Australian Government
Civil Aviation Safety Authority

AIRWORTHINESS BULLETIN

Cracked MS 21042 / NAS 1291 - Series Nuts - Hydrogen Embrittlement

AWB 14-002 **Issue** : 1
Date : 12 October 2011

1. Applicability

All aircraft using aircraft Standard hardware MS 21042 / NAS 1291 - series self-locking nuts.

2. Purpose

Alert all aircraft owners, operators and maintenance personnel to in-situ failures of new MS 21042 and NAS 1291 series nuts.

3. Background

CASA has recently received a report of cracked MS21042 L4 nuts which attach the main rotor blade of the R44 helicopter main rotor blade cuff to the hub. The discovery was made following an investigation into an oil leak in the cuff region.

Robinson Helicopter Company (RHC) have issued Service Letters for the R22, R44 and R66[(i)] on these failures. Other helicopter manufacturers, including Bell[(ii)] and Agusta Westland[(iii)] have also issued Bulletins and Letters on the same subject having received similar reports of failed MS21042 and NAS 1291 series self-locking nuts; to remind all owners, operators and maintenance personnel of the importance of inspecting such Standard hardware for cracking. The in-flight failure of such items of hardware may well result in a serious accident.

It is widely acknowledged that items of aircraft Standard hardware, such as these high tensile nuts, are used throughout the aviation industry in a wide variety of locations on an aircraft and that Standard hardware manufacturing processes are outside the control of aircraft manufacturers.

These failures are typical of hydrogen-induced delayed cracking (hydrogen embrittlement), a condition resulting from the presence of hydrogen in the steel (attributed to improper heat treatment at manufacture or following re-plating [iv]) and a sustained tensile stress. The stress is induced from the moment the nut is torqued and may fail hours, days or weeks later, with one or more cracks appearing approximately in-line with the longitudinal axis of the nut, frequently splitting the nut wide open but staying in place, as if it were serviceable.

When the nut has failed in this way, it no longer functions as designed and it releases all the tension on the stud or bolt. This failure may have serious secondary effects. The bolt to which it was attached may fall out and/or as with the R22/44 main rotor blade cuffs, higher loads are now immediately transferred to the remaining fasteners, which may result in over-loading and subsequent failure of the bolts or studs some time after the nuts have been replaced.

Figure 1 - Example of a failed nut (Courtesy ATSB)

4. References

(i) Robinson Helicopter Company: R22 Service Letter SL 58; R44 Service Letter SL 38; R66 Service Letter SL 01.

(ii) Bell Helicopter Textron Operation Safety Notice GEN 11-43

(iii) Agusta Westland Information Letter GEN-11-024.

(iv) CASA AWB 85-11 Piston engine Overhaul - Dangers of Replating Engine Hardware following in-situ failures of inadequately re-plated aircraft hardware.

5. Recommendation

CASA recommends that:

(a) pilots and maintenance personnel closely monitor the occurrence of hydrogen-induced delayed cracking in high-strength steel standard aircraft hardware, such as nuts via close inspection following installation and thereafter at Daily / Preflight and periodic inspections.

(b) Before simply replacing cracked/failed nuts with new items, consider contacting the manufacturer for advice regarding replacement of associated fasteners which may have suffered over-loading as a result of the failure of one or more nuts.

(c) Report all MS 21042 and NAS 1291 series nut failures to CASA via the SDR system.

6. Enquiries

Enquiries with regard to the content of this Airworthiness Bulletin should be made via the direct link e-mail address:

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or in writing, to:

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