CONTROL LINE MODEL AEROPLANE

Drawing No. **A4CL2/3** Date: 26 June 2001

1/2A TYPE BASIC/STUNT TRAINER

Building Instructions

Before You Begin

It is important that you read all these instructions and study the plans (Drg No's. A1CL2/1 [Parts Details] and A4CL2/2 [General Arrangement]) carefully before you commence construction. You need to have a thorough understanding of how the model is going to be built before you even start. It is also recommended that you read Tools, Materials, Tips & Tricks.

Design

General Particulars:

Wing Span	586mm (23")
Length (excluding motor)	353mm (13.9")
Wing Area	682cm^2 (105.8in^2)
Engine	0.8cc (0.049cu.in) with integral fuel tank for use as a basic trainer
	OR
	1.0cc (0.061cu.in) with integral fuel tank for use as a basic stunt trainer

This model is one of the cheapest and easiest to build. It also has high strength, simple construction, and ease of operation.

High strength is of the utmost importance because the tyro is fairly certain to make at least one error during the first few flights, and rugged construction will help to withstand rough landings, nose overs, and other mild mishaps. Solid construction is the best method of achieving maximum strength. A solid flying model can absorb numerous dents and scratches and still remain in flying condition well after a built-up model has had to be retired.

Simplicity of construction is reflected not only by the solid construction but also by the profile fuselage. A profile fuselage offers the illusion of a conventional type when in the air and on the ground, except when viewed from the top.

Ease of operation is essential for the novice, and this has been taken into consideration in the configuration of the design. A beginner's trainer must be easy to handle but must give the "feel" of flying.

One of the most important factors in establishing the sensitivity of a C/L model plane is the position of the balance point. If this point is too far back, the controls will be sensitive, and the model will react suddenly to the slightest control-handle movement – a factor that could spell disaster for the inexperienced flyer.

Another factor that governs the sensitivity of the controls is the area of the elevator. Manoeuvrability will increase as the elevator area increases.

Materials

These are the minimum material requirements for building the control line trainer.

No. Req'd	Description
2	3mm x 75mm x 900mm (1/8" x 3" x 36") medium balsa for wing, stabiliser and elevator
1	6mm x 75mm x 450mm (1/4" x 3" x 18") hard balsa for fuselage
1	1.5mm x 150mm x 450mm (1/16" x 6" x 18") plywood for engine bulkhead, bell-crank mount, tail doublers, fin, elevator doubler and lead-out guide

No. Req'd	Description
1	1.5mm (1/16") diameter x 450mm (18") piano wire for control rod and tail skid
1	0.5mm (0.02") diameter x 750mm (30") piano wire for lead outs
1	M20 (3/4") steel washer wing tip mass
1	20mm (3/4") nylon control horn with securing nuts ("Du-Bro" No. 107 [2 per pack] or similar)
8	25mm x 12mm (1" x 1/2") pieces of nylon cloth for elevator hinges
1	0.8cc (0.049cu.in) for basic training or 1.0cc (0.061cu.in) for stunt training glow-plug control-line model aeroplane engine. Novel BigMag Startup recommended with integral fuel tank / engine mounts. An alternative is a similar Cox engine.
1	propeller to suit engine (se the instructions that come with the engine and get more than one, you will break them)
4	engine securing bolts to suit with nuts, washers, and spring washers
1	38mm (1-1/2") or 50mm (2") nylon or aluminium control-line bell crank with mounting bolt, washers and nut
1	118ml (4fl.oz) 15 minutes or 30 minute aliphatic resin glue ("Pacer" Z-Poxy or similar)
1	50ml ((2fl.oz) balsa cement (cyano-acetate type)
1	250ml (10fl.oz) fuel-proof model aircraft dope
1	sheet of model aircraft tissue paper (Silkspan or similar)
1	1.6mm (1/16") ID x 100mm (4") fuel tubing for glow-plug fuel ("Du-Bro" No. 221 or similar)
1	control line handle
1	2-line 0.4mm x 9m to 12m (0.015" x 30' to 40') braided stainless steel control line kit with securing clips
1	1.5V heavy duty starter battery
1	glow-plug lead
1	fuel squeeze bottle
1	bottle of fuel suitable for the engine
1	starter (or "chicken") stick to start the engine (see the instructions that come with the engine)

Other optional materials are-

No. Req'd	Description
1	2-56 threaded ball link ("Du-Bro" No. 181 or similar) with 2-56 threaded coupler for 1.6mm (1/16") diameter wire ("Du-Bro" No. 111 (2 per pack) or similar) for connecting control rod to control horn
1	225ml (8fl.oz) balsa tint super light filler ("Dave Patrick's" Model Magic or similar), great for fixing those little mistakes and providing fillets at the wing and tail roots
1	12V electric engine starter with battery (an expensive luxury item not normally required)
	Decals to suit
	Fuel proof paint (colours to suit)

All of the wood, piano wire, glues, paint, and dope should be readily available from your local hobby shop. Make sure the engine is suitable for a control line aeroplane. Most engines today come fitted for radio control aeroplanes; they need modification for control line use. Much of the other hardware may be difficult to obtain as C/L aeroplane models are not that well catered for. For any "hard-to-get" materials or parts, TCI Hobbies Inc. is recommended. Visit their web site. They specialise in C/L model aeroplanes and are most helpful with advice. Their contact details are-

TCI Hobbies Inc.
621 1st Avenue
Two Harbors MN 55616
USA

Ph: + 1 218 834 7190

Fax: + 1 218 834 2620

E-mail: info@ucontrolmodels.com

URL: www.ucontrolmodels.com

TCI Hobbies have an excellent mail order service with delivery world-wide generally within one to two weeks. Even with postage and insurance, the cost is about the same as you would pay in your local hobby shop.

Fuselage Construction

Begin construction with the fuselage (see Drg No. A1CL2/1 [Parts Details]). Transfer the shape of the fuselage profile from the plan onto the 6mm x 75mm x 450mm (1/2: x 3" x 18") hard balsa. This can be done by either drawing the shape on the balsa from the dimensions given on the plan or using "pencil" carbon paper between the plan and the balsa and tracing around the shape of the fuselage. This should include the opening for the wing and stabiliser. Be certain that the wing and stabiliser cut-outs are parallel. Cut the fuselage to shape with a coping saw.

The wing and stabiliser openings are made by first drilling a 3mm (1/8") diameter hole at the after end of the wing opening and another at the forward end of the stabiliser opening. Then, using a sharp blade, cut the 3mm (1/8") and 5mm wide slots, being careful not to split the fuselage. It is best to start cutting from the hole towards the end of the fuselage. If the fuselage does split, glue it back together again with balsa cement and try again. For the cut-out in way of the elevator hinge, remove the blade from the coping-saw frame and slip the blade through the stabiliser slot. Reassemble the saw and proceed to cut the opening for the elevator hinge. When complete, remove the blade from the frame, take it out of the opening, and again reassemble the saw. The two plywood tail doublers are now drawn or traced and cut to shape with the coping saw.

> **Tip**
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> Glue the fin into position (see the Tail section below) before attempting to cut the elevator hinge cut-out. This will provide additional strength to the fuselage near the top of this cut-out as you are cutting.
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> Make sure that the fin offset allows for the fitting of the 1.5mm (1/16") thick tail doubler on the left-hand side.

Wing

The wing cord is 148mm (5-3/4"), and since standard balsa is 75mm (3") wide, the wing has to be constructed from more than one piece of balsa. The wing span is 586mm (23"), and the standard balsa plank is 900mm (36") long.

First, cut the 586mm (23") length from the planks. The remaining pieces will be used for the stabiliser and elevator. Using balsa cement, edge glue the two 586mm long pieces together to form a plank 586mm long by 150mm (6") wide. This should be done on a very flat surface so the finished wing plank is absolutely flat.

Transfer the shape of the wing from the plan onto the 3mm x 150mm x 586mm (1/8: x 6" x 23") balsa plank. This can be done by either drawing the shape on the balsa from the dimensions given on the plan or using "pencil" carbon paper between the plan and the balsa and tracing around the shape of the fuselage.

Round the leading and trailing edges and tips of the wing. Do not put any airfoil shape into the wing. Carefully carve out the slot for the lead-out guide.

Slide the wing into the wing slot in the fuselage and epoxy glue into position. Be sure that the wing is square to the fuselage when looking from both the top and from the forward end of the fuselage. It is most important that on the finished model, the wing and stabiliser are parallel.

While the wing is drying, cut to shape the 8 nose doublers from 6mm (1/4") balsa. Once the wing is dry (at least 30 minutes), cement the nose doublers into position as shown on Drg No. A1CL2/2 [General Arrangement]. There are four nose doublers on each side of the fuselage, 2 above the wing and 2 below the wing.

When the nose doublers are dry, you may carve and sand them into a nice streamlined shape. Be careful not to take any material out of the wing.

Epoxy glue the wing tip mass to the underside of the right-hand wing. The actual location of the mass is not that critical, however it should be reasonably near the wing tip.

Tail

Draw or trace and cut to shape the stabiliser and elevator from the 3mm (1/8") balsa using a single-edge razor blade or modeller's knife (see Drg No. A1CL2/1 [Parts Details]). Trace and cut to shape the fin and fin fairing from the 1.5mm (1/16") plywood using the coping saw (see Drg No. A1CL2/1 [Parts Details]). With fine sandpaper, round off the leading and trailing edges, and the tips of the stabiliser, elevator, fin and fin fairing piece.

Epoxy glue the fin fairing and fin into position onto the top of the fuselage. Be sure that the fairing and fin are vertical with the fuselage. The fin must be offset from the centre of the fuselage at the forward end to the right-hand side of the fuselage at the after end. This offset will tend to cause the flying model to pull away from the pilot, thus helping to keep the control lines tight.

Now it is time to fit the elevator hinges. These hinges consist of nylon cloth strips. The strips are cemented first to the upper and lower surfaces of the stabiliser as shown on Drg No. A1CL2/2 [General Arrangement]. Be careful to apply the cement only where the cloth is in contact with the upper or lower surfaces of the stabiliser. If cement gets onto the cloth strips where they have to bend, the hinge will become stiff and the elevator hard to move.

Once the cloth strips are dry on the stabiliser, position elevator and cement the free ends for the cloth strips to the elevator. The strips that were cemented to the lower surface of the stabiliser pass through the gap between the stabiliser and the elevator and are cemented to the upper surface of the elevator. Likewise, the strips cemented to the upper surface of the stabiliser are cemented onto the lower surface of the elevator. When all is dry, the elevator should move freely up and down on the cloth hinges.

Cement the elevator doubler onto the elevator so it is positioned as shown on Drg No. A1CL2/2 [General Arrangement]. When dry, mark and drill the holes for the control horn.

Slide the stabiliser/elevator assembly into position in the fuselage through the slot. The stabiliser is cemented into the 3mm (1/8") wide slot. Be sure that the stabiliser is square to the fuselage when looking from both the top and from the forward end of the fuselage. It is most important that on the finished model, the wing and stabiliser are parallel.

Once the stabiliser has dried, apply balsa cement to tail filler and insert it into the 5mm wide slot in the tail of the fuselage. The plywood tail doublers are then cemented against the side of the fuselage in the proper location. Slide the plywood back and forth a little to evenly distribute the glue.

While this is drying, the tail skid can be bent to shape (see Drg No. A1CL2/1 [Parts Details]).

You will be surprised to discover how tough the spring steel piano wire is. It must be bent with pliers, and they must be gripped very firmly so they won't slip off the wire. Although tough, the wire can not be bent more than twice, or, because of its very toughness, it will break, A vice and small hammer can help bending. Once the landing gear has been bent to shape, remove the excess wire with the wire cutters incorporated in the priers.

Drill a 1.5mm (1/16") diameter hole into the underside of the fuselage and epoxy glue the tail skid into position.

Lead-out Guide

Draw or trace and cut to shape the lead-out guide using the coping saw (see Drg No. A1CL2/1 [Parts Details]). With fine sandpaper, round off all corners until nicely rounded. Drill two holes in the guide. Glue the lead-out guide into the lead-out guide slot in the upper surface of the wing using epoxy glue.

Engine Bulkhead

Cut out the two pieces of plywood for the engine bulkhead using the coping saw (see Drg No. A1CL2/1 [Parts Details]). Glue the two pieces together using epoxy glue to form a bulkhead 3mm (1/8") thick. Allow to dry for at least 30 minutes. Position the engine centrally on the engine bulkhead with the cylinder head pointing up and mark the position of the mounting holes.

Remove the engine and drill suitable mounting holes in the engine bulkhead. Take the engine securing bolts and, with a washer between the bolt head and the bulkhead, epoxy glue the securing bolts into position in the bulkhead through the holes. Be careful not to get any glue on the thread of the bolts where the nuts are to run.

While the bolts are drying, sand the front of the model flat and square to the fuselage where the engine bulkhead is to be positioned. Do not offset the engine. This is best done with sandpaper on a large sanding block.

Once the engine securing bolts are dry, place the engine bulkhead up against the front of the nose fairing and mark where the bolt heads are positioned. Remove the bulkhead and carve small indents into the nose fairing to accommodate the bolt heads so that the bulkhead will mount flush against the nose fairing. Glue the engine bulkhead to the front of the nose fairing using epoxy glue. Allow to dry for at least 30 minutes.

Control Installation

The lead-out wires are cut from 0.5mm (0.02") diameter piano wire. Bend the wing-tip end of each as shown on Drg No. A1CL2/2 [General Arrangement]. They should both end up being of equal length. Pass the lead-out wires through the holes in the wing-tip end plate. Bend the bellcrank ends of the lead-out wires 90° and pass them through their respective holes in the bellcrank. Then bend the bellcrank end of the lead-out wires into a "U" around the bellcrank so that they do not come out of their bellcrank holes.

Fit the nylon control horn to the elevator as shown in Drg No. A1CL2/2 [General Arrangement]. Bend the wire control rod to shape as shown on Drg No. A1CL2/2 [General Arrangement]. If using a threaded ball link at the control horn end, there is no need to bend the control rod at that end. Fit the control rod to the bellcrank through the hole nearest the bellcrank securing bolt. The other end of the control rod should be passed through the hole in the control horn that is furthest away from the elevator. The holes selected for the fitting of the control rod will ensure that the elevator has the least movement in relation to movement of the bellcrank. These holes may be changed later as you get use to flying the model aeroplane.

If you are using a 2-56 threaded ball link with 2-56 threaded coupler, solder the threaded coupler onto the end of the control rod.

Bellcrank Installation

Give special attention to the installation of the bellcrank. The bellcrank must be securely installed because this attachment absorbs the entire pull of the model as it speeds around the flight circle and therefore must be strong enough to support several time the weight of the model.

Cut out the bellcrank mount from 1.5mm (1/16") plywood. Drill a hole in the centre of the mount to take the bellcrank securing bolt. Take the bellcrank securing bolt and, with a washer between the bolt head and the mount, epoxy glue the securing bolt into position in the mount through the hole. Be careful not to get any glue on the thread of the bolt where the bellcrank and nut are to run. Allow to dry for at least 30 minutes

The bellcrank assembly should be firmly mounted to the bellcrank mount. With the control rod and lead-out wires fitted, position the bellcrank so that the elevator is in the neutral position when the long arm of the bellcrank is parallel to the fuselage. Mark this position and carve a small indent into the wing to take the head of the bellcrank bolt.

> **Tip**
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> To be sure the elevator is in the neutral position, clamp the stabiliser/elevator between two pieces of balsa held together with elastic bands. This will ensure that the elevator and stabiliser are in line (i.e., the neutral position).

When properly positioned, glue the bellcrank mount onto the underside of the wing using epoxy.

Finishing

First, remove all hardware. This will make it easier to finish the model.

The plane should receive a final light sanding all over with very fine sandpaper, and then two coats of dope should be liberally brushed onto the entire model. Use a camel's-hair brush about 10mm (3/8") wide and flow the dope onto the model. Be careful not to get the dope on the elevator hinges because it will make them stiff. When the dope is thoroughly dry, sand the entire model with very fine sandpaper. Apply a four more coats of dope. Lightly sand between each coat of dope after it is thoroughly dry.

If you will be painting your model, now is the time to apply the fuel proof paint in accordance with the manufacturer's directions. If you will not be painting the model apply two more coats of dope, lightly sanding between each coat, and allow to thoroughly dry.

Once the finishing has been completed, refit all the hardware.

Engine Instillation

Last but not least is the engine installation. Using the bolts glued into the engine bulkhead, bolt the engine in place. The engine should be aligned with the centreline of the fuselage. The engine should be offset a few degrees so that it tends to pull the aeroplane to the right. This is done by fitting one or two washers to the left-hand side engine securing bolts between the engine bulkhead and the engine mount.

> **Tip**
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> If using a Novel engine (recommended), be aware that they have a reputation of being fairly "tight" when new, thus requiring careful running-in. Follow the manufacturer's instructions on running-in and check their web site for the latest advice.

Trim

Touch up the paint here and there as needed, and add decals to suit your taste.

Balance

The model must be balanced correctly before you try powered flight. The optimum balance point is shown on Drg No. A1CL2/2 [General Arrangement]. Balance the aeroplane at this point. If the tail drops add a lead weight to the extreme forward end of the engine mount; if the nose drops, add a lead weight to the extreme rear of the fuselage. All weights should be firmly affixed with screws and epoxy glue.

Test Flight

Your model is now ready to fly. Follow the instructions in Drg No. A4CL0/2 [Basic Flying Instructions] and you will discover the unparalleled enjoyment of model aeroplane flying.