Light Aircraft Association

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

Eligibility

Each year, a number of aircraft in the UK emerge from long-term rebuilds under LAA supervision. Before commencing such a project, the first thing to do is to establish whether the rebuild can be carried out under the auspices of the LAA. If the individual aircraft has been operating on an LAA permit previously, and has not since then operated on a C of A, then almost certainly it can.

If on the other hand the aircraft has not previously been on an LAA (or PFA) permit and previously operated on a C of A, or has been operating on the foreign register, or is an ex-military aircraft, then only in very special circumstances will it be able to transfer to the LAA system. Basically, these circumstances are:

- The aircraft must be of a type which is either amateur-built, or an EASA Annex I type which is either ex-military or orphaned and not supported by a type certificate holder. Under the CAA policy established in 2011, the existence of a TRA (Type Responsibility Agreement) for the type does not exclude owners from the possibility of a Permit to Fly should they choose, rather than a Certificate of Airworthiness. Annex I types such as the Piper J3 and Luscombe are generally no longer eligible to transfer to the LAA system but individual aircraft which were formally accepted by the CAA for transfer to the PFA/LAA prior to this change in policy are still allowed to continue on the LAA route.
- The aircraft must be of a type that is supported by adequate evidence of airworthiness and within the LAA limits in terms of power, speed, seating capacity and weight.
- The individual aircraft must be able to be shown to be airworthy as regards design, build and maintenance standard.

Contact LAA to find out what the position is BEFORE committing to the project. If it looks promising, the LAA will apply to the CAA for the aircraft to be transferred to LAA control. Alternatively, you can contact CAA Applications and Approvals Department directly for advice. The CAA may take several weeks to reach a conclusion and the results of their deliberations are unpredictable because the criteria which the CAA applies follows a complex protocol.

LAA inspection

LAA inspectors are a team of men and women approved by LAA HQ to carry out inspections on LAA aircraft, who generally either have a professional background in aircraft engineering or extensive experience as an amateur builder/owner. For brevity, where what follows refers to ‘he’ or ‘his’, this may be construed also to mean ‘she ‘ or ‘her’ etc.

LAA procedures require a rebuild project to be inspected throughout the rebuild process at stages agreed between you and your inspector. As the process reaches completion there will be a particularly intensive period of inspection, leading up to the aircraft being ready to be cleared for flight. This applies to all aircraft rebuilt within the LAA system and whilst owners of rebuild projects remain wholly responsible for the quality and conformity of the finished aircraft, these inspections are aimed at helping the owner ensure the aircraft meets accepted standards of build quality, conforms to the approved design and complies with various legal requirements.

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

To set the process in motion you need to establish contact with a suitably approved LAA inspector. The LAA website contains a search tool to identify inspectors in your area. You need to use an inspector whose approval includes the class of aircraft you are involved with, eg wood and fabric, metal or composite. Ideally you will find an inspector who has previous experience of the aircraft type you are involved with, or at least with similar types eg Cub, Auster, Taylorcraft.

Your inspector will need to carry out an initial examination of the project 'as is', talk you through what work will be needed and at what points he wants to inspect your progress. At this stage you need to submit a proposal to LAA Engineering describing the extent of the work required for the intended rebuild, the manuals (maintenance manual, repair manual) you have on hand to work to, and the expected inspection stages.

From this stage onwards it's up to you to liaise with your inspector and to contact him in times of difficulty or whenever you reach a stage when he's asked to be called in.

Your inspector is always your first port of call in the event of a technical query and inspectors are generally only too happy to give advice if they can. In inspecting your project it is the inspector's decision that counts. If he says do it again – then do it again you shall. Of course you have a right to swap inspectors on the way but we strongly advise that it's in your interest to use one inspector throughout the rebuild as the continuity this provides is most likely to allow a good working relationship to flourish.

The commercial arrangements between you and your inspector are a matter for yourselves. Some LAA inspectors are also busy professionally qualified licensed aircraft engineers and may make a charge but some are keen experienced builders themselves and we know of a few who are embarrassed to accept anything more than expenses. One thing your inspector can never do is approve modifications. So as the owner, if you wish to deviate from the plans or manuals, permission must be sought from LAA Engineering by submitting a modification application.

What your LAA Inspector can expect from you

Although all inspectors approved to certify the work on an LAA aircraft have expressed a willingness to do so, they are under no obligation to do so. There are all sorts of good reasons why an inspector may not be available at a particular time. Generally an inspector is willing in the first place because he is an interested enthusiast himself, but he will not expect to be telephoned in the dead of night in order to tell you how to safety wire a turnbuckle when such questions could perhaps wait until his next visit.

When your inspector calls, attend to his comfort and give him as much of your time as he needs. He may wish to be left alone for a while to concentrate on his task. Don't waste his time by asking him to visit when you know you haven't actually done what he's asked you to do. Give him plenty of notice that you are about to reach a stage when you need a visit. It does help if, with small components, you take them to him for inspection rather than ask him to come to you.

For a new rebuild project the inspector will first want to find out what he can about you, the restorer. He is not going to be there most of the time you are restoring your aircraft, so to assure himself of the integrity of your handiwork he will need to develop an idea of how much help and advice you are going to need and how much you can be left to get on with it. Err on the side of caution – better to appear too ignorant and get more guidance, rather than making a better impression and having your wing spar scrapped later – or worse, building a lethal defect into your aeroplane.

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

Workshop and Storage facilities

The inspector will have to check your workshop facilities to make sure they are up to the job. You are going to need a dedicated working area with adequate lighting, heating and ventilation, and an appropriate collection of tools. If yours is a composite project he will be particularly intent on checking the means of monitoring the temperature and humidity and keeping them within the allowable limits for the resins. He will need to be satisfied that you have proper storage space for the aircraft materials, for example lengths of wood will have to be stored horizontally and properly supported in a reasonably stable environment otherwise they will warp and twist like a dog's hind leg. It is essential that glass cloth is kept free of contamination by dust, grease etc when in store and you will need some sort of clean work surface for preparing the glass cloths as well as storage for your rolls. Epoxy resins and glues must be stored at room temperature – not out in the shed where they may be alternatively frozen or overheated depending on the time of year.

The inspector will also need to check that the glues and resins are 'in date'. Some resin manufacturers are prepared to take time-expired resin back to test and re-validate it, but this is usually uneconomic. The answer is to buy resin in relatively small quantities, resisting the temptation to purchase enough to build the whole aeroplane at a discounted price.

Sources of information

When rebuilding an aircraft it's essential to refer to the applicable technical data (manuals, drawings, etc) and not just put it back together based on how you assume it was originally. There may be important components that have been lost along the way, and while an assembly might fit together without these parts, and seem complete, it may be disastrously flawed. Or there may be important procedures that have to be followed, which may not be obvious. Knowledge of how one type of engine, propeller etc goes together may be helpful in assembling another similar type of engine or propeller, but there may be critical differences that will only come to light by studying the literature – or if none exists, seeking out someone who does have experience on the particular model or components concerned. Several years ago, a recently rebuilt high wing aircraft crashed because it was assumed that the wing strut ends were hollow rivetted to the streamlined strut tubes – they weren't, they were supposed to be bolted on, and what the restorer had been taken to be the rivet heads were in fact just the bushes awaiting the fitting of bolts which had never been replaced.

Workshop Discipline

It is worthwhile taking a highly methodical approach to any aircraft disassembly and rebuild. Typically, once established in the workshop, the aircraft should be carefully dismantled, whilst at the same time making the effort to properly catalogue and box or bag all parts. Suitable tagging and labelling is worthwhile, as is recording the order of work undertaken. You probably can't take too many photographs of assemblies, pre and during disassembly. It's amazing how much such records can help when it comes to reassembly, which, like it or not, might be an unanticipated number of years later (and possibly even by a subsequent owner). And don't forget that similar looking parts are often right or left handed, but once removed, without proper marking it can be impossible to tell which side was which. Make sure that parts are stored in appropriate conditions, and consider the need to inhibit parts against corrosion and potential environmental damage. One benefit from methodical storing and labelling of parts is that, on completion of a rebuild, a box of bolts left over will ring alarm bells, and alert you to the fact that A's not yet been attached to B, etc. Also, don't throw

anything away. Often, scrap parts which you don't intend to use again will render clues as to how they were fitted which can be very helpful when installing replacement parts.
Take particular care if creating traps for yourself by temporarily or partially assembling something but leaving the job unfinished – for example trial fitting nuts and bolts but without torqueing up, or without fitting split pins. Will you remember, perhaps years later, that there's still essential finishing off tasks outstanding ? Some restorers use a paint stripe to identify nuts that have been finally torqued, others red-tag parts that look complete but still need work. Both are good ideas – but if tagging, don't rely only on the tags to know what's left to do – tags can so easily fall off or have been removed for the benefit of that photographer….

Sourcing of Materials and Processes

The inspector will need to satisfy himself of the origin and identity of the building materials and parts you are using. Not all materials need to be 'released' but he will need to be convinced that they are adequate, and he will want to check the paperwork for all the more significant items of raw material and hardware used. With metal parts he will have to check not only the type of metal specification but also the state of heat treatment – some commonly used aircraft metals (such as S.514) are supplied in the softened form for ease of cutting and bending the parts to shape but must be hardened by a carefully controlled process of heat treatment to achieve their full strength before being painted and bolted into place. Failure to harden the parts could result in the structure failing at a drastically reduced load. The heat treatment must be done by an organisation approved for this kind of process and again, the inspector will want to see the paperwork relating to the heat treatment. The same applies to processes such as anodising, plating etc which are similarly critical to airworthiness and must be done to appropriate aircraft specifications.

Frequency of Inspections

The inspector should be invited to look at any structure or system just before it is 'closed off', for example in the case of a wooden box spar he will want to see the job fully prepared (including the internal varnishing and preparation of the closing web) before the closing web is glued in place, rendering the internals invisible from then on.

Wooden Aircraft Structure

The inspector will need to check each piece of wood carefully to ensure that the grain count (grains per inch) is no less than the minimum allowable, the orientation of the grain is correct and the grain is not running out excessively along the length of the piece, and that there are no other visible defects. In some cases he may insist on samples of the wood undergoing a compression strength test. The fact that you bought the wood from a reputable source will cut no ice with the inspector if the wood doesn't meet the applicable British Standards BS 2V.37 and BS 2V.38 (spruce), V36 (douglas fir) or 3V.4 (ash). He may need to examine the wood under a magnifying glass to check for almost invisible compression shakes, which can drastically reduce its tensile strength. Shakes are usually caused by the tree having been felled carelessly, allowing the trunk to crash to the ground rather than lowering it gently, with the result that the wood fibres are overstressed in bending. Compression shakes of this type are particularly hard to see in Douglas fir and particular care is therefore needed in selecting this type of wood.

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

Glue Joints

Glue used in the construction of a wooden aircraft must be of an approved type. The standard glues used are Ciba-Geigy Aerolite 306 and Aerodux 500, the latter being more slow-setting and used mainly for complicated jobs which require longer 'shuffling time' eg laminating wooden spars, ply skinning, etc. Certain epoxies are also acceptable. Whatever glue is used, it is essential that all the glue manufacturer's instructions are strictly followed with regard to storage, mixing, application, clamping pressures, etc as these can critically affect the strength of the joint.

The inspector will want to test to destruction sample glue joints made from each batch of glue you use. As each batch of glue is mixed he will ask you to bond scrap pieces of spruce together and date them, so that upon his next visit he can break the joint apart and check that it is the wood rather than the adhesive bond which fails. If the adhesive fails, all joints made with that batch of glue become suspect and will need to be remade. Either the glue batch might be at fault or poor joint preparation might be the cause – any grease or other contamination will drastically reduce the strength of the joint. Failure to lightly sand the surface of plywood to remove the remains of the waxy ply press release agent, or to plane off the oxidised surface of wooden members to reveal clean new wood will have the same effect. Incorrect mixing of the glue or too miserly or liberal an application in the joint will also reduce its strength. With some types of glue it may be preferable to leave a glue fillet around each joint, in others (such as Aerolite 306) this may cause distortion of thin plywood panels and shrinkage cracks which can provide a route for moisture to penetrate the joint and precipitate an early glue failure, in which case excess glue is best wiped away before it sets.

Welding

If your project requires welding to be done, then it is required that any welding which is 'of significance to airworthiness' must be carried out by a CAA approved welder. 'Of significance to airworthiness' includes primary structure, engine mountings, control system, undercarriage and anything else which would be critical if it were to fail in flight. Many homebuilders have gone through the process of gaining CAA approval in order to weld their own projects – if you are skilled enough at welding to work on a flying machine then you will find the CAA's welding tests quite straightforward. Details of the welder's approval process can be found on the CAA website – refer to BCAR chapter A8-10 (CAP 553)

Alternatively, you can take the work to someone local already CAA approved for welding. We have a list of CAA Approved Welders on Technical Leaflet TL 3.04 which is downloadable from the website or your inspector can probably point you in the direction of a welder familiar with LAA type work.

Welded Tube structures

Welded tube structures often suffer from corrosion from the inside out, this is particularly prevalent in unsealed steel tube wing struts and the tail ends of fuselages, where water tends to collect. Restorers usually use a pointed steel tool, pressed onto the outside surface, to try to detect whether the tube wall has become weakened by internal corrosion. This method has obvious limitations however and in critical structure it's strongly recommended - and your inspector may insist - to use an X-ray test – specialists can bring portable equipment to carry this out at your workshop.

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

Nuts and Bolts

All hardware should be examined carefully to determine if it is still in an airworthy condition. Any signs of surface corrosion or other distress should normally be considered cause for the component to be replaced. Where hardware is carrying out a highly critical function (wing and tail attachment, undercarriage, engine mount etc) it's normal practice to replace the hardware as a matter of course, the cost of doing so being small in relation to the peace of mind that comes from knowing that these essential parts are new. The old nuts and bolts might look good as new but there's no knowing what overloads they may have been subjected to in their time. Be particularly careful when replacing hardware to replace like with like, and not to mix thread forms, for example due to inadvertently mixing AN and AGS hardware.

Rivets

In restoring an aircraft with rivetted joints, it's easy to make the mistake of assuming that a rivet that looks in good condition on the surface is sound and doesn't need any attention. Unfortunately this isn't the case – restorers describe finding rivets on vintage aircraft whose heads separate from the stems very easily when subjected to exploratory prizing action with a hard plastic chisel, or when starting to drill them out, at the first touch of the drill bit. This occurs due to corrosion having occurred in the zone between the stem and the head, probably of the type known as stress corrosion cracking (SCC) induced by the built-in stresses in the rivet left by the action of forming the rivet when the aircraft was built. The problem is more prevalent in 5% magnesium (green coloured) rivets than in the purple coloured hiduminium rivets that are normally substituted these days. Sometimes, but not always, a suspect rivet is shown up by signs of so-called 'smoking' (grey marks on the surface) where corrosion and wear products have started to leach out to the surface.

Because of these problems, and the obvious safety implications, at rebuild all rivets should be examined critically and consideration giving to replacing rivets that may be internally corroded especially where they carry out a critical function. Large diameter rivets (3/16" or ¼" diameter) are just as vulnerable to corrosion problems as small ones, and, because they are usually used in high stress applications, these large rivets are at least as worthy of replacement as the smaller, easier ones ! In particular, it would be well worth drilling out and replacing as a matter of course any rivets that are not part of a large multiply-redundant group, and are performing a function that's critical to safety eg strut ends, pushrods, wing and tail attachments, engine mount brackets etc, even though they might appear to be still in good condition.

Cables, pulleys, bearings, rod ends, turnbuckles, tyres, harnesses and other vital parts

Just as vital rivets and nuts and bolts should be replaced if there's any doubt of their condition, and are best replaced as a matter of course, the full rebuild is also an appropriate time to replace any other off-the-shelf parts that are inevitably prone to wear and tear or corrosion. It's tempting to clean up and re-use old parts but the phrase about spoiling the ship for a ha'porth of tar comes to mind. These days the internet allows even quite obscure parts to be sourced much easier than in days gone by. Be sure however not to be taken in by outfits selling bogus or re-claimed parts or 'new' components that were made decades ago but may have deteriorated in storage. Non-metallic components such as rubber seals and hoses and webbing seat harnesses deteriorate with age, even if they have no formally stated life. Metal parts may look good enough to return to service but who knows what abuse they may have suffered in the past – corrosion pits in metal encourage almost invisible cracking and are a definite cause for replacement.

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

Restoration practices

The restoration needs to be carried out in accordance with accepted rebuild procedures, e.g. as laid down in AC43.13 (available from the LAA booklist, or the FAA website) and CAP 562 (available from the CAA website). Any deviations from the original design must be cleared through ourselves. In general we would discourage any variations: the original aircraft has normally established a reputation for reliable operation over many years, which you will compromise if you start making arbitrary changes. You may find it worthwhile to contact other owners and 'type clubs' to discuss worthwhile upgrades which may have already proved themselves worthwhile, for example substitution of modern wheels and brakes. It is advisable to get any changes cleared BEFORE any work is started on the change, in case we have any objections or suggestions to make.

Standards of Workmanship

The inspector will probably advise you to start the job by rebuilding a relatively small assembly such as the rudder or tailplane, so that any mistakes made while you are on the steepest part of the learning curve will not result in the scrapping of a large and costly assembly such as a wing or fuselage. When the time comes for the inspector to view the first assembly he will be keen to check the quality of workmanship. Wood parts should be planed smooth but not to the extent that the cross-section of the members is less than that called for on the drawings. Metal fittings must be free of scratches and burrs, all file marks carefully dressed out and all bend radii suitably large and smooth to avoid fatigue cracks starting in the bends in service. All bends will need to be formed over a suitable radiussed form block – any parts bent directly in the jaws of a vice will be terribly scored and will be consigned to the scrap bin. Some drawings specify the orientation of the grain of the metal (yes, metal has a grain direction too) and the inspector may have to show you how to determine this. All holes drilled must be round, correct in size and drilled in the correct position so that the edge margin is as shown on the drawings. If a drawing shows four bolts holding a fitting in place, the bolts cannot go just anywhere – they must be positioned exactly as shown on the drawing. A bolt hole too close to the edge of a fitting or the underlying wood block will drastically weaken the attachment.

Compliance with the Drawings / Manuals

Having satisfied himself with the workmanship, the inspector will also need to check that you have complied with the drawings or manuals, that you have used the correct materials and the orientation of grain in wood or glass cloths in a composite structure are as specified. He will need to check that all the critical dimensions called up on the drawing have been followed, both to check that the finished aeroplane will fly properly and have adequate strength reserves but also to try to save you from that awful moment later on when 'somehow the wings just won't fit onto the fuselage'. He will be wary of the fact that even the best aircraft drawings contain an error here and there and it is well worth checking through the drawings for arithmetic mistakes made by the draughtsman. If, for example, two bolt holes are shown 3" apart on a bracket and 4" apart on the component which the bracket is bolted to, it will be better to find this out before the parts are made rather than after.

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

LAA Worksheets

Between you and your inspector, you will need to write up worksheets describing the rebuild, to be signed up by your inspector as you go along. A copy of the worksheets are to be submitted on completion of the rebuild. It's a good plan to make a photographic record of the work as it is being undertaken, and submit that along with the worksheets.

Fundamentally, a worksheet is a piece of paper which is completed when work is done on an aircraft, to provide a record of what has been done, where it is impractical to include enough detail as an entry in the aircraft's logbook. The legal obligation to do this is contained in the article 34 and Schedule 6 of the Air Navigation Order. Worksheets are also a means of recording what inspections have been carried out and as a vehicle for an inspector or licensed engineer to certify the work (ANO article 22) by appending on each sheet the appropriate Certificate of Release to Service (CRS) or, for Permit aircraft, Permit Maintenance Release (PMR) statements which the LAE or inspector can sign up.

The important point here is that worksheets are not created specially to satisfy LAA Engineering, they are a normal part of aircraft maintenance record keeping, so when LAA Engineering ask for copies of worksheets it should not mean having to create them specially; rather just that we are asking for copies of what should already have been created anyway.

A further function of the worksheet is to demonstrate that the aircraft owner, his maintainer and LAA inspector (or LAE) have taken appropriate steps and followed required procedures, and so protect them for accusations of not maintaining the aircraft properly. If the aircraft were ever to be involved in an accident, and the airworthiness of the aircraft were to be questioned, the owner (and previous owners, in the case of an aircraft that changes hands) will be in a much more robust position if there's a clear set of maintenance records showing that they have done a conscientious job. That's not to suggest that the quality of the paperwork always reflects the quality of the aeroplane, of course, but the fact is that when things go wrong it's often the paperwork left behind which is crucial to the allocation of blame. Even where there's no accident or safety issues, good record keeping will also enhance the value of the aircraft and minimise the risk of post-sale grumbles.

The worksheet is important not only to fulfil the legal obligations of the ANO but also, practically, to aid owners and inspectors/maintenance engineers in tracking down exactly what the aircraft consists of, which may save a great deal of time when maintaining it in the future, and help ensure that all required maintenance actions are carried out to ensure safety and keep the aircraft in an airworthy condition. Conversely, good record keeping can also help avoid the need for extra time and money being spent on work that may not be necessary. For example if an Airworthiness Directive (AD) were to come out on your aircraft type which called for the fin spar to be X-ray checked if the fin is of a particular range of serial numbers, you would need to look through the logbooks and worksheets for the aircraft's whole history, to see whether the fin fitted to your aircraft falls inside the affected range and whether it has been X-rayed already. If the records show that the fin has been changed at some point but there's no record of the serial number of the fin, or what aircraft it came off then there'll be no option but to strip the aircraft down to try and find the serial number. Or even to remove the fin and have it X-rayed on the basis that there's no evidence of it not being one of the suspect batch - a costly and time wasting exercise that most likely could have been avoided by better record keeping.

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

Finally, when trying to clear mods, repairs, permit renewals etc a good set of worksheets helps the person with the job of signing off the application to have confidence that the aircraft is being properly looked after and that all is in order. Worksheets with entries that are only supplying the bare minimum details might satisfy the legal obligation but it certainly helps keep the job moving if there's every indication that the people doing the job are meticulous in their attention to detail and willing and able to submit the minuter details to scrutiny. Strictly, it might be OK to record a fuel flow check as having been carried out and for the result to be satisfactory, but if the test has been carried out properly, why hasn't an actual figure been presented in gallons per hour, preferably with a short description of how the test was carried out ? Without an actual flow rate figure to compare against, how will anyone know whether the flow rate has deteriorated or not next time they want to check it ? For us at HQ it would be encouraging to see that the fuel flow available was well in excess of what the engine required, rather than 'only just', and that the person doing the test knew that the flow was supposed to show at least a 25% excess for a pumped system and 50% excess for a gravity feed. And conversely, if the flow result was ten times the expected figure we would have an opportunity to query whether the test has not been done properly, or the decimal point has slipped. If copious data is provided, and all bears scrutiny then the signing authority will be confident that the work is in order.

So what exactly should the worksheet contain ? Looking at the actual wording of ANO article 34, the legal obligation is to provide:

- detailed information about all maintenance work carried out on the aircraft or its equipment
- detailed information about any defects occurring in the aircraft and of the action taken to rectify such defects
- detailed information about any overhauls, repairs, replacements and modifications relating to theaircraft or any such equipment as aforesaid

Of course this begs the question 'how detailed is detailed ?'. Rather like 'how long is a piece of string ?', of course, but here's a shot at the fundamentals, not all will be relevant to every job:

- Identify the aircraft by type, registration and serial number
- What was done
- What was the work done in accordance with (for example maintenance schedule, Airworthiness Directive, drawing, LAA mod number, build manual chapter X page Y etc)
- What materials and parts have been used
- Serial numbers of parts
- For life-limited parts, life used to date
- Where parts have been sourced from
- What process specifications have been followed
- What inspections / checks have been carried out
- When the work was carried out and who by
- Who inspected it and when

Where a worksheet is completed, there must always be a corresponding entry in the relevant logbook (airframe, engine or propeller) which refers to the worksheets concerned so that the two can be identified as being linked. For example, where a worksheet was raised to record a recover of an aircraft, the worksheet would most likely describe the removal of the old fabric, inspecting the underlying structure, making good any minor underlying defects, touching up the paintwork on the frame, the type and grade of fabric used, the taping, stitching, doping and painting scheme, batch numbers for the materials and origin of the materials. The corresponding logbook entry, on the other hand, might simply refer to 'aircraft re- covered

using Stitts process in accordance with aircraft build manual, ref worksheet dated 21.07.13'.
When unplanned work is done on the aircraft but the logbooks aren't available, perhaps because a snag developed while away from base and the owner has the log books at home, a worksheet with the appropriate CRS or (for a permit aircraft) PMR signed by the appropriate inspector or LAE provides a means of fulfilling the legal obligations and to allow the aircraft to carry on flying. The ANO doesn't specify how soon the logbooks themselves must be brought up to date with the appropriate cross-referenced entries, and we're not aware of any other CAA guidance on this but its best to make the entries as soon as practical, and staple the worksheets into the logbook or add them to the aircraft's 'essential records' file rather than have loose worksheets skulling about in the aircraft where they risk getting trodden on or blowing away.

The actual format used for worksheets is not fixed. LAA Engineering provide a worksheet format that can be downloaded from the LAA website
http://www.lightaircraftassociation.co.uk/engineering/Maintenance/Aircraft_Maintenance.html
but this format is really aimed at defect rectification and contains seven lines to deal with seven 'defects' and their 'rectifications'. This is fine for, perhaps, coping with the typical snag list that might result from a permit renewal inspection but is not suitable for larger jobs such as the rebuild of a whole wing, fuselage, tailplane, engine etc. For these longer-running, more substantial tasks a free format is more appropriate allowing plenty of space for the much greater amount of information and text applicable to such a job. In the case of a major rebuild of a Tiger Moth, for example, it might well be that there'd be a page or two of worksheet devoted to each of the four wings, one for each of the tail surfaces, two for the fuselage and another couple for the rigging and final checks, so that by the time the worksheets have been stapled together along with the logbook certificates relating to such things as engine rebuilds, a 'form 1' for a new propeller, certificates of conformity for flying wires, calibration certificates for the instruments and engine ground run results, it all makes up to quite a substantial 'work pack'.

When creating worksheets it's as well to bear in mind that the various major component being worked on may well end up at some stage being used on different aeroplanes, in which case it'll be really helpful if the work relating to each major assembly is on a separate sheet, so that a copy of the relevant worksheet can simply be transferred to the records for the aircraft receiving the donor component. In other words avoid having entries on one worksheet relating to different major assemblies as this would get confusing if the records subsequently get split up.

Bitter experience shows that it's important to get worksheets written and signed up as you go along. It's a big mistake to leave the writing of the worksheets till the job is complete and then hope the inspector will be able to sign up inspection stages that he can scarcely remember amongst the mental fog of all the other aeroplanes he's probably inspected in the meantime. However unlikely the possibility might seem at the start, remember that if you fall out with your inspector before he's signed up your work, or he emigrates or passes away you might be left 'high and dry'. Much better to write up the worksheets as you go along, and get them signed up after each inspection visit. If you are paying for the aircraft to be rebuilt, don't let a situation develop where all signatures are withheld pending your final payment for the job, otherwise you could be left in a pickle if the company goes belly-up while your aircraft's half-finished. Some people use the writing of the worksheets in draft form at the very start of the project as part of the 'project management', and then get it signed up as they go along but if you try this, be prepared to make changes to the draft as you will almost certainly find that the programme of work needs to be adapted as more defects come to light or you opt for an even more extensive overhaul, so your worksheets will need to grow accordingly. There never seems to be less work needed than anticipated !

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

Continued Airworthiness Information

You will need to check that all applicable AD, SBs and MPDs are considered and complied with as necesary, and submit a checklist at the end describing the compliance status against each one.

Alternative engine or propeller type

Sometimes restorers wish to fit a different type of engine during the rebuild. Apart from such issues as rated power, torque, engine weight, fuel consumption, noise output etc, it's essential to check that the engine you wish to use is a type accepted by the LAA for use in this class of aircraft, which is a reflection of its expected reliability. For example it would not be acceptable to replace the Continental A65 engine in a Luscombe 8A with a Rotax 582 two-stroke, because (apart from the cg problems that would arise due to the disparity in engine weights) the A65 is a certified engine whereas the 582 is not. The Rotax 582 is only approved by the LAA for use in microlights and very light amateur-built aircraft.

It will be necessary to submit a mod application dealing with the engine installation, engine mount, cowlings, controls, cooling system, exhaust, propeller, spinner, tachometer temp gauges, oil pressure gauge, etc. You need to show that you have complied with the requirements of the engine manufacturer's installation manual and the applicable requirements of an appropriate design code, e.g. CS-23, see particularly paras 361, 363 and the whole of subparts D and E. You can download CS-23 off our website, from the 'Engineering Publications' page which is itself accessed from the list of options found at the base of the 'Engineering' homepage.

It will be as well to get the design of the engine mount and the general layout of the installation cleared with LAA before you start cutting metal. The mount could be cleared by analysis, or by limit and ultimate load testing (although this should be treated as a last resort) or by comparison with another, already accepted very similar mount.

Engine history

We will need details of the engine history. We do not encourage the fitting of a 'time expired' engine into a newly restored aircraft. If you are determined to fit an engine that has passed its TBO, you will need to make the case that the engine is in good shape, and fit for return to service. This might include, for example, the results of a strip inspection and dimension / wear check against engine manufacturer's specified tolerances.

Aircraft with more than two seats

If the aircraft has more than two seats, an LAA requirement is that the engine and propeller be either certified or of equivalent safety. This means that engines and propellers that you may have seen on LAA single and two seaters may not be acceptable. For example if you were looking for a variable pitch propeller, a non-certified type such as a Woodcomp or Arplast PV50 would probably not be accepted; you would need to use a certified one such as an MT or Hoffman.

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

Shoulder harness

Imported aircraft are sometimes found to be without shoulder harnesses on the front seats, as required in the UK by the ANO. Unless the aircraft is one of a very small number of types that are exempted from this requirement because it is impractical to fit shoulder harness, it will be necessary to have an acceptable shoulder harness installation before a UK Permit to Fly can be issued. If the shoulder harness installation is not original fit, you will need to show that the design of the installation meets appropriate requirements.

Substitute Parts

Substitute parts must be cleared through LAA Engineering who will require you to demonstrate that they are fit for purpose. Making parts 'to pattern' is often possible, but depends on knowledge of the original material specification, manufacturing processes, etc. For example a machined part may not be as strong as an original forged part, or a tie rod with cut threads will most likely have inferior fatigue characteristics to an original tie-rod with rolled threads. The heat treatment condition of metals has a major effect on the properties, and material specifications that appear similar may perform very differently – for example the yield strength of aluminium alloy 2024-0 is less than a quarter that of 2024-T3.

Placards, instruments and markings

In the case of an imported aircraft with foreign-language placards, it will be necessary to change the cockpit placards and controls/switch annotations (eg 'fuel pump', 'on/off' etc) to English language, and the instruments will need to be reviewed for suitability, i.e. altimeter in feet and millibars. While we always encourage the use of knots or miles per hour, for a European-built aeroplane an airspeed indicator calibrated in km/hr is acceptable providing the operating limitations and flight manual are in these units.

It will be necessary to fit a fireproof plate with the UK registration engraved on it, in the vicinity of the cockpit, along with the new markings on the fuselage and wings.

Any existing foreign registration markings must be removed / permanently painted out as it is not permitted to display more than one registration mark.

Weight and balance

It will be necessary to re-weigh the aircraft and create a new schedule. A special LAA weight and balance schedule can be downloaded from the LAA website.

Logbooks

Unless they are already in place, it will be necessary to raise new UK logbooks of the CAA approved type, or best of all, the custom LAA type logbooks, obtainable from the LAA shop which have special wording appropriate to a Permit aircraft.

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

On Completion

Eventually the time will come when, standing before you is a shiny newly restored aircraft, new paint scheme and ready to go. But stop, is it really finished? Did you put that split pin in that you were going to leave till the end? Did you tighten that hose that you tried for size six months ago?

Final inspection / sign-off

When the rebuild of the aircraft is complete, a final inspection must be carried out. Normally this takes the form of an annual check as listed in the LAMS schedule or the LAA generic maintenance schedule (see TL 2.19). In addition, a symmetry check and in-depth rigging check is carried out and all systems calibrated and tested, fuel flows checked and engine ground run.

Application to check fly or flight test

If the aircraft hasn't had an LAA Permit before, on completion you'll need to request an application form from LAA HQ, who will send an application pack appropriate to the type of aircraft concerned. LAA Engineering will need to check through the rebuild paperwork and the proposals for the flight testing, including details of the proposed pilot and airfield to be used. The LAA Permit to Fly issue fee is payable at this time. Check the latest copy of 'Light Aviation' for the appropriate fee.

Alternatively, if the aircraft previously held an LAA permit, you instead need to submit an application for check flying, this is done by sending the worksheets and weight and balance report etc to LAA HQ along with a permit renewal form. The permit renewal form is sourced from your LAA inspector. LAA Engineering will check through the rebuild paperwork and the proposals for the check flying, and also decide whether modifications or repairs have been carried out warranting the flying being upgraded from check flight to flight test status. The LAA permit renewal fee is payable at this time.

When you really are sure that the aircraft's finished, and your inspector is satisfied, and you've applied to LAA HQ for flight testing or check flying, HQ Engineering staff will usually write back, phone or email to discuss one or two technical queries – it is not possible to address all the issues at stake in a simple application form. Your application will of course get prompt attention, but be prepared for the fact that in the busiest time of year there may be a few others already stacked up, so your file may have to spend a few days in the holding pattern.

Once attended to, and all queries cleared up, the aircraft will be cleared by HQ for test flying or check flying by a suitable pilot. A formal flight test is required before a full Permit to Fly can be issued. Normally the flight test period takes about five flying hours - this assumes that no great snags are encountered or modifications required, in which case it will probably take longer. In many cases LAA Engineering call for a specified minimum number of hours that must be flown to establish reliability of operation, before the Permit to Fly can be issued - the number of hours depending on the type of aircraft and its individual configuration and history. A highly modified, accident- repaired or one-off aircraft of unknown provenance or aged design would be likely to have to fly more hours on test than one which is a standard example of a well-established model that's been restored by someone with a great deal of experience on type.

REBUILDING AN AIRCRAFT UNDER THE LAA SYSTEM

A check flight, by contrast, is a simpler procedure with a different kind of authorizing paperwork, a more basic test schedule and usually with no particular number of flying hours – just as long as it takes to get the aircraft trimmed, deal with any snags, re-establish reliability and carry out the check flight schedule. The results are submitted to LAA HQ, and if all's in order the aircraft's already existing Permit to Fly will be revalidated for a further year and the Certificate of Validity sent to the owner.

Issue of the Initial Permit to Fly

On completion of flight testing, the owner sends the test reports and any other material requested by LAA Engineering (typically, copies of the logbook entries relating to the test period). If satisfied with the test results and maintenance records, LAA Engineering will then apply to the CAA for the issue of a Permit to Fly. When this is received from the CAA, providing all loose ends are tied up, fees paid etc then LAA Engineering will validate the Permit for a period of one year and send it to the owner, allowing the aircraft to be flown within the parameters and limitations included with the Permit.