DUAS26

Posted on 04.01.2024 by Rupert Dent

Category: Drone

Report Title Broken propellor flanges

Initial Report

Upon completing a flight, the UAS was landed, and the battery changed. When starting the rotors for a subsequent flight the left rear propellor did not spin up as expected and a grinding sound was heard. The UAS and Controller were switched off and inspection of motor assembly was made assuming motor failure. Motor was resistant to rotation and assumed failed. On removing the propellor it was noted that two of the three flanges that secure the propellor to the propellor hub had failed and entered the motor housing (see pictures) There was no suggestion of this impact or damage prior to carrying out the previous flight. Total Estimated Flight time on the propellor set is in the region of 27 hours. The failed parts were removed from the motor housing and motor freedom was tested. The propellor was replaced and the UAS restarted. Ground running test completed satisfactory, and short flight test completed satisfactorily and UAS returned to service.

The UAS is checked both prior to flight and post flight before being packed away. It is noted that this is the required check in the Operations Manual and complies with the requirements of the OM and Flight Reference Cards. It is important here to recognise that there is currently no requirement to perform a transit check upon each take-off and landing or after each battery change.

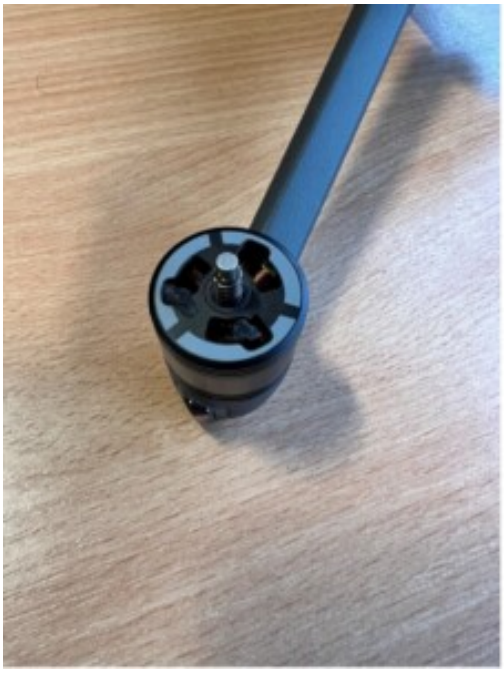
From a Risk Assessment point of view, it may be the path of least resistance would be to incorporate a transit check after each take-off and landing; however, this could potentially quickly become arduous to the point Remote Pilots will not carry it out.

A reasonable compromise is that, in line with carrying out a repeat control check, the Motors and Propellors are inspected as part of a transit check during each battery change. This provides the best compromise I believe, between checking every flight and only checking pre and post flight therefore reducing risk to an acceptable level and is in line with the Operating Practices for a Normal Take-off with this Operator. A “normal take-off” being (Lookout; Announce “Take Off”; Start UAS motors manually using controller; Increase height to above head level, perform a control check in Pitch, Roll, and Yaw).

One possible failure mode that was considered after the event was observed is the way that the UAS is unfolded and folded. If Remote Pilots were to continually use the propellor to extend and unfold the arms this could put excessive stress on the propellor hub flanges over a period of time

and eventually weaken the structure to the point of failure.

Below are pictures of the broken propellor flanges and the motor with the two flanges that had broken off stuck in the housing.



Lessons learned:

Consider adding an interim hardware check after each take-off and landing or each battery change.

Review of Propellor loading and replacement requirement (currently 100 hours).

Inspection of all other propellor hubs.

Comment

This is an excellent example of Human Factors with a positive outcome. The fact that a check was undertaken between flights enabled the issue with one of the propellers to be identified before it caused an accident. The aircraft in question was a DJI Mavic 3. This is in fact a relatively new model from DJI. The DJI Phantom 4 had several issues with its propellors, and it is disappointing to see a possible recurrence of a propellor weakness on the Mavic 3. Whilst this is not necessarily an operator-related HF issue, it is perhaps a manufacturing related HF issue, in quality control. The reporter's suggestion of checking propellers between each flight would be a sensible mitigation, particularly in a world where if one comes off in flight, the ground risk is substantial. After all, a variety of basic checks is very much something that happens between flights in the crewed aviation world. You should always for example check full and free movement of the controls between flights. The reporter interestingly mentions that folding and unfolding the rotor arms by holding the propellors themselves rather than the arms may have been an underlying cause of stress on the flanges. We think that if this was indeed the way the arms were being unfolded, it may well be a root cause of the flanges being sheared off.

CHIRP recommends that folding and unfolding propeller arms is always done by pulling the arm itself rather than the propellor blades.

Collectively, we need to monitor whether other occurrences like this are reported in the future. The Mavic is a widely used aircraft and quality related issues associated with manufacturing the propellor attachment need to be identified as early as possible. It is worth noting that on some DJI models with folding rotor arms, the design has been changed and the propellers are now permanently attached using screws. Whilst it is uncertain whether this is a mitigation against previous problems associated with propellors being detached from the hub, it is worth keeping an eye on the new arrangement to see if it leads to separate issues.