.007in Material thinning from inside out
NTSB	Check gear box for alignment pin presence - inconclusive evidence regarding if pins were present or not. No obvious indication of hole elongation. 8/29
Bell	Mounting studs, reverse bending, yielding within the threads. Flat areas of fatigue - tried to count striations (smearing evident). Count on forward stud on one side of reverse bending was 9000 cycles (2500 rpm)~ 3min

*Notes in Red font are notations added from a follow-on telecon Held on 8.29.2017

10.05.2017 Telecon

NTSB	Van McKenny
NTSB	Joe Epperson
Bell	Robert Figueroa
Bell	Tim Ledbetter
PHI	

- Conclusion of the examinations of incident blade:
 - Adhesive bondline porosity throughout the tip block bond surfaces

- Undetermined surface contamination identified
- Adhesive cure for leading edge was 75%(top) & 80%(bottom). All other areas cured at 90-100%
- Bell has updated procedures to correct
 - Adhesive coverage due to vacuum cure - vacuum cure eliminated, pos pressure cure imposed
 - Incomplete cure - thermocouples, heat blankets
 - Block prep and cleaning process more detailed
 - Grit blasting
 - Cooling block before the repair can lead to moisture absorption - this process was eliminated. Purpose was to keep the adhesive from getting too tacky
 - Increased pull test load by a factor of 1.5 (proof load)
- ☒ • Bell to send email with the repair changes that were made. Changes to all the facilities that do tip block repair (RBI, RBI-H Dubi, RBL (canada))
- Bolt studs failed in high load, low cycle fatigue