CREATING A TAILORED MAINTENANCE SCHEDULE

Part 2. By Chief Engineer Francis Donaldson

Last month I discussed aircraft maintenance planning and the different approaches that aircraft owners adopt to fulfil the requirement on every LAA aircraft's Permit to Fly - that the aircraft can only be flown if the aircraft is maintained in an airworthy state. This month we explore how to go about creating a tailored maintenance schedule that takes into account the features of the particular aircraft, its usage, age and the depth of the owner's pocket.

Individual engine accessories may have different TBOs and inspection requirements, are they catered for in your maintenance schedule?

HOW DO I START TO PUT TOGETHER A TAILORED MAINTENANCE SCHEDULE?

Many aeroplane types are provided with maintenance schedules by the manufacturer, which form an obvious first choice as the starting point for your tailored maintenance schedule. After all, no-one knows more about your aircraft and how to look after it than the manufacturer, right?

Well, probably. If you do use a manufacturer's schedule, we'd suggest transforming it into a Word document or spreadsheet so that you can easily edit it to your own requirements. If there is no manufacturer's schedule available, a good alternative is the LAA's generic maintenance schedule, which you can download as a Word document from the LAA website, for just this reason.

NOW, GET TAILORING

First of all, you can probably exercise your 'delete' button by knocking out maintenance items relating to any equipment that your aircraft isn't fitted with. If your starting point is the LAA generic schedule and your aircraft is a fixed-gear job with a fixed-pitch prop, you'll find there's plenty of line items that you can get rid of because the things they relate to simply aren't fitted.

Then, while the schedule is in an unembellished bare-bones form, sanity-check it line by line. Does every instruction really make sense? Some manufacturers seem to regard the maintenance schedule as something of an afterthought that they've had to do to tick a box, but have put scant effort into the detail. Whether this is an attempt to soft-pedal the actual amount of maintenance work that's needed to keep their product airworthy is often hard to say.

The periodicity of the various maintenance items may have been devised with a particular type of utilisation in mind, for example typical club use where it's flying every day, which may be inappropriate if applied to a private aircraft with flies much more rarely.

One manufacturer's schedule suggested that the tailplane of their popular kitplane needs to be removed only every 500 hours' flying to check the mountings for signs of issues developing. With the typical sole-owned kitplane averaging less than 50 hours flying a year that meant that the metal parts, made of a highly corrodible alloy, would go more than ten years between a good inspection opportunity.

Of course, it's a matter of judgement and you don't want to increase the risk of damage through too frequent intervention, but we'd suggest that for a low utilisation aircraft, this particular check be scheduled at every 500 hours or three years, whichever comes sooner. Or, if removing and re-fitting the tailplane was a very straightforward job, consider bringing it in as an annual task.

Next, incorporate the maintenance requirements of the things that are fitted, ›

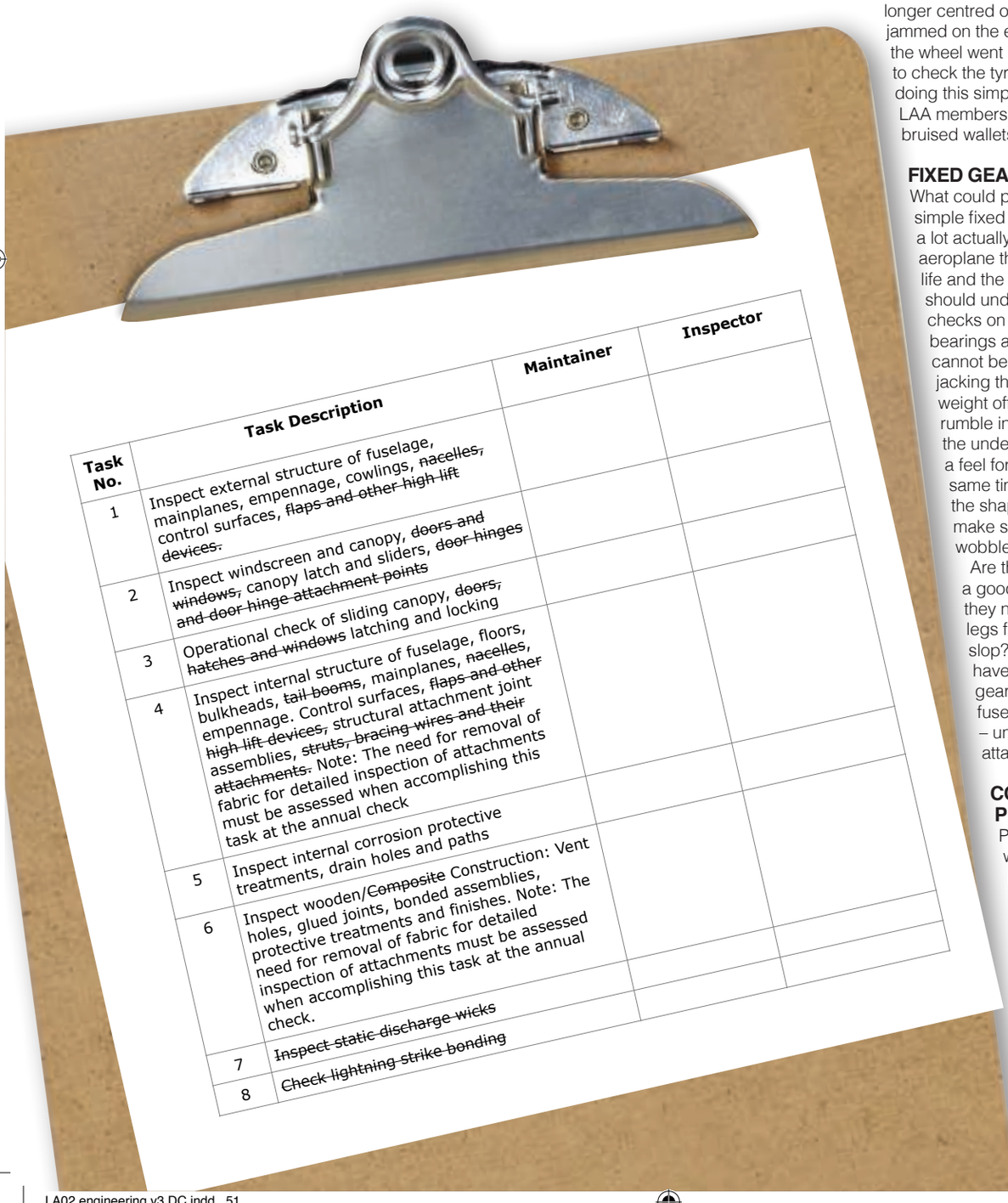
but perhaps weren't envisaged by the person who wrote the original schedule. You may have a different engine and propeller combination, for example, so you'll have to check the maintenance schedules provided by your engine and prop makers and substitute those into your aircraft's developing schedule. If your aircraft type was designed for a Rotax engine, for example, but yours has a custom Jabiru engine installation, you can go to the Jabiru website, pull up their engine maintenance schedule and cut and paste it into your tailored schedule, substituting for the Rotax-related bits. The same goes for magnetos, fuel pumps, alternators, constant speed units etc.

APPROPRIATE MAINTENANCE FOR SPECIAL FEATURES

You may have extras such as a ballistic chute that has a required schedule for its re-packing, or an air bottle for a starter system that needs a regular pressure test. Remember that some jobs may need doing more frequently than the 50 hour/six-monthly check, others may be very infrequent (e.g. every 18 years for a Tiger Moth's tie rod change) so you'll need to accommodate these into your schedule too, even though they fall outside the usual 50 hour/annual/three yearly periodicity.

"Remember that some jobs may need doing more frequently than the 50-hour/six-monthly check"

(Below) **With this article we show three examples of the development of a Tailored Maintenance Schedule. The first section shows the deletion of wording not applicable to the aircraft concerned.**



Task No.	Task Description	Maintainer	Inspector
1	Inspect external structure of fuselage, mainplanes, empennage, cowlings, ~~nacelles,~~ control surfaces, ~~flaps and other high lift devices.~~		
2	Inspect windscreen and canopy, ~~doors and windows,~~ canopy latch and sliders, ~~door hinges and door hinge attachment points~~		
3	Operational check of sliding canopy, ~~doors, hatches and windows~~ latching and locking		
4	Inspect internal structure of fuselage, floors, bulkheads, ~~tail booms~~, mainplanes, ~~nacelles~~, empennage. Control surfaces, ~~flaps and other high lift devices,~~ structural attachment joint assemblies, ~~struts, bracing wires and their attachments.~~ Note: The need for removal of fabric for detailed inspection of attachments must be assessed when accomplishing this task at the annual check		
5	Inspect internal corrosion protective treatments, drain holes and paths		
6	Inspect wooden/~~Composite~~ Construction: Vent holes, glued joints, bonded assemblies, protective treatments and finishes. Note: The need for removal of fabric for detailed inspection of attachments must be assessed when accomplishing this task at the annual check.		
7	~~Inspect static discharge wicks~~		
8	~~Check lightning strike bonding~~		

RETRACTABLE UNDERCARRIAGES

We suggest that aircraft with retractable undercarriages should always be jacked up at least annually and a full retraction check done, including the use of both normal and emergency systems. The absence of normal jacking points on some of our lightweight retractables is no excuse for not doing a retraction check – it's simple enough to build well-braced padded trestles to support the aircraft's weight during the test.

Unless retraction checks are done, it's very likely that the mechanism, microswitches etc, will either progressively seize, or slowly go out of adjustment and one day the gear won't lock down properly, or stay stubbornly up.

We've seen several retractables with gear that won't come down for the simple fact that, for one reason or another, a wheel was no longer centred on its wheel well and the tyre jammed on the edge of the aperture when the wheel went up. It takes only seconds to check the tyre clearances all round, but doing this simple check would have saved LAA members some very red faces (and bruised wallets) in recent years.

FIXED GEAR

What could possibly go wrong with a simple fixed undercarriage? Well, quite a lot actually - this is one part of the aeroplane that inevitably gets a tough life and the maintenance schedule should undoubtedly include regular checks on the condition of the wheel bearings and undercarriage legs. This cannot be done effectively without jacking the aircraft up to take the weight off the wheels to feel for any rumble in the bearings, looseness in the undercarriage legs, and to get a feel for drag on the brakes. At the same time, take a proper look at the shape of the unloaded tyres to make sure there are no bulges or wobbles.

Are the wheel bearings in need of a good clean and regrease – or do they need changing? Are the gear legs free of unwanted rattles and slop? The Jabiru range of aircraft have had problems with the gear legs becoming loose in the fuselage, and going unnoticed – until the overstressed leg attachment bolts break.

CONSTANT SPEED PROPELLERS

Perhaps one of the hardest working items on an aircraft is its propeller. You can fly as gently as you like but the propeller will still be working incredibly hard transferring rotational energy from the engine into thrust for flight.

Manufacturers of the 'certified' variable pitch propellers often used on LAA aircraft normally set

their propeller overhaul requirements in terms of operating hours and calendar time. For most currently used propellers the TBO (time between overhaul) is somewhere between 1,000 and 2,000 hours, determined by wear (all moving parts will eventually wear out and, eventually, stop functioning properly) and by fatigue considerations.

The second overhaul requirement relates to calendar time; note that this calendar time limit doesn't relate to time 'in service' but simply to time on the planet. Issues relating to time concern problems of corrosion (often on components hidden inside the hub) and a general degradation of flexible seals and of the oils and greases used to lubricate the unit.

Normally, manufacturers design the propellers to allow their calendar life limits roughly to coincide with the anticipated using up of the permitted operating hours, based on an expected annual usage rate. The typical six yearly calendar life for these props, so contentious among LAA owners, is therefore no particular problem for operators doing 300 hours a year, but this is roughly ten times the typical annual utilisation for an LAA aircraft, which inevitably run up against the propeller's calendar limit first.

Because so many VP propellers used on LAA aircraft get caught in a situation where they've only flown-off a couple of hundred hours at the six year 'calendar overhaul' point, the LAA has been working with the propeller manufacturers over the last few years to come up with an LAA inspection scheme which is more appropriate for normal LAA usage patterns, which emphasises the calendar age related issues over those of wear and fatigue.

We're trialling an inspection programme right now and call it the LAA Low hours Propeller Inspection Protocol, or LPIP for short. We'll be explaining this in a little more detail over the coming months and we hope that a more 'appropriate' inspection routine for propellers will reduce the running costs for a certified VP prop, while preserving safety.

Of course, scheduled propeller maintenance in-between overhauls must be carried out in accordance with the maker's instructions and these requirements vary considerably between propeller types (even between models). Inevitably these include removing the spinner and conducting a close visual inspection of the whole propeller, checking for signs of cracks, leaking grease, excessive blade free-play and other signs of distress. If you're operating a VP propeller, then be sure to have a copy of the instruction and service manual to hand and add the routine maintenance points into your tailored maintenance schedule.

> "LAA approved modifications and repairs also often include the need for special inspections of the affected parts, which you will need to incorporate into your schedule"

(Below) **The section partially tailored showing the wording adapted to suit the design of the aircraft concerned (in red), including maintenance requirements gathered from the maintenance manual, MPDs etc.**

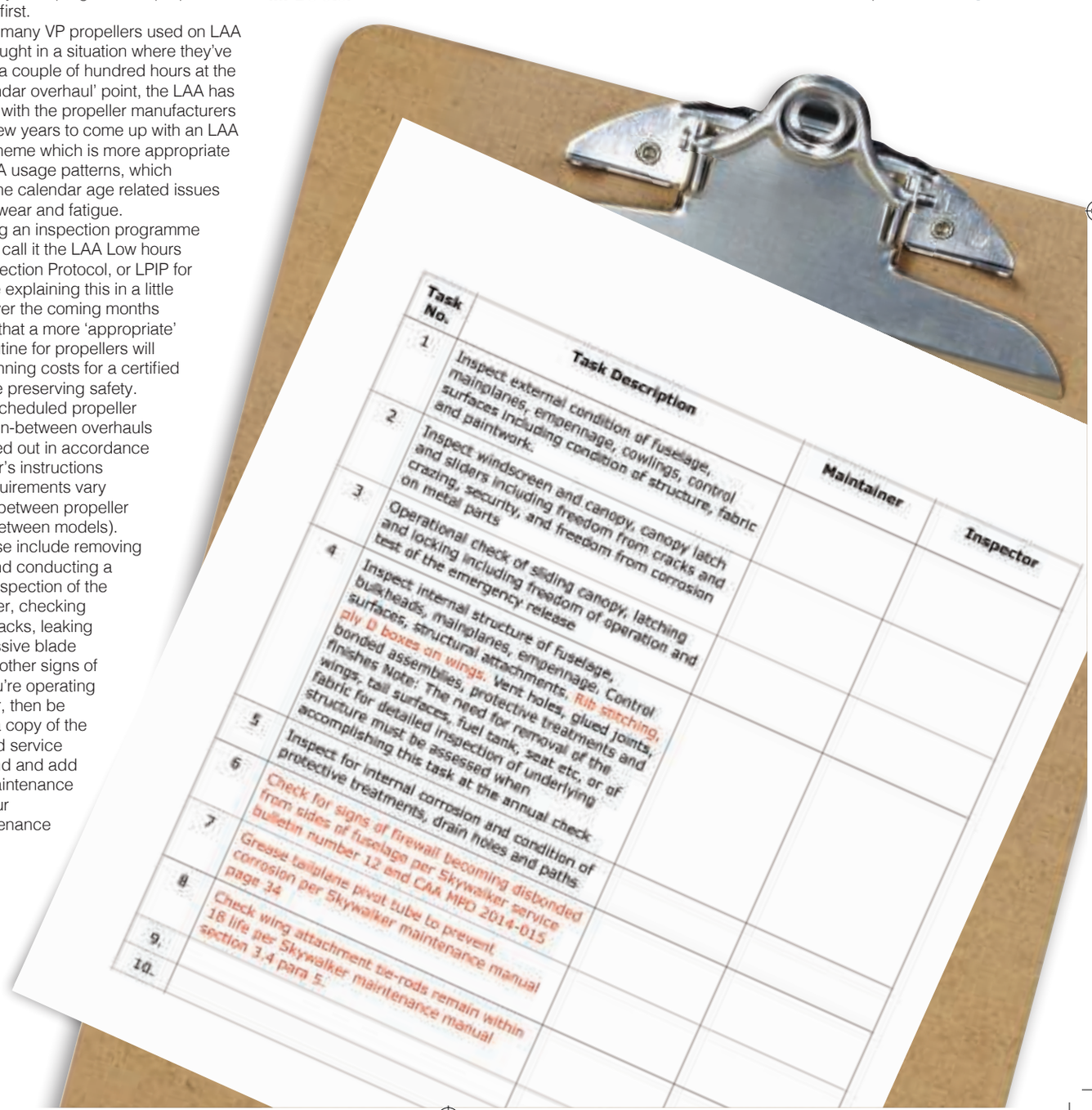
SERVICE INFORMATION

You'll need to go through the requirements of any ADs, MPDs, LAA AILs and manufacturers' service bulletins to find out those items with re-occurring maintenance actions or inspections which can be included in your tailored schedule.

To see what applies to your aircraft type, check the LAA Type Acceptance Data Sheets (TADS) and past copies of *Safety Spot*, which you can download off the LAA website. Remember that actions called for by ADs are legally mandatory for ex-certified aircraft and mandated by LAA policy for other types, as are AILs that are so classified.

Service bulletins are optional, at the owner's discretion unless backed up by an AD or MPD. Such pieces of service information might introduce the need for regular inspections that need to be added to your schedule, or specify the replacement intervals of life-limited parts. If they call up one-off inspections or one-off replacements then, of course, these don't affect the maintenance schedule, but are dealt with separately as instructed.

LAA approved modifications and repairs also often include the need for special ›



inspections of the affected parts, which you will need to incorporate into your schedule. So, if your aircraft contains LAA mods, look out the mod approval sheets from LAA and check the section containing instructions for continued airworthiness. Not sure if your aircraft has LAA mods or not? Owners can check this out online using the member's section of the LAA website.

Nowadays most such service information can be sourced from the web, or via the links on the maintenance pages of the LAA website. When finding MPDs, remember that while most MPDs are contained in the CAA's CAP 661, the most recent ones are listed separately.

LOW OR HIGH UTILISATION

As in the kitplane tailplane example above, aircraft with low utilisation may need the maintenance schedule tailored by introducing calendar-based inspection intervals on items previously specified based on hours flown, to put a 'back-stop' on the length of time between doing these checks.

This applies particularly to issues such as corrosion, rot, cracking tyres and so on, which are largely time dependent, but not for wear, cracking etc, which come about due to usage rather than storage. You should always consider bringing the oil change interval onto a calendar basis, at least as a backstop, rather than leaving the same oil in year on year waiting to reach its 50-hour point. An extra oil change or two will be a lot cheaper than a new camshaft and a set of cam followers.

Conversely, for aircraft with high utilisation, and particularly, those subjected to an inordinately punishing take-off and landing cycle (such as glider tugs), you may need to raise the frequency of inspections associated with high wear items such as the undercarriage and its mountings, which will take quite a beating, especially if operated off a rough field. Glider tugs have more than the usual amount of wear and tear on the undercarriage because of the much longer take-off runs involved with a glider strung on the back.

> "Parts may be of unknown history and therefore may have been involved in all sorts of misadventures in a previous life"

AGED ITEMS

If the aircraft is ancient, or embodies ancient parts, then you may want to increase the frequency of checks because the design or manufacture is questionable, or because many of the parts may be approaching the ends of their useful lives. Parts may be of unknown history and therefore may have been involved in all sorts of misadventures in a previous life. You might want to change the inspection interval from a 50-hour cycle to a ten or 20 hour cycle, for example. Some of the most ancient engines in the LAA fleet, the rotaries, have an overhaul life of about 20 hours and both they, and the airframes that they attach to, are given a very thorough check after every few sorties.

ON CONDITION ENGINES

If the engine is operating 'on condition' past its TBO, or is approaching TBO, then it's particularly important to monitor its condition (oil pressures, compressions, max rpm etc.) so that any deteriorating trend can be spotted before the engine enters a terminal decline, and the engine withdrawn from service before it becomes a high risk. In this case the tailored maintenance schedule should include prompts for regularly recording of this data, and ideally provide a format for recording the numbers that allow trends to be easily checked.

NEW THINGS CAN GO WRONG TOO

Conversely, with a brand new homebuilt or a totally rebuilt vintage aircraft, the first 50 or 100 hours' use may well throw up 'initial build' and 'infant mortality' problems (vibration-fatigued brackets, cracked baffles, cowling hot-spots and wear points etc) which will need sorting out before the aircraft can settle into its most reliable mid-life operating phase.

If the aircraft is a prototype or highly modified one, then it will be even more likely to need attention during its early days, for no new designs work exactly right straight from the drawing board. With any newly built aircraft you

A more thorough 'deep' inspection every few years, such as checking the wiring, connections and hoses etc, behind the instrument panel, will almost certainly help prevent future problems.

should consider reducing the time between inspections during its first few seasons, while all these youthful problems are emerging.

HOW THE AIRCRAFT IS STORED

Clearly, if your aircraft lives outdoors then it will be much more likely to suffer the effects of weathering than if it is hangared, so consider altering your maintenance schedule to reflect this. These days it's pretty much accepted that being parked out exposed to the sun, wind and rain is no place for a fabric-covered wooden aeroplane, but these conditions take their toll on metal and composite aeroplanes too.

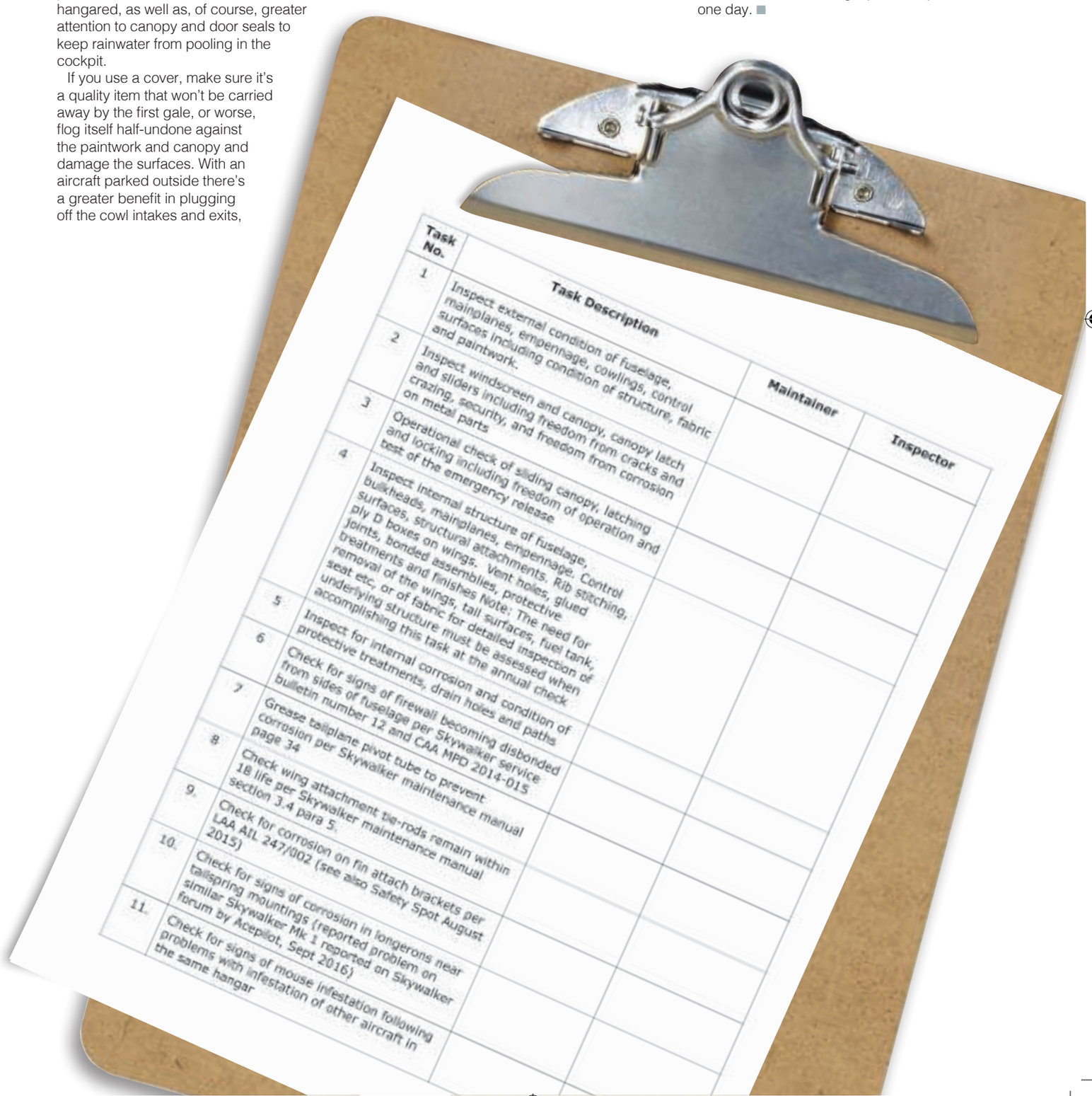
For an aircraft that lives outside, to minimise the impact your schedule should perhaps include more regular lubrication of hinges and joints, and closer attention to preserving the protective finishes than for an aircraft that's hangared, as well as, of course, greater attention to canopy and door seals to keep rainwater from pooling in the cockpit.

If you use a cover, make sure it's a quality item that won't be carried away by the first gale, or worse, flog itself half-undone against the paintwork and canopy and damage the surfaces. With an aircraft parked outside there's a greater benefit in plugging off the cowl intakes and exits, exhausts etc. to keep out moisture and wildlife.

There's an Extra that I've several times seen at the local airfield parked outside, facing 'out of wind' causing its exquisite oversized control surfaces to slam from stop to stop in the breeze. Apart from the obvious action of encouraging securing the stick with the harness while parked, if for some reason the risk of this abuse was inevitable, I'd want to tailor its maintenance schedule with special inspections of the control system stops and hinges.

SEARCH THE WEB

These days, the web provides a fruitful source of advice about snags and inspection issues for just about any aircraft – just try Googling 'problem' followed by your aircraft type. Of course much of this falls into the category of 'gossip' but if an owner in some other part of the world found that the left-hand widget on his Kitfox broke for no apparent reason, putting him into a dangerous situation, then there's no harm in adding a special inspection of the widget on your Kitfox into your tailored maintenance schedule – or the subject of a dozen other owners' webchat woes, for that matter. For the sake of a few moments extra attention with a mirror and a torch, it might just save your bacon one day. ■



Task No.	Task Description	Maintainer	Inspector
1	Inspect external condition of fuselage, mainplanes, empennage, cowlings, control surfaces including condition of structure, fabric and paintwork.		
2	Inspect windscreen and canopy, canopy latch and sliders including freedom from cracks and crazing, security, and freedom from corrosion on metal parts		
3	Operational check of sliding canopy, latching and locking including freedom of operation and test of the emergency release		
4	Inspect internal structure of fuselage, bulkheads, mainplanes, empennage. Control surfaces, structural attachments. Rib stitching, ply D boxes on wings. Vent holes, glued joints, bonded assemblies, protective treatments and finishes Note: The need for removal of the wings, tail surfaces, fuel tank, seat etc, or of fabric for detailed inspection of underlying structure must be assessed when accomplishing this task at the annual check		
5	Inspect for internal corrosion and condition of protective treatments, drain holes and paths		
6	Check for signs of firewall becoming disbonded from sides of fuselage per Skywalker service bulletin number 12 and CAA MPD 2014-015		
7	Grease tailplane pivot tube to prevent corrosion per Skywalker maintenance manual page 34		
8	Check wing attachment tie-rods remain within 18 life per Skywalker maintenance manual section 3.4 para 5.		
9.	Check for corrosion on fin attach brackets per LAA AIL 247/002 (see also Safety Spot August 2015)		
10.	Check for signs of corrosion in longerons near tailspring mountings (reported problem on similar Skywalker Mk 1 reported on Skywalker forum by Acepilot, Sept 2016)		
11.	Check for signs of mouse infestation following problems with infestation of other aircraft in the same hangar		

(Below) **The completed tailored section of the maintenance schedule, showing the inclusion of special inspection items gathered from Safety Spot articles, and from a search of the web, and a local issue with mouse infestation in the storage hangar.**