AIRWORTHINESS BULLETIN

Wooden Propeller Maintenance (Rewrite of AAC 17-3 and AAC 187-1)

AWB 61-007 **Issue :** 1
Date : 11 March 2008

1. Applicability

This AWB is applicable to all wooden propellers fitted to aircraft.

2. Purpose

The purpose of this AWB is to bring to the notice of Maintainers of aircraft fitted with wooden propellers recommended techniques previously published in AAC articles.

3. Background

During recent discussions with aircraft maintenance personnel it was suggested that a number of AAC articles published in the past still have relevance today. The first of these is a rewrite of AAC 17-3 and 187-1.

4. Information included in AAC 187-1. <u>The following information does not constitute approved data.</u>

1. There are two basic methods of transmitting the engine torque to the propeller:

    a. By static friction between the propeller hub and the engine crankshaft flange. This is the case for most wooden propellers. Some older designs, (mostly large propellers), were driven by specially designed drive bushings incorporated into the propeller hub.

    b. By drive bushings or dowels incorporated in the engine crankshaft flange. This is common in metal propellers utilizing the high bearing strength available.

2. Most of today's light aircraft engines have their drive flanges equipped with bushings or dowels. If used with a flat faced wooden propeller the bushings or dowels should be removed, or alternatively, (subject to approval by the propeller designer, in most cases a CAR 35 design approval will be required), the propeller hub should be counter bored.

3. The engine torque transferred to the wooden propeller is therefore a function of:

    a. The friction co-efficient between the wood and the engine flange alloy. And;

b. The size of the friction surfaces, (common engines up around 180 BHP (134.2KW) have flanges of adequate size to achieve successful torque transfer using friction alone. Bigger engines may need special care in this respect, e.g. enhancement of the co-efficient of friction by the use of friction disks or pads, or mechanically connecting a front plate to the crankshaft flange thus creating a friction drive to both faces of the propeller, or simply by increasing the drive flange diameter. And;

c. Compression load between the propeller and the crankshaft flange. This is applied through the attaching bolt tension.

4. Wooden propellers have a natural tendency to 'work loose' over time.

a. Despite protection of the propeller by multiple coats of lacquer, the wood due to its nature is very susceptible to changes in humidity, which can adversely affect the compression load applied by the attaching bolt tension.

b. When an aircraft is operated in an area of high humidity or during the wet months of the year, the timber in the propeller swells, and as the expansion area of the hub between the two flanges is limited by the hub bolts, some of the wood fibres are crushed. As the propeller dries out during dry weather and shrinks, the timber no longer fills the space between the two flanges. Accordingly, the hub bolt nuts become loose; the propeller is then allowed to slip and causes charring and possible sheering of the wood adjacent to the bolt holes, this sheering could eventually lead to cracking and possible propeller failure.

5. One method of overcoming this problem is to check the tension of the attachment bolts whenever there is a significant increase in ambient humidity in either direction, or when there is a change in seasons or a change in aircraft locality. In addition the bolt tension should be checked after the first flight following fitment of the propeller and at each periodic inspection, or prior to flight after the aircraft has been idle for an extended period of time (for instance two changes of season), (AD/PFP/1 outlines this requirement and makes it mandatory).

6. Not withstanding the requirements of AD/PFP/1,(which still must be carried out) the problem of bolt tension retention can be overcome by the installation of some spring elements under the nuts, which can automatically compensate for changes in wood thickness and maintain interface pressure. The usual method has been to use one or more 'Belleville' washers. Unfortunately quite often the installation method of these washers will nullify their purpose and usefulness. In some instances require that the washer is fully flattened and then released to a set thickness. Unfortunately testing of some of these washers has revealed that this method can cause a loss of approximately 20 to 25% of their available spring retention rate.

Note: If the Propeller, Engine or Aircraft manufacturer has not approved the use of 'Belleville' washers during propeller installation CAR 35/36 approval must be sought.

7. To fully utilise the characteristics of 'Belleville' washers the following should be considered.

   a. Use a front plate that encircles the propeller hub. This plate will distribute the bolt tension evenly to the whole hub. This will also avoid direct contact between the washers and the propeller hub surface.

   b. Install a flat steel washer under the 'Belleville' washer/s. 'Belleville' washers have sharp edges which could cut into aluminium alloy of the cover plate.

   c. Install the 'Belleville' to compensate for the maximum changes in the wood thickness. See Figure 1 which shows how different washer arrangements will affect the spring rate available.

   d. Avoid flattening the washers. Measure the deflection then compare it to the pre-fitment size.

   e. Use a torque wrench to tighten the bolts whilst simultaneously measuring the deflection. Subtract washers if they are not deflected sufficiently that is less than 1/2 deflection and add washers if the deflection is too great that is above 2/3 deflection.

   f. Do not use previously flattened washers.

8. Most WOODEN propellers have no fixed overhaul period so consequently may remain in service as an 'on condition' item, as long as the responsible LAME is satisfied that it meets all of the appropriate standard. They are normally only removed when the engine is removed for maintenance. Wooden propellers should be carefully inspected when they are removed, for damage, security of leading edge strips, screws and rivets. Careful attention should be paid to the area around the bolt holes for cracking and crushing.

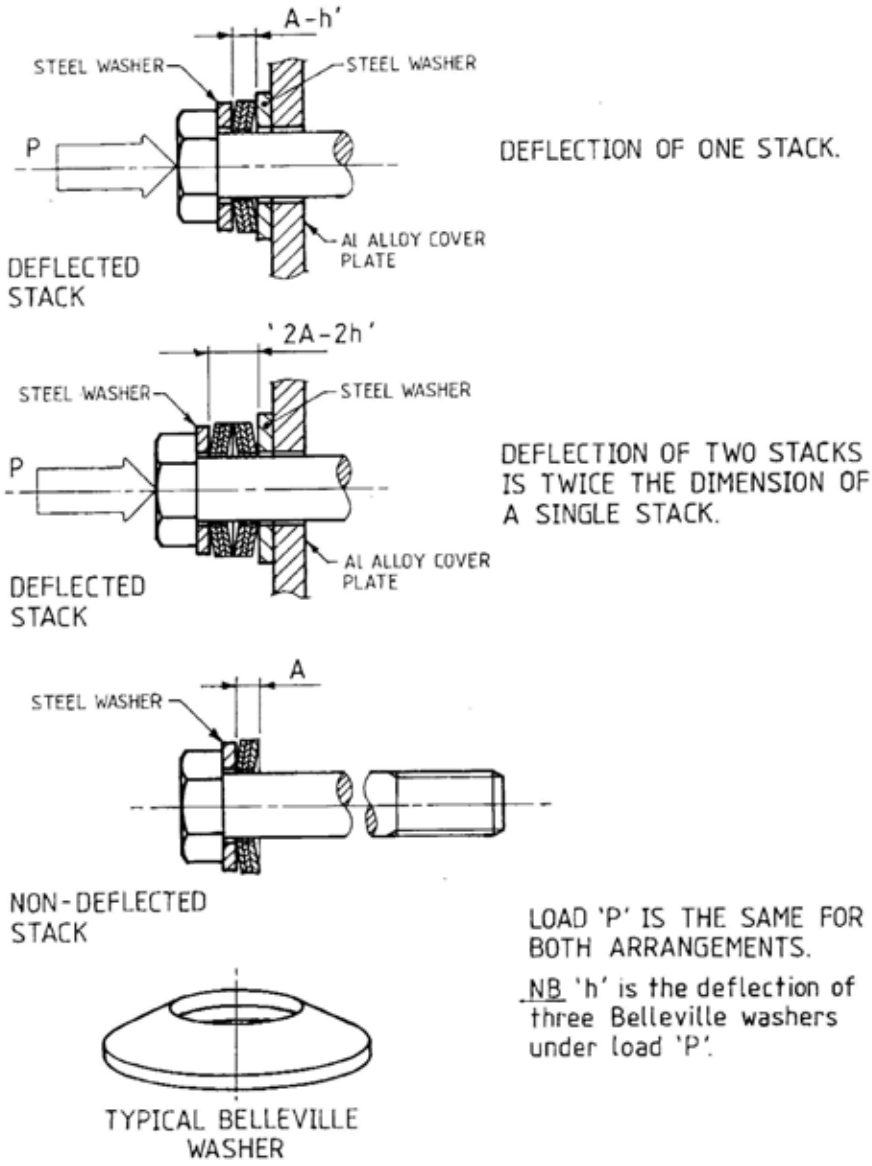

FIGURE 1.

5. Enquiries

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

AirworthinessBulletin@casa.gov.au

Or in writing, to:

Airworthiness Engineering Branch
Civil Aviation Safety Authority
GPO Box 2005, Canberra, ACT, 2601