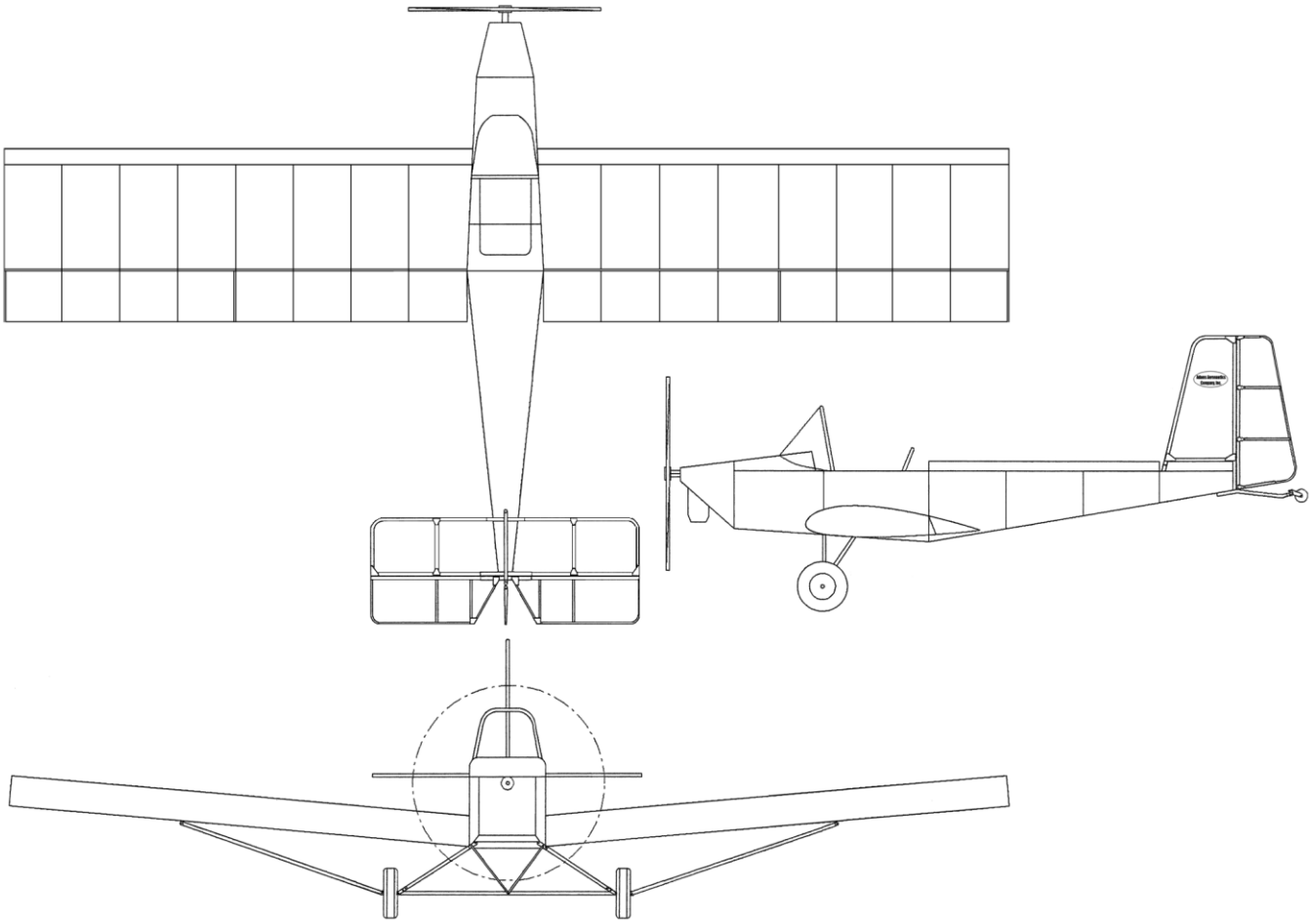
CA-2 Information Manual



Adams Aeronautics Company, Inc.

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Thank You for Your Interest!

Thank you for your interest in the CA-2. We appreciate you and your desire to learn more about this wonderful ultralight/experimental airplane. We look forward to supporting you with your questions or project. We are excited about the day your CA-2 will be flying and look to that day with much anticipation.

Ride the Wind!

Kenneth L. Adams, Jr.
President/CEO
Adams Aeronautics Company, Inc.

CA-2 Introduction

The CA-2 is a low wing sport aircraft that was designed to be built and qualify for the US FAA FAR Part 103 ultralight category. Part of the design goal was to provide an aircraft that would fulfill the need for a homebuilt ultralight of conventional aluminum sheet construction using standard aircraft design and construction practices. All parts are designed to be easily fabricated from aluminum sheet and standard extrusions (angle and tubing) with a minimum of difficult forming. The CA-2 design criteria was based on the desire to meet the FAA Part §23.337 utility load category (-2.2G to 4.4G).

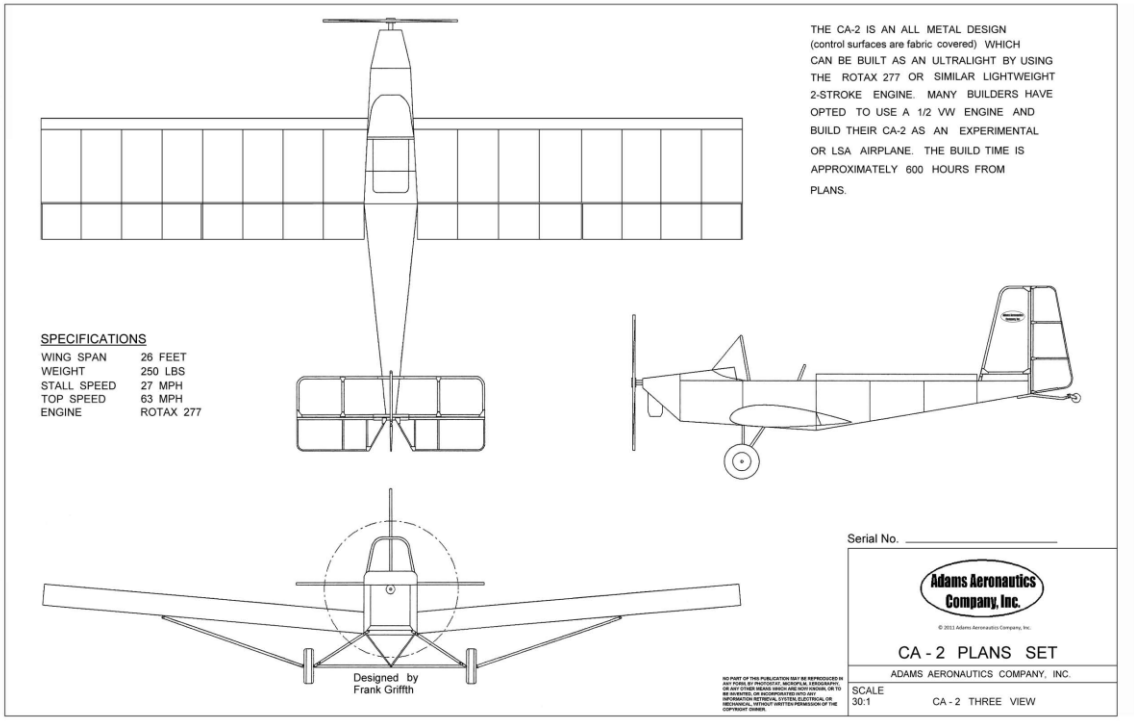


Figure 1 - Three View of CA-2 as found in the plans

Construction on the prototype started in March of 1993 and it was ready for flight by the 4th of July. The first flight was in July of 1993 and took a big leap of faith on the part of Frank Griffith, the CA-2 designer and initial test pilot. A perfectly calm evening was chosen, and Frank was the only one at the airport. At that time, he only had 25 hours logged in a Cessna 172 and had no ultralight, low wing, tail dragger, or open cockpit experience. The aircraft climbed well, and he took it up to 2000 feet above the runway and gradually began checking out the feel of the aircraft. He slowly reduced power until a slow descent was set up and kept that up until he was back on the ground at the airport. The first flight was extremely successful and uneventful. For the initial flight the center of gravity (C.G.) was set to 28% and the plane was stable but was a little light in pitch. Subsequently, the C.G. was moved to 25% and that position gave good control harmony.

After the CA-2 started flying more and more it began to gain some very positive notoriety and others expressed an interest in the design along with a desire to build one for themselves. This was very encouraging for Frank and so a set of plans and construction manual were completed. The plans are 40 pages of CAD created, B sized (11” x 17”) drawings. The construction manual is 76 pages with diagrams, step by step instructions, and parts lists.

The construction manual along with the plans were written and drawn to allow the builder to easily construct a CA-2 ultralight/light aircraft from scratch. The aircraft is constructed mainly of sheet aluminum and common extrusions (angle stock and tubing). Aluminum sheet construction was chosen for its proven reliability and high strength. Wood is also used in the construction, but only a small amount for the seat and floorboard. Surprisingly, the plane goes together quickly with minimal aircraft building or sheet metal skill required. Access to two specialized tools, a bending brake capable of

bending 0.040 aluminum sheet up to 30" long and a 1” tubing bender will be required. The tubing bender is needed for 5 bends in the tail surfaces and roll bar. All other tools are common, inexpensive home shop tools. A recommended list of tools will follow later. Working with aluminum is similar to working with hardwood and similar tools can be used. Aluminum has the advantage of being homogeneous and can be worked with in any weather conditions. Much of the construction of the prototype was done in the winter in an unheated shop.

Only simple fabrication and assembly methods are used. All aluminum sheets are applied flat or formed in place. This makes the project accessible to those with minimal metal working skills. A flat 2’ x 14’ worktable, a simple jig for wing assembly, and a jig for rib construction are all the tooling that is required. All joining is done with standard aircraft hardware and stainless pop rivets. Standard drill bits can be used for all holes and there are no close tolerance holes in the project. A single car garage will provide enough area for most assembly work.

Probably the most time-consuming aspect of the construction is aligning the parts in an assembly for drilling. Using a level, squares, triangles, and clamps helps here. It is best to make as complete an assembly as possible before drilling holes. For example, all the ribs can be attached to the spars and aligned carefully before any holes are drilled. The drilling, bending, riveting, and finishing operations go rather quickly.

Materials

Most of the materials specified are of aircraft quality and substitutions of lower strength materials should not be done. There is a big difference between common hardware store materials and aircraft grade. In some cases, the hardware store item will

have only 1/3 the strength but look similar to the aircraft item. Your safety is at stake so use only specified materials.

Making substitutions would seriously affect the safety of the CA-2. Substituting 2024-T3 in place of 6061-T6 would be acceptable except for the unnecessary higher cost. In most of the cases where 6061-T6 extrusions are used, failure will occur by long column action first. Going to a higher strength alloy will not give the builder any strength advantage in that part.

Flat Table

A flat table is used as a guide to build the fuselage, wing spars, and tail surfaces. An adequate table can be built using 1” x 8” pine and a sheet of 3/4” plywood. Pick two 14’ 1x8s that are straight and snap a chalk line near the top edge. Plane or sand the high spots down to the chalk line. Then assemble into a 2’ x 14’ box as shown with 1” x 8” stiffeners placed every 24”. Pick a sheet of plywood that has a smooth top to allow accurate pencil lines to be drawn. Use drywall screws to assemble.

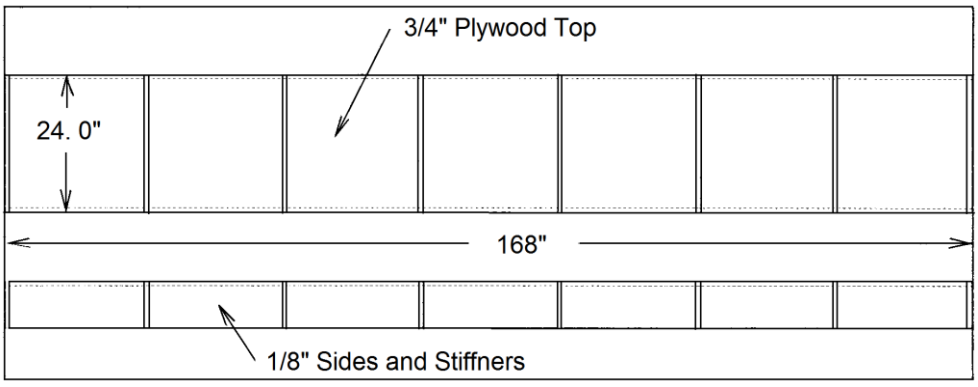


Figure 2 - Flat Table (DIA4)

Tools

The CA-2 can be constructed with a basic set of home shop tools, but a few specialized tools make many jobs go a lot easier. A few helpful tools you may want to consider purchasing are as follows:

* Wire size drills of #30 (for rivets) and #19 (for 8x32 screws).

* 6” and 12” extension drill bits in #30, #19, 3/16”, and ¼” sizes help in drilling holes in difficult locations.

* A closepin deburring bit used to deburr holes in tubing works very nicely. This tool is available from U.S. Industrial Tool & Supply Co.

* A 100 degree counter sink for the AN509 screws used to attach the main spar thru.

* A bending brake capable of bending 0.040 aluminum sheet 30” long.

* A tubing bender for bending 1” tubing in the tail surfaces. A commercial unit designed for heating contractors was used. Only five bends are required so it would be nice not to buy the tool.

* Offset aviation snips. All thin aluminum sheets can be cut with these snips. A regular single action type snips for making long straight cuts is preferred.

* Small metal cutting band saw. A cheap horizontal/vertical saw sold to cut tubing can be used, set it up vertically with a small table. This type of saw can cut long pieces because the blade is twisted slightly but has a small throat. A small table mounted band saw would work nice too and has the advantage of a larger throat size.

* A combination disk/belt sander. A small 6” model such as those sold by Sears works well enough. Most fittings and gussets require some final shaping which is done quickly with one of these units. The job becomes tiring with a file but can be done.

* A small drill press. Most holes can be drilled with a handheld variable speed drill but making larger holes in fittings is better done with a drill press. A fly cutter can be used for the large holes (1” on up). A cross table vise helps to hold small parts for drilling and is a most helpful addition.

* A collection of clecos and other small clamps. At least 100 clecos and ten 2” C - clamps and ten 1” C - clamps makes assembling go much easier.

* A fine line permanent marker for laying out parts on sheet. Sometimes a soft lead pencil works on extrusions.

* Level, carpenters square, draftsman triangle, and metal straight edge.

Plans

The CA-2 aircraft design is depicted in the plan set. Many of the parts and all the gussets are shown full size with crosses depicted for the location of the holes. These can be cut out and used as templates. The designer made several templates out of the soft aluminum flashing sheet sold in hardware stores. The aluminum templates can be reused a number of times without becoming deformed.

Most of the assemblies are shown half scale. Large assemblies are shown in the appropriate scale. All drawings are CAD drawn to an accuracy of 0.001” but reproduction causes some distortion. You can use an engineer’s scale to take dimensions off the drawings. An engineer’s scale is calibrated in 10^{th}, 20^{th}, and so on.

In Figure 3 you will see the layout depicting the top view of the fuselage. The scale on this drawing is 10:1 in the plans; obviously the scale is different for this image. However, this gives you a good example as to what the plans look like and will show you. All measurements are shown for this particular assembly and there is a close up view of the tail post which is shown for clarity.

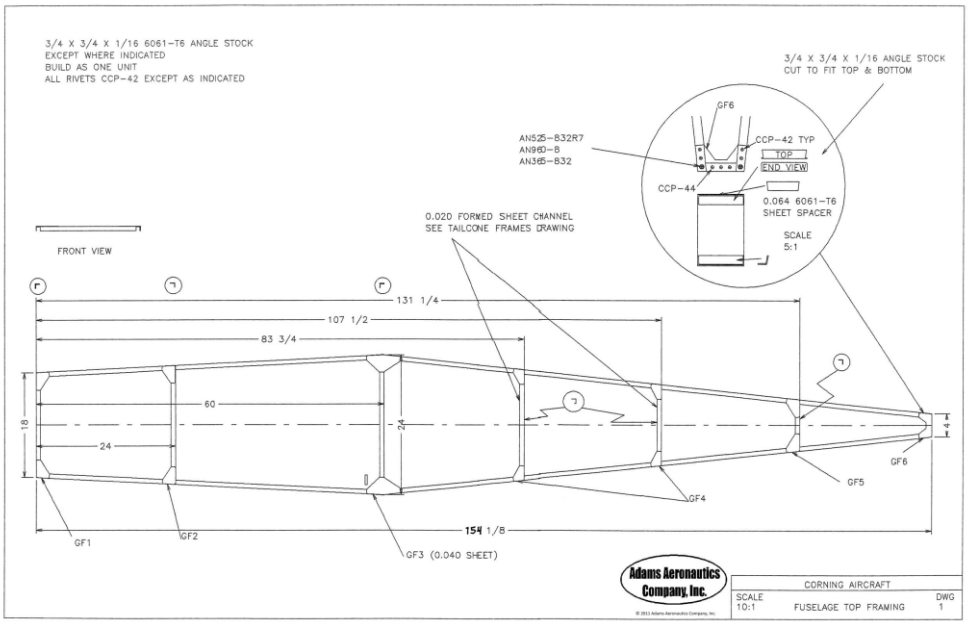


Figure 3 - Example of Drawings Scale for Fuselage

The dimensions shown on the drawings have a tolerance of 1/32 of an inch. Generally, the locations of the holes need to be maintained to this tolerance with 1/16" being adequate for the outside dimension of many parts.

Figure 4 is an example taken from the plans of a drawing that doesn't show any actual measurements other than the hole sizes. When you see this type of drawing in the plans you will notice that it states that the scale is "Full". This drawing will have been printed as a "full size" image and will be used as a template to make parts.

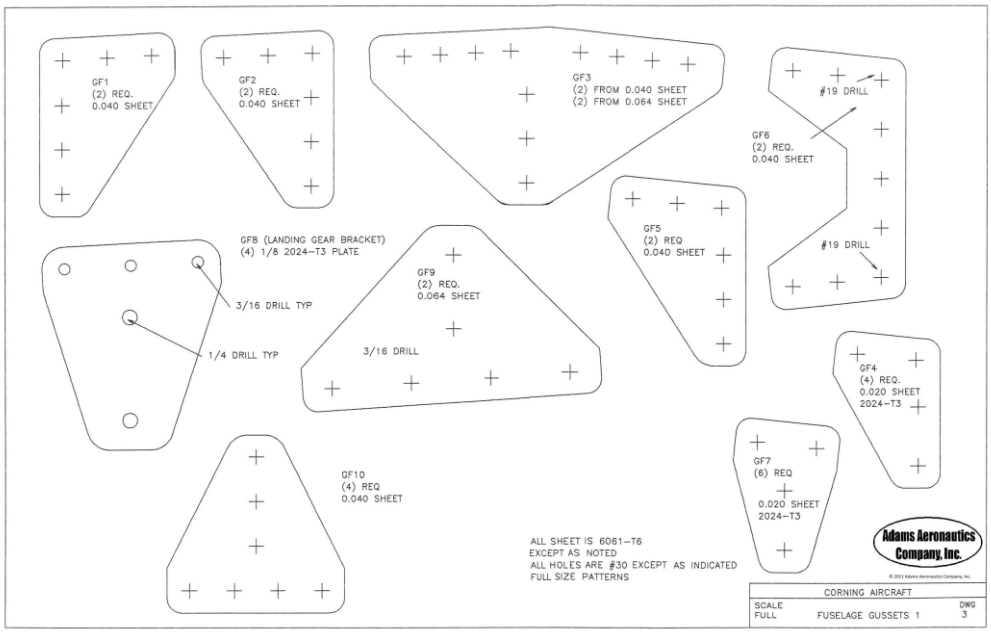


Figure 4 - Example of Drawing Scale for Gusset Templates

In some of the drawings you will see the scale referred to as “Full” and still have measurements provided. Figure 5 is a good example of this type of drawing.

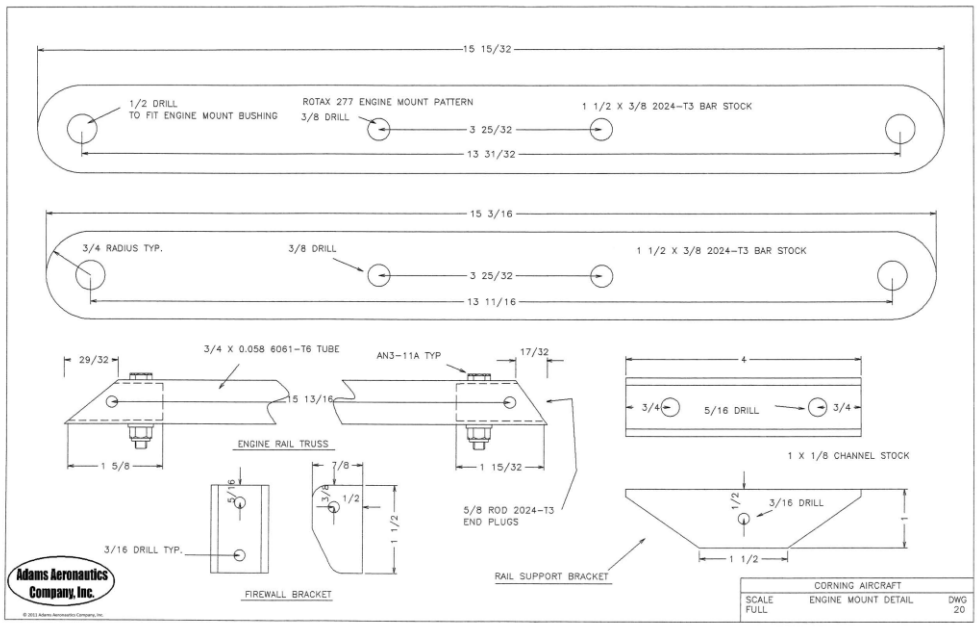


Figure 5 - Example of Drawing Scale Full with measurements

To avoid problems during assembly, use the plans and construction manual together because many details are described in the manual. If you get to a point where things just do not make sense, walk away from the work bench and take a break. A good break always seems to help to clear the mind. You can always contact us here at www.adamsaero.com as well for further discussion of the plans.

Example excerpt from the Construction Manual – Controls

Controls

Pushrod aileron and elevator controls are used to provide smooth and positive control. Rod end bearings and bell crank bearings are used to make the correct connections.

Rudder pedals are bolted to the plywood floor in a fixed position. Each builder will be able to choose a pedal location to suit their needs. The pedals connect to the rudder by conventional aircraft cable. Tail wheel steering is conducted with link chain to a control horn on the bottom of the rudder.

Control stick bearings are made by drilling AN5 bolts. This provides a simple low-cost stick assembly.

Flying

Inspect the aircraft carefully for loose bolts and wires. Pay particular attention to the engine area, flying surfaces, and control system.

Break in the engine, following the manufactures instructions. After the break in, check the aircraft over carefully for loose part etc., vibration can do strange things. Torque the propeller bolts and engine mount bolts. The air pressure in the tires should be about 8 psi. Use a dial type gage to perform the measurement.

Before attempting to fly your aircraft make sure your flying skills are current. A couple of hours of instruction in a tail dragger will help. The airstrip used for your first attempts should be a smooth grass strip at least 2000’ long. It is the opinion of the author of this information manual that grass is easier to fly off with a tail dragger because the tail wheel will slide around a bit instead of causing the aircraft to swerve. Also, an aircraft without brakes is much easier to stop in grass.

Pick a time when the wind is very low, nearly calm. The wind is a big factor in an ultralight and there is no need to complicate your first trials. Start out by taxing at a walking pace. Gently jab the rudder pedals to keep it rolling straight. Note the alignment of the rudder and tail wheel system. Check to see if the rudder pedals are in a neutral

position when the aircraft is tracking straight. Spend at least one session getting used to the low speed taxing behavior.

When you feel ready, apply full forward stick and advance the throttle slowly until the tail comes up. After the tail is up, retard the throttle a little to keep the speed from building up. The aircraft is now dependent on the rudder only to keep it tracking straight. Note that it takes a little more attention to keep it straight. Taxi the aircraft down the runway holding forward stick with the tail up to get comfortable feel of the rudder.

Spend enough time with the high-speed tests, that keeping the aircraft tracking straight becomes second nature. Later on, the throttle can be advanced more quickly to bring the tail up faster, and then retard the throttle to keep below flying speed. With just a little more throttle, flying speed can be achieved and the plane will lift off a bit. At that point, retard the throttle slowly to bring it back down. Do not try to force the aircraft into the air with the stick as a stall may result. Concentrate on using the throttle to control the aircraft.

After each test period, check the aircraft over carefully for any damage, cracks, or loose parts. When you feel ready to fly and the weather is proper, plan on taking it up and staying up for a 1/2 hour or so. However, before you take off, check the engine for full throttle RPM.

Advance the throttle smoothly to full while applying forward stick to raise the tail. Let the aircraft fly off the ground without pulling back on the stick and climb out at a fairly shallow angle. After a minute or so back off the throttle a little and continue climbing. On the prototype, the airspeed indicator turned out to be defective and the flight had to proceed by feel.

Climb above the pattern altitude and fly the path of the pattern at a level attitude. Note the elevator trim and the aileron sensitivity. A little rudder is required to make coordinated turns. Perform some approach to stalls to get a feel for the low speed qualities. The stall in the CA-2 results in a high sink rate but with little pitch over.

To land the aircraft, fly the pattern at 300' to 500' above the runway or follow the documented traffic patterns designated by your particular airport for ultralight use. Fly a fairly wide pattern and carry a fair amount of power to make the approach long and shallow so that you have time to properly set up your landing. Remember that a stall results in a high sink rate so carry the power all the way to the ground being careful not to flair out too high above the runway. If most of your flight time is in factory aircraft, it may take some time getting used to the high sink rate of an ultralight during power off decent. Otherwise, the handling qualities are smooth, easy, and predictable. Because the design contains a large amount of drag, the speed range is limited but that is true of ultralights in general. Once on the runway, you will notice that the wide stance of the landing gear gives the aircraft gentle ground handling characteristics.

General Characteristics and Performance

Characteristics

- Crew — one
- Capacity — no passengers
- Length — 16 ft. 6 in (5.03 m)
- Wingspan — 26 ft. 0 in (7.93 m)
- Wing area — 117 ft² (10.9 m²)
- Empty weigh — 250 lbs. (113 kg)
- Useful load — 270 lbs. (122 kg)
- Max takeoff weight — 520 lbs. (235 kg)
- Power Plant (prototype) — 1× Rotax 277, 28 hp. (21 kW)
    - The new Hirth (https://hirthengines.com/) F-33 engine has proven to be a good alternative engine as well as the Polini Thor engines (https://www.polinithor.com/en/).

Performance

- Never exceed speed — 80 mph (130 km/h)
- Maximum speed — 63 mph (102 km/h)
- Cruise speed — 50 mph (81 km/h)
- Stall speed — 26 mph (42 km/h)
- Range — 125 sm. (203 km)
- Service ceiling — 10,000 ft. (3050 m)
- Rate of climb — 600 fpm (3.05 m/s)
- Wing loading — 4.4 lb./ft² (21.6 kg/m²)
- Power/mass — 18.6 lb./hp. (0.09 kW/kg)

Plans Price and Shipping

The CA-2 plans set may be purchased using US funds in the amount of $150.00 plus:

Shipping:
U.S.P.S. mail to Continental US: $15.00
U.S.P.S. mail to Alaska: $20.00
U.S.P.S. mail to Hawaii, Mexico, and Canada: $25.00
U.S.P.S. mail to other foreign countries: Contact us for shipping costs.

The plan sets will be shipped out insured and placed in a padded shipping envelope for protection. We do not charge a handling fee; the shipping price is the cost required to package and mail the plans. You may use a personal check (must clear both banks), US Postal Money Order, Certified Check, or Cashier's Check for payment purposes. Note: Georgia residents must add 7% sales tax. If you would like to send a check, please address it to:

Adams Aeronautics Company, Inc.
301 Lake Charles Drive
Jasper, Georgia 30143

If you wish to purchase online at PayPal use the "Send Money" option which allows you to use:

Use "***contact@adamsaero.com***" for the recipient ("To") e-mail address. Remember to add the appropriate shipping amount plus tax if applicable to the plans total.

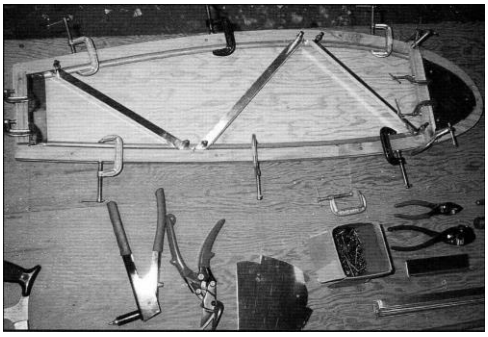
Who We Are – Our Company

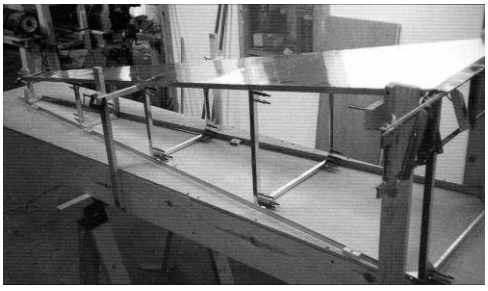
We are a small, family owned business built on the principles of making quality aircraft products and providing the highest level of service to our customers. We have been in business since early 2000 and incorporated as Adams Aeronautics Company, Inc. since 2005.

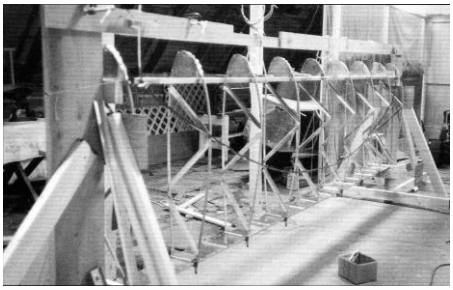
Our product range continues to grow and with the popularity of the US Light Sport Aircraft (LSA) regulations, new and unique aircraft are coming available. We are encouraged with this trend and are continuing to develop our CA-2 and other designs. With the purchase of the already tested and proven Turner T-100D Mariah in 2007, we have provided an aircraft that our clients can build, fly, and enjoy as a true legal US Ultralight, an LSA, or in the Experimental Amateur Built Category. With the recent addition of the Turner T-40 line of experimental aircraft, we now offer designs in the high performance experimental category. The CA-2 brings an all metal design to the fold and provides our customers with an option of either aluminum or wood construction. We currently have two other designs that are in the works and will hopefully be completed soon.

Improving our products and listening to our customers is of great importance to us at Adams Aero™. We look forward to many years of fun and exciting aviation related activities and we thank you for learning more about us. If you have questions or comments about our company, you may contact us in writing at the address above or by e-mail us at contact@adamsaero.com. We welcome comments about our website, as well.

Pictures







Statement of Policy on CA-2 Construction Plans

The purchase of a CA-2 plans set grants to the buyer the license to build one CA-2 aircraft. No ownership rights to the CA-2 design shall be deemed to have been transferred to the CA-2 builder/plans set holder, Adams Aeronautics Company, Inc. retains all ownership rights to the CA-2 design. If the builder wishes to build another CA-2, the purchase of an additional set of plans is required. Plans for the construction of the CA-2 ultralight/experimental homebuilt airplane are sold with the understanding that the airplane can be built only as specified in the Federal Aviation Administration regulations for Ultralight aircraft, FAR Part 103, and for amateur-built (experimental), FAR 21, under the Light Sport Aircraft Category, or under the guidelines of other countries civil aeronautics boards. Any person who builds, modifies, or operates a CA-2 aircraft/ultralight will assume all responsibilities, risks, and liabilities that are involved by the use of the Adams Aeronautics Company, Inc. CA-2 plans set.

No Warranty Written, Express or Implied

This information manual has been furnished to show the potential CA-2 plans purchaser information to better enable them to make a decision on the purchase of a CA-2 plans set. The CA-2 drawings are based on the original and successful flying CA-2 prototype designed and built by Frank Griffith of Corning Aircraft. This information manual, drawings and construction manual show the builder how to replicate a production version of the CA-2. Since we cannot exercise any control over the builder, the work performed by the builder which is outside of the oversight of Adams Aeronautics Company Inc., nor can we control the builder's experience and knowledge, the quality of materials selected by the builder, or the quality of workmanship used in the manufacture of parts and components covered by these drawings to build a CA-2 ultralight/experimental aircraft, no warranty, either written, express or implied, is made by Adams Aeronautics Company, Inc., as to the builder's ability to build a flying ultralight/experimental homebuilt aircraft. With all this stated, the plans are extremely easy to follow for the first time builder so we do not expect the builder to have major issues. If issues are encountered, please contact us for support. Yes, we have a proven prototype with many examples of the CA-2 flying around the world.