



Light Aircraft Association

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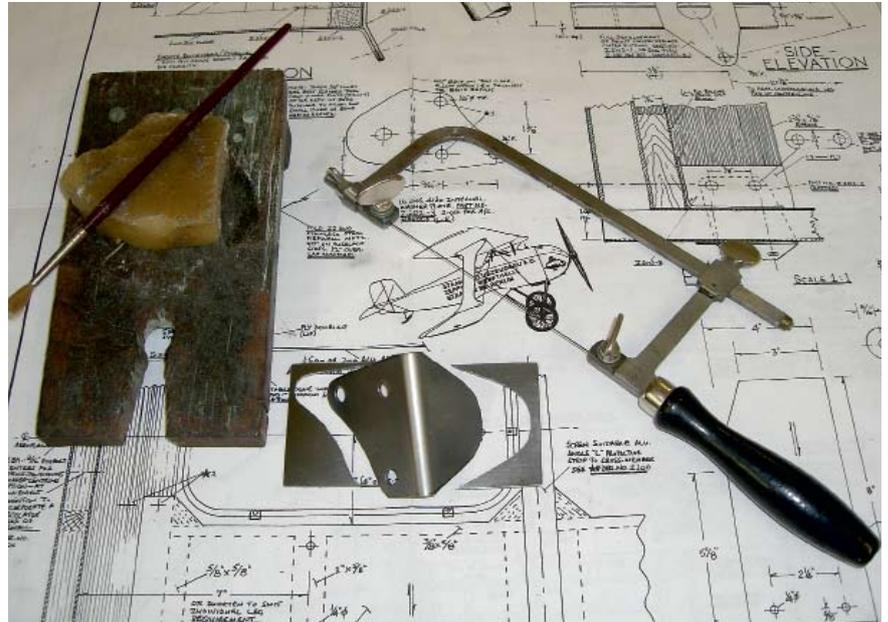
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Volume 1 Issue 11 November 2008



A piercing saw makes very fine cuts once you have mastered it.

Metalwork tooling for beginners

Purchase of good tooling is vital to any project, but what to buy? Flitzer builder Adam Wankowski offers his tried and tested advice

I was some way into the metalwork for my Flitzer when it occurred to me that I was rather enjoying this phase of the project.

Like many scratch-builders (or at least those who don't list 'owns a light engineering firm' as the day job), I had approached the metalwork with some trepidation. My previous clock making work seemed hardly likely to give me the skills to bend chunks of 4130 steel into all the multitude of little metal brackets



Bender bars modified for use with the Warco Magnum bender.

needed for a wooden biplane.

I was happily slicing through some 14g sheet one evening when it occurred to me that it was thanks to the quality of the tooling that I had assembled in my workshop that this job was so pleasant.

The arrival of my copy of the smart new 'Light Aviation' magazine in the post next morning, prompted further thought. I have seen plenty of 'How to' articles but none on workshop metalwork tooling. Hence pen to paper, or to be more accurate, two fingers to keyboard, and a guide to some metal-working equipment for beginners. I will cover my most useful machine tools and a couple of hand tools that I have found particularly invaluable.

CUTTING

During an early visit to my Inspector he mentioned the existence of metal cutting vertical bandsaws. I had never seen one, but the thought of easily cutting sheet instead of hacksawing and chain drilling seemed very attractive.

The result of a search on ebay





The Warco Magnum bender is fitted to a movable stand for practicality.

and a trip to Herefordshire left me the proud owner of a Startrite Bandit vertical bandsaw.

These machines are solid and heavy for their size, and are equipped with an all important gearbox to reduce blade speeds to the low range needed to cut steel. They have not been produced for many years but are extremely robust and do turn up on ebay quite often. Spares are still available (via a quick internet search), though rather pricey.

I first tried cutting 4130 with a standard metal cutting blade but after a couple of inches all the teeth had vanished!

Back to my tool supplier and he sold me a cobalt blade which has so far cut all the sheet parts and is still as good as new. This gem of a machine also makes nice straight cuts across aircraft tube, and with care will cope with 3/4 inch mild steel bar!

The available higher speed ranges also mean that these saws will cut wood like any other bandsaw.

With the addition of a safety stop and dust extraction (a domestic vacuum hose and a plastic funnel) and some ear

defenders, 'health and safety' are also fairly happy.

BENDING

Quite early in my crash course in aircraft metalwork I came up against the problem of making precise bends in sheet steel. The appearance of the 'Magnum Bender' designed by Paul Prince seemed like an ideal answer. This machine has fulfilled every promise and with minimal adaptation, even more! Paul's recent articles in this journal are well deserving of study.

With the addition of a digital angle gauge I have taken a delight in producing precise bends of specified radius with almost no tears or additions to my scrap bin. A major limitation of the Magnum Bender did produce

problems - many of the Flitzer metal parts are of narrow 'U' profile and cannot be produced with this machine as supplied. I soon found that it was quite easy to produce 'one off' bending bars of narrow section to fit my 'U' profile parts and have even managed to use a tapering bending bar.

My only problem with the bender is that it requires access from both front and back in use - this has been tricky in my small workshop - solved by bolting it to a stand that is in turn bolted to a chunk of 1 inch ply so that I can slide it around the floor to gain access and then stand on the ply to hold it steady in use.

DRILLING

Holes are, of course, an obsession with aircraft builders. Seemingly hundreds

'I first tried cutting 4130 with a standard blade but after a couple of inches all the teeth had vanished'



A quality bandsaw is an excellent investment, check out ebay



A jeweller's pendant drill - a more powerful alternative to the Dremel.

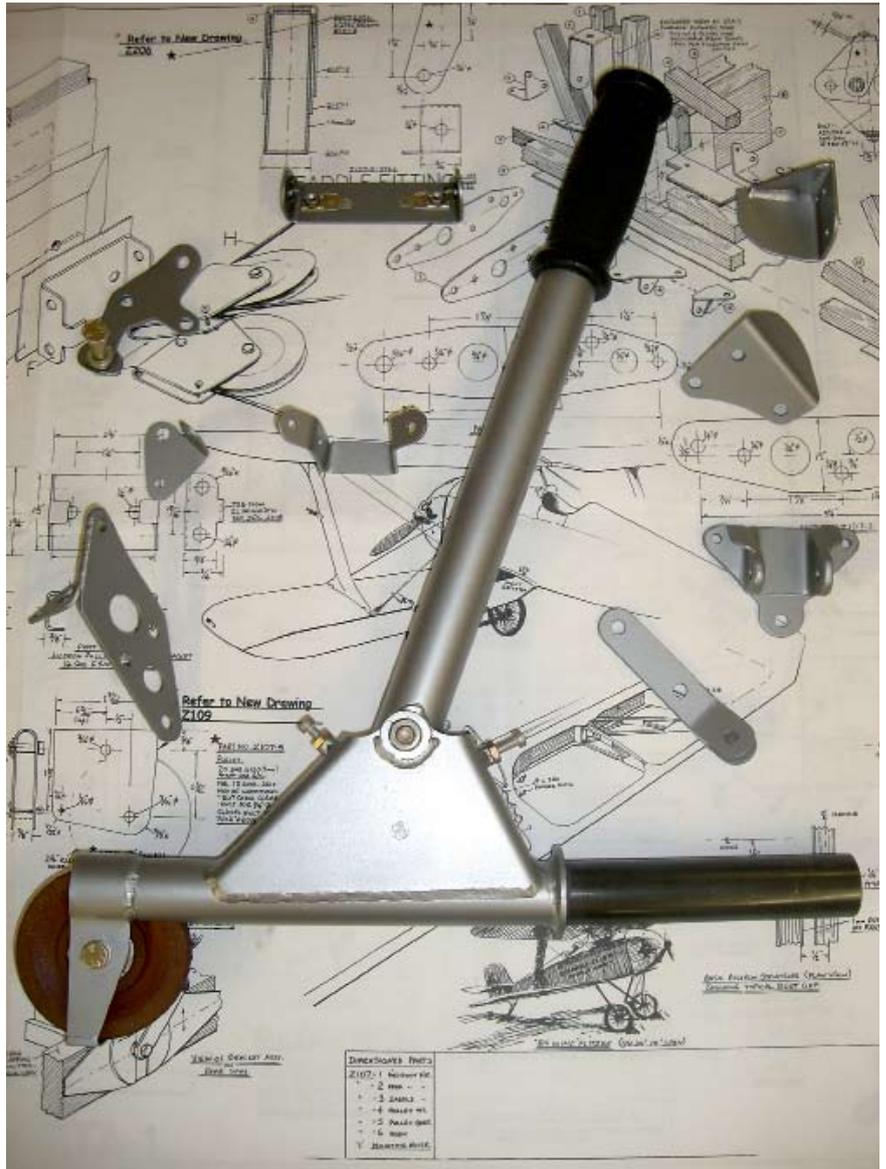
of precisely located and sized holes are needed and their production can occupy a very large slice of building time.

I acquired a good solid pillar drill before starting my project - the extra versatility of a floor-standing model has been useful. Again ebay is a good place to look for drills.

British made machines seem very reasonably priced at present, though beware 3-phase machines as re-motoring can cost almost as much as a used drill. My machine came without a rise and fall mechanism for the table - the addition of a suitably cut down 'Acro' prop solved this quite easily.

I soon found, however, that almost all my metal parts needed holes at several locations and it was taking me an age to locate and clamp the part for each hole.

'A jeweller's pendant drill has a lot more power. It is controlled by a foot pedal, giving variable speed'



A collection of various Flitzer metal components... with the plans in the background.

Once again my ever helpful inspector provided the answer - a compound table bolted to the drilling machine table quite transformed the machine.

Clamp the part in the drill vice, twiddle the knobs of the compound table to locate the first hole; drill and ream and then twiddle the knobs again and the second hole is soon located and drilled.

Easy when you know how! I even began to feel like a real engineer!

When drilling 4130 I rapidly found that standard high speed steel bits blunt almost instantly - cobalt bits are needed. Fortunately, as only three sizes of hole are used in the Flitzer airframe only a small range of drill sizes is needed.

I keep mine in simple racks with their relevant reamers alongside. It's all too easy to select the wrong size of drill

otherwise (so adding to the scrap bin!)

OTHER TOOLS

Turning now to smaller tools. I have found my jeweller's pendant drill invaluable for edge preparation of metal parts.

I purchased a laser cut metalwork kit early on in my build but much of it proved unusable. The parts I could use required the hardened edge to be carefully removed.

A Dremel is often used for this purpose but the jeweller's drill has a lot more power. It is controlled by a foot pedal, giving variable speed. It will swiftly join chain-drilled holes and then grind the remaining jagged edge to a line using a small size diamond burr - this is shown in the accompanying photo. This can be a long job with a file, done in a trice with the pendant drill!

A tool in almost constant use by clockmakers is the jeweller's piercing saw. As can be seen in my photo the blade is very thin indeed. It has a rounded back so will turn very sharp corners when cutting. I was delighted to find that using

good quality Swiss blades I can cut 4130 sheet as fast as with a large hacksaw (the fine blade of course removes much less metal) and parts with curved outlines can be rapidly cut out, exactly to the line, with only light filing required to produce a smooth edge.

The saw is used vertically, the part being cut is held flat on the table shown-this being clamped in the bench vice. Lubrication with beeswax makes cutting a lot easier and I use a small brush to remove the metal dust produced by cutting so that my line is not obscured. Lastly you sit on a high stool to use a piercing saw! This will be quite alien to most engineers but I would commend the use of this tool - it takes some practice at first (and quite a lot of broken blades) but is well worth the effort.

OPTICAL CENTRE PUNCH

Finally the optical centre punch. Get one! Mine was a very acceptable birthday present years ago and it makes the location of my centre dots easy and completely reliable. Care taken in marking out is wasted if centre punch marks are not accurately located.

The Perspex rod is light gathering and the lower end is marked with cross hairs. The upper end is a magnifying lens. Simply place the holder onto the work roughly over the centre mark, pop in the Perspex rod and adjust by moving the holder till the cross hairs are over the centre mark. Then replace the Perspex rod with the dot

'Finally, the optical centre punch. Get one! Bingo! One precisely located dot and a happy builder'

punch and tap with a small hammer.

Bingo! One precisely located dot and a happy builder.

Good advice has also of course played a very large part in enabling me to produce acceptable aircraft metalwork and I would be remiss if I did not mention

the tireless efforts of my inspector Trevor Crossman, and also my welder Richard Kimberley (richardkimberleyservices.co.uk) who have been ever patient and helpful in fielding my questions, bringing me closer to my goal of a complete self built aircraft.



An optical centre punch maximises your careful marking out.

Join us NOW!

There has never been a better time to become a member of the Light Aircraft Association.

Recently, we conducted a major survey on exactly what our members want from the LAA, and we've been working hard to make sure they get exactly that.

Whether you're a builder, pilot, enthusiast or aviation-related

supplier, the new LAA is set to become the primary organisation for every aspect of light aviation.

In our new updated monthly magazine, *Light Aviation*, we'll bring you more articles, more pictures, covering more light aviation subjects than ever before.

We'd like you to join us today!

Membership includes

- ✓ Monthly magazine *Light Aviation*
- ✓ Airside access at all LAA events
- ✓ Access to engineering website

The LAA will always

- ✓ Fight against airfield closures
- ✓ Promote safe and affordable flying, friendship and fun
- ✓ Encourage design, construction and operation of light aircraft
- ✓ Promote restoration of vintage aircraft

Membership rates*

Adult	£48
Seniors (over 65 after one year at full rate)	£33
Juniors (under 18)	£12
Student (full-time - under 25)	£12
Joint Membership	£58
Foreign Membership	£55
* Plus initial joining fee (not juniors)	£5

To join the LAA

or renew your subscription, just call us at Head office on

01280 846786

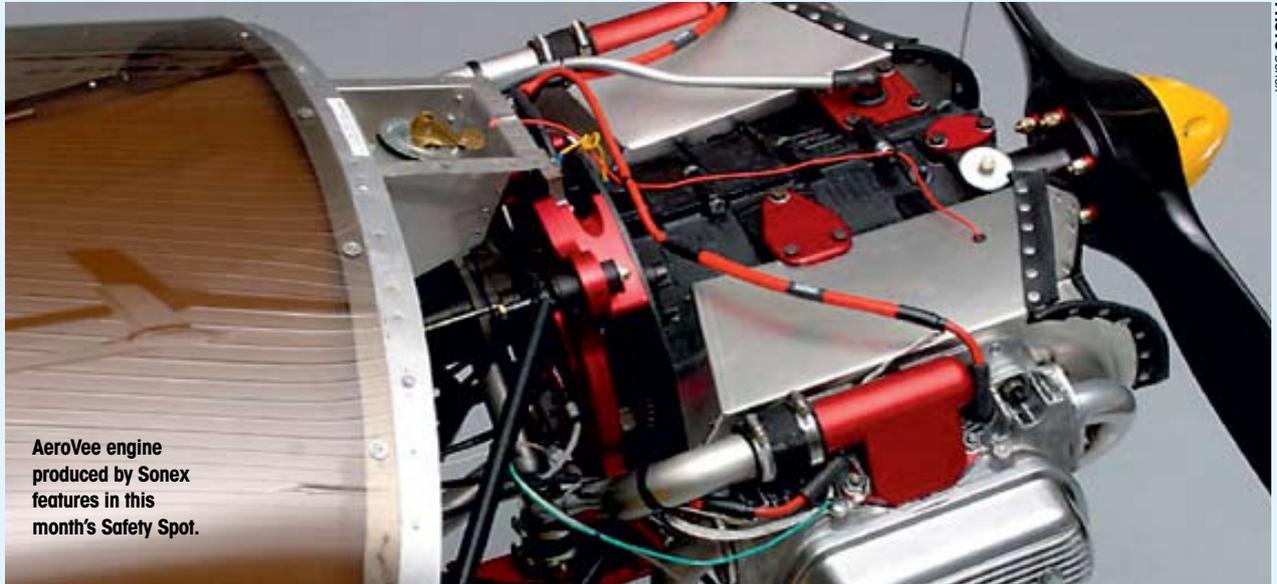
or join online at

www.laa.uk.com



SAFETY SPOT

With Malcolm McBride Airworthiness Engineer



AeroVee engine produced by Sonex features in this month's Safety Spot.

PHOTO Sonex

Check, check again

Don't tick the box until you've completed the task

HAVE you ever heard of displacement activity? My dog, for example, exhibits this sort of behaviour very regularly. If I chastise him and, in his opinion, he doesn't deserve it, he puffs up his chest and demands to be let out into the yard. Once the back door closes and he thinks that he is not being observed, he will launch himself onto almost any object within reach – garden tools, boots or shoes, and, with a fearsome, almost manic, gleam in his eyes will set about destroying whatever object he has chosen.

I enjoy watching this performance, rarer now as he moves into his dotage and has come to terms with the fact that he is indeed, 'just a dog'. It is rather worrying though when one considers that in his mind's eye, the object of his vengeance is me. In other words, he thinks he has sorted something (or someone) out, when in

actual fact he's just thought about it.

I'm no expert on the subject of social behaviour in animals but, as we are often reminded, Homo Sapiens is indeed an animal and 'Human Factors' often, perhaps mostly, are at the root of many maintenance errors.

Thinking you have done something and not having done it, is a very common cause of problems. I see the results all the time in my job. Sometimes, and I bet you can relate to this, simply thinking "I must remember to do this or that" ticks the box in the mind which should be reserved for actually doing the job. Don't tell my dog this, but there is a difference between thinking a job's done and actually doing it!

I remember, rather too many years ago, causing a bit of a stir because I was sure that I had done something ... but hadn't ... the result caused a nose undercarriage of a brand

new Seneca III to jam, roughly centre travel, on the downwind leg at Oxford Airport.

I was actually climbing into my car having finished my shift, when I heard the fire alarm go off... something told me to go back to the hangar. I cannot remember exactly why I had the undercarriage in bits but, whilst I was working on the aeroplane, someone asked if they could borrow my torch.

The rather flustered pilot managed, eventually, to get a green nosewheel light and landed without incident and, after taxiing back to the hanger, stopped the machine.

Quite a few people, including me, leapt into the nose undercarriage bay to see what had happened.

What was immediately obvious was a torch, bent like a banana, resting on one of the drag braces. The pilot, who was a friend of mine, by this time had joined in the party, grabbed

the torch and started to inspect the undercarriage with it. This action, which I still feel was the mark of a true gentleman, was immediately spotted by a keen-eyed inspector ('ello, 'ello, that torch is not exhibiting any light). The rest, including a week's suspension without pay, is history.

The point of this foray into the rather extensive World of Malc's mistakes, is to remind the reader to check, and then check again. After any maintenance procedure, check the job has been done correctly and, as in my failure, nothing has been left lying about. The reason why I forgot the torch was that I had ticked the torch box in my mind – because I thought I had lent it to another Engineer.

So, what's been happening in the LAA 'events' world? Well, Terry Williams did a terrific job landing his Nicollier Menestrel 2 in a field after the engine quit, so well done Terry.

SAFETY SPOT



PHOTO Terry Williams

Sheared cap screw
on the flywheel
of the AeroVee
engine.

AeroVee 2180 alternator failure

Why did a nearly new engine 'mash up' its ignition system?

THIS story really started for me at one of this year's Inspector Seminars/Training days. This particular day was organised by LAA member Mike Moulai of Silver Fern Microlights at Sandtoft, and focussed mostly on the Sonex kit.

Mike is also the UK agent for AeroConversion's Volkswagen engine conversion kit, known as the AeroVee, about which Mike gave a small talk. My son is in the process of building a small seven-cylinder radial as a 'static', but hopefully runnable, plans project.

So I was really surprised to find that it was possible

to build your own 'flyable' engine. I must say that I was extremely impressed by both the concept of the 'self-build' engine and the pictures Mike had of the finished project.

Then I had to put my LAA hat on and start to consider the implications of this from a safety standpoint.

When I returned to HQ I began the process of collating facts about this engine and discovered that the LAA had cleared two Menestrels and a Flitzer with the AeroVee.

As is the way of this sort of thing, it wasn't a couple of weeks before this engine

type was forced into my consciousness... one of the AeroVee powered Menestrels had ended up in a field.

As is normal with this sort of investigation I first spoke with the aircraft's Inspector, Geoff Martlew. He said that it looked as if the flywheel had separated from the crankshaft and had 'mashed-up' the ignition systems.

Terry Williams, the owner and pilot, later confirmed that the engine had, "pretty much just stopped".

Log book checks revealed the engine was only 40 hours old, hardly run-in, so what caused the failure?

The damaged parts were removed from the now disassembled engine and shipped to the suppliers for inspection, I opened up communication with Jeremy Monnett, one of the principals at Sonex Aircraft, manufacturers of the AeroVee engine.

I expect you know aircraft normally always include twin, independent, ignition systems. The exceptions to this rule are motorised gliders, where the engines are classed, like the engines in yachts, as auxiliary and not necessary, and microlight aircraft, which have a very low wing loading and

With Malcolm McBride Airworthiness Engineer



PHOTO Terry Williams



AeroVee's
flywheel
drive.

can therefore land almost anywhere.

There are very good reasons for twin independent ignition systems, many are obvious involving the statistics of ignition component failure, and some less so involving the complete charge burn in low-compression/under-square engines.

Naturally, very few connected systems are actually completely independent. In the case of a conventional aero-engine system, two magnetos provide a spark for each cylinder via two sparking plugs. Magnetos, by their very nature, provide electrical energy independently from the aircraft's electrical system, so they are independent in that sense. But, magnetos often share a common drive path and it was partly this common drive path that failed in the AeroVee, stopping the engine.

The AeroVee engine uses a purpose-built ignition system which, to quote LAA member

'The AeroVee engine uses a purpose-built ignition system which is "absolutely brilliant in it's simplicity"'

Rupert Wasey, a Staaken Z-21 Flitzer and AeroVee engine builder is, "absolutely brilliant in it's simplicity". The primary ignition system comprises a fixed magnet fitted to the rotating flywheel, it really is fixed - there's no adjustment. This magnet induces a current in the coils that are fitted to the flywheel housing, and each coil supplies two sparking plugs. That's it. No adjustment, no points and, in over 250 hours on Rupert's Flitzer, no problems.

The system powering the other set of plugs is slightly different, using a Hall-effect sensor coupled to two 'conventional' coils powered by a battery. The AeroVee flywheel also drives the magnet ring (rotor) for the 20 amp alternator. If the flywheel/crankshaft

connection fails the engine will stop. This connection is effectively made using four cap screws which must be torqued and thread-locked in place.

I will let Jeremy Monnett complete the story: "While it is impossible to tell exactly what happened leading up to this failure, the most likely series of events were:

1. One or more of the cap screws holding the secondary trigger assembly started to back out.
2. One or more of the cap screws then hooked the stator assembly and shredded it and eventually hooked onto the body of the stator.
3. The secondary trigger cap then likely separated from the flywheel assembly. All of this load on the flywheel also likely led to the primary trigger

magnets contacting the magnetron ignition units and sheared the second series of four cap screws - there is damage (see the photo) to the leading edge of the primary ignition magnet mount, which is why we can say it so conclusively".

Jeremy went on to say that it would be a good idea to check these cap screws "periodically".

Naturally, I think that this is a good idea but, to our knowledge, this is the only example of a failure of this type and regular readers of Safety Spot will know how easy it is for screws/bolts/etc to come undone if they are not correctly fitted in the first place. Issues involving threadlock, or perhaps lack of it, seem to be becoming a bit too regular!

SAFETY SPOT With Malcolm McBride

Airworthiness Engineer



Elsewhere...

Good spots in the LAA fleet in a quiet month

SO, what else is happening amongst our fleet? Well, last month was the quietest ever

for 'event reports' and so I will end with a few pictures of some good 'spots'. Thanks go to the

contributors as always - one picture is worth a thousand words... Fair Winds!



PHOTO Eric Stokes

When was the last time you had your spat off? (ooo...duckie)



PHOTO Ron Neal & Al Mathie

Good spot on an Auster Rudder Bar, get your head down!



PHOTO Steve Clearhugh

Over tightening a tapered pipe fitting cost this owner £340 to replace this Rotax 912 oil filter housing

ENGINEERING STOP PRESS!

FILSER AD

The AD that has affected Filsler TRT transponders has now been lifted for the TRT 800, though some versions of the TRT 800H and A will require factory modification as explained below. TRT 600 units that have not yet been upgraded to TRT 800 will also require factory modification.

The Funkwerk avionics info letter is at http://www.funkwerk-avionics.com/cms/upload/Presse/AD_ServiceInfo_07_E.pdf

The Service Bulletin is at http://www.funkwerk-avionics.com/cms/upload/Presse/SB_TRT800-A-H-1_Rev1.04.pdf



LAA ENGINEERING SCALE OF CHARGES

LAA Project Registration

Kit Built Aircraft	£300
Plans Built Aircraft	£50

Issue of a Permit to Test Fly

Non-LAA approved designs only	£40
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Initial Permit issue (Max Weight Authorised)

Up to 390kg	£300
391 to 499kg	£405
500kg and above	£540
Three seats and above	£600

Permit Renewal (Max Weight Authorised)

Up to 390kg	£100
391 to 499kg	£135
500kg and above	£180
Three seats and above	£200

Modification

Modification application (per individual modification)	£22.50
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Transfer

(From C of A to Permit to Fly OR CAA Permit to LAA Permit to Fly)

Up to 499kg	£135
500kg and above	£250
Three seats and above	£350

Fourseat Aircraft

Manufacturer's/Agent's Type acceptance fee	£2,000
Project Registration Royalty	£50

Category change

Group A to Microlight/ Microlight to Group A	£110
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Spars - The latest amendment to Notes to LAA Aircraft Inspectors (SPARS) is number 14, July 2006

ACCESS TO ENGINEERS: 2pm to 4pm

Please ensure you pay adequate postage when sending in your Permit/aircraft documents