

Super Quickie Conversion Report

By
Brock and Jinx

April 24 1985

Edited for PDF format
by
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July 1 2000

Index

Into

The following is a digital version of the Rotax conversion report for the Quickie. The original was created in 1985 and consisted of hand written notes and drawings. I've reproduced the report text exactly as written. I've redrawn some of the original drawings in cad to make them more legible and clear. As per the wishes of Jinx and Brock this report should be freely distributed without charge.

DK

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General Discussion

Jinx and I have been receiving a lot of phone calls from all over the world regarding what we did to convert our Quickies into 50 hp machines. We decided to put together this small report to help answer them.

This paper only describes what we did and what appears to be working for us. Our converted airplanes are now fully FAA certificated and seem to be functioning well. I have about 40 flight hours on this modification and Jinx has about 75. (He's retired and can fly more). So far performance has exceeded our expectations.

Short runways, higher density altitudes and climb angles are problems of the past. Cruise speed is now limited by airframe redline, or in bumpy air by manoeuvre speed. Jinx and I usually throttle way to a comfortable cruise to both reduce fuel flow and enjoy the sights. At full power these engines become pretty thirsty and we're still working out of our 8 gal tanks. As is, a two hour x-c flight a reasonable reserve.

Do not view these as plans or instructions to modify your Quickie. This is merely a report on how we approached the task. If something does not look right, or to you does not look right, or strong enough, that's fine. You should run your own analyses that you are happy with. We do not endorse this modification for your particular Quickie nor warranty the structural integrity of our conversion. We absolutely refuse to sell this report and its provided free to you with our complements, from two fellow builders. Please accept it in that spirit.

Thank You,

Brock

Engine Selection

Engine Selection
(By Jinx)

Everyone wants a good reliable smooth, lightweight, at least 30 hp 4 stroke. Frank Kopecky and Brock have tried several 4 stroke purchases with no success. Therefore, I'll only cover 2 stroke engines here.

We did review the ultralight field at Camarillo and the majority of the engines were Rotax, but no one bad-mouthed the Kawasaki's or Cuyuna's. The capacitor discharge ignition system in them is still appealing vs the old points and condensor ignition in the Rotax engines.

In a hanger near ours, two Goldwings have Cuyunas with excellent engine experience, when you ignore the "rocks through the prop" and misaligned pulleys and belts. One engine was receiving a set of rings and the other had 150 hours and was running fine.

A Rotax 503 installed in an ARV was reliable, quiet and powerful with a belt drive.

The Silhouette aircraft was performing well with the Rotax 447 dual carb configuration and 2.58 gear reductions (Rotax gear box)

Some Mikuni carbs had a mixture control adjustable from the cockpit. As a feature it is good, but there is the added risk of forgetting to richen up again as you descend. Since we do not go to altitude extremes we decided to minimize the risk and keep it simple, we use fixed jets. (Note from Brock: I've flown with fixed jets to over 10,000' during my test period)

The Silhouette aircraft and several ultralights use a primer for starting. It may be great in cold weather, but near seal level in California. We decided to stay with the remote activated choke on the Bing carb. Brock usually applies choke, pulls through 2 compressions, turns on the ignition and it started on the first lanyard pull. Jinx pulls through approximately 20 compressions with the choke, switches the ignition on, and it starts on the first or second pull. If the engine is warm, it always starts on the first pull.

In spite of the Rotax 447's lower compression ratio, lower weight (7lbs), and slightly smaller size, Brock with his usual ex-navy fighter approach, negotiated, demanded, intimidated and cajoled me into buying the Rotax 503 i.e. no substitute for cubic inches and torque and reliability.

Since I'm handwriting this input from Jinx, it makes it easy to offer prompt rebuttal to these snide comments.

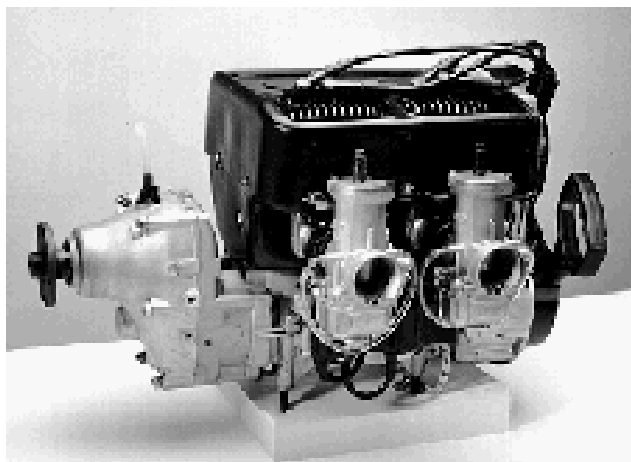
- 1. If 40 hp is good, 52 must be better!*
- 2. I'd rather "loaf" a big engine, than run the hell out of a smaller one.*
- 3. It's a safe feeling knowing the extra power is there even though it's seldom used.*
- 4. The 503 crankshaft is much "beefier"*
- 5. The 503 enjoys a superb track record.*

Take that!! Brock

Jinx Cont.:

We procured the shock/vibration insulators (Barrymounts) directly from Task Research - Santa Paula, CA like they use on a Silhouette, because they provide a good soft system for light aircraft Jinx

Engine Selection



46 HP SC @ 6250

50 HP DC @ 6500

**2 CYLINDER/2 CYCLE OIL INJECTED
LUBRICATION, FAN-COOLED**

- Bore: 72mm/2.84in
- Stroke: 61mm/2.40in
- Displacement: 496.7cc/30.31cu.in.)
- Power output: 34.0 kW (46 hp) single carb 37.0 kW (50hp) dual carb
- Maximum RPM: 6800 1/min
- Direction of engine rotation: Counter clockwise, viewed towards PTO
- Cylinder: 2 light alloy w/ cast iron sleeves
- Piston: Aluminium cast w/ 2 piston rings
- Ignition System: Redundant breakerless DUCATI ca-pacitor discharge dual ignition w/magneto generator
- Generator Output: 170 W AC at 6000 1/min & 13.5 VRMS
- Carburetor: 2 x BING 36mm, hand lever or cable choke
- Fuel pump: Pneumatic fuel pump DF-44
- Fuel: Premium Unleaded NOT BELOW MON88 or ROM 90 (OCTANE RATING)
- Lubrication: 2 stroke oil in fuel or oil injection
- Mixing ratio: 70:1
- Lubrication: oil injected, 50:1, mechanical lever

ITEM LBS ITEM LBS

Engine 69.2 E Gearbox 24.7

2 Carbs 4.0 Generator, 230 W DC 2.4

Exhaust System 11.2 Oil Tank, 2.4 L. 3.5

2 Air Cleaners 0.7 Oil Pump 0.7

Dual Air Cleaner 1.1 HAC Kit 0.4

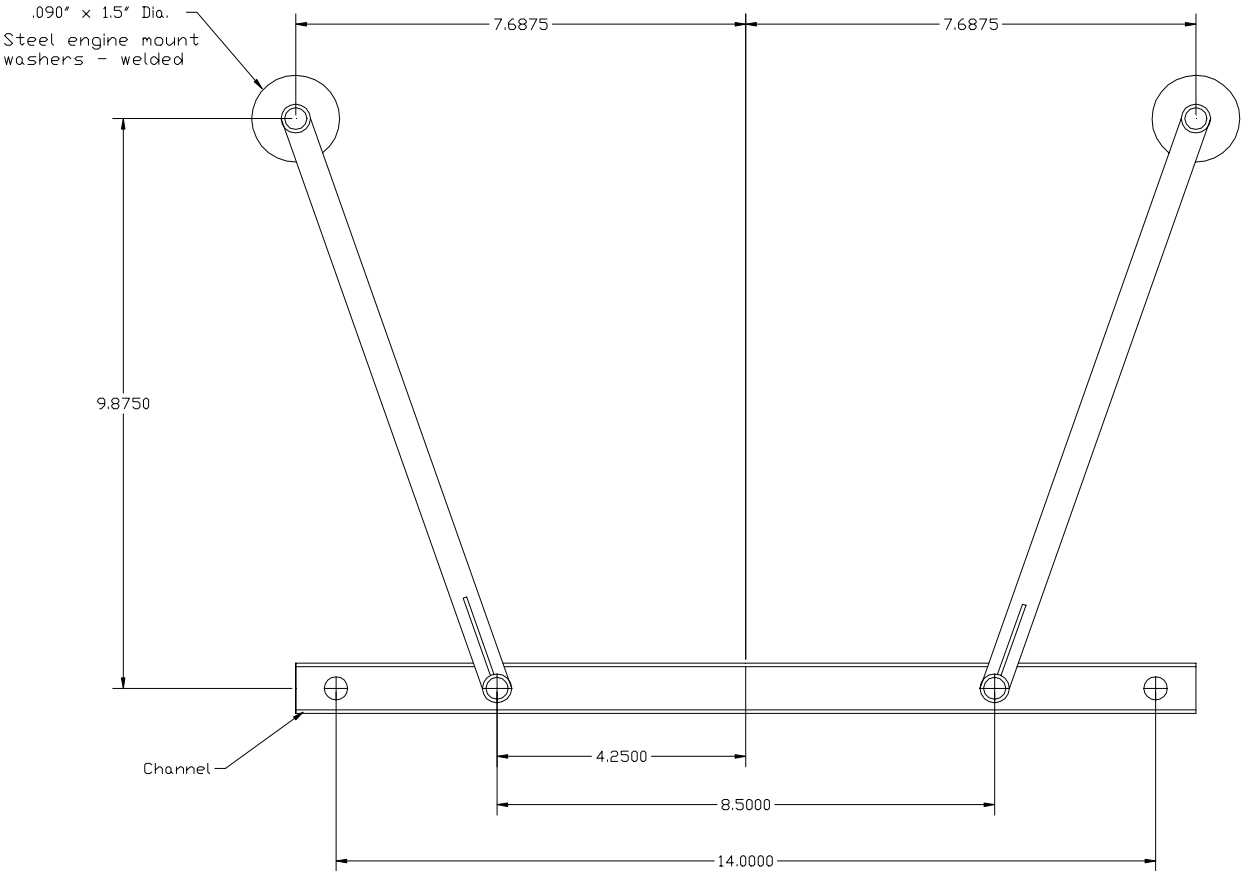
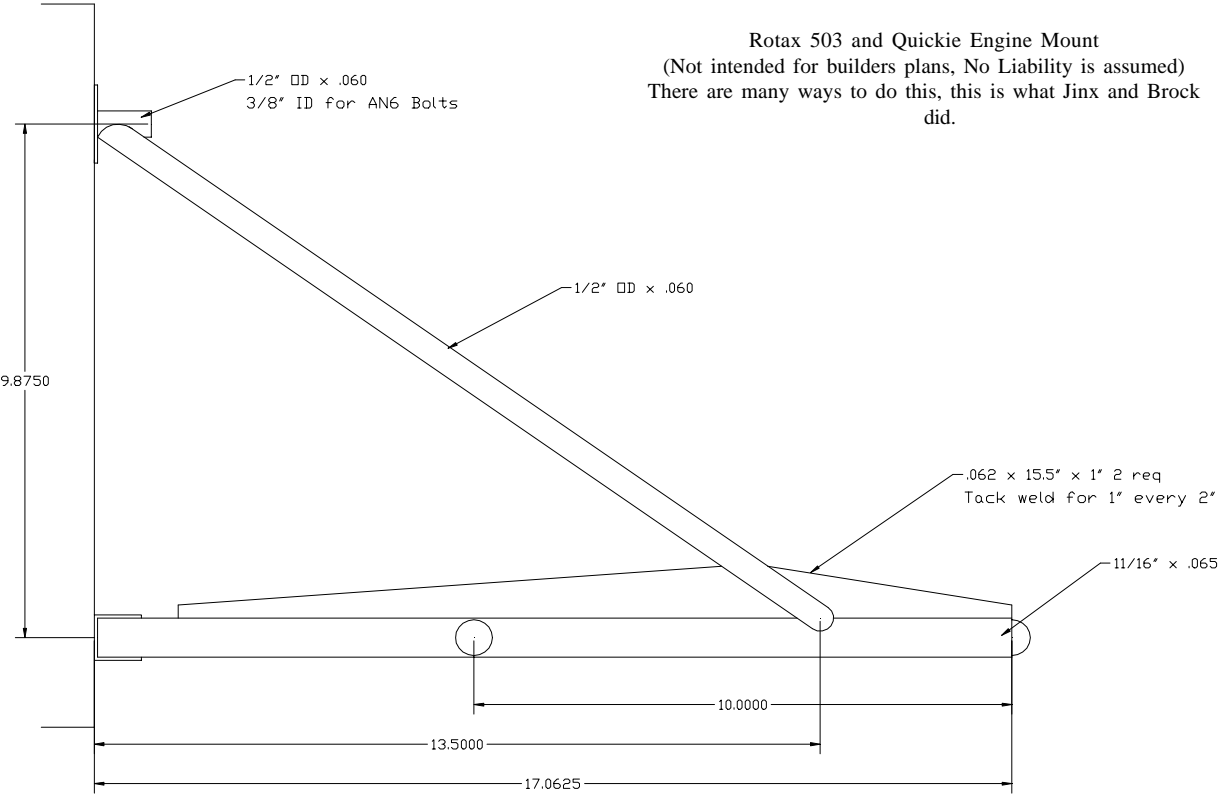
Electric Starter 7.7 Intake Silencer 1V 1.8

B Gearbox 9.9 Intake Silencer 2V 2.4

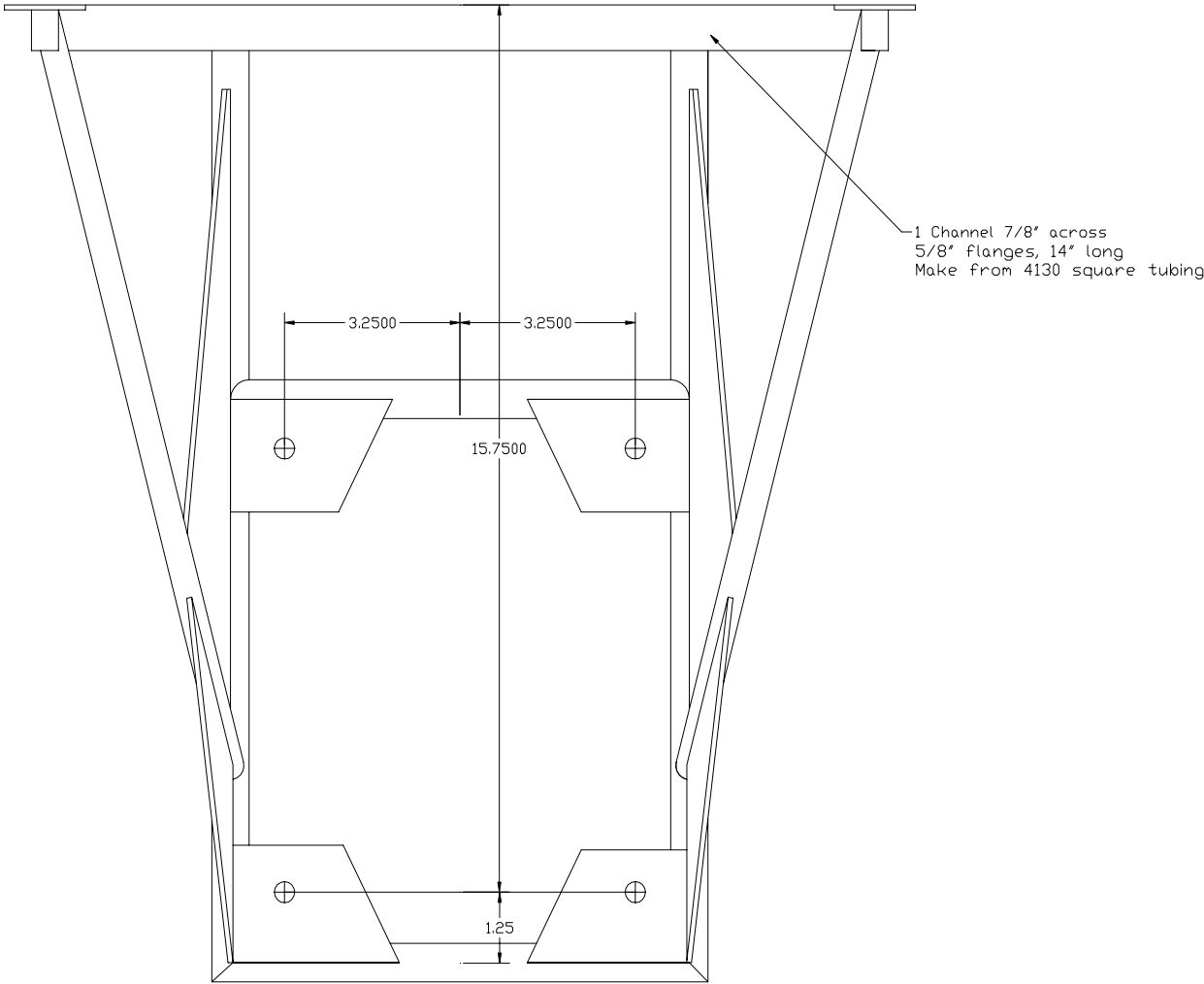
C Gearbox 17.6 After Muffler 3.5.

Engine Mount

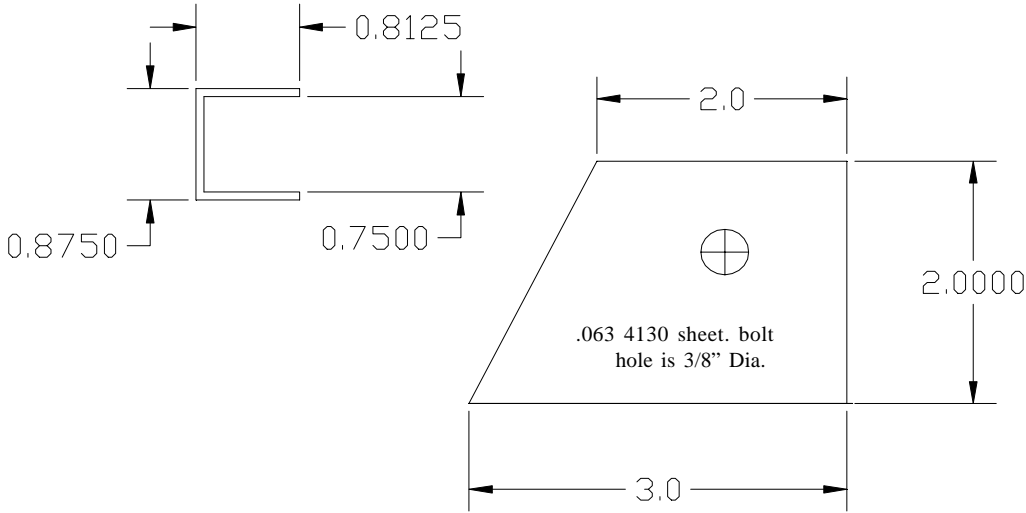
Rotax 503 and Quickie Engine Mount
(Not intended for builders plans, No Liability is assumed)
There are many ways to do this, this is what Jinx and Brock did.



Engine Mount

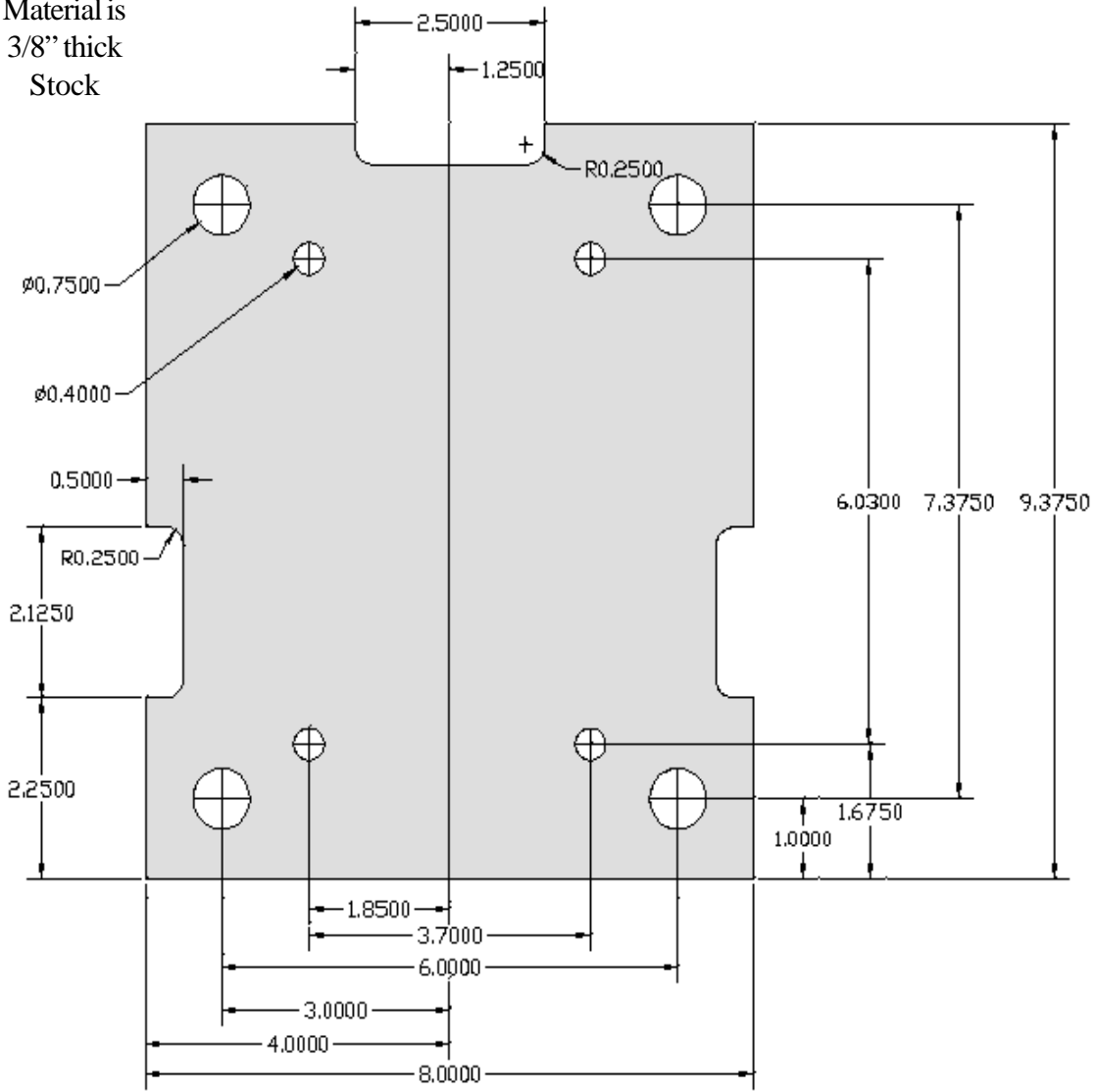


Remove face with hack saw or band saw to form channel. You need one piece of 7/8" x 1/16" wall 4130 square tubing.

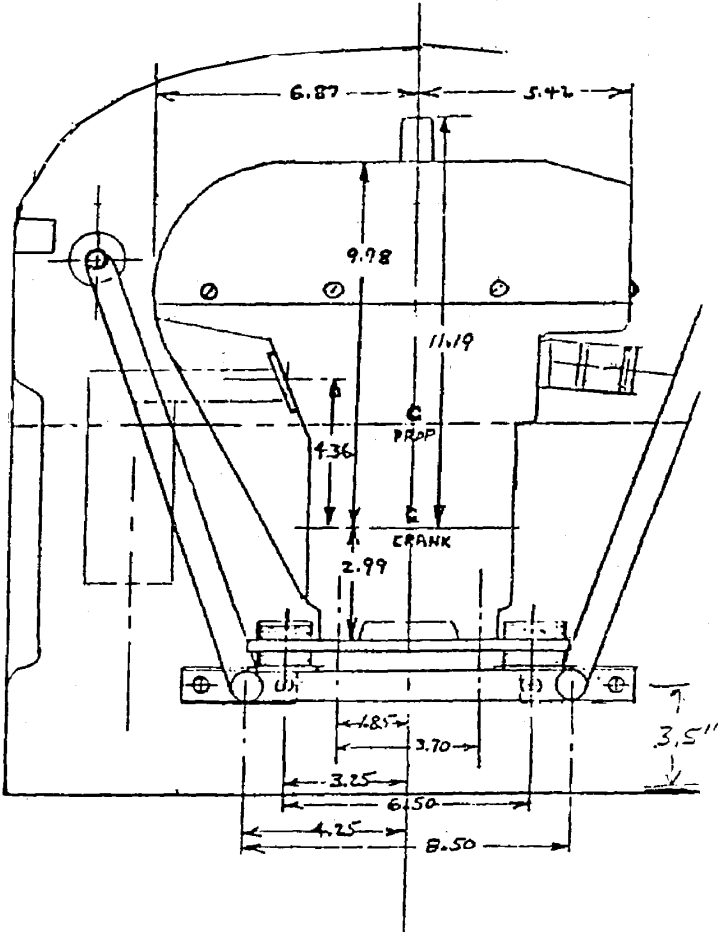
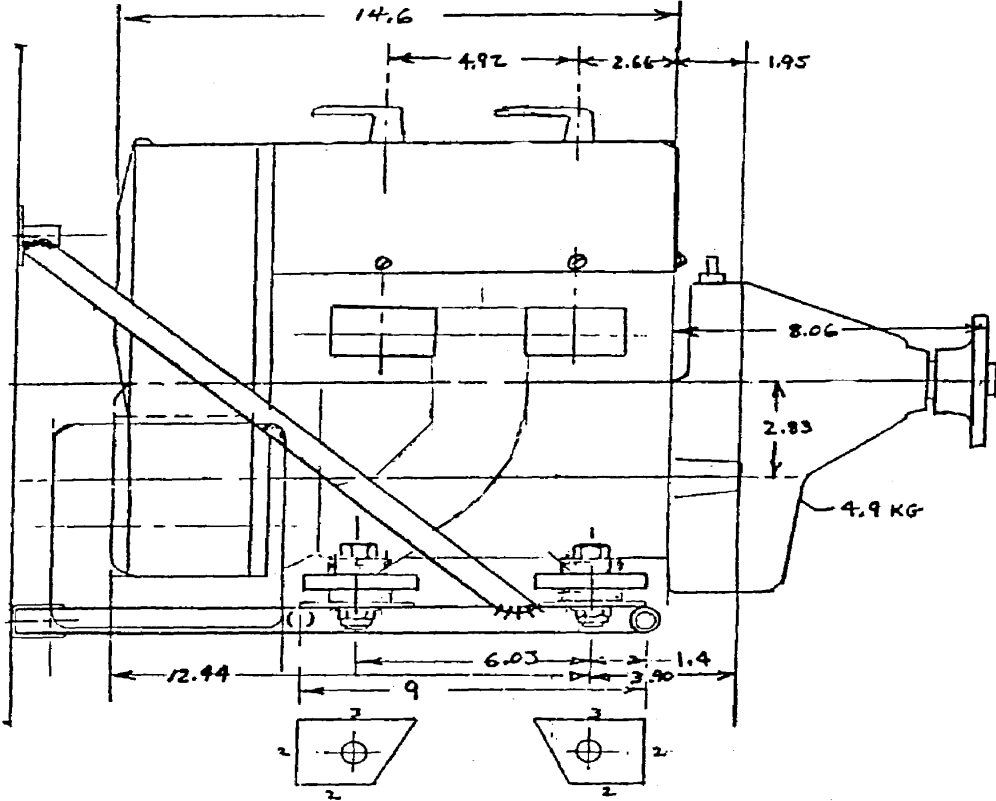


Engine Mount

Material is
3/8" thick
Stock

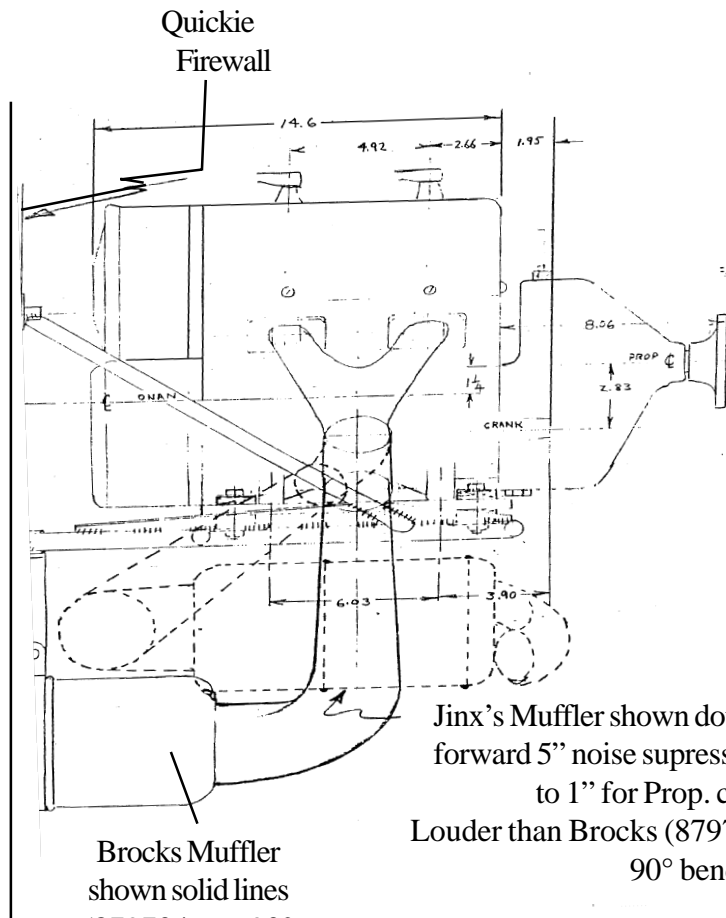


Engine Mount



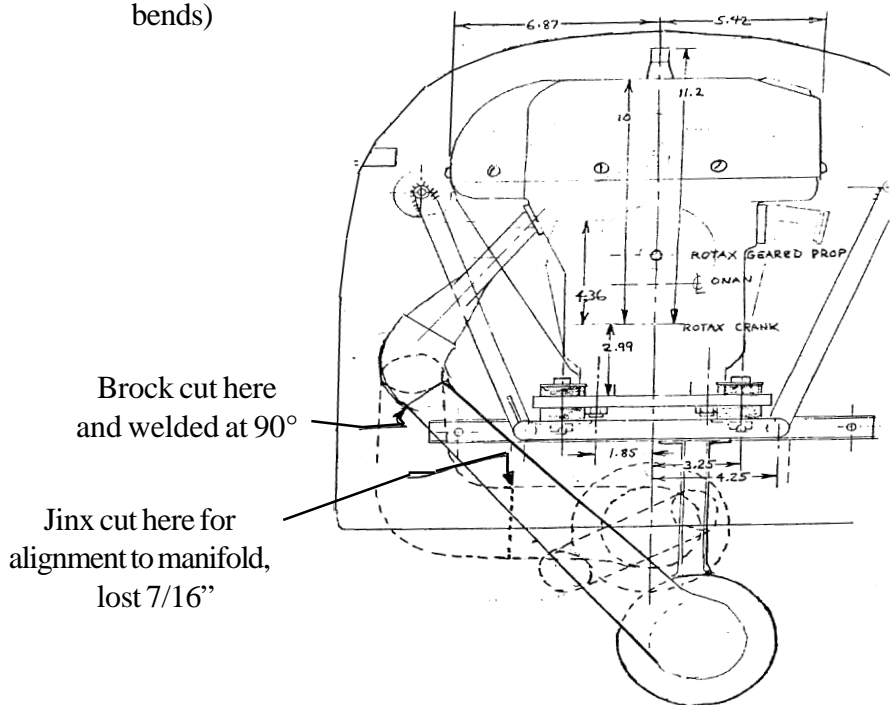
Muffler

Rotax 503 Quickie Data 4/11/85 V.D. Hawks
4/6/87 Add Mufflers



Brocks Muffler shown solid lines (879704 two 90° bends)

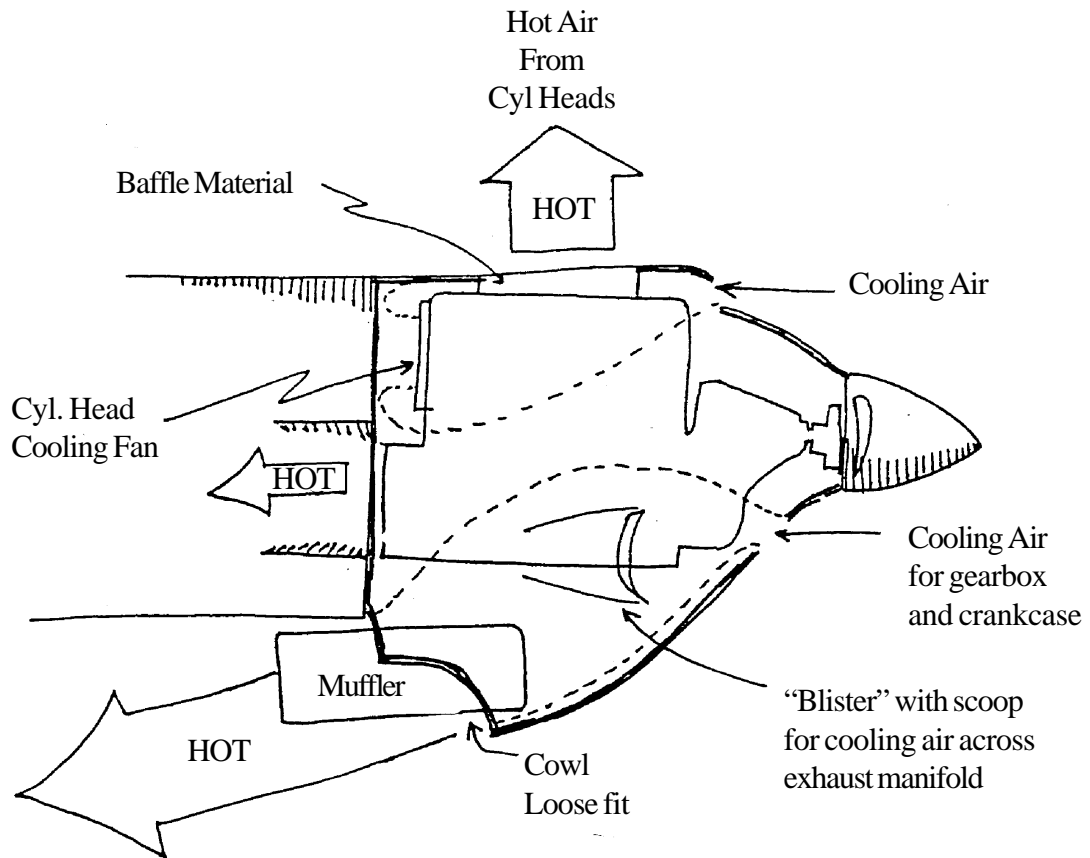
Jinx's Muffler shown dotted lines. (Note forward 5" noise suppressor section shorten to 1" for Prop. clearance) Louder than Brocks (879708-180° bend & 90° bend)



Brock cut here and welded at 90°

Jinx cut here for alignment to manifold, lost 7/16"

Cooling Plan



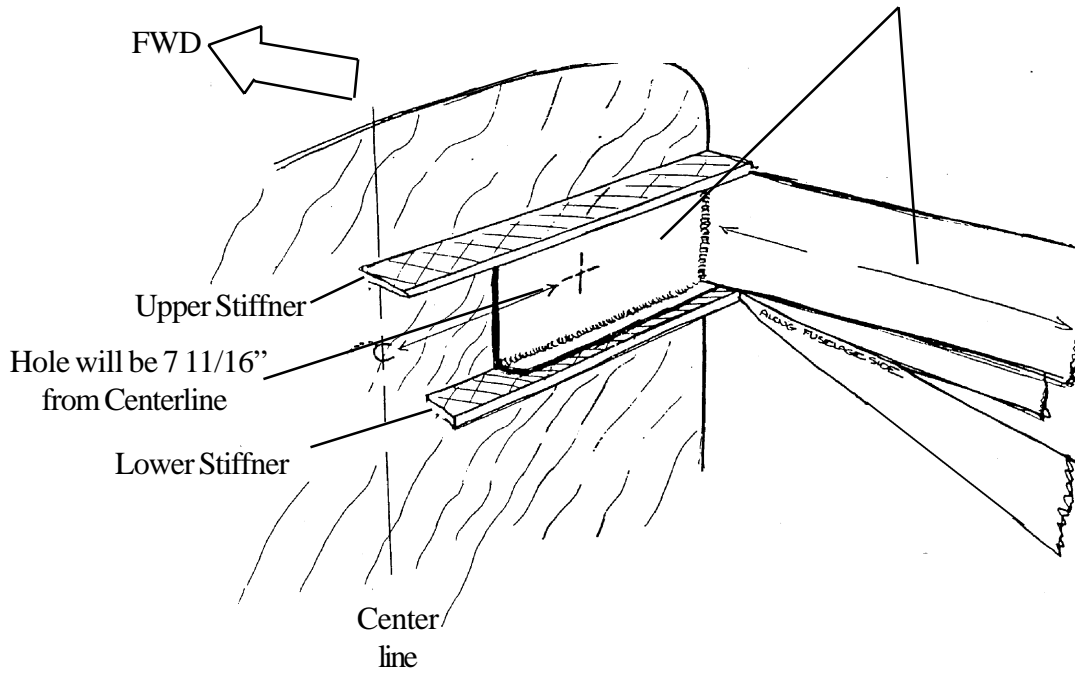
**IT IS VERY IMPORTANT TO PROVIDE
COOLING AIR FOR CRANKCASE**

Firewall Preparations

1. Remove EVERYTHING from firewall... Especially anything that has “ONAN” written on it.
2. Drill out pop rivets that hold on stainless steel firewall and pie pan.
3. Throw pie pan like a frisbee into trash.
4. Fill all holes in firewall.
Big holes: use plywood.
Little tiny holes: I used Foam/Mic
5. Re-Glass firewall over patches. Don't forget to sand existing surfaces for good glass-to-glass bonding.
6. Cover firewall with “FIBER FAX” material.
7. Re-skin firewall with a new piece of sheet metal. Since you used Fiber Fax, you can now use aluminium - which is much easier to work with.

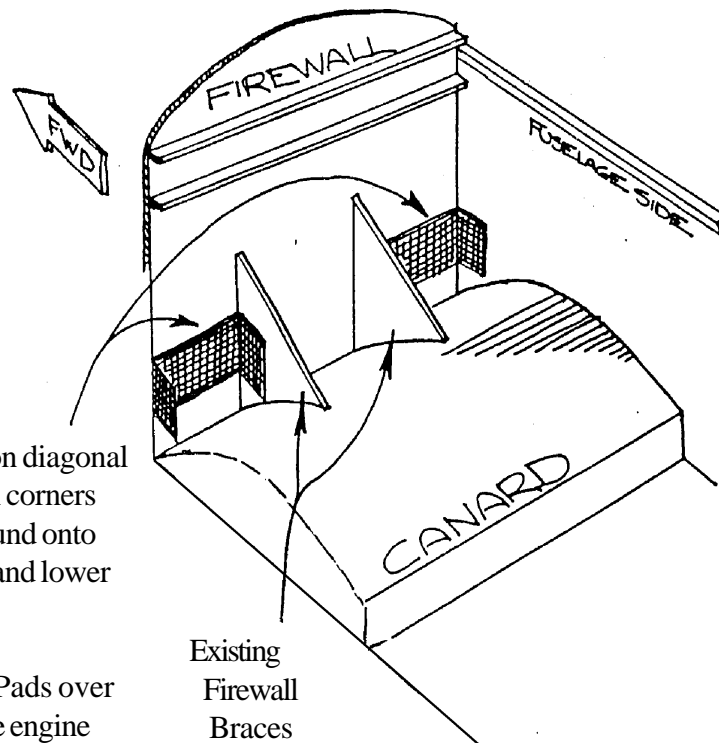
Firewall Preparations

Layup 8 plys of BID between the stiffeners to provide "Pads" for each upper mount point. Overlap plys with Flox radius onto each stiffener and around side of fuselage. Each ply should extend approximately 10" aft, along fuselage side. Fan out each strip to distribute the load. (Do right and left side)



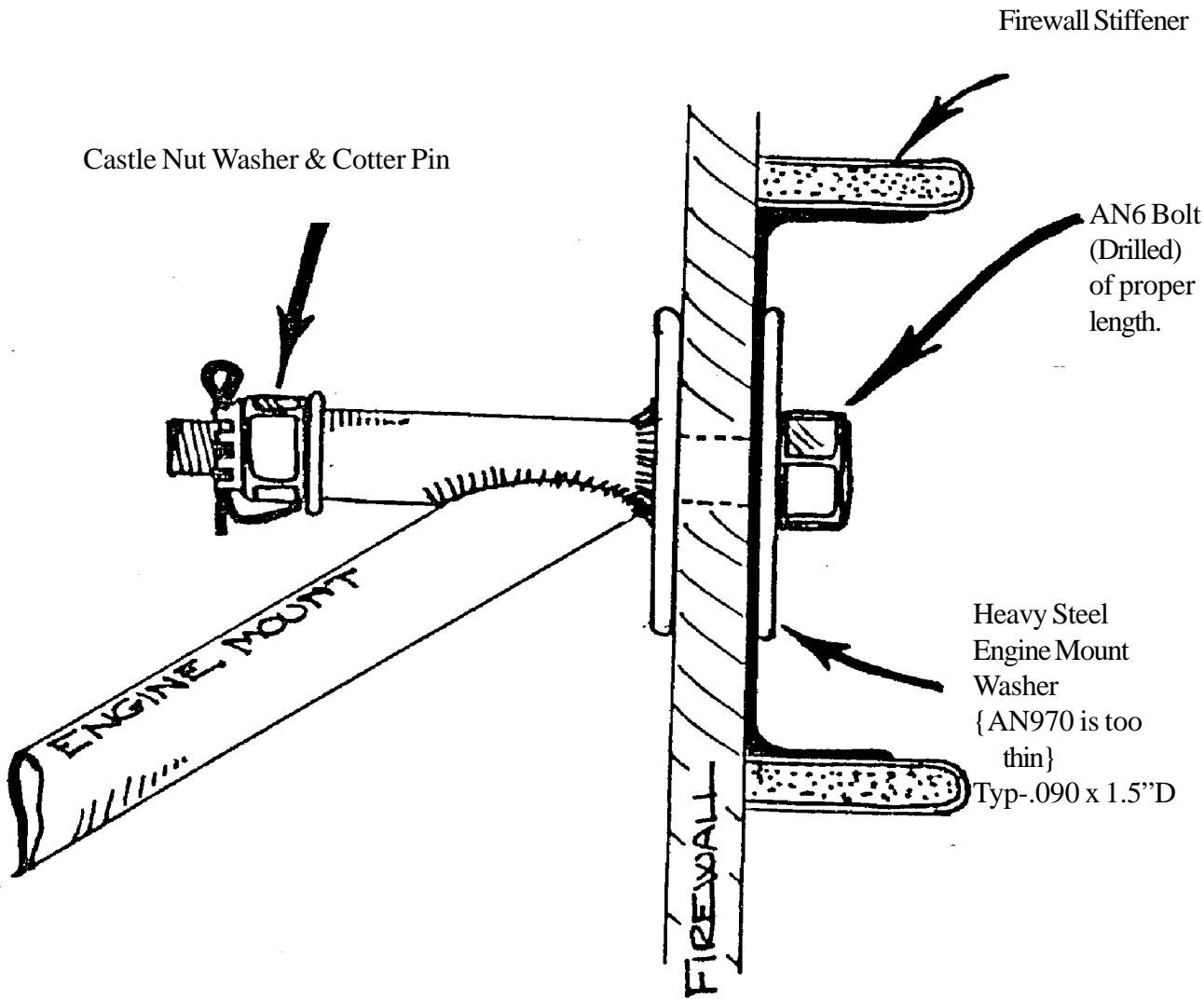
4 ply of BID on diagonal bias with Flox corners wrapping around onto fuselage side and lower stiffeners.

Locate these Pads over location where engine mount contacts



Existing
Firewall
Braces

Firewall Preparations

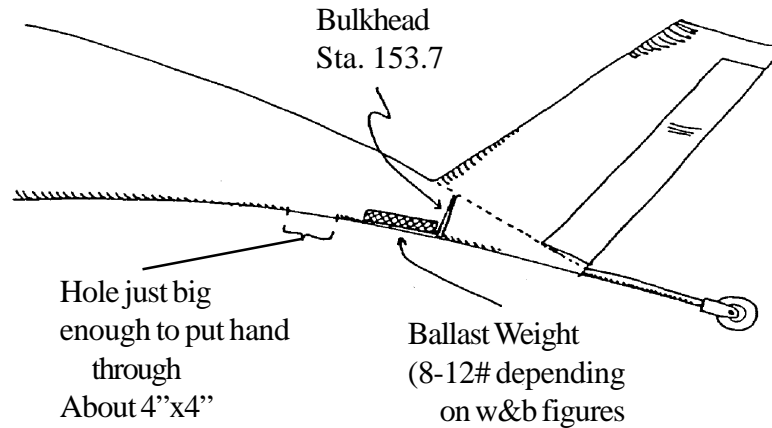


Upper Engine Mount Attachement

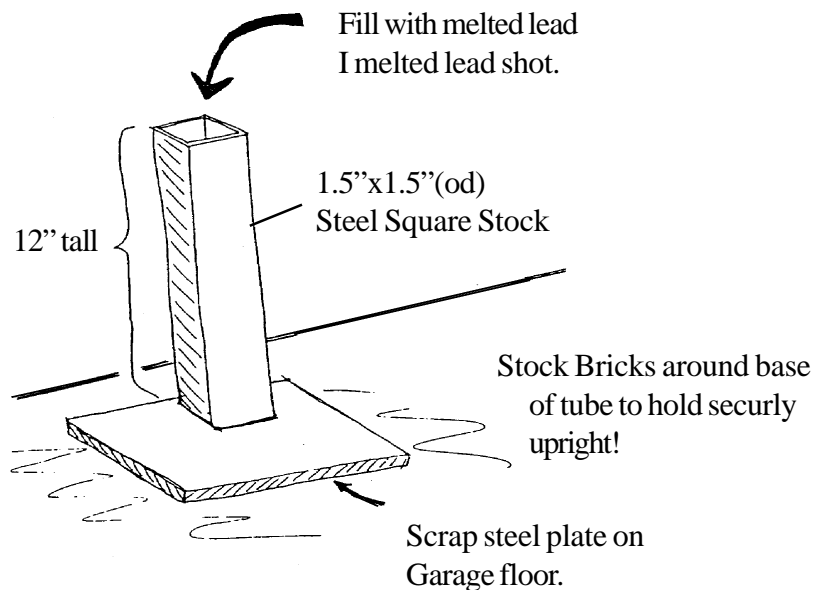
Ballast Installation

Here is the way I adjusted the weight and balance of my Quickie to slide the C.G. back aft within original limits. Proper weight and balance is very important....

General Idea:



How I made my Ballast weight

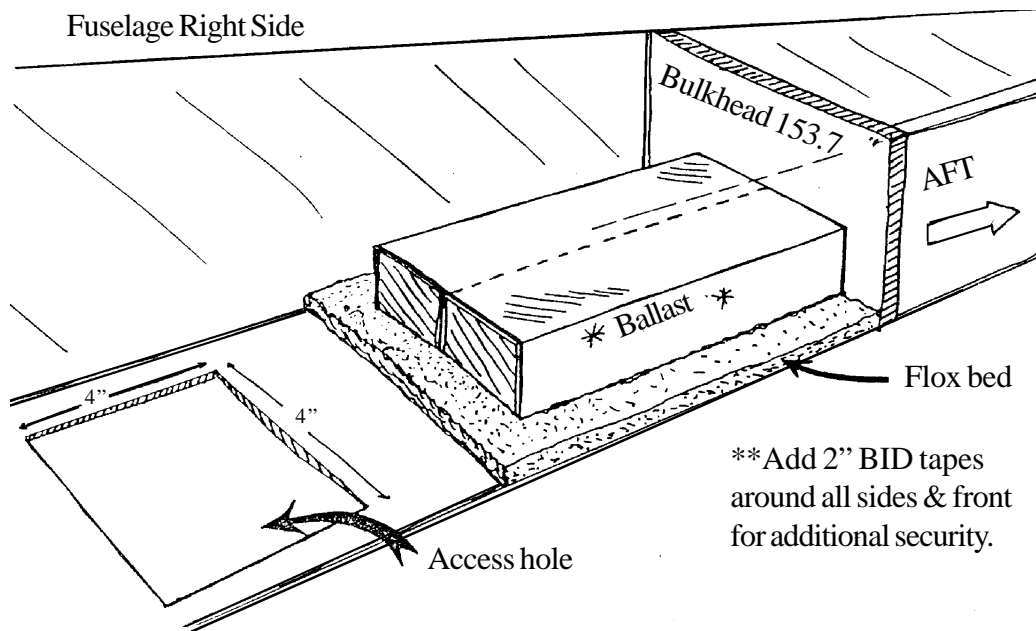
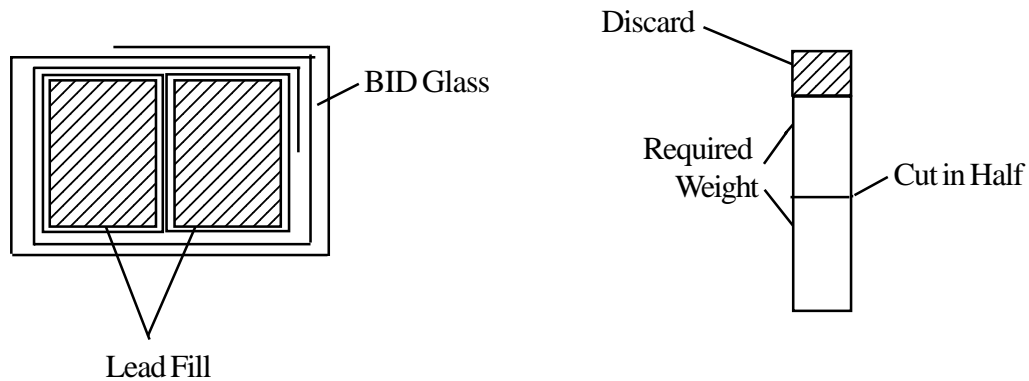


** Wear long pant, long sleeves, shoes, goggles and gloves.

Note: Some lead may leak out of the bottom even with a close tight fit.

Ballast Installation

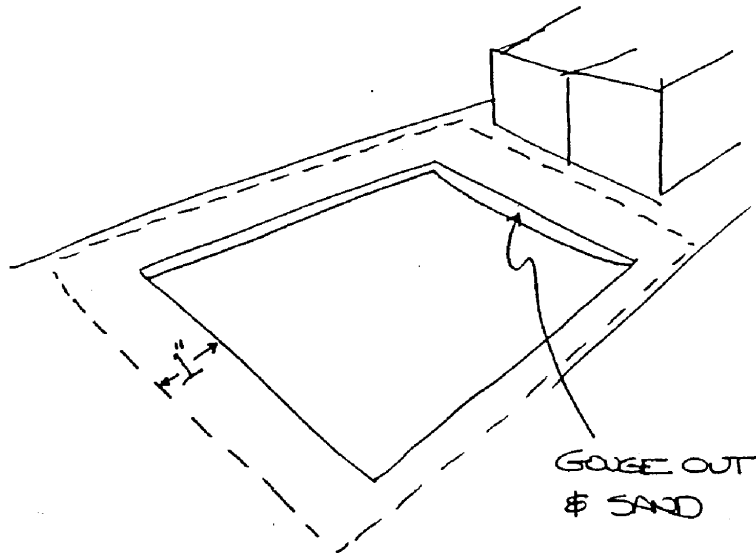
1. Take Lead "Bar" & weigh it.
2. Determine weight per inch.
3. Cut bar to approximate length so as to end up with enough weight to meet forward most c.g. (little pilot, full gas, no baggage)
4. Cut bar again, this time in half.
5. Scuff up each half on all sides with a grinding wheel. Do so thoroughly.
6. Place both pieces side by side and wrap glass around the two pieces 2-3 times.



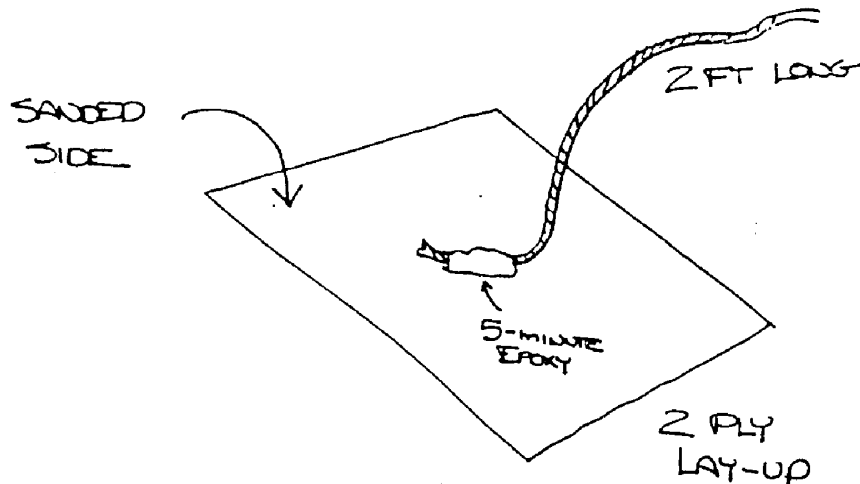
Ballast Installation

To repair access hole in the bottom of the fuselage:

1. Lay-up on wax paper 2 ply of bid approx. 2" greater in length and width than the hole dimensions.
2. Gouge out approximately 1/2" of foam between inner and outer skins that are exposed by hole, sand.
3. Scuff-up with sandpaper, the top of the inside skin for at least 1" around hole.

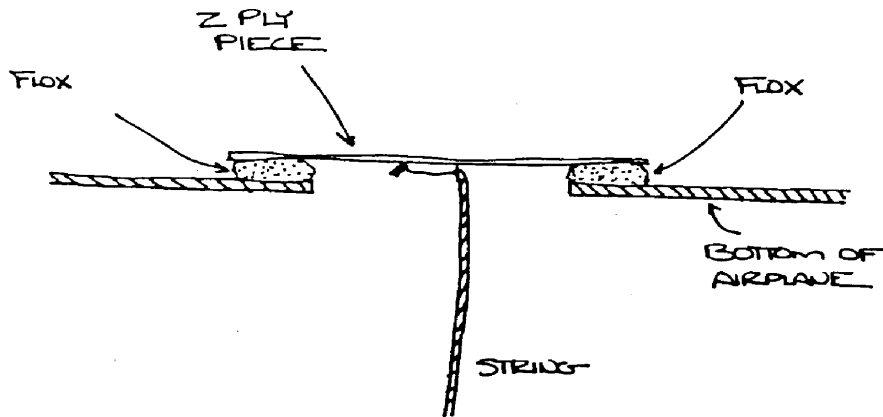


4. Separate 2 ply lay-up from wax paper and thoroughly sand one complete side.
5. One sanded-side, affix the end of a two foot piece of heavy twine to the center with 5 minute epoxy.
6. Let "5-Minute" stuff dry for an hour.

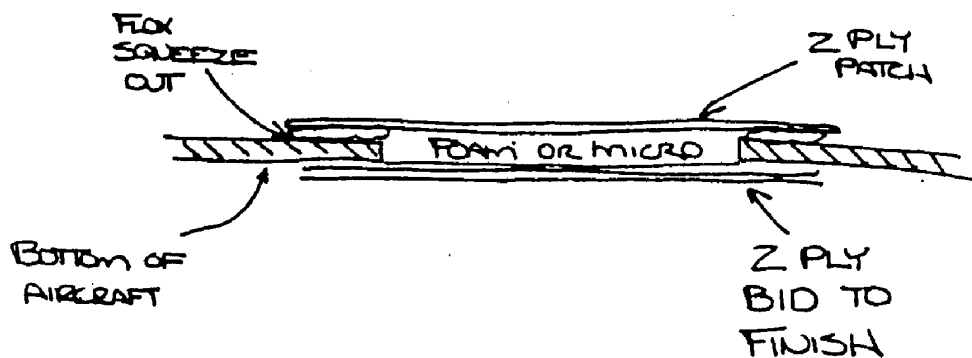


Ballast Installation

- At the same time, fill “gouged out and sanded” area around the hole with more flox.
- Now comes the trick, Maneuver the 2-ply piece with the string on it, up into the hole and position it on the floxed border with the string hanging down.



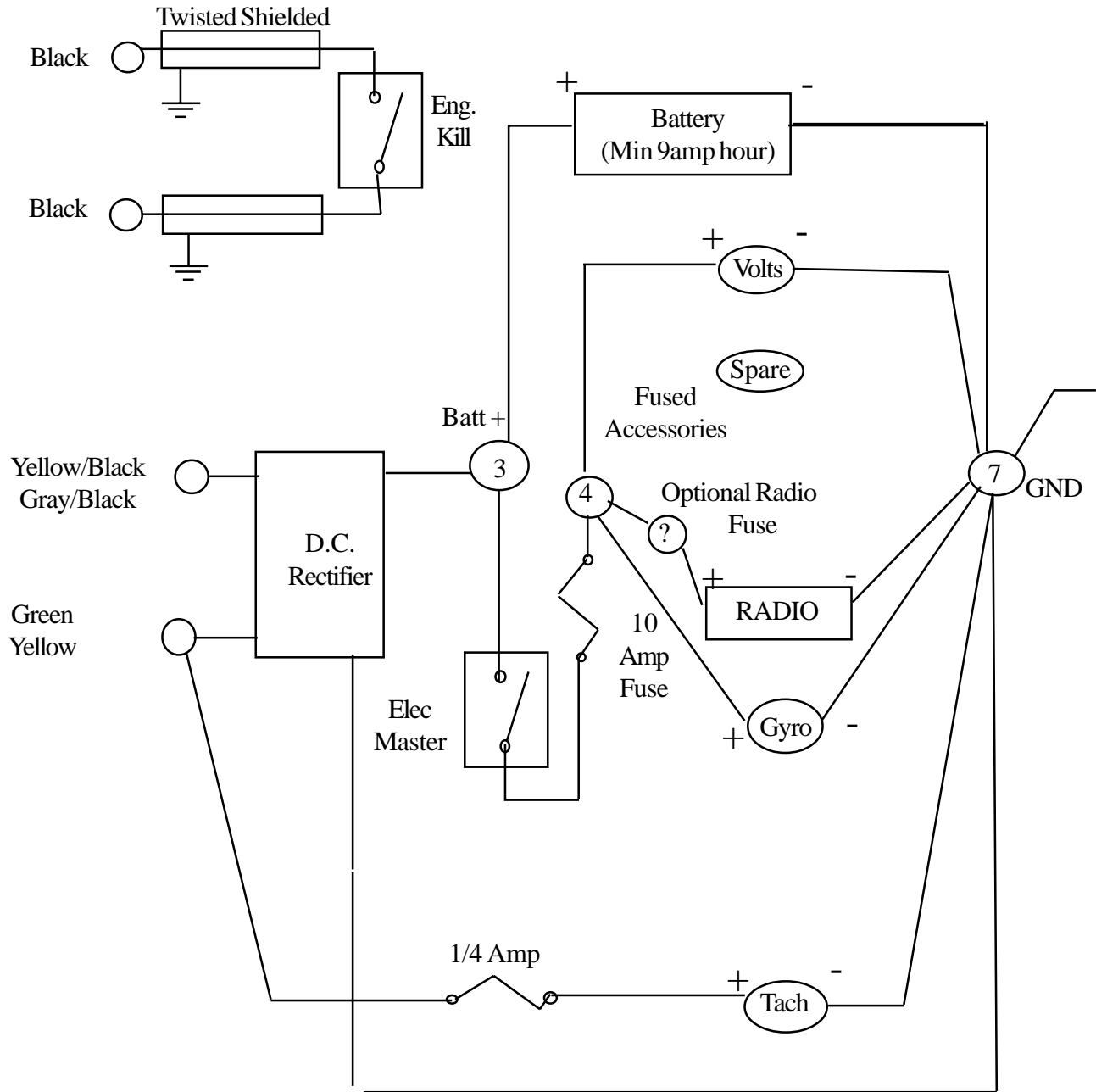
- Pull on the string to get a good flox squeeze out. Then tie a weight to the string until flox has cured. Be careful not to break the string or the 5 minute Epoxy.
- When the Flox has cured, snip the string off to remove.
- Now on the outside around the hole, sand and remove at least an inch of paint.
- If the hole remaining is deep, micro some foam in place and sand to conform to bottom of aircraft. If the hole is shallow, fill with dry micro and sand to shape.
- Glue with 2 plays of Bid. Overlap at least one inch on to sanded border all the way around the hole.
- When cured, smooth and paint.



Wiring Diagram

ROTAX 503 Wiring Diagram

6-26-85



Instrumentation

TEMPS:

I monitor EGT and CHT on both cylinders. Since my engine has a carburettor for each cylinder, I like to know what's going on on each side. High temps can be catastrophic with 2-cycles. I use dual gauges for both EGT and CHT.

EGT Max => 1200°

CHT Max => 400°

Trash oil temp and oil pressure gauges. There is no oil system remember.

RPM:

Avoid the kind that hooks into the kill switch wires. If the gauge shorts, it could kill your engine! Use at least a 0-8000 rpm range.

Flight Testing

Considerations I used for initial flight testing

1. Ground run the engine until confident in sustained smooth performance. Be vigilant of EGT and CHT. EGT max 1200° and CHT max 400°. Keep rpm below 2000 until 200° CHT.
2. Assume you have never, ever flown a Quickie, so ground taxi the hell out of it. Start slowly. During faster runs I hold forward stick to keep the beast on the ground. Yes I allow the tail to come up briefly. Rudders are now a very big deal!
3. On first flight, do not forget the left rudder to keep from flying sideways.
4. The only difference on landing is due to a higher residual thrust at idle. I notice slightly shallower glides and a bit slower deceleration on the roll outs.
5. I try not to make any fast jerky throttle movements - its not good for any engine, not to mention 2 strokes.
6. I use 7000 rpm as an in-flight limit. I saw this number only twice and that was with a flatter prop. 6000 is a more typical maximum.
7. Avoid long periods at idle (in flight), clear the engine, by advancing the throttle slightly, now and then to preclude fouling of spark plugs.
8. Develop a fool proof system that will not let you forget to add the 50:1 oil mix to the gas. This is a new habit pattern to learn.

Flight Testing

INITIAL FLIGHT TESTING OF YOUR QUICKIE

QAC - April, 1979

Introduction

Once the construction of your Quickie is completed, you are ready to prepare your Quickie for flight testing. This task should not be taken lightly, and a thorough, professional approach will assure you of years of trouble free fun.

The information contained in this document is intended to aid you as you prepare for first flight. It does not replace good common sense on your part. If you are not sure of some phase of preparation, call QAC and ask questions.

Beware of individuals in your community who profess a great knowledge in this area; they may or may not be competent.

This document is divided into two basic sections:

1. Pilot preparation
2. Aircraft preparation

Quite often while building a homebuilt aircraft, the owner-builder-pilot allows his own proficiency to slip in order to expedite completion of his aircraft. This move is unwise.

Pilot Preparation

We recommend the following steps to prepare oneself for first flight:

1. Ten hours of flying time in the last 3 months.
2. Check-out in at least 3 different types of aircraft shown in the logbook
3. One hour of takeoff and landings in a taildragger within the proceeding 3 months.
4. A private pilots certificate with no restrictions.
5. Study the Quickie Owner's Manual thoroughly.

In addition, the pilot should feel confident in his ability to fly a new aircraft. If he does not, he should check out in different types of aircraft until he feels comfortable, even if it means delegating first flight in his Quickie to a more competent pilot.

The above are suggestions that we believe to be conservative and desirable before the flight flight of any homebuilt aircraft.

Flight Testing

Aircraft Preparation

Before the initial taxi tests of your Quickie are performed, you must carefully make a complete inspection of the entire of the aircraft, with particular emphasis on the flight systems. This is similar to what a factory built aircraft goes through before it is delivered to the dealer.

The following list can also be used for each annual inspection:

1. Check all fasteners for proper security and safetying.
2. Check control system travels at the surfaces:
 - a. Rudder travel +/- 30 deg.
 - b. Aileron travel +/- 25 deg.
 - c. Elevator travel +/- 17 deg.
3. Ailerons should fair into the trailing edge of the wing with the control stick at neutral.
4. Check that canopy sponge seals are in place and that canopy locking handle is adjusted so it must be forced *hard up* to lock. This is extremely important to eliminate any possibility of it being bumped open in flight. Verify that the secondary canopy latch functions properly.
5. Check elevator and aileron pushrods for proper installation (spacers, washers, bolts, locknuts, etc. Installed properly).
6. Check elevator and aileron pushrods for freedom of movement throughout control travel.
7. Check pitch trim for proper function and freedom of movement.
8. Check elevator and aileron hinge attachments for security.
9. Check elevator and aileron for freedom of movement throughout range without binding or chafing.
10. Check rudder pedals, cables and attachments for freedom of movement throughout range without binding or chafing.
11. Check brake system for freedom of movement.
12. Check main tire inflation at 50-60psi. Re-check 2 days later for leaks. Check axle bolts for function and security.
13. Check tailwheel area for freedom of movement and proper security.
14. Check safetying and security on all actuating mechanism hardware.
15. Check instrumentation: CHT and Oil temp with a match or hot water at the probe; check pitot static system for leaks; check remainder of instrumentation system on initial engine run.
16. Check engine compartment; Propeller bolts for proper torque and safetying; propeller for proper track (within 1/8"); engine mount bolts for security and safety; oil level; throttle and carb heat controls for security and proper function; ignition wiring for security and redundancy; clock prop vertical when points open; and check baffling for tight fit around engine and cowl, otherwise overheating may occur.
17. Check fuel system; fuel cap seals securely and vent system clear; flow check your fuel system by removing the fuel inlet line to the carburettor and verifying that backup squeeze-bulb fuel pump flows a steady stream of fuel with constant squeezing of the bulb; check fuel shut-off valve for function; clean the fuel filter after flushing entire system; calibrate fuel gauge by pouring fuel into tank in increments and marking gauge.
18. Check battery secured and vent line exits bottom of fuselage.

Flight Testing

Weight and Balance

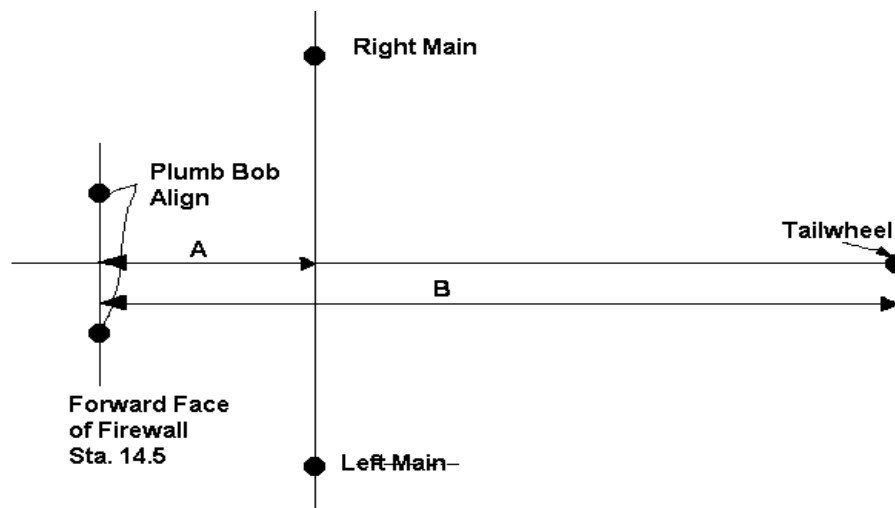
It is extremely important to do an accurate weight and balance on your Quickie to determine your aircraft's c.g. The measurements should be recorded in the aircraft logbook and used for all future c.g. computations. The following procedure is recommended for performing an accurate weight and balance:

Equipment required - 3 Scales (platform type preferred); one level; some chalk; a 12' measuring tape; 3 pieces of 1" x 12" lumber to distribute the weight evenly over the scales; and miscellaneous wood to set the tailwheel scale on at the proper vertical height. Calibrate the scales by weighing a known object.

Step 1 - Position the aircraft on the scales with the waterline 0.00 line level. Record the scale readings with the aircraft only (i.e. no fuel, no pilot, no baggage)

Step 2 - With the aircraft off of the scales, but still level, use your plumb bob to locate on the floor the centerlines of the main gear axles and the tailwheel. Also mark the location of each forward face of the firewall on the floor using the plumb bob.

Step 3 - Make the measurements shown below:



To get the moment arm (fuselage station) of the main gear add distance A to 14.5 (it should be about sta. 42.3); To get the moment arm of the tailwheel, add distance B to 14.5 (it should be about STA 186.0)

Step 4- Make a tabulation along the lines of the following;

Item	Gross Weight	Tare	Net	Arm	Moment
Left Main	121.5 lbs	-1.0 lbs	120.5 lbs	42.5	5097.2
Right Main	123.0 lbs	-2.0 lbs	121.0 lbs	42.3	5118.3
Tailwheel	3.0 lbs	-1.0 lbs	2.0 lbs	186.0	372.0
Total			243.5 lbs	43.5*	10587.5 inches

*Sta of empty Cg

Divide the total moment by the total net weight to obtain the empty c.g.

Flight Testing

Step 5 - Now you can perform some weight and balance calculations using the sample problem and curves in the Quickie Owners Manual. To be absolutely accurate, it would be a good idea to do another weight and balance with pilot in the aircraft since pilot location in cockpit will effect his moment and aircraft c.g. location. You should placard the maximum and minimum pilot weights allowable from your calculations on the instrument panel.

Flight Testing Your Quickie

After having spent months building your Quickie, you are going to be in a big hurry to fly it. This is a big mistake, flight testing any new aircraft is something that must be approached cautiously. Read over the first parts of this document. Is *everything* checked and completed? Now think carefully, what else can you think of that you should do to get ready for first flight? Spend days or weeks... literally, thinking about that question. If any item on the aircraft needs attention fix it now! Do not do any engine runs or taxi tests until you are sure that the aircraft is ready to fly. Many taxi tests end up with an unexpected first flight; don't be caught unprepared.

Ground Tests - Run the engine is for at least 5 hours at various speeds, and with the cowling on. Watch all engine instruments for any signs of problems. Do not exceed 400 deg. CHT. The Quickie Owners manual details how to properly adjust your engine. Frequently take the cowling off and carefully inspect the engine compartment for loose bolts, excessive vibration, or leaks. After the 5 hour run-in, do a very careful inspection of everything in the engine compartment. Remember, don't rush. When you button up the cowling for the last time, be able to say to yourself that the aircraft is ready for first flight.

Basic Taxi Tests - Now you are ready to taxi the aircraft around on the ground for a little bit to get accustomed to the cockpit environment. Don't stop until you feel completely at home with the aircraft's very low speed characteristics; make sharp turns, apply brakes, listen for the sounds of the engine and aircraft.

Taxi Tests - Taxi tests can be divided up into two regimes; low speed (under 30 m.p.h.) and high speed (over 30 m.p.h.). Spend at least 30 minutes in the low speed area getting used to the sound and feel of the aircraft. Always be prepared for a liftoff and first flight if it should accidentally liftoff. Now park the Quickie for a day to think about everything you have learned. Do not do the high speed taxi tests until you have had this 1 day cooling off period.

High Speed Taxi and Liftoffs - Do these procedures in a basic aircraft like a Cessna 150 before doing them in your Quickie.

Find an airport with the following conditions today;

1. Weather; wind calm, or straight down the runway and smooth, and no turbulence aloft (check with another aircraft)
2. Runway; smooth at least 4500 feet long and preferably over 6000 ft. long.

Check the aircraft to verify that you have about 3 gallons of fuel. Check yourself to make sure you are not tired or too excited. There is always tomorrow.

Perform high speed taxi tests at increasing speeds (i.e. 35 m.p.h., 40 m.p.h., 45 m.p.h. and 50 m.p.h., Repeat until you feel absolutely comfortable.

Flight Testing

Perform the tests by accelerating to the aim speed, bringing the power smoothly to idle and decelerating to a stop.

Evaluate whether your airport has sufficient room to make a runway flight (i.e. liftoff, fly straight and level for about 5 seconds, and land). If it does you may want to do this to feel out the aircraft.

First Flight - The first flight is just a short step up from the runway flight. The main items to look for are proper operation and function of all controls and proper indications on all engine related instruments. The first flight should be only 15-20 minutes long; enough to feel comfortable in the aircraft for landing but not so long that you feel obliged to “ring” the aircraft out. After first flight, every part of the aircraft should be checked out carefully to determine any problem areas.

The Flight Test Program - In subsequent flights, concentrate on learning more about the aircraft, and getting accustomed to flying it. Expand the operational envelope slowly (e.g. don't dive up to redline speed on the second flight, and don't operate in 50 knot winds right away). Remember there is no substitute for good judgement. Call QAC if you have any problems.

Random Comments on Testing your Quickie

1. Do not fly your Quickie unless all instruments standard in the Quickie kit are installed.
2. Pay close attention to all limitations listed in the pilot's manual, particularly the RPM and temp limits.
3. Your Quickie should touch down tailwheel first with full aft stick, and also the tailwheel should not lift off before the mains on takeoff with full aft stick. If either or both of these statements are not true for your aircraft, contact QAC for help. Basically you will make a small adjustment for rigging of the ailerons. These comments apply to mid-aft c.g. location. At forward c.g. the tailwheel may liftoff first on takeoff.
4. If you are seeing erratic airspeed indication on takeoff and/or in-flight, contact QAC for help in modifying your cockpit static source.
5. Read the pilots manual on the aircraft charging system; if the voltmeter is not between 13-15 above 2000 rpm do not fly until the system is troubleshooted, even though a fully charged battery is sufficient 1.5 hours of flying.
6. Do not fly your Quickie if you find the vibration level to be so high that it concerns you. Our 77Q is relatively smooth, and yours should be also, unless you have one or more errors in the engine installation. Contact QAC for help on troubleshooting.
7. Remember, there is always tomorrow to fly your aircraft if it is not ready today; be cautious, conservative and use common sense.
8. Do not fly the aircraft or even perform taxi test until you have done an accurate weight and balance test.

Flight Testing

9. We do not recommend that you fly your Quickie in the rain during the initial 20-30 hours of flying. Moisture on the canard causes an increase in the stick forces that the pilot feels, according to testing that we have done with 77Q. This change in force required might be disconcerting to a low time Quickie pilot. The increased force for a given airspeed will tend to drop the nose until the pilot corrects by increasing the force on the stick. Testing on 77Q has shown no change in the minimum speed, but a large increase in force required.

Flight Testing

