AVRO LANCASTER
by Ivan Pettigrew
Construction Notes

For ease of transportation, the model may be built with the wing in three sections. The sections are held together with nylon clips. Assembly at the field does not requite any tools, and set up time is only a few minutes. Assemble the wing upside down so that the nylon clips under the wing, and aileron clevises are easily accessible. If using a typical seven seat mini van, it is best to leave the middle and rear seats upright (without headrests,) and slide a six foot long sheet of thin plywood in from the rear, resting on top of the seat backrests. The centre panel of the wing will sit across the centre passenger seat, with the outer wing panels on top of it. The fuselage sits on the plywood sheet, leaving room for other models and equipment.

FUSELAGE

The fuselage is a simple framed up box with bulkheads added to the top and bottom. First build the two sides of the fuselage over the plan, (shaded sticks) and join together. Notice that the sides slope inwards slightly towards the top, the width of the fuselage at the top being less than at the bottom. Also note the sketch on the plan that shows how the nose section is removable, along in one piece with the upper section of the fuselage that covers the centre section of the wing. This makes for easy access to the batteries. With this nose section and cover removed, wing removal, and access to the radio and servos is also simplified. When the lower/rear section of the fuselage is framed up, the bulkheads for the curved section on the top and bottom are added, longerons glued in place, and applicable parts sheeted with 1/16" balsa. If contest balsa is used for this sheeting, it will result in some weight saving, and will also be easier to work with. The removable nose/upper section of the fuselage is built as a separate unit, but may be best left until the wing has been completed. It can then be built on the model with the wing in place. Doing it this way makes it easier to get the correct fit where it covers the wing centre section.

WING CONSTRUCTION

The full depth sheet spar is continuous throughout the length of the wing. The ribs are cut where they meet the spar, and are attached to the front and rear surfaces. Construction is as follows.

(1) Build the spar over the plan, taking care to get the sweep back angle correct at the dihedral break.

(2) Add reinforcing strips of basswood or spruce to the top and bottom edges of the sheet spar as indicated.

(3) Cut out all ribs, and then cut into two pieces where they meet the spar.

(4) Place the spar on edge over the plan and pin in place. Only the flat portion of the wing between the dihedral breaks will be built at first.

(5) Attach the rear section of each rib to the back of the spar, and attach the trailing edge and secondary spars.

(6) Glue the forward portions of the ribs to the front of the spar. NOTE: If retracts are being incorporated as shown on the plans, the forward sections of the ribs must be threaded onto the retract operating torque rods, which run from the centre section to the engine nacelle, before the ribs are glued in place. Next glue the inner leading edge strip to the nose of the ribs. The second strip will be added after the sheeting is applied to the upper and lower surfaces.

(7) Sheet the lower surface from the leading edge to the main spar.

(8) Put the motor wiring in place behind the leading edge from the centre section to the engine bays.

(9) Weight the wing down on a flat surface and apply sheeting to the top surface from the spar to the leading edge. There is no washout in this section. After the top sheeting is applied, the wing is very rigid in torsion, so it is important that the wing is weighted down to a very flat surface while the top sheeting is applied.

(10) Add the outer leading edge and shape to the correct profile.

(11) Block up one end of the section completed, so that the outer section of the spar at the other end is flat on the plan.

(12) Build this section of the wing, from the dihedral break to the wing join, in the same manner as the central part. Repeat this for the other end of this wing section.

(13) Build flaps as indicated.

(14) Add 1/ 16” sheet to top and bottom of wing at centre section. Add 1/16” x 1/4” cap strips to the top and bottom of ribs from main spar to trailing edge.

(15) Build the outer removable wing panels in the same manner as for the main section. Before adding the sheet to the upper surface, block up the trailing edge at the tip rib 1/4” to provide for washout. Add ailerons.

(16) Build the tongue and box wing joining sections as shown. To keep the wings in place during flight, nylon clips (snap links) are added to the lower surface adjacent to the main spar.

The motor mounts and pedestal for mounting the undercarriage are built up from strips of hardwood, using good quality glue or epoxy. Gussets help in joins where there is most stress. Following the sequence, A, B, C, D etc, indicates the sequence for construction.

A dummy gear leg is formed by adding a thinner wire to the gear leg as shown. Then fairings are added to both legs before hooking up the retract servo, operate the undercarriage manually. The compensating spring should be adjusted in tension (length) so that approximately the same force is used extending the gear as retracting. This only applies of course if the test is done with the wheels in place, and when the wing is in a horizontal position. If gear doors are used, they are held up with lengths of thin rubber fastened between the rear corner of the gear door and the upper reaches of the wheel well.

The motors are attached to the beam mounts with small hose clamps. The cowlings are built with the motors installed. Make the nose block first and make it a snug fit on the front of the gearbox so that it is held in place while the cowlings are being built. Next make the flat side panels of the cowlings which are screwed at the rear to the undercarriage mounting bulkhead, using two #2 screws. Use a strip of 1/64" ply to reinforce the rear strip where the screws are located. The front of the side panels are glued to the nose block. Next the curved top of the cowling is formed and glued to the side panels and nose block. Finally the lower panels are made the same way. Remove the screws and take off the cowling, then enlarge the hole in the nose block to give more clearance for the gearbox and propeller shaft.

In multi motor electric models, there is an increased risk of problems with radio interference from motor brush noise. It is always recommended to put a diode across the terminals of each motor in addition to the usual capacitors. The best diode to use is a Schotky, but a small 2N4001 is often sufficient on a lower powered model such as this. The radio and servos should be kept as far as possible from the motors and motor wiring, but this is taken care of with the layout shown in the plans. Servo leads must be kept short. Do not use outboard servos for the ailerons. These would require long leads running along the wing parallel to the motor wiring, and they would be very prone to picking up interference. At the low airspeed of this model, one standard servo is ample to operate the ailerons.

ADDED NOTES:
The wheels shown in the plan are 5 inch. They were reduced to 4½ inch because of availability of lighter wheels with softer tires. Gear operation may be difficult if the wheels are too heavy. When the model was built in 1996 there were no retract servos

readily available, so the winch method shown on the plan was designed, incorporating a servo modified to act like a “sail winch.” Slow moving high torque retract servos are now available, and it is recommended that one of these be used to operated the crank in the centre section of the wing.

Split flaps were used in the original model. They do slow the landing speed a little, but are not necessary because of the low wing loading of the model. They are never used for take off. Making flaps like this is a considerable amount of work. Being so thin, they are difficult to keep rigid without being built too heavy. Flap travel is limited to 25 degrees. In retrospect, if I were building this model again, I would not install flaps. They do not make the landing any easier. The Lancaster is quite a floater, and does beautiful slow three point landings at low speed without flaps. Flaps are a lot of work and add weight. The main value of flaps is in the appearance, and being split flaps, how many people notice that they are down?

The basic airfoil is an Eppler 197, but the outer wing panels are modified to incorporate a NACA type leafing edge cuff. Hence the airfoil of these outer panels resembles a flat bottom section with blunter leading edge.

SPECIFICATIONS:
Avro Lancaster. (1996) 1/12 scale (1996) Four Master Airscrew (Mabuchi 540) motors with 3:1 ratio in series on 25 cells driving 13 x 8 three blade props at 3,750 RPM.

Static current 22 amps. Span 103 inches. Wing area 1,300 sq.ins. Length 70 ins. Weight 12 lb 11 ozs. Wing loading 22.4 oz/ sq.ft. Retracts and flaps. Ace Smart Throttle ESC. Airfoil Eppler 197.

1999 Upgrade of motors
In 1999 the motors were changed, and the model presently flies on four re-timed 27 turn car motors (stock) from 18 cells, the motors being wired series / parallel. The motors run as if on 9 cells each, and are more efficient at this voltage than the original Mabuchis were on the equivalent of 6 1/4 cells to each.motor . With the reduction in number of cells, and the car motors being lighter than the original Mabuchis, the total weight saving is about 20 ozs. The gear ratios have been changed to 5.1:1. The same three blade 13 x 8 props turn at 3,900 RPM.. Each motor draws 12.5 amps, so the battery drain is 25 amps. With the weight saving, the climb rate has increased and the landing speed has decreased, wing loading now being 20.3 oz/sq.ft.

July 2003: Recommendation
For future builders, the 22 turn Magnetic Mayhem car motor is recommended, with the four motors being wired series parallel from 18 cells. The Magnetic Mayhem motors have a slightly longer armature and are significantly more efficient than the regular car motors. They are also available with reverse rotation timing, and these should be used if a

simple single stage gear reduction is employed. Master airscrew now makes plastic 3 blade 13x8 props, so they are made to order for the Lancaster. When I built the original model, I had to make my own from two blade wood props that were cut up and glued together into 3 blade configurations. The remaining variable is the gear ration of the gearbox. The MEC gearbox is suitable, since the ratio can be readily changed. My estimate of a starting point for the gearbox would be about 5:1. The aim should be to turn the props at about 4,000 RPM, and total current draw from the battery should be in the range of 27 to 33 amps; half of this to each motor because of the series/parallel set up. This low power makes for excellent efficiency with these motors, and makes for good flight endurance and long motor life. I will welcome input on what gear ratio works out for those building this model.

When this model was built, the Sanyo 1700 SCR batteries were in regular use and the most obvious choice. Now there are many options, but my recommendation would be the Sanyo CP-1700 SCR. These are considerably lighter than the old 1700 cells, and will fly the model better because of the weight saving. The flight time should be in the range of eight minutes so it is not necessary to go to larger cells to get a longer flight time. The cells of 2400 capacity and larger are quite a bit heavier. This means that the flying speed is higher which may detract from the flight realism. It is the slow stately flying of the Lancaster that is most impressive. The home made retracts as shown on the plan have proved to be very reliable, but are not designed for excessive weight, so this is another reason for not recommending larger cells.

LIGHTWEIGHT RETRACTS

The retracts described here were designed for electric powered models of multi engine aircraft, and have been used in several the have weighed from seven to twelve pound. The only item needed for the construction is a good vice, and the strength does not depend on any solder joints.

Absorption of bumps in the runway is important. In this design, when a wheel hits a bump, the landing gear leg is allowed to flex backwards. This is due to the ‘torsion bar’ effect of section A to B of the landing gear leg where it passes through the nylon landing gear straps that form the pivot point. Because of having the axle behind the pivot point, as the landing gear leg flexes backwards, the axle also moves upwards, thus reducing effective vertical length of the gear and absorbing the bumps very effectively. The bend in the landing gear leg between the pivot point and axle is for cosmetic reasons only. The only part visible below the nacelle is the vertical part, and looks better than if it were raked backwards directly from the pivot point to the axle.

The landing gear leg is actuated by the end of the operating crank. It slides in a slot which is formed by a long “U” shaped bend at the top end of the gear leg. Forming this “U” shaped slot is perhaps the most challenging part of the construction, so this end of the gear leg should be made first, the rest being quite straight forward. The wire is bent cold with the use of a vice. When the gear leg is in the down position, the end of the crank is “over centre” in relation to the slot, so the rearward force on the gear leg forces the crank into the dead end of the slot, thus preventing a gear collapse. The positioning of the operating crank is quite critical in order to get this effect, along with the correct amount of travel for the gear leg.

A long 3/32” wire shaft is used from the retract servo out to the engine nacelles to operate the retracts. When building the wing, the nose ribs have to be threaded onto this wire shaft before they are glued in place. The motor mounts and pedestal are made of hardwood. My preference is basswood. The glue joints need to be of good quality, using epoxy, and gussets may be used where thought necessary. The sequence for construction is shown on the plans using numbers, starting with 1. (On some of the older plans such as the Lancaster, the sequence is with letters “A,B,C,D” etc.)

The spring from point S1 to S2 compensates for the weight of the landing gear leg and wheel. With the correct tension, it is possible to raise and lower the gear with very little force, but this only applies when the wing is held in a horizontal position, and the wheels are in place. Before connecting up the retract servo, operate the gear manually. Adjust the tension of the compensating spring so that approximately the same force is required to lower the gear as raise it. When this has been done, connect the retract servo. The engine nacelles are built after the gear is completed and is operating satisfactorily. Next the cowlings are made.

If the gear legs get bent back due to a heavy landing etc, it is possible to remove them by taking off the two nylon straps that hold them in place at the pivot point. Access to these straps is possible through the wheel well opening. The legs may then be set to their original position in a vice. It is not advisable to try and bend them back to their original position while in the plane.

The small diagram enclosed shows a layout typical of that used in most of the models that I have built retracts for. The Lancaster is different though because of the wheel being very large and wanting to retract into the area where the main spar would normally be located. Although the layout of the Lancaster retracts is different from this diagram, the operating principle is similar.

Good luck with your retracts.

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