Low-Hours Propeller Inspection Protocol (LPIP)

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1. Introduction.

There can be little doubt that the propeller is one of the hardest-working components fitted to the average light aircraft; it is not surprising then, that both propeller manufacturers and certifying authorities require that they are subjected to regular and very detailed inspections. At the present time, with regard to variable pitch propellers, LAA policy advises engineers to operate under the principle that a variable pitch propeller should be maintained and overhauled in accordance with manufacturer's overhaul instructions. Where specific manufacturer's instructions are not available, propeller overhaul should be carried out in accordance with the requirements of the CAA Generic Requirements for propeller overhaul (CAA CAP 747 GR No. 17).

Normally, a manufacturer of any critical component will consider a number of issues when deciding on a life limit and in this context, three stand out.

1a. The Assessment of Risk.

The assessment of risk is a complex science in its own right, of the many factors that need to be considered, one stands head and shoulders above the rest. In this context the question that needs to be answered is, 'what would happen to the aircraft if the component or assembly in question failed?' Clearly, a failure of a propeller could easily lead to the loss of the aircraft, so it is essential that any overhaul requirement is completed well within a time before a failure could occur. Decisions about this are made by completing difficult calculations, normally these sums are augmented by the manufacturer's field experience gained over the years with identical or very similar products.

1b. Wear and Fatigue Limits.

The second issue involves manufacturers deciding on the point when checks will be required to ensure that the individual parts in the propeller are likely to have worn below acceptable tolerance limits. Some parts of the propeller can be inspected easily at normal inspection points. For example, advice is given by most propeller manufacturers about how to carry out the process of 'dressing-out' minor nicks from the leading edge of metal propeller blades. Though not considered wear, the overall effect is similar as, after successive re-profiling, a blade may reach a point where it no longer complies with profiling limits set by the manufacturer.

Changes in blade profile can affect both the load bearing aspects of a propeller and the propeller's overall performance. Calculation and previous product experience is used by manufacturer's to determine wear limits, fatigue life, and the effect on blade performance due to profile changes; these limits are checked during a manufacturer's overhaul.

1c. Materials Degradation Over Time.

The third aspect considered by a manufacturer when deciding on an overhaul point, requires knowledge of the normal rate of degradation over time. Oils and greases degrade relatively quickly, most especially if they are allowed to settle. Most types of flexible seals, especially those made from polymeric or natural rubber compounds will become brittle and eventually fail and, when they do, leakage (both in and out) can occur. Also, field experience shows that propellers that aren't used that often are far more prone to hidden internal corrosion than their well-used cousins.

Even though most propellers operating in the Permit to Fly world complete a relatively small number of flying hours in an average year, they will still be subjected to the temporal effects of aging and corrosion. Because of this, a bespoke overhaul and inspection protocol has been developed by LAA Engineering in partnership with a number of the UK's leading propeller overhaul shops. This is the Low-Hours Propeller Inspection Protocol (LPIP).

2. Maintenance and Overhaul Requirements in the LAA system.

The ongoing continuing airworthiness management of aircraft operating under an LAA administered Permit to Fly, is based on an annual inspection overseen by an LAA Inspector. This annual inspection isn't necessarily coupled with maintenance activity, though, primarily because most Permit aircraft do not reach an hours-based maintenance point in an average year, more normally it will be. Another point that needs to be considered, when thinking about the mandatory compliance against a manufacturer's overhaul schedule, or a manufacturer's previously defined life limit, is that, generally, components on most of our aircraft remain in use often long after their previously pre-determined overhaul lives. Engineers call this, operating on an 'On-Condition' basis. Naturally, any component or airframe life limit mandated by an Airworthiness Directive (AD) must comply with the rules laid out in the AD.

Correct assessment of the condition status of any part fitted to an aircraft can be a difficult thing for an LAA Inspector to accurately achieve; it is therefore essential that an assessment of the local risk factors associated with a components failure are considered when deciding whether a part remains fit for continued service.

Clearly, as mentioned earlier, the failure of a propeller could easily lead to the loss of the aircraft; for this, and other reasons, it remains the position of LAA Engineering, that a propeller should be overhauled by a competent and approved facility when it reaches the manufacturer-defined operational hours or calendar life limits. LAA Inspectors are advised that they shouldn't 'sign-off' an aircraft after its annual Permit to Fly revalidation inspection if the propeller has exceeded its operational or calendar life limits.

3. The Low-Hours Propeller Inspection Protocol – LPIP defined.

The LAA's Low Hours Propeller Inspection Protocol, LPIP, is a scheme where propellers can be inspected against a different schedule than that laid-down in the requirements for a full manufacturer overhaul. The reason for its introduction, is that it has been recognised by manufacturers and their approved service and overhaul facilities, that many propellers that reach their calendar-life limit have only accrued a very small percentage of their hours-based life limits. With the exception of blade profiling limits, this means that inspections, needed to ensure that the components that go to make the complete propeller system remain within their specific wear limits, will not be necessary. Equally, the issue of fatigue won't be an issue, and so specific testing in this area isn't considered necessary.

It is LAA Engineering's expectation that, in the fullness of time, a generic LPIP overhaul/inspection schedule can be agreed. At the present time, the agreed LPIP overhaul/inspection schedule follows the requirements of an appropriate, already extant, manufacturer's schedule. By far, the most common variable-pitch propeller types of 'certifiable' variable pitch propeller operating in the LAA fleet, are the Hartzell (HC) series and the MT (V) series propellers; schedules have been agreed, and fully trialled, for both these manufacturer's products.

The LPIP inspection for the Hartzell range of propellers is based upon the 'return to service after long-term storage' inspection. This inspection ensures that a brand new propeller, that has laid in storage for (generally) more than two years, is indeed as new when passed to the customer. To ensure this, the propeller must be stripped and carefully inspected: the propeller is then reassembled using new seals, gaskets, oils and greases.

As part of this check, any outstanding Airworthiness Directives or manufacturer's Service Bulletins or upgrades are complied with. Because none of the parts would have been used in service there is no need to strip paint or anodic finishes, most especially from the blade, to carry out this inspection: Hartzell deem that, following this inspection, the propeller is, both from an operating-limit and the calendar-based perspectives, zero-houred. Though, when used as the basis for an LPIP, only the calendar-based requirements are reset to zero, hours-in-service remain the same.

The schedule chosen as the basis for an LPIP inspection for the MT range of propellers, is a specific inspection schedule designed for propellers operating on aircraft that regularly carry out advanced aerobatics. This is a virtually identical propeller 'strip' inspection to that used on the Hartzell propeller and includes the AD/SB compliance checks.

MT-propeller GmbH, as do most propeller manufacturers, require a different inspection schedule to that used on non-aerobatic types. In what has become an industry standard, a strip inspection is normally required at 1/3 of the normal Time Before Overhaul (TBO). The reason for this is that the forces on the propeller, in particular the blade shank (the blade section near the hub) and the butt (the portion of the blade inside the hub that retains the blade) are higher during aerobatics, both because of the increased gyroscopic forces and because the propellers will most likely be operating for longer periods at maximum RPM.

4. Can I Choose An LPIP Inspection Instead Of A Full Overhaul?

If you own an MT propeller or a Hartzell (HC) series propeller that has completed less than 50% of the propeller's hours-based TBO, then the answer is most likely to be yes. If the propeller has completed more than 50% of the hours-based TBO, then possibly. In all cases, and rightly in the view of LAA Engineering, the final decision as to the appropriateness of the application of LPIP must remain with the approved propeller overhaul companies.

If your propeller has done more than 50% of the hours-based TBO, then an assessment must be made as to whether it is likely that the propeller will likely remain serviceable during the next period before overhaul. A propeller must never be allowed to exceed the maximum allowed hours in service.

The most common calendar TBO is 72 months (six years), but hours-based TBOs vary considerably between different models of propeller and, in some cases vary according to the engine type/propeller type combination. If you are not sure what the hours-based TBO for your installation then check the propeller manufacturer's data sheets, both MT and Hartzell publish these on-line.

As a rule of thumb, based on the service experience of the propeller shops we've been working with, it's likely that a propeller that has reached 75% of its hours-based life will need extra work before the overhaul company would be prepared to release it back into service. In some cases this will mean that a propeller sent for an LPIP-based inspection will need to have the inspection upgraded to a manufacturer's overhaul.

5. What paperwork Will I Need From The Propeller Overhaul Company?

In the LAA system, the person that signs for the aircraft's annual inspection, is your LAA Inspector. With regard to the status of the propeller as part of the overall aircraft system he or she will need to be satisfied that (a) the propeller has been overhauled in accordance with an acceptable procedure and, (b) that the propeller has, if appropriate, been fitted to the aircraft in accordance with the engine/propeller manufacturers' joint procedures. In terms of (a): the paperwork you get from the overhauler may vary; for example, some will issue an EASA Form 1, some a Certificate of Conformity. As described earlier, on-going discussions between LAA Engineering and the propeller overhaul companies, should lead to a defined LAA Generic LPIP Schedule which will be accompanied with bespoke certification.

For the time being, an Inspector will accept written proof from the overhauler that an LPIP inspection has been completed – the accompanying paperwork must include registration of the aircraft, the date of release to service, the propeller's full details (serial numbers etc) and details of any work done to the propeller during the inspection/overhaul. After the propeller has been fitted and successful ground-runs have been accomplished, an Inspector will sign a Permit Maintenance Release (PMR) so that the aircraft may return to service. Your propeller log book should be updated to describe the inspection and this entry must be signed by your LAA Inspector.

6. Can I Carry Out More Than One LPIP Inspection?

LPIP has been described by some as a Light-Touch schedule, this is not the case. The inspection itself is a very thorough one and is completed in accordance with the propeller manufacturer's requirements laid out to ensure that the propeller remains safe for the following operational period. We would describe LPIP as a more appropriate inspection schedule so, providing the total hours in service remain such that the propeller overhauler is satisfied that an LPIP inspection is appropriate, then it can be repeatedly cleared back to service through this route.

In effect LPIP is an alternative means of compliance (AMC) with the LAA's general rule, that previously certified ancillary equipment should follow manufacturer's rules with regard to continuing maintenance and inspection requirements. Successful completion of this (LPIP) AMC on a propeller, that is due for a manufacturer's overhaul because it has reached its calendar life limit, allows an LAA Inspector to sign-off the aircraft at the annual Certificate of Validity renewal inspection.

If you think that an LPIP inspection makes sense for the propeller on your aircraft have a chat with your LAA Inspector to make sure that he or she agrees that this is a sensible route to follow. LPIP isn't an appropriate inspection schedule for propellers that have reached, or are approaching, their operating hours limits.

7. What About the Governor?

The governor (CSU) acts as the mechanical interface between the engine and the propeller and could be considered a component of either. During an assessment of overall risk for this device, LAA Engineering consider that the failure outcome would not be catastrophic for the aircraft. Taking this into account, LAA Engineering considers that, in line with normal 'On-Condition' protocol, the operation of the propeller governor (Constant Speed Unit – CSU) should be regularly checked for correct operation, but does not automatically form part of a propeller overhaul requirement.

8. Where Can I Get An LPIP Inspection Done?

At this time, three of the UK's propeller shops are offering, where appropriate, the opportunity to opt for an LPIP inspection. LPIP inspection regimes have been agreed for the two most common propeller types in the UK (Hartzell and MT variable pitch propellers).

Should you think that an LPIP inspection would fit the bill for your propeller when it becomes due for a manufacturer's overhaul the why not chat this through with a technician at one of the LAA's 'partner' propeller overhaul overhaulers listed below:

BRINKLEY – PROPELLER

Unit 1,
Montgomery Way,
Stratton Business Park,
Biggleswade,
Bedfordshire,
SG18 8UB
+44 (0) 1767 314954
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GENERAL Aero Services Components Ltd

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Parkers Farm Road,
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