Lancair Propjet Supplement

Note:

(*) **Parts Optional - available through Kit Components Inc.**
(**) **Parts not included with Propjet Kit - supplied with retro fit option**

1. INTRODUCTION

The Lancair PropJet supplement is supplied with the Lancair IV-P manual. The basic airframe of the two aircraft is the same. The main differences are firewall forward and the belly tank used on the PropJet. Chapters 1 through 11 are the same for both aircraft. Follow Chapter 12 except the instructions relating to the firewall. Follow chapter 13 through 22 with the exception of section I of Chapter 15. Refer to section M of this supplement for the rudder pedal installation. There are some slight differences in Chapter 23 which will be pointed out in this supplement. Follow chapters 24 through 26. The fuel system in chapter 27 is also slightly different and differences will also be pointed out in this supplement. Follow chapters 28, 29, and 30. Omit the firewall forward chapter 31. The wiring chapter, chapter 32 is slightly different. Please consult with Lancair Avionics. Follow chapter 33.

Note that the supplement shows the retrofit installation in section A. The retrofit only applies to kits with the retrofit option. All regular propjet firewalls already have the PropJet firewall installed.

A. RECOMMENDED BACKGROUND INFORMATION

This manual provides detailed step-by-step instructions for assembling the **Lancair Prop Jet Kit**. Hands on experience with fiberglass construction techniques and various hand tools is assumed. If you do not have that background knowledge, the study of other, more basic texts will be necessary. Suggested references are given on the following pages.

EAA
Whittman Airfield
Oshkosh, WI 54903-3065
920- 426-4800
www.eaa.org

WARNING

IF DURING CONSTRUCTION YOU HAVE ANY QUESTION OR DOUBT ABOUT A CONSTRUCTION PROCEDURE, DO NOT CONTINUE UNTIL YOU HAVE OBTAINED THE NECESSARY INFORMATION OR SKILL. IF YOU ARE NOT KNOWLEDGEABLE IN FIBERGLASS OR OTHER REQUIRED CONSTRUCTION TECHNIQUES OR TOOLS, OBTAIN THAT KNOWLEDGE BEFORE STARTING CONSTRUCTION.

NO CHANGE TO THE AIRCRAFT DESIGN OR SPECIFIED CONSTRUCTION PROCEDURES IS PERMITTED. SUCH CHANGES MAY ADVERSELY EFFECT THE AIRCRAFT'S STRUCTURAL INTEGRITY OR AIRWORTHINESS.

FAILURE TO FOLLOW THIS WARNING AND OTHERS FOUND THROUGHOUT THIS MANUAL COULD RESULT IN COMPONENT FAILURE AND LOSS OF AIRCRAFT CONTROL CAUSING SERIOUS INJURY OR DEATH.

COMPOSITE MATERIALS PRACTICE KIT: This kit contains various materials with which to practice and develop your fiberglass construction technique. It also contains a copy of Burt Rutan's **Moldless Composite Sandwich Homebuilt Aircraft Construction** book described below. This kit is recommended for all newcomers to fiberglass construction and is a good refresher for others.

MOLDLESS COMPOSITE SANDWICH HOMEBUILT AIRCRAFT CONSTRUCTION: by Burt Rutan. Though the hot wire shaping technique covered by this book is not used on the Lancair, this book has a great deal of other excellent, basic fiberglass construction information. Highly recommended.

BUILDING RUTAN COMPOSITES: This is a video tape by Burt Rutan. Although it covers some techniques not used on the Lancair, it shows you how the experts handle fiberglass construction. Highly recommended.

COMPOSITE CONSTRUCTION FOR HOMEBUILT AIRCRAFT: by Jack Lambie. This book is an additional source of useful construction information and goes into the theory of aircraft design as well. Jack's Chapter 9, Safety in Working With Composite Construction, is particularly worth reading. This book would be a useful addition to the above.

KITPLANE CONSTRUCTION: by Ron Wenttaja. This is a resourceful book with information on metal, wood, and composites.

The above publications, practice kit and video tape are available from:

Aircraft Spruce and Specialty Company
225 Airport Circle
Corona, CA 91720
Toll free order line (877) 477-7823
Customer sevice (800) 861-3192
Fax (909) 372-0555
Email: info@aircraft-spruce.com

The following recommended books largely describe aspects of aircraft construction other than working with fiberglass:

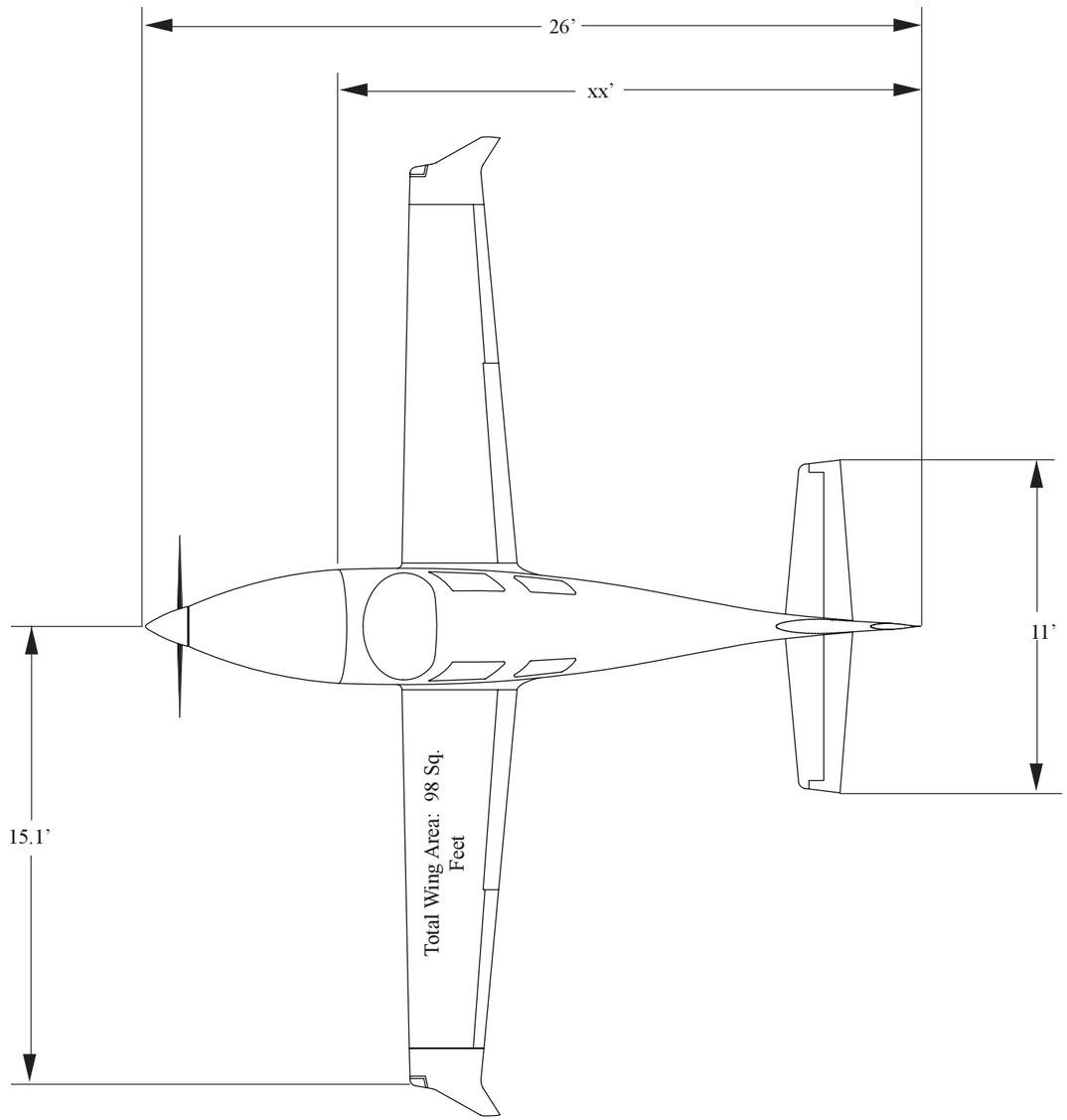
FIREWALL FORWARD: by Tony Bingelis is packed with vital info about engine installation. You'll need this when you're getting ready to install the engine.

THE SPORTPLANE BUILDER: by Tony Bingelis has a lot of useful information on aircraft construction in general such as electrical systems, instrumentation and fuel systems. The chapter entitled :You and the FAA" gives important information on the procedures that you will need to follow during construction in order to get your homebuilt's airworthiness certificate.

These two books can be obtained from:

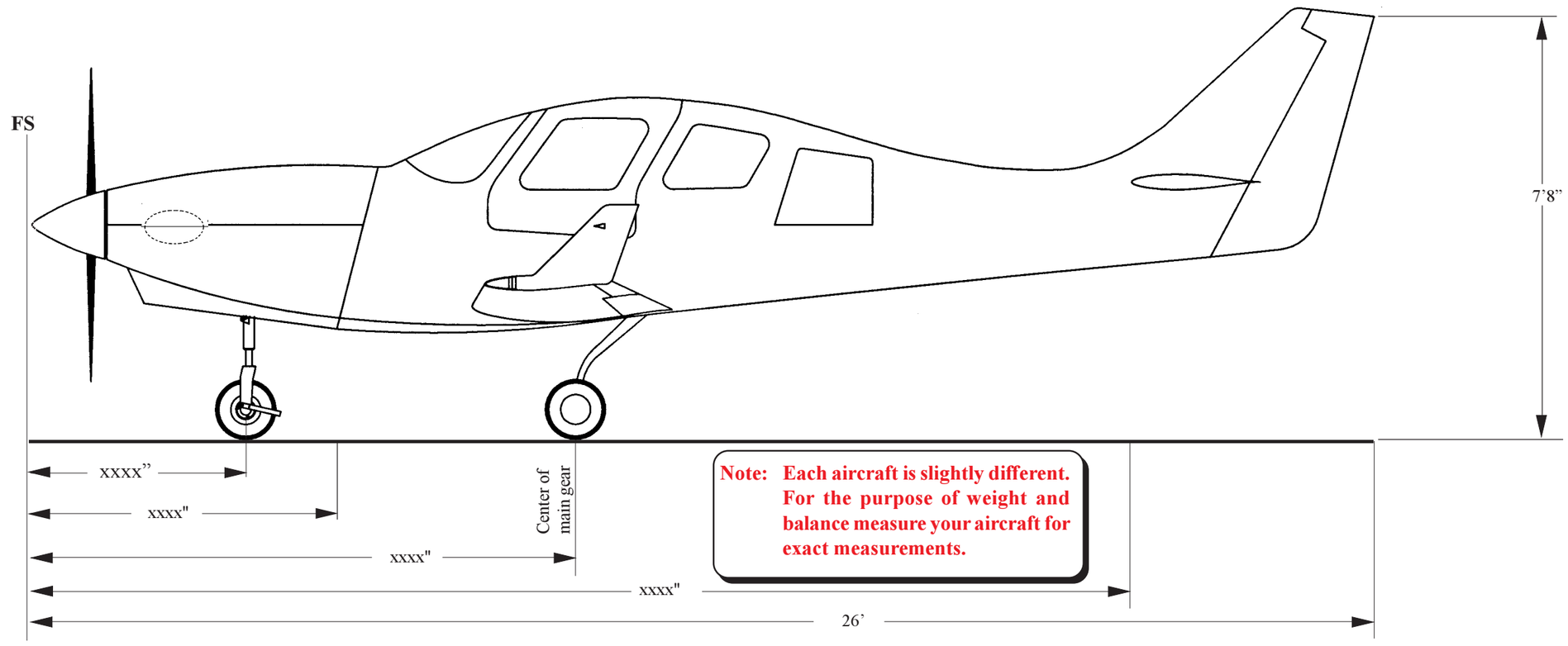
EAA Aviation Foundation
Whittman Airfield
Oshkosh, WI 59403-3065
Phone: 1-920-426-4800

Shop Floor Area
Fig. I:A:1



Note: To remove the wing, you’ll need 4 extra feet of room beyond the wing tip.

Aircraft Dimensions
Fig. I:A:2



B. MANUAL LAYOUT AND USE

PLEASE- READ THIS MANUAL. In this age of computers that are "user friendly", cars that talk and tell you what their status is, and all of the other bubble-packaged, pre-digested things on the market, many people have gotten out of the habit of reading the manual. That philosophy will not work here. While there really aren't any "complex" steps to building this aircraft, there are many that must not be overlooked. So, please do read this manual.

For ease of understanding and use, this assembly manual is laid out in a logical progression of assembly steps. The first section explains the technique used to prepare and join mating parts. This technique is used throughout the kit assembly process, and is shown in detail.

Following that, actual assembly instructions begin with the horizontal stabilizer. Directions are provided for preparing the necessary fixtures for alignment, installing the spars, ribs, etc.

Assembly instructions for the remaining parts are given in a sequence that either makes for convenient construction or is necessary due to the kit design.

A. CHAPTER ARRANGEMENT

Each chapter is arranged in a similar sequence:

1. **INTRODUCTION:** This describes, in a brief overview, the work that will be performed throughout that chapter.

2. **SPECIAL PARTS, TOOLS & SUPPLIES LISTS**

   A. PARTS: providing a complete list of all parts or components within the chapter as well as diagrammatic exploded views of the components.
   B. TOOLS
   C. SUPPLIES: This list will consist of the tools and supplies required for assembly of components in that particular chapter.

3. **CONSTRUCTION PROCEDURE:** This section is typically divided into specific areas of assembly, and each division is defined by an alphabetical prefix: a, b, etc.

B. REVISIONS

From time to time, revisions to this assembly manual may be deemed necessary. When such revisions are made, you should immediately replace all outdated pages with the revised pages. Discard the outdated pages. Note that on the lower right corner of each page is a "revision date". Initial printings will have the number "0" printed and the printing date. All subsequent revisions will have the revision number followed by the date of that revision. When such revisions are made, a "table of revisions" page will also be issued on a "per chapter" basis. This page (or pages) should be inserted in front of the opening page of each chapter that is affected. A new "table of revisions" page will accompany any revision made to a chapter.

Each chapter should be read through entirely and understood before beginning the work it describes. The equipment and supplies called for in each chapter should be on hand and ready for use.

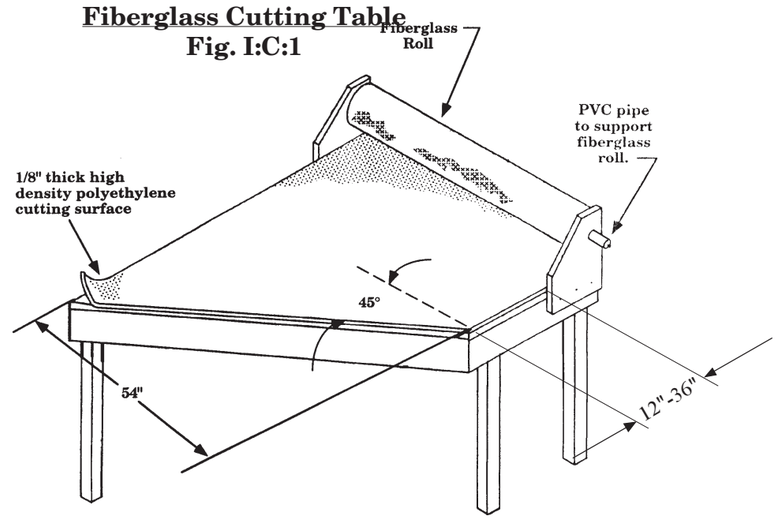
C. SETTING UP YOUR SHOP

Your work area should be well lit, clean and uncluttered, and have at least one large table to cut on and work with the fiberglass. Since parts will be placed on the floor occasionally, oil, grease and dirt must be removed from the floor to prevent contamination of the parts.

If work is to be done when the outside temperature is less than 70°F, a heat source may be necessary. Working with adhesive or fiberglass resin at lower temperatures, wetting the fiberglass out becomes difficult.

Cutting Tables
One of the focal points of any composite shop is the fiberglass cutting table. Those of us who previously built composite planes without a cutting table can't believe we were so naive. If you have the room, build a cutting table in your shop!
The cutting table should have the fiberglass roll mounted at one end so you can unwind the cloth onto the table. You should be able to unroll at least four feet of cloth onto the cutting surface. A PVC pipe, or any pipe, can be used as a roller for the cloth roll. Mount the pipe through two plywood supports nailed to the sides of your table.

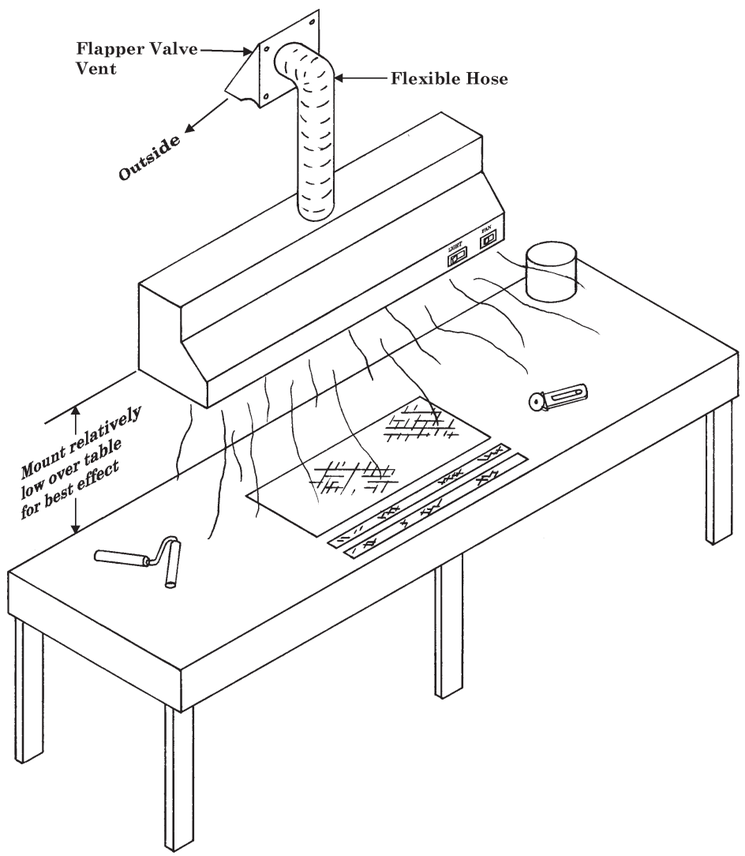
Fiberglass Cutting Table
Fig. I:C:1



The cutting surface should be a hard plastic, such as 1/8" thick, high density polyethylene (HDPE). Some home supply stores have similar sheets of this material called "Tileboards" for use as shower liners. Check plastic supply stores also. When the plastic surface gets well used and you don't get clean cuts anymore, simply flip the plastic sheet over and use the other side, provided it still fits the table. When the cutting table is not in use, it's a good idea to at least cover the fiberglass roll with plastic to keep the dirt from settling on it.

This setup for a layup table comes in quite handy when it comes time to start your wet layups. Construct the table about 3' X 8' and mount the exhaust hood low over the table surface. Use the same hard plastic as you installed on the cutting table.

Layup Table
Fig. 1:C:2



D. TERMS AND DEFINITIONS

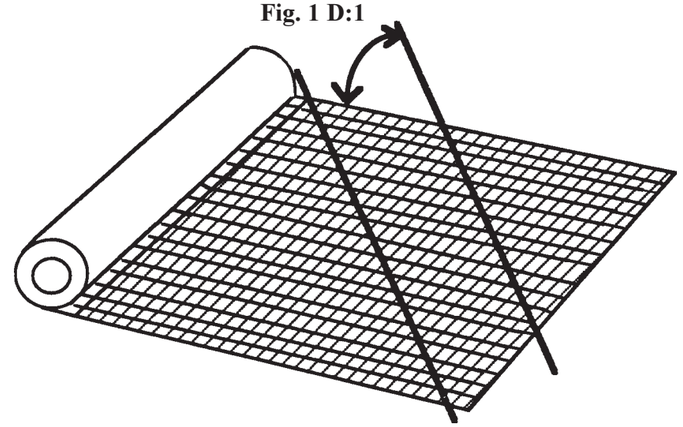
Aft Back side or measured back.

BID tape A strip of BID cloth cut on the bias, usually 2-4 inches wide.

Bidirectional glass cloth Bidirectional glass cloth (BID) means that 50% of its fibers are running in one direction, and 50% of the fibers are running perpendicular (90°) to the other fibers.

Cutting on the bias Cutting BID cloth on the bias is to cut in such a way as to leave the fibers on a 45° angle to the edge. See drawing. You can wrap a smaller radius corner when the fibers are running on a 45° angle to the corner.

Fig. 1 D:1



Chord The length of the airfoil; from the leading edge to the trailing edge of the wing.

Fig. I D:2

Cotton Flox Finely chopped cotton fibers which are in appearance nearly as fine as micro balloons. The big difference is that flox is structurally stronger than micro when combined with epoxy. **USE:** Mixed similarly to micro and used for strengthening glass to glass areas where BID tapes can't be used. Can fill small gaps where pure epoxy might run out and leave a void, also large amounts of pure epoxy is heavier and too brittle. Flox is heavier than micro. **Should be used sparingly- can add a lot of weight if used without discretion.**

Ctr Center.

BL Baseline. This line is used to measure distances outward from the centerline of the fuselage. Thus, the baseline is the actual center line. BL measurements are given in inches and positive to the left or right.

WL Water line. This is an imaginary line used to measure vertical distances on the plane. On the Legacy 2000 the top of the longeron at the canopy is WL 25.

WS Wing Station. The line formed by the chord lines. WS 0 is in the middle of the fuselage

FS Fuselage Station. This imaginary line is used to measure distance forward or aft on the fuselage. FS 0 is the aft face of the spinner.

Dihedral Looking at the front of the aircraft, most non-swept wings form a positive angle to the horizontal. That angle is called dihedral. Dihedral improves roll stability on non-swept wing aircraft.

FSLG Fuselage.

Ftg Fitting.

Fwd Forward.

Inbd Inboard.

Longeron A lengthwise structural member of the fuselage. Some planes have top and bottom longerons.

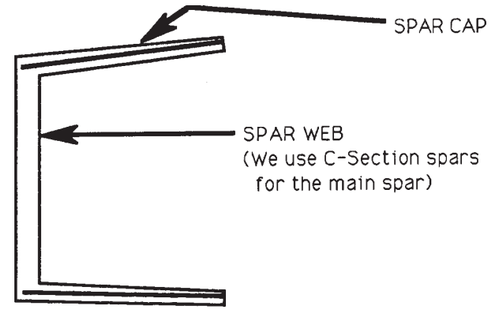
Micro Microballoons. These are very small thin-walled air-filled glass bubbles. Being extremely light for their volume, they can be added to resin to produce a very lightweight filler material that is easy to shape and sand. They do not add strength to the mixture however, and should be used where "cosmetics" is the consideration, not strength.

Outbd Outboard.

Peel Ply A non-structural fabric used in the manufacturing process but must be removed from the part. It is light in color and usually has darker stripes for identification.

Shearweb Typically the part of the wing spar that runs vertically.

Spar cap The top and bottom members of a spar, held in proper relation by the shear web.



Typ Simply means "typical" when seen on a drawing.

E. STRUCTURAL ADHESIVE

DURING AIRCRAFT ASSEMBLY TWO TYPES OF EPOXY ARE USED: A STRUCTURAL PASTE ADHESIVE AND A LAMINATING RESIN.

THE LAMINATING RESIN IS USED TO MAKE FIBERGLASS LAYUPS AND IS ALSO MIXED WITH FLOX OR MICRO.

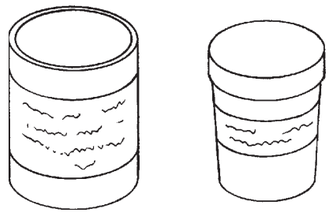
THE STRUCTURAL PASTE ADHESIVE IS USED TO STRUCTURALLY BOND MOLDED PARTS TOGETHER.

THESE EPOXIES ARE NOT INTERCHANGEABLE. FOLLOW THE INSTRUCTIONS CONCERNING WHICH SYSTEM TO USE.

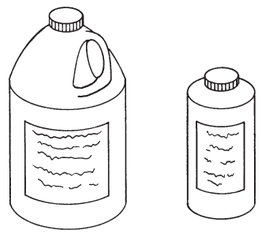
NOTE: Although Hysol 9339 Structural Adhesive and a laminating resin from Jeffco are illustrated, other structural adhesives may be used instead of this type if deemed appropriateby the factory. Mixing ratios will also differ.

BE SURE TO CHECK FOR PROPER MIXING RATIOS OF STRUCTURAL ADHESIVES AND LAMINATING RESINS SUPPLIED. FAILURE TO PROPERLY MIX STRUCTURAL ADHESIVES OR LAMINATING RESINS COULD RESULT IN BOND FAILURE.

HYSOL 9339 ADHESIVE
Mix: 44.5 parts 9339A(blue)
to 100 parts 9339B(White)



JEFFCO 3102/1307LV
Mix: 25 parts 3102
to 100 parts 1307LV



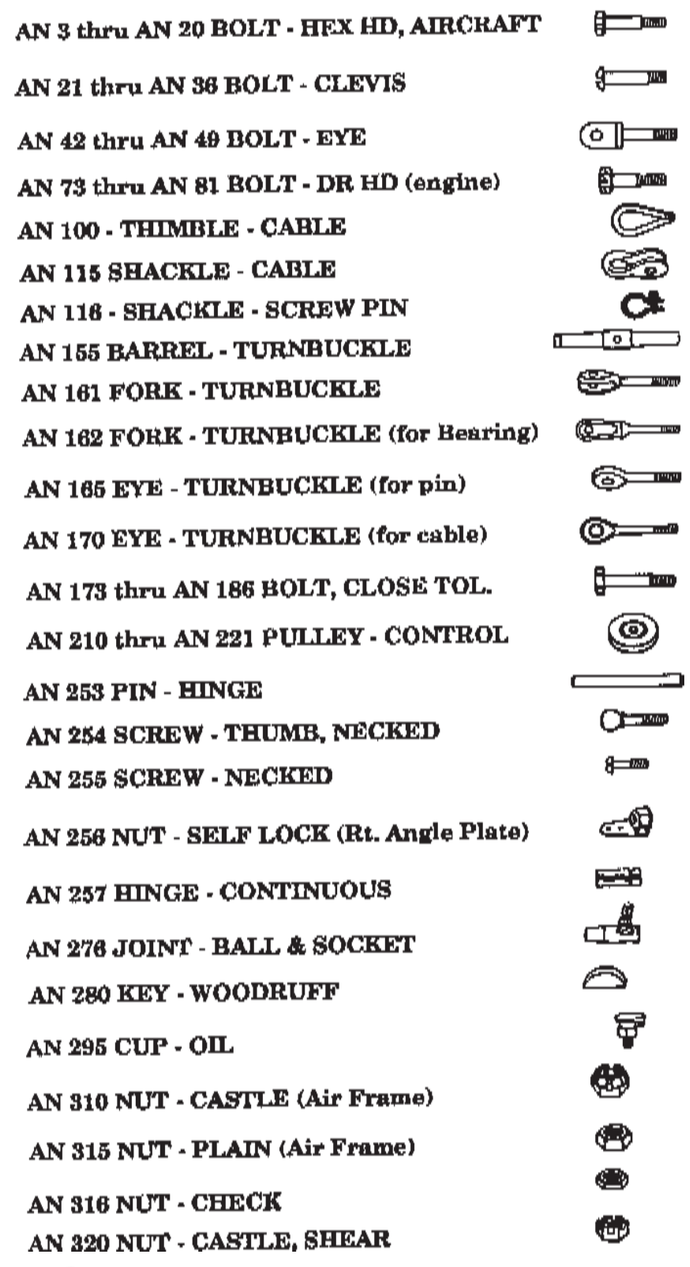
SAMPLE ILLUSTRATIONS, OTHER SYSTEMS MAY BE SUPPLIED AS STANDARD WITH YOUR AIRFRAME KIT. SEE ABOVE WARNING.

NOTE: Most epoxies have a manufacturer's recommended shelf life of typically one year. In some cases this is quite conservative. However, the manufacturers recommendations should obviously be followed.

F. AN- BOLT AND HARDWARE GUIDE

This guide to AN hardware can be helpful if you are not familiar with the code number system.

Fig. 1:F:1



AN 335 NUT - PL. HEX (NC) Semi-Fin)
AN 340 NUT - HEX, MACH. SCREW (NC)
AN 341 NUT - HEX, BRASS (Elec.)
AN 345 NUT - HEX, MACH. SCREW (NF)
AN 350 NUT - WING
AN 355 NUT - SLOTTED (Engine)
USAF 356 NUT - PAL
AN 360 NUT - PLAIN (Engine)
AN 362 NUT - PLATE, SELF-LOCK. (Hi-Temp.)
AN 363 NUT - HEX, SELF-LOCK. (Hi-Temp.)
AN 364 NUT - HEX, SELF-LOCK. (Thin)
AN 365 NUT - HEX, SELF-LOCK
AN 366 NUT - PLATE, SELF-LOCK
AN 373 NUT - PLATE, SELF-LOCK. (100° CTSK)
AN 380 PIN - COTTER
AN 381 PIN - COTTER, STAINLESS
AN 385 PIN - TAPERED, PLAIN
AN 386 PIN - THREADED TAPER
AN 392 thru AN 406 PIN - CLEVIS
AN 415 PIN - LOCK
AN 416 PIN - RETAINING, SAFETY
AN 426 RIVET - 100° FL. HD., ALUM.
AN 427 RIVET - 100° FL. HD., Steel, Monel, Copper
AN 430 RIVET - RD. HD., ALUM.
AN 435 RIVET - RD. HD., Steel, Monel, Copper
AN 442 RIVET - FL. HD., ALUM.
AN 450 RIVET - TUBULAR
AN 470 RIVET - UNIVERSAL HD., ALUM.

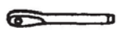
AN hardware guide (continued)

AN 481 CLEVIS - ROD END
AN 486 CLEVIS - ROD END ADJ.
AN 490 ROD END - THREADED
AN 500 SCREW - FILL. HD. (NC)
AN 501 SCREW - FILL. HD. (NF)
AN 502 SCREW - DR. FILL. HD. (Alloy Stl.) (NF)
AN 503 SCREW - DR. FILL. HD. (Alloy Stl.) (NC)
AN 504 SCREW - RD. HD. SELF TAP.
AN 505 SCREW - FLAT HD., 82° (NC)
AN 506 SCREW - FLAT HD., 82° SELF TAP.
AN 507 SCREW - FLAT HD., 100° (NF & NC)
AN 508 SCREW - RD. HD. BRASS (Elec.)
AN 509 SCREW - FL. HD. 100° (Structural) (ALLOY STEEL)
AN 510 SCREW - FLAT HD. 82° (NF)
AN 515 SCREW - RD. HD. (NC)
AN 520 SCREW - RD. HD. (NF)
AN 525 SCREW - WASHER HD. (Alloy Stl.)
AN 526 SCREW - TRUSS HD. (NF & NC)
AN 530 SCREW - RD. HD., SHEET METAL
AN 531 SCREW - FL. HD. 82° SHEET METAL (Type B)
AN 535 SCREW - RD. HD. DRIVE (Type "U")
AN 545 SCREW - WOOD, RD. HD.
AN 550 SCREW - WOOD, FLAT HD.
AN 565 SCREW - HDLESS., SET
AN 663 TERMINAL - CABLE, DBLE. SHK. BALL (FOR SWAGING)
AN 664 TERMINAL - CABLE, SGLE. SHK. BALL (FOR SWAGING)
AN 665 TERMINAL - CABLE, THDED. CLEVIS

AN 666 TERMINAL - CABLE, THDED (for swaging)

AN 667 TERMINAL - CABLE, FORK END (for swaging)

AN 668 TERMINAL - CABLE, EYE END (for swaging)



AN 669 - TERMINAL - CABLE, TURNBUCKLE (for swaging)

AN 737 CLAMP - HOSE

AN 741 CLAMP - TUBE

AN 742 CLAMP - PLAIN, SUPPORT

AN 900 GASKET - COP. - ASBESTOS, ANGULAR

AN 901 GASKET - METAL TUBE

AN 931 GROMMET - ELASTIC

AN 935 WASHER - LOCK, SPRING

AN 936 WASHER - LOCK TOOTH (Ext. & Int)

AN 960 WASHER - FLAT, AIRCRAFT

AN 961 WASHER - FLAT, BRASS (Elec.)

AN 970 WASHER - FLAT, LARGE AREA

AN 975 WASHER - TAPER PIN

AN 986 RING - LOCK

AN hardware guide (continued)

AN804 TEE, Flared tube with Bulkhead on run	**AN824** TEE, Flared Tube	**AN842** HOSE ELBOW, Pipe Thread 90°
AN807 ADAPTER Hose to Universal	**AN825** TEE, Flared Tube with Pipe Thread on side (MS20825)	**AN844** HOSE ELBOW, Pipe Thread 45°
AN814 PLUG AND BLEEDER, Screw Thread	**AN826** TEE, Tube with Pipe Thread on Run (MS20826)	**AN911** NIPPLE, Pipe Thread
AN815 UNION, Flared tube	**AN827** CROSS, Flared Tube	**AN912** BUSHING, Pipe Thread Reducer
AN816 NIPPLE, Flared Tube and pipe thread	**AN832** UNION, Flared Tube, Bulkhead and Universal	**AN913** PLUG, Square Head, Pipe Thread (MS20913)
AN818 NUT, Coupling	**AN833** ELBOW, Flared Tube, Bulkhead and Universal, 90°	**AN914** ELBOW Internal and External Pipe Thread, 90°
AN819 (MS20819) SLEEVE, Coupling	**AN834** TEE, Flared, Tube, Bulkhead and Universal	**AN915** ELBOW, Internal and External Pipe Thread, 45°
AN821 ELBOW, Flared Tube, 90°	**AN837** ELBOW, Flared Tube, Bulkhead and Universal, 45°	**AN919** REDUCER, External Thread
AN822 ELBOW, Flared Tube and Pipe Thread, 90° (MS20822)	**AN838** ELBOW Hose to Universal, 90°	**AN924** NUT, Flared Tube, Bulkhead and Universal Fitting
AN823 ELBOW, Flared Tube and Pipe Thread, 45° (MS20823)	**AN840** HOSE NIPPLE, Pipe Threaded	**AN929** CAP, Flared Tube Fitting

Torque Chart
Fig. 1:F:2

BOLTS Steel Tension	BOLTS Steel Tension	BOLTS Aluminum
AN 3 thru AN 20 AN 42 thru AN 49 AN 73 thru AN 81 AN 173 thru AN 186 MS 20033 thru MS 20046 MS 20073 MS 20074 AN 509 NK9 MS 24694 AN 525 NK525 MS 27039	MS 20004 thru MS 20024 NAS 144 thru NAS 158 NAS 333 thru NAS 340 NAS 583 thru NAS 590 NAS 624 thru NAS 644 NAS 1303 thru NAS 1320 NAS 172 NAS 174 NAS 517	AN 3DD thru AN 20DD AN 173DD thru AN 186DD AN 509DD AN 525D MS 27039D MS 24694DD
	Steel shear bolt NAS 464	

NUTS		NUTS		NUTS	
Steel Tension	Steel Shear	Steel Tension	Steel Shear	Aluminum Tension	Aluminum Shear
AN 310 AN 315 AN 363 AN 365 NAS 1021 MS 17825 MS 21045 MS 20365 MS 20500 NAS 679	AN 320 AN 364 NAS 1022 MS 17826 MS 20364	AN 310 AN 315 AN 363 AN 365 MS 17825 MS 20365 MS 21045 NAS 1021 NAS 679 NAS 1291	AN 320 AN 364 NAS 1022 MS 17826 MS 20364	AN 365D AN 310D NAS 1021D	AN 320D AN 364D NAS 1022D

FINE THREAD SERIES

Nut-bolt size	Torque Limits in.-lbs.		Torque Limits in.-lbs.		Torque Limits in.-lbs.		Torque Limits in.-lbs.		Torque Limits in.-lbs.		Torque Limits in.-lbs.	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
8 -36	12	15	7	9					5	10	3	6
10 -32	20	25	12	15	25	30	15	20	10	15	5	10
¼-28	50	70	30	40	80	100	50	60	30	45	15	30
5/16-24	100	140	60	85	120	145	70	90	40	65	25	40
⅜ -24	160	190	95	110	200	250	120	150	75	110	45	70
7/16-20	450	500	270	300	520	630	300	400	180	280	110	170
½ -20	480	690	290	410	770	950	450	550	280	410	160	260
9/16-18	800	1, 000	480	600	1, 100	1, 300	650	800	380	580	230	360
⅝ -18	1, 100	1, 300	660	780	1, 250	1, 550	750	950	550	670	270	420
¾ -16	2, 300	2, 500	1, 300	1, 500	2, 650	3, 200	1, 600	1, 900	950	1, 250	560	880
⅞ -14	2, 500	3, 000	1, 500	1, 800	3, 550	4, 350	2, 100	2, 600	1, 250	1, 900	750	1, 200
1 -14	3, 700	4, 500	2, 200	3, 300	4, 500	5, 500	2, 700	3, 300	1, 600	2, 400	950	1, 500
1⅛ -12	5, 000	7, 000	3, 000	4, 200	6, 000	7, 300	3, 600	4, 400	2, 100	3, 200	1, 250	2, 000
1¼ -12	9, 000	11, 000	5, 400	6, 600	11, 000	13, 400	6, 600	8, 000	3, 900	5, 600	2, 300	3, 650

Note: All bolts should be torqued according to the above chart unless otherwise specified.

G. BASIC SHOP TOOLS

The tools listed are not mandatory for your shop, but we have found them extremely useful in ours. The tools we feel are most important are marked with an asterisk (*).
You probably won't be familiar with some of the tools listed, but the purpose and description of these items will be explained.

Saber saw (jig saw)*

Very handy for cutting out large or complex shapes from pre-preg material. You can use a manual saw, but it won't be fun, or a very pretty sight. Either way, be sure you get sharp blades, and change them often. Dull blades will chew up the edges and make for more sanding/smoothing work later. We use carbide tipped blades exclusively for composite cutting. They work great.

Electric and / or cordless drill motor*

Most of the material you would have to drill on a glass kit is fairly soft and thin, and should require no more than a small drill motor with at least a 3/8" chuck. If you don't already have one, go buy one with a variable speed (variable, not two speed), and get one with a 1/2" chuck. The extra couple of bucks they cost will be worth it in the long run, and some of the stuff you need to drill, like plastic parts, must be drilled at a very slow speed that is below the range of all single and most two speed drills.

Drill press

Here's a tool that most people don't have, but no one that's ever had one will be without again. For precision drilling it is a must. For instance, it can be used in drilling out broken bolts, and with a fly-cutting tip it can cut holes large enough to amaze your neighbors. I wouldn't run right out and buy one just for building the plane, but I would make friends with that guy down the street that has one gathering dust in his garage.

Drill bits (Numbered AND Fractional)

It takes a lot of cheap drill bits to make a lousy hole that one good bit could have made quickly and perfectly. If you have a vault to keep them safe in, bite the bullet and buy a good set of numbered drill bits. If cared for, they will last longer and give you better service than your foreign made car. Unfortunately, a good set will seem to cost about as much as that car.

Rotary sander (rotary or orbital type)*

This, I would go out and buy for building a kit-plane, unless you want arms like Arnold Schwarzenegger. It will definitely make sanding and smoothing the rough edges a lot easier, and a good orbital can be had with a trapper bag to keep a lot of the "stuff" out of the air. And your clothes. And your nose. And everywhere. We don't use one with a bag here, which is why sometimes even in July it looks like it just snowed in the shop.

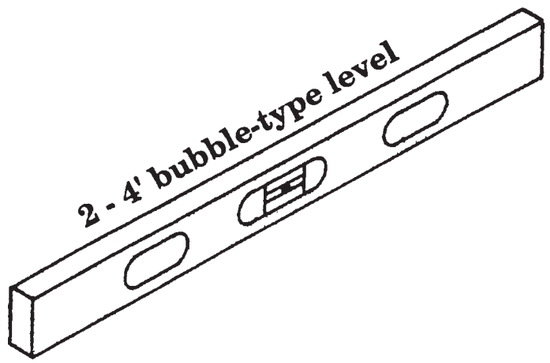
Die grinder (angle grinder)

If you have one, bravo. This is a powerful tool that can custom fit your ribs and bulkheads quickly. Be very careful though, if the high speed grinder surface gets away from you, it can quickly customize everything in the general vicinity. While not a necessity, if you have a used tools store in the area, it would give you an excuse to browse around.

2 & 4 ft. Carpenter's levels*

If you want a plane to fly straight, you should build it straight. These are indispensable in a good shop. Get the good aluminum ones (you'll be holding them up, down and at various angles in between for hours at a time), make sure they have straight edges, and round the sharp ends a bit so you won't gouge any holes into precious prepared surfaces. All you might find is just a few, little, easily filled dents.

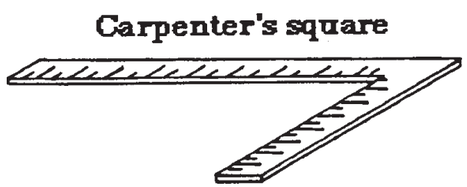
Carpenter's Level
Fig. 1:G:1



Carpenter's square

Buy this when you get the carpenter's levels, and for the same reason. Don't round these ends, just be careful.

Carpenter's Square (Framing Square)
Fig. 1:G:2.



Clamps (Vise grip clamps, spring clamps, and "C" clamps)

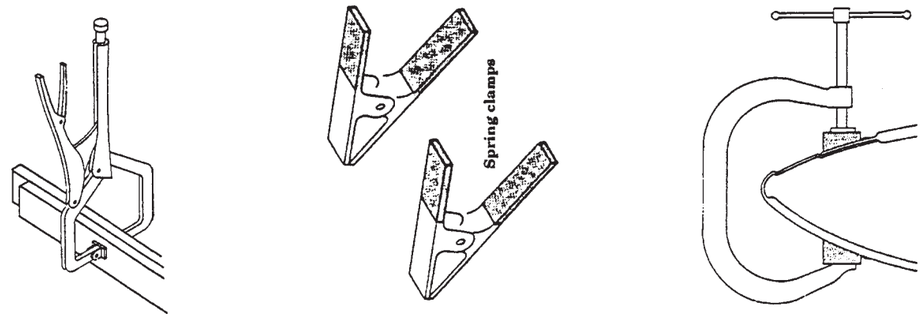
Here's a brief description of the clamps you will need.

A couple of the vise grip clamps for really forcing things together (never-stress again, never use these on any fiberglass, prepreg or carbon composite parts. They grip with enough force to do great damage to the parts, which may not be visible to the naked eye.)

Spring clamps- get a bunch of these when you wander through the used tool store. Three or four large ones like Arnold uses for strengthening his grip, and about a dozen that you can work with one hand while you try to hold the six other parts in exact proper position.

"C" clamps. These should be in the bin next to the spring clamps in the used tool store. If there is an assortment, get three or four of each. Again, use caution when applying these to any glass parts. Tighten slowly, and only until just snug.

Clamps, Assorted
Fig. 1:G:3



Now that you have clamped the parts together and drilled the holes, the instruction book tells you that you need to insert pop rivets. The best thing to do this with is a pop rivet tool. The second best thing to do this with doesn't work. Get the pop rivet tool. It should come with three extra tips for use with all four common sizes of pop rivets, 3/32", 1/8", 5/32", and 3/16". Three cheap ones will get you through most any project, but a good one will last a lifetime. Get the good one. Besides, it's cheap if you buy it at that used tool store you've been spending so much time in lately.

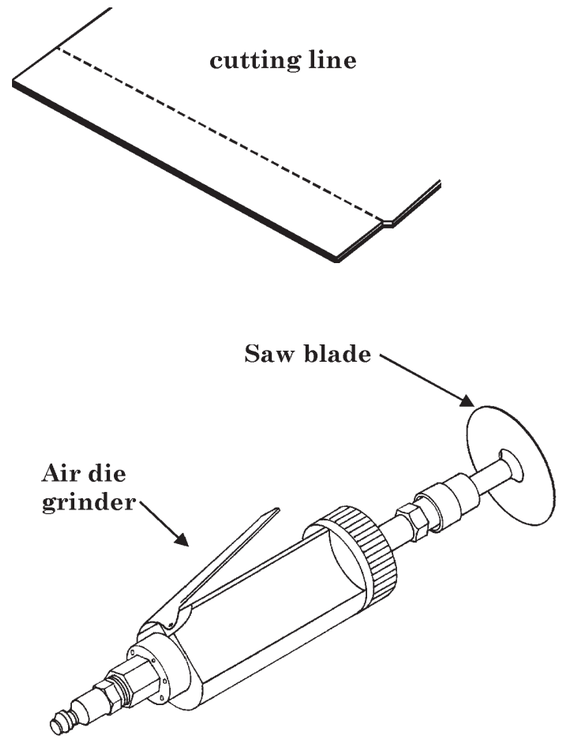
SPECIALIZED TOOLS

We call them specialized shop tools because it makes it a little easier to swallow the higher price tags on these items. Again, the tools listed are not mandatory for your shop, but we have found them extremely useful in ours. The tools we feel are most important are marked with an asterisk (*).

Air die grinder tool*

The one we have shown here has a saw blade installed, but they come with a fantastic array of special bits (there's that special word again). We can't imagine building a composite aircraft without a die grinder tool. You'll use this tool more than any other in your growing collection.

Die Grinder
Fig. 1:G:4

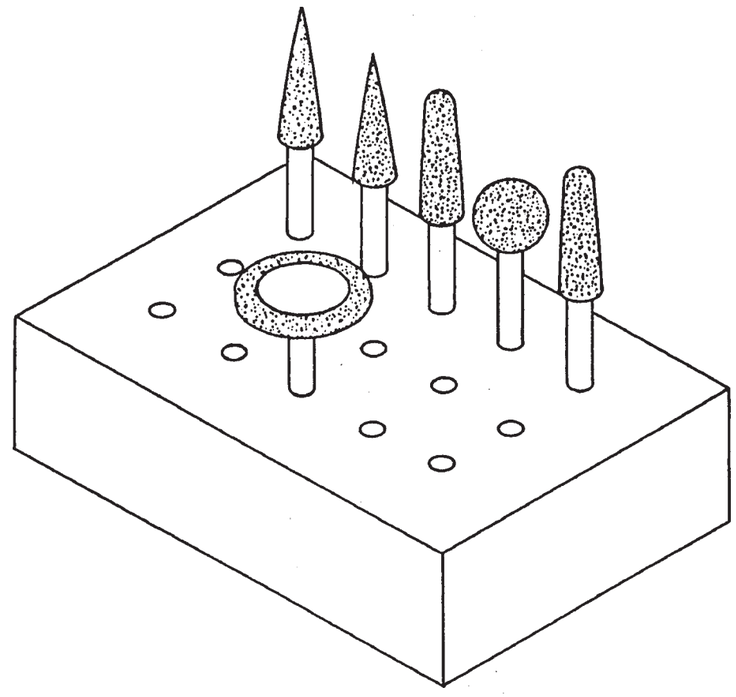


Note: If you don't have an aircompressor consider getting a Dremmel tool. The Dremmel works similarly to the air die grinder but it is not as powerful.

Tungsten carbide bits for Dremel tool*

During construction of the prototype Lancair we were in need of a Dremel bit that could easily cut prepreg. The prepreg is very easy to work with, but it eats power tool blades/bits for breakfast. Dremel's tungsten carbide cutters come in various shapes and sizes and are the best bet. Some Dremel part numbers to look for are 9931 through 9936. We now use these bits almost exclusively because they really cut. As long as you don't use them on aluminum or Kevlar™, which tend to gum them up, the carbide bits last a long time. They're expensive, though. We paid about $12.00 for a single bit, but they're worth it in the long run. For availability check hobby stores, hardware stores, Sears, as well as the Lancair Kit Components, Inc. (KCI) Catalog. They also offer a wide range of cutting, grinding, buffing, polishing, etc. bits for use with the Dremel. If they have them at that used tool store, get one of each. You may never use them all, but they'll sure impress your neighbors. Especially if you make one of these snappy little holders to display them in. You can make it out of a piece of 2x4, drilling holes as you add bits to your collection.

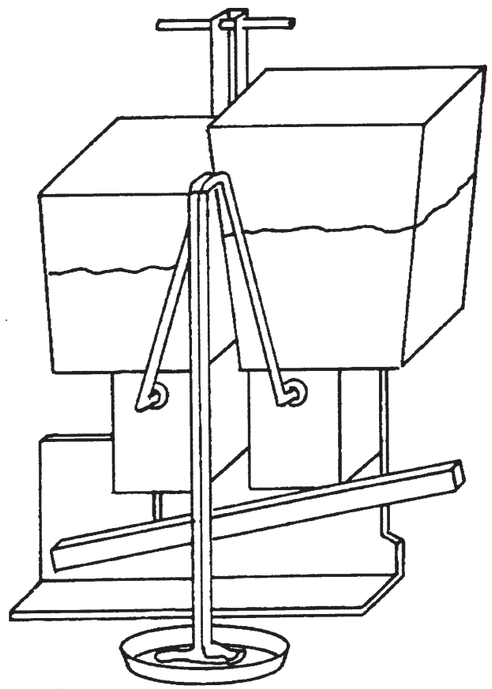
Tungsten Carbide Bits and Snappy Little Holder
Fig. 1:G:5



Epoxy pump (Sticky Stuff dispenser)*

The Sticky Stuff dispenser will pay for itself in saved epoxy. With every pump of the handle, you receive the proper amount of resin and hardener, no weighing, no measuring. With practice you'll know the proper number of pumps needed for the size of lamination you are doing. We offer this item in our KCI catalog, and highly recommend its use. Many builders are using a light bulb heated box over their epoxy pumps to keep the epoxy warm and thin. This is fine, we do the same, but if you're not going to use the pump for a week or so, turn the light bulb off in the box. Otherwise the volatiles in the epoxy can evaporate out and cause faulty curing or no curing at all. If you are a dedicated builder, using the pump every night (I've heard there are such people) you needn't worry about evaporation and can leave the heat on. Use no higher than a 25 watt bulb in your pump box.

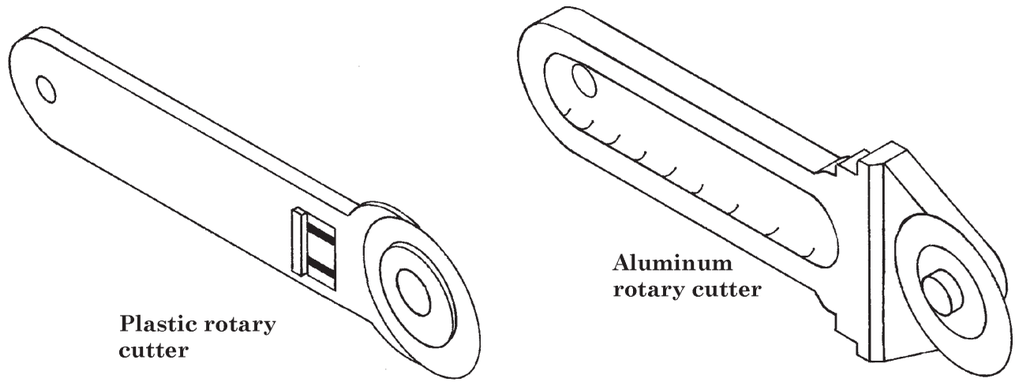
Epoxy Pump
Fig. 1:G:6



Roller blade for cutting fiberglass*

Don't even think of using scissors to cut the fiberglass you've just unrolled on your new cutting table. That's like using a 1/2" brush to paint the Golden Gate Bridge. Use a roller blade (looks like a pizza cutter, but it ain't) and you'll cut the time you spend cutting cloth in half (at least!). These roller blades are available through our KCI catalog, or your local fabric store. They sell under the names of roller blades, rotary cutters, and fabric cutters, but all models closely resemble each other. Pick up a couple of extra blades when you buy it and save yourself a trip later. We suggest getting the aluminum rotary cutter (P/N G-T-01001) for fiberglass work as it tends to last much longer and stands up to acetone.

Roller Blade
Fig. 1:G:7

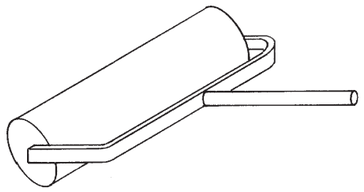


Here at Lancair, our pet name for the roller blade was "pizza cutter". As word spread to our builders of this handy tool, sure enough, we started getting complaints that these vaunted "pizza cutters" didn't cut fiberglass worth a s@*t. Yes, they were using true pizza cutters, not actual blades. Sorry for the mix-up, guys, gals and abondanza!

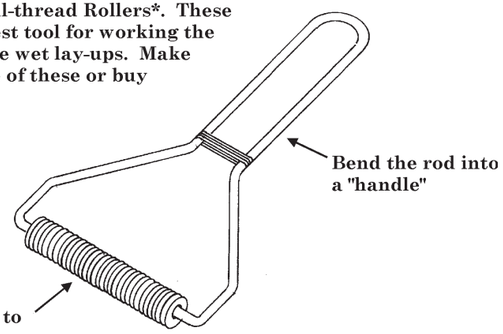
2" side paint roller (without furry part) or wallpaper roller*

Another simple but handy tool in our shop is the roller. We use a small, 1-1/2" wide paint roller (without the furry paint sleeve), and a larger, 3" wide roller for pushing the air bubbles out from under laminates. Try sliding a length of PVC tubing onto the paint roller to get a smooth, hard rolling surface. Common paint rollers work okay, but we made a solid aluminum roller that works even better. Wallpaper rollers are also good for this application.

Smooth, Hard Faced Roller
Fig. 1:G:8



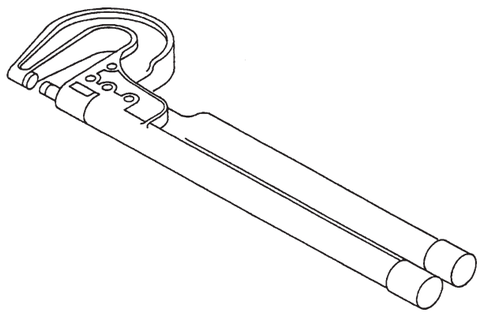
1 to 1-1/2" wide all-thread Rollers*. These rollers are the best tool for working the bubbles out of the wet lay-ups. Make yourself a couple of these or buy them finished.



Rivet squeezer

This tool will save hours whenever you are installing rivets. Next trip to the used tool store, get one of these, too.

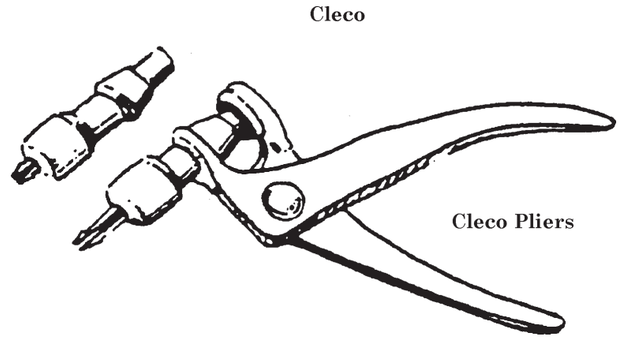
Rivet Squeezer
Fig. 1:G:9



Cleco™ Pliers and Clecos*

These are very handy. You should have the Cleco plier (P/N C-200) tool and about 50 of the Cleco bits (P/N C-1/8). We sell them, use them and recommend them to all of our friends.

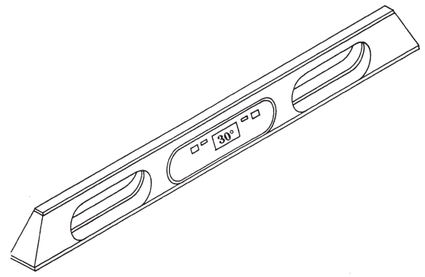
Clecoes and Cleco pliers
Fig. 1:G:10



Digital level*

The digital Level has an LCD readout instead of a bubble. The center of some digital Levels pops out to become a small, six inch level that's extremely handy for measuring control surface throws, seat back angles, firewall angles, engine thrust lines, etc., all with an accuracy of 1/10th of a degree.

The Digital Level
Fig. 1:G:11



You aren't very likely to find one of these at that used tool mart. We've received a few inquiries where to buy digital levels. KCI is now carring a digital level. It's not cheap, over $100 just for the center module, progressively more expensive with the longer rails. This is a great tool, but always remember to re-calibrate the level module when you turn it on, otherwise you could be off by a couple of degrees.

KCI
Kit Components, Inc.
2244 Airport Way
Redmond, Or. 97756
541-923-2244
kci@lancair-kits.com

Tubing bender

This will be at the used tool store, where you should be on a first name basis with the owner by now. Tell him you just need one for 1/4" tubing. It should be in the bin right next to the 37° Flaring tool.

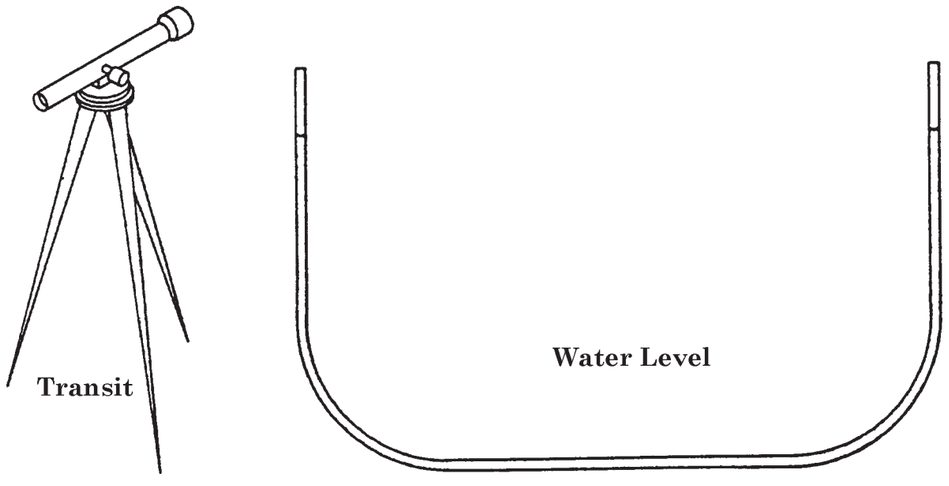
37° flaring tool

Keep this with your tube bender. You won't need it often, but when you do nothing else will work. Don't use automotive type flaring tools- they have a different flaring angle.

Surveyor transit

If you love gadgets, this one will be fun, but a water level would work just as well for a whole lot less money (just keep a mop around). It may save you an hour or two in setup time, and can usually be rented from surveyor/construction suppliers. Like the water level, it still takes two people to use it effectively, but you can quickly level fuselages, wings, horizontal stabs and jigs, staying dry in the process.

Transit and Water Level
Fig. 1:G:12



Water level

A cheap and simple means of checking wing washout, horizontal stabilizer position, and other big jobs on the airframe. We use 1/4" inch I.D. clear tubing, available at the hardware store. I've heard that dying the water in your water level tube with food coloring can make it easier to read, but when I tried it, the coloring didn't help much, it just messed up the tube.

Plumb bob

These should be laying around the tool store somewhere. Since you will be (hopefully) working indoor out of the wind, you will only need a small one for measuring things for vertical.

1" Makita belt sander

A real handy item, you might score one of these at the local tool shop (isn't your wife starting to wonder about all the time you've been spending there lately?). Get an assortment of different grit belts for it, they'll all come in handy before this is over.

Heat gun

If you have one of these, it can help to warm a couple of parts you want to bond, to straighten a warped part, or a lot of other jobs. It can also destroy parts if care is not taken. Take care when using. The heat gun is a well used tool in our shop, not only for heating parts but for gently heating to cure epoxy, shrinking heat shrink tubing on electrical connections, etc.

SUPPLIES

1 mil thick plastic drop cloths

You will use a lot of these. Fortunately you can probably get them at most hardware stores for about a buck a roll. They're not only great for covering things, but you'll be using them in the preparation of BID tapes and other fiberglass layups. Get several, but be sure they are all the 1 mil thick ones. Thinner, and they won't be easy to handle and thicker, they will be too hard to work . More about that later.

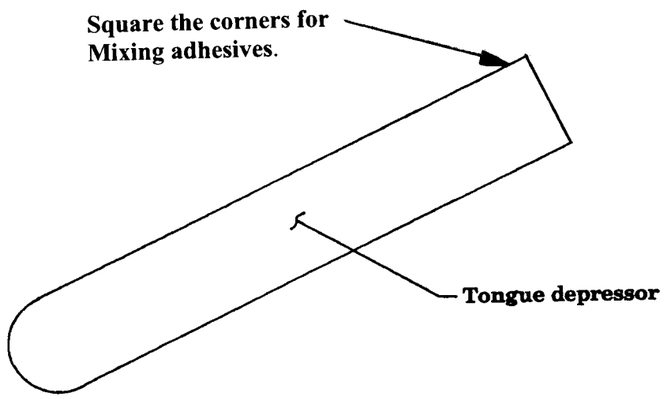
Paper towels

If you have a lot of storage room, buy these by the case. If not, keep at least 3 or 4 rolls on hand. You'll be using them for cleaning up drips and dribbles of this and that, as well as using them for some other trick things we'll talk about later in Chapter 5.

Tongue depressors

We supply these in the kit, and there should be enough to complete the project with a few left over. You'll be using them mostly for mixing sticks to mix up the epoxy you pump from your nifty Sticky Stuff epoxy dispenser (you do have that on order now, don't you?). You will also be shown how to make a neat little tool out of one later, the kind that you will want to cherish and hang from a special hook on your shop wall.

Tongue Depressor
Fig. 1:G:13



Brushes (1" wide)

These too are supplied in the kit. There's a whole bunch of them in there, but don't give them away, you'll need most of them for the project. Simply clean in acetone and re-use.

Brush, 1" Wide
Fig. 1:G:14

Note: Cut half of the bristles off

Rubber squeegees

Hit up the auto parts store for a set of the plastic Bondo™ smoothing paddles. There should be 3 or 4 different sizes in the package. They will all come in handy for getting excess epoxy and air out of layups, applying and smoothing out micro, and any number of other things. Clean up is pretty easy and they should last through the project.

By cutting them in half, they fit perfectly into most rubber hand sanding blocks. 3M calls them "The Green
Corps" and, of course,the paper is green. Auto body supply and auto paint stores should carry it.

Instant glue

You'll find some of this in the kit, and it will come in handy for many of the steps called out in the manual. You can use it to temporarily tack most any parts together, it is void-filling, and it can become permanent if you use too much. Just a drop or two will suffice for any of the steps in the manual. You can use it to glue a piano hinge in place and measuring where clecoes would get in the way. You can test the placement of brackets, you can find your wife using it to repair broken fingernails, you can lose it to the rest of your household of you don't keep it hidden somewhere. If they do get it, just call us. We keep it in stock, along with the accelerator spray.

Instant glue accelerator

The ultimate stuff for impatient people, this makes instant glue even faster (more instant?). A quick spray of this stuff and the glue is set, right now.

The eyeball

Our last tool used to check how straight an edge is, it is the most complicated in design and yet the cheapest and most accurate of all. It's called the human eyeball. These eyeballs are widely available and should be used whenever possible.

Eyeball
Fig. 1:G:15

If an edge or surface looks straight to the eye, they are straight enough. Even minor discrepancies in wing tip washout can easily be detected by kneeling down ten feet in front of your Lancair, closing one eye, and swiveling your head. Sight one trailing edge tip above the high point of the wing, swivel your head, and sight the other tip, comparing the two. The eyeball, use it!

I. PROCEDURE

Cleaning, care, and handling of parts

1. Cleaning Parts
You will find instructions calling for the use of cleaning agents throughout this manual. We have found that Methylene Chloride (MC) cleaner is very good in its ability to remove impurities from surfaces. As with all cleaners, be sure to read and follow the safety directions. Acetone is a good cleaner but Methylene Chloride (MC) is superior. *MEK should not be used.*

2. Storage of Premolded Parts
The manner in which your pre-molded parts are stored is very important. Care and thought should be exercised when laying pre-molded parts away for some future use which could be months away. Try to store these parts in a position that won't produce any distorting forces (i.e., store them supported in a position as close to the actual use orientation as possible).

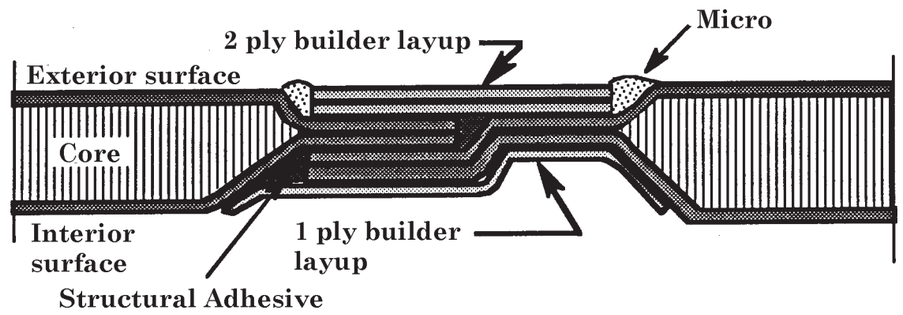
Unlike fiberglass composite parts, the carbon fiber parts are much stiffer and less prone to distortion, however it is still highly recommended that great care be exercised when storing these valuable components. Also, all composite parts should be kept away from direct sunlight for any extended periods of time. An afternoon or a day is perhaps okay. However a week, for example, in direct sunlight would not be acceptable.

3. Honeycomb Prepreg Panels
The prepreg honeycomb panels are available in two types: 3/8" core + 2 BID per side and 1/4" core + 1 BID per side. All BID ply schedules must remain the same when using prepreg panels (i.e., if a part calls for 6 BID on one side and 2 BID on the other side, the 2 BID honeycomb panel will require 4 additional BID on the first side). Also, all attachment BID schedules must remain the same (i.e., if plans call for a 6 BID attachment, then 6 plies (wet layup) must be used.) Typically 1" contact on each surface unless otherwise noted is sufficient.

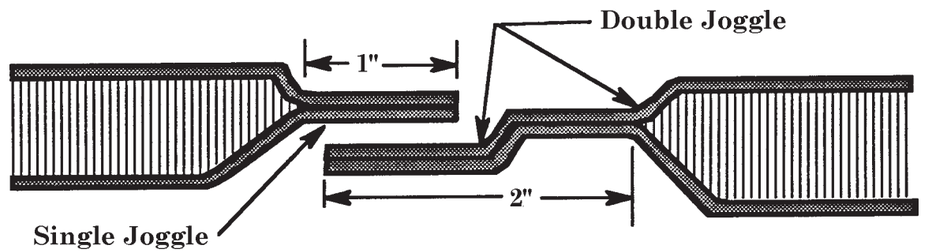
J. JOINT DESCRIPTION

Adjoining parts are attached with bonded, overlapping joints (joggles) reinforced with fiberglass strips, see Figure 1:J:1. Figure 1:J:2 shows the overlaps prior to assembly (the dimensions shown in the figures are approximate). As supplied, the part edges may have excess material. To obtain the dimensions shown the excess material must be trimmed by the builder.

Reinforced Overlapping Joints
Fig. 1:J:1



Trimmed Parts
Fig. 1:J:2



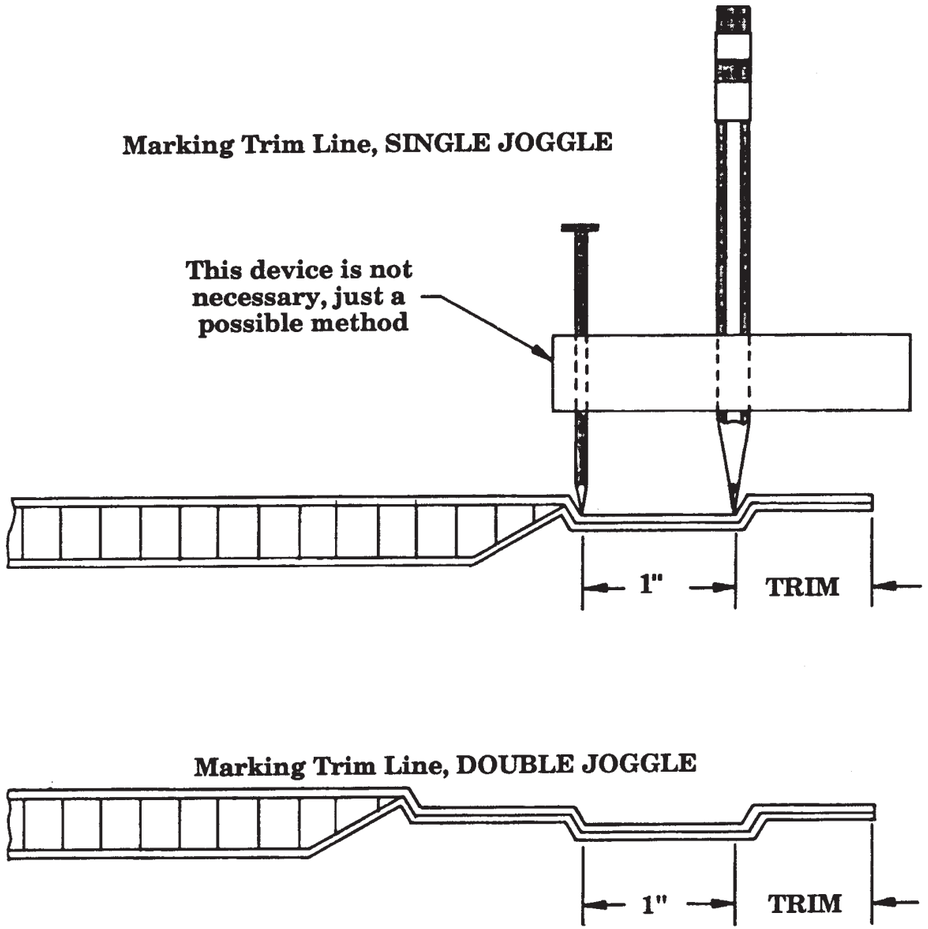
Note: Before trimming, single and double joggle surfaces may look similar. To learn what each looks like, examine the front of the fuselage. The joggle that is forward of the firewall, where the bottom cowl will meet, is an example of a single joggle. The area above and behind the firewall, where the forward deck will mount, is a double joggle.

CAUTION:
EDGES OF PARTS MAY BE SHARP. HANDLE WITH CARE, USE GLOVES OR FILE/SAND OFF SHARP EDGES.

K. TRIMMING PROCEDURE

1. Place the fuselage on a convenient working surface. Mark a line on all joggle surfaces as shown in figure 1:K:1. A marking tool can be made from a piece of wood, a nail and a pencil. Make sure the nail tip is well rounded and has no sharp edges which could damage the glass fibers during use. On double joggled surfaces, mark a line as shown in figure 1:K:1.

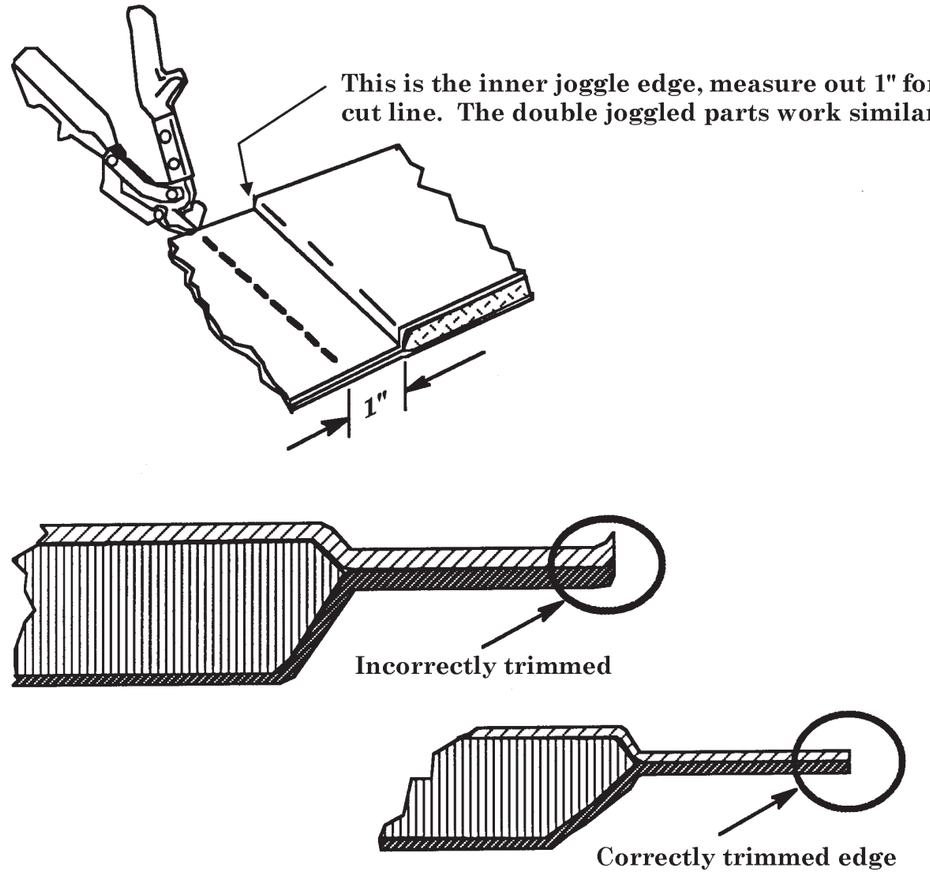
Trimming Procedure
Fig. 1:K:1



2. Using the shears, cut along the lines. Refer to Figure 1:K:2 for proper appearance of the edge after trimming. If necessary, trim additional material to obtain correct edge shape. Some sanding may be useful to complete the trim and smooth the edge.

3. Repeat this trimming procedure for all joggles.

Shearing Joggle
Fig. 1:K:2



L. DRILLING ALIGNMENT HOLES

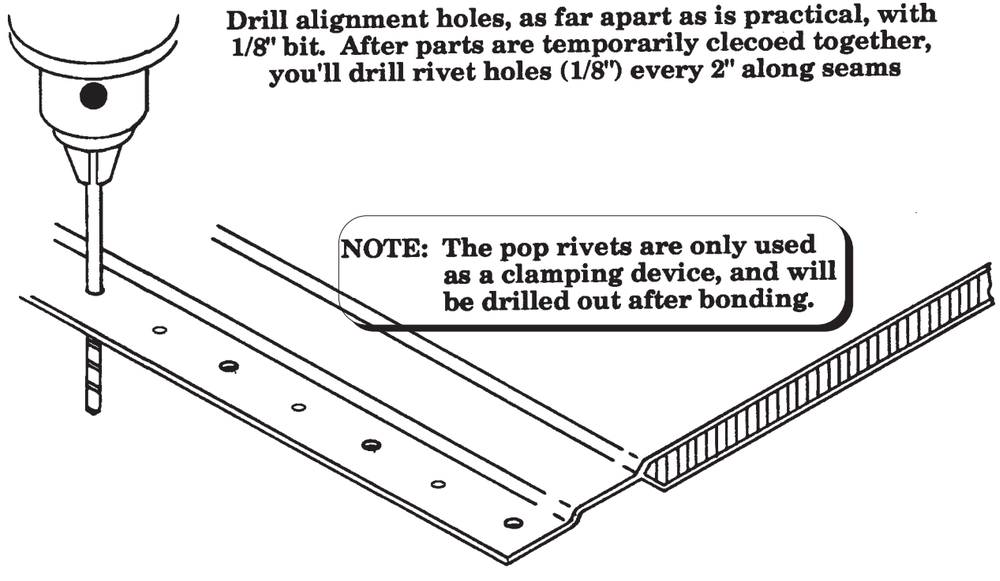
1. Equipment required:
   Electric drill
   1/8" Drill bit

2. Procedure
   To obtain proper overlap alignment during assembly, holes are drilled for screws or clecoes, which are placed in these holes to hold the parts in proper alignment during cure time.

Using a 1/8" drill bit, drill alignment holes in the two parts to be joined (See Fig. 1-27).

Place screws or clecoes in the alignment holes, and drill the rivet holes every 2" in-between alignment holes.

Drilling Alignment Holes
Fig. 1:L:1



M. REMOVING THE PROTECTIVE COATING (PEELPLY)

1. Description of Parts
Molded parts are shipped with a protective coating of "peelply" material on their inner surfaces. This material will interfere with bonding and must be removed. The peelply usually sticks out from the edge of a part in at least one area and looks like white cloth. Where the peelply meets and lays on the part surface it becomes transparent.

WARNING:
ALL PEELPLY MUST BE REMOVED FROM BOND AREAS TO OBTAIN GOOD BONDS. BONDING OR LAYING FIBERGLASS OVER PEELPLY COULD RESULT IN STRUCTURAL FAILURE.

Most of the peelply has already been removed from your pre-molded parts, but some may remain.

Peelply is removed by hand. It can require considerable force to pull the peelply off in some places. As it is pulled off, it usually tears off in odd shaped pieces. Use a utility knife to pick up a new edge when necessary. Use care not to cut into the glass of the parts.

The white cotton strips running in irregular directions on the surface of the peelply are required by the manufacturing process. These will come off with the peelply but more pulling force will be required.

NOTE: Although removing peelply looks simple, it can cause serious injury if your hand slips and scrapes a sharp edge. This has happened to us here at Lancair and it is not at all fun. **Please be careful.** The peelply can be removed from parts at this time. However, it does provide some protection and may be left on until those parts are needed for assembly. **At that time it MUST be removed.**

It takes practice to drill a close tolerance hole in aluminum and fiberglass. We're not all precision machinists here at the shop, but through trial and error we've come up with some drill combinations that work well for various size screws and rivets.

First a note about tolerances. When a bolt is holding a bracket tight against a bulkhead, rib, firewall etc., you needn't drill a .001" tolerance hole, because the bolt's clamping action will keep the bracket from wearing the bolt hole larger. This applies to rod end bearings and bellcrank bearings that are mounted tight with elastic locknuts. In this case, the slop in the bearings are not dependent on the tolerance of the holes.

Here is a list of drills we commonly use for various bolts and rivets:

-AN 426 rivets are .097" diameter, use #40 drill.

-1/8" rivets are .125" diameter, use 1/8" or #30 (.1285") drills.

-#6 screws are .137", drill a sloppy #29 (.136) hole or a tight #28 (.1405").

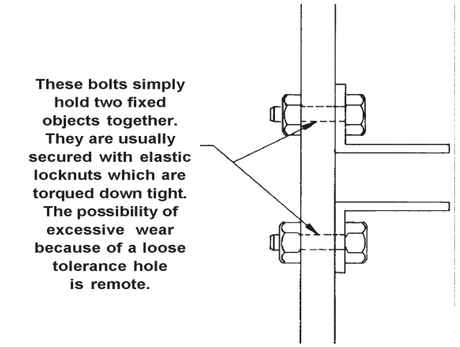
-#8 screws are .161", #20 (.161") and #21 (.159") both work well.

-3/16" (AN3) bolts can use, in addition to the obvious 3/16" drill, a #13 hole with reaming to get a tight fit, (See above section when and where this is necessary). A #12 hole is sometimes too sloppy but can be used for unimportant, quick and dirty holes.

-1/4" (AN4) bolts use 1/4" drill, of course. Also handy are lettered drills, like "E" (.250") or D (.246") with a reamer.

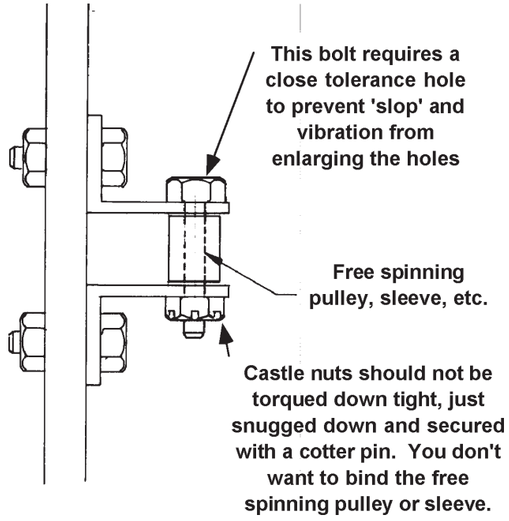
When drilling, creep up on your final drill size. If you want a tight AN4 hole and simply use a 1/4" drill first, the hole will be loose and usually triangular shaped. Try drilling a 3/16" hole first, then 7/32", then 1/4". The extra one minute spent changing drills is well worth it, especially if you're drilling a hole that needs a tight tolerance (See above).

Bolt Holes Not Requiring Tight Tolerance
Fig. 1:N:1



One the other hand, bolt holes that require close tolerance are those in which the bolt can rotate freely. When a castle nut and cotter pin are called for, it means the nut and bolt will not be tightened against a fixed object but will allow the object to float between the brackets. A loose tolerance bolt hole will allow the bolt to vibrate and slowly enlarge the hole.

Bolt Holes Requiring Tight Tolerance
Fig. 1:N:2



O. FASTENING PARTS TOGETHER

1. When parts are to be fastened together using epoxy or structural adhesive, they must be held tightly in position until the bonding material has set. Several methods are available, but pop rivets remain the best way to be sure of a proper bond. Typically, the bonding sequence is:

The parts are prepared for bonding-

a. peelply is removed

b. Joggled surfaces are trimmed

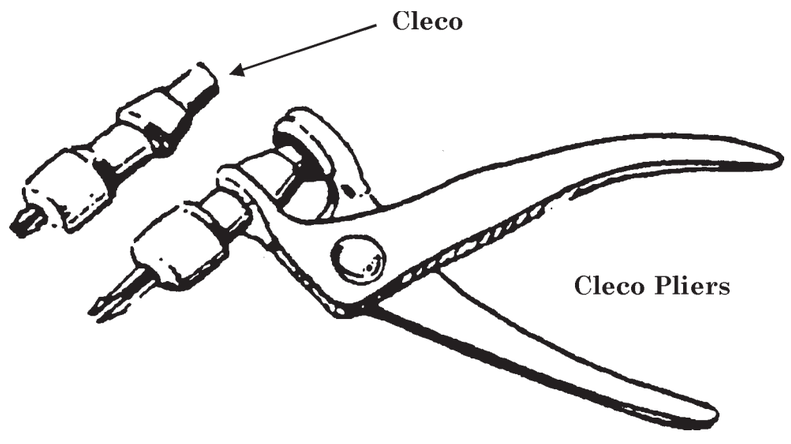
c. Alignment holes are drilled

d. Sheet metal screws or clecoes* (Fig. 1:O:1.) are installed into these holes to hold the parts in alignment while holes are drilled about every 2" from pop rivets.

*Clecoes™ are a sheet metal fastening device used extensively in the aircraft industry (refer to Fig. 1:O:1). A special pair of pliers (cleco tool) is used. The tip of the cleco is inserted into the alignment hole. When the pliers are released, the cleco locks itself into the holes, tightly holding the parts together. Clecoes and cleco pliers are available from aircraft supply stores or catalogs (ours included). Surplus clecoes are inexpensive, and only about 15 are needed for the construction of your airplane.

NOTE:
Either sheet metal screws or clecoes are used as fasteners. If the fastener you will use has grease, oil or other such contaminates, it must be thoroughly cleaned before use to prevent contamination of surfaces which will be bonded later. Methylene Chloride may be used as a cleaning fluid.

Cleco and Cleco Pliers
Fig. 1:O:1



Squeeze the pliers and the grippers extend and come together. Insert into the hole, press parts together, and release the cleco. The grippers will spread, holding the parts together.

e. The surfaces to be bonded must now be cleaned since they may have become contaminated during handling and storage. The screws or clecoes are removed and the surfaces to be bonded are cleaned thoroughly with wax and silicone remover, acetone or MC.

WARNING:
FAILURE TO FOLLOW CLEANING STEPS CAN RESULT IN EVENTUAL BOND FAILURE. EVEN SURFACES WHICH APPEAR CLEAN MUST BE CLEANED SINCE NOT ALL CONTAMINANTS ARE OBVIOUS.
FOLLOW CAUTIONARY LABEL ON THE WAX AND SILICONE REMOVER CONTAINER. WAX AND SILICONE REMOVER IS FLAMMABLE AND MUST BE KEPT AWAY FROM SPARKS, HEAT AND OPEN FLAMES. HARMFUL OR FATAL IF SWALLOWED. DURING USE AND UNTIL ALL VAPORS ARE GONE: KEEP AREA WILL VENTILATED AND DO NOT SMOKE. EXTINGUISH ALL FLAMES, PILOT LIGHTS AND HEATERS. TURN OFF STOVES, ELECTRICAL TOOLS AND APPLIANCES THAT COULD ACT AS AN IGNITION SOURCE. VAPOR IS HARMFUL. AVOID BREATHING VAPORS AND USE ONLY WITH ADEQUATE VENTILATION. AVOID SKIN AND EYE CONTACT. WEAR RUBBER GLOVES OR SUITABLE PROTECTIVE SKIN BARRIER. WASH HANDS IF THEY COME IN CONTACT WITH THIS LIQUID. IF SPILLED ON CLOTHING, REMOVE AND LAUNDER BEFORE RE-USING.

f. Dampen one cloth or piece of toweling well with the wax and silicone remover and wipe it along the bond surface of either part. Do not rub or scrub the surface as that may work the contaminants into the surface. Follow within seconds with a dry cloth or toweling piece to absorb the solvent and the contaminants it removes from the bonding surface.

g. Continue that process until that seam has been cleaned. Then replace both the wetting and drying cloths with new pieces and repeat the cleaning process for the other half. It at any time the wetting or drying cloth shows any soiling or the drying cloth becomes wet, replace it immediately with a new one.

h. If any obvious contaminants still remain, the above process may be repeated with methylene chloride.

WARNING:
FOLLOW CAUTIONARY LABELS ON THE METHYLENE CHLORIDE CONTAINER. METHYLENE CHLORIDE IS A VOLATILE SOLVENT. CAUSES IRRITATION OF THE EYES, SKIN AND RESPIRATORY TRACT. PROLONGED BREATHING OF VAPOR CAN CAUSE LOSS OF CONSCIOUSNESS. DO NOT GET IN EYES, ON SKIN, OR CLOTHING. DO NOT TAKE INTERNALLY. AVOID BREATHING OF VAPORS. WHEN HANDLING WEAR CHEMICAL SPLASH GOGGLES, PROTECTIVE CLOTHING AND SOLVENT RESISTANT GLOVES. WASH THOROUGHLY AFTER HANDLING. USE ADEQUATE VENTILATION IN WORK AREA.

i. After the seam is cleaned, repeat the cleaning process for the other part.

j. Using clean #80 grit abrasive paper roughen all cleaned surfaces lightly until the surface shows a fine white powder. Remove the powder with a clean cloth or clean brush.

k. The bonding material (epoxy, epoxy/flox, epoxy/micro or structural adhesive) is prepared and applied to one or both surfaces to be bonded.

WARNING
THE CONTAINERS USED TO MIX THE ADHESIVE MUST NOT BE WAX COATED. THE WAX COATING COULD CONTAMINATE THE ADHESIVE AND REDUCE THE BOND STRENGTH. LIKEWISE, THE MIXING CONTAINER MUST BE FREE OF DIRT, GREASE, OIL OR OTHER SIMILAR CONTAMINANTS.

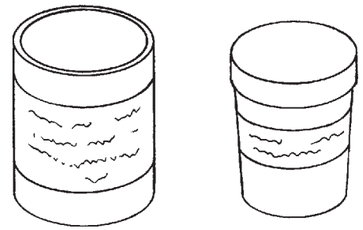
WARNING
READ THE CAUTIONARY LABEL ON THE EPOXY CANS. THIS EPOXY IS EXTREMELY IRRITATING TO THE EYES AND CAN CAUSE PERMANENT EYE DAMAGE. MAY ALSO CAUSE SKIN IRRITATION OR SENSITIZATION REACTION IN CERTAIN INDIVIDUALS. PREVENT EYE AND SKIN CONTACT WITH EPOXY MATERIALS. AVOID BREATHING VAPORS. USE ONLY IN WELL VENTILATED AREA. AVOID INHALATION OR EYE CONTACT WITH DUST FROM GRINDING OR SANDING OF CURED EPOXY. REMOVE CONTAMINATED CLOTHING AND LAUNDER BEFORE RE-USE.

If structural adhesive is to be used, prepare it as follows:

HYSOL 9339 Epoxy can be mixed in the proper weight ratio only by using a good scale. A small calculator will help, too. IMPROPER MIXING CAN SPEED OR SLOW CURE TIME AND DECREASE ADHESIVE STRENGTH. ATTENTION TO THE MEASURING PROCESS IS IMPORTANT.

Hysol Structural Adhesive
Fig. 1:O:2

HYSOL 9339 ADHESIVE
Mix: 44.5 parts 9339A(blue)
to 100 parts 9339B(White)



The mixing ratio for Hysol 9339 is 100:44.5, part A to part B. The easiest way to do this is put the mixing cup on the scale and record its empty weight. Guessing at how much epoxy you will need for the job, take about 2/3's of that amount from the Part "A" can and put it in the cup, weigh, and subtract the weight of the empty cup from the new weight, giving you the weight of just the epoxy in the cup. Multiply the weight of the epoxy in the cup by 1.455. Add the weight of just the epoxy in the cup to this figure, and now add Part "B" until the cup weight is the same as your calculated figure. Maintaining nearest 1/10 oz. is plenty close enough.

a. Example:
   1. Weight of empty cup: .5 oz.
   2. Weight with 2/3's (estimated) of the material you'll need, Part "A": 3.7 oz.
   3. Weight of Part "A": 3.2 oz
   4. Multiply by mix ratio 100:44.5: x 1.4
   5. Total weight of Part "A" and Part "B" needed is: 4.6 oz.
   6. Add the weight of the cup back in: .5 oz.
   7. The total weight, once you've added the proper amount of Part "B": 5.1 oz.
   8. Add Part "B" to the cup until it weighs 5.1 oz., mix, and you're ready.

b. Mix the Hysol 9339 epoxy adhesive components as follows:

1. Read all the instructions and information on the epoxy cans. Temperature of the adhesive ingredients and the surrounding room temperature must be 60°F or more.

2. The 9339 adhesive has a working life of 2 hours at 77°F. However, at higher temperatures or with a larger batch this working life will be less. Therefore, before mixing adhesive, all necessary equipment should be ready.

3. For the same reason, it is better to mix too much adhesive than too little. If you run out and must mix a second batch, the first batch may have already begun to thicken making it difficult to compress the seam properly and possibly reducing bond strength when cured. Another reason for mixing more than you need- If you have a little left over, leave it in the corner of the cup with the mixing stick in it. Because cure time varies with temperature, by leaving a little in the cup and leaving the cup near the part you have epoxied, the cup can now be used as your test for curing. Wait at least 24 hours after joining parts. Then, before touching parts, try to move the stick around in the epoxy in the cup. If you can move it at all, your parts have not cured. Wait another 24 hours and repeat. Handling parts before cure is complete can reduce the bond strength, and should be avoided.

The epoxy cure time depends on the temperature during cure time. Because of the fire hazards involved with most heaters, it is not recommended to have a heater operating in the room that could cause a fire. However, getting the room nice and warm before applying adhesive, so the parts and air temperature is above 77°F, will help shorten cure times, but remember it will also shorten the pot life/working time of the adhesive.

(a) Estimate the amount of adhesive that you will need for the first seam and measure a sufficient amount of Part "A" and "B" to make that amount.

(b) Using a mixing stick, thoroughly mix the two parts for at least two minutes. Mix longer for larger batches. Occasionally scrape unmixed material from the sides of the cup. Uniform blue-gray color will result.

(c) Apply the structural adhesive as follows (the following assumes the seams have been cleaned and sanded as previously described. If not, do so at this time).

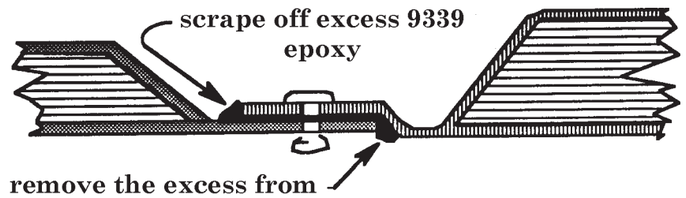
(1) Beginning with the seam of the first part you have chosen to start on, with a wood spatula, spread an even layer of adhesive on the overlap surface of the part. Repeat the adhesive application process on the overlap surface of the other part.

(2) Overlap the two adhesive coated surfaces and align the holes in the surfaces. Insert a screw or cleco into a hole at each end of the part, or every foot along the part if it is longer than 18". Starting at either end, insert rivets into the predrilled holes and form the heads (backup washers are normally not necessary).

(d) Remove the fasteners and place rivets into those holes.

(e) While the adhesive is still soft, scrape off the excess that squeezes out (Fig. 1-32). Adhesive is much harder to remove when hardened. Use methylene chloride on a clean cloth to remove adhesive that smears on the fiberglass surface. Clean adhesive from the clecoes if any were used.

Removing Excess Epoxy/Adhesive
Fig.1:O:3



Make sure you're wearing work clothes, since the adhesive may drip on you. Also check for adhesive on hair, arms, etc., and wipe it off before it cures. A long sleeve shirt and long pants are highly recommended.

(f) Wait at least 24 hours, then test your mixing cup residue for cure. If solidly cured, then the part should be ready to start work on once more. Drill out the rivets using a 1/8" drill, and remove any loose pieces.

(g) Fill the rivet holes with a 50/50 mix of micro/flox, clean off any excess, let it harden, and you're done with the seam. To make things a little neater, you can put a piece of tape over the back side of the seam, covering the bottom of the rivet holes, to help contain the filler mix and make a smoother neater finish, that requires less epoxy (and adding less weight, something to think about all through the construction process).

3. Epoxy

(a) Mixing epoxy: As with the structural adhesive, you can use a scale for measuring the proper amount of laminating resin and hardener. There are also some good measuring pumps on the market that will probably pay for themselves (about $265) since you'll waste less epoxy with them, and have less chance of spills or improper mixes. We offer one in our catalog that has performed well here in our own shop for years now.

Typically, you will be using from 1 to 6 ounces at a time.

If you prefer to use a scale instead of a dispenser, you can measure the two parts as you did for the Hysol, except use 1.44 instead of 1.445.

Another way is (Jeffco resin system used here for example purposes only. Use the appropriate ratios for your supplied system of resins.)

(1) Place your empty cup on the scale.
(2) Record the weight of the empty cup.
(3) Estimate amount of epoxy you will need.
(4) Add .25 oz of hardener (yellowish) to cup for each 1-1/4 oz you'll need.
(5) Pour 1 oz of resin (clear) into cup for each .25 oz of hardener and mix thoroughly.

(a) Working time can be as short as ten minutes if it is hot, so be sure everything is in place and ready to go before you begin mixing.

(b) As with the Hysol, the surfaces must be totally free of oil, grease or other contaminants, and slightly roughened. Fasten with pop rivets, let harden, remove fasteners & fill holes.

NOTE: USE CARE TO MIX YOUR RESINS AND ADHESIVES ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS FOR THE PARTICULAR SYSTEM YOU ARE USING. THEY ARE ALL DIFFERENT. AN IMPROPER MIX RATIO COULD RESULT IN IMPROPER BONDING - OR NO BONDING AT ALL.

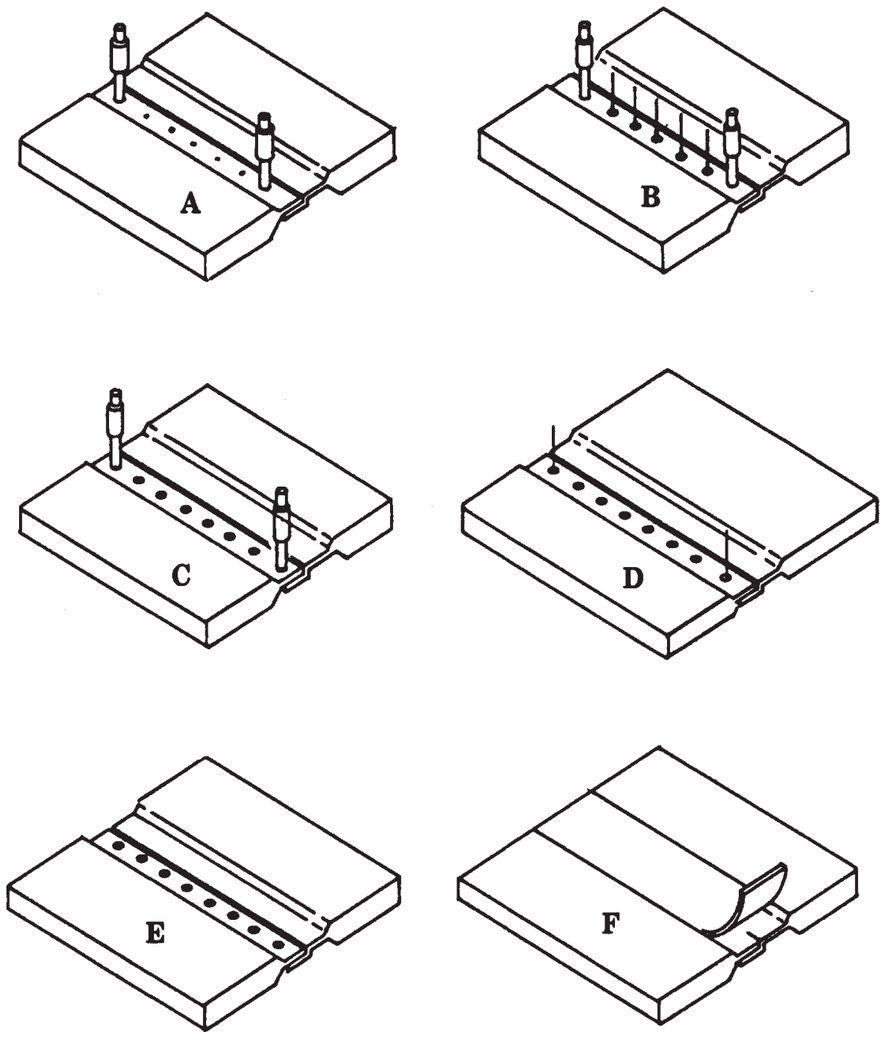
BE CAREFUL TO PAY ATTENTION TO THE MANUFACTURER'S INSTRUCTIONS!!!

P. FIBERGLASS STRIP INSTALLATION

1. Description

To stiffen joints and provide a double bond, fiberglass strips are laid over the bonded seams as shown in the sequence of drawings in fig. 1:P:1.

Joining Parts
Fig. 1:P:1



a. Fig. 1:P:1A shows the two pieces to be joined. After the adhesive has been place along the inside of both pieces to be joined, the two clecoes were installed to hold the parts in alignment.

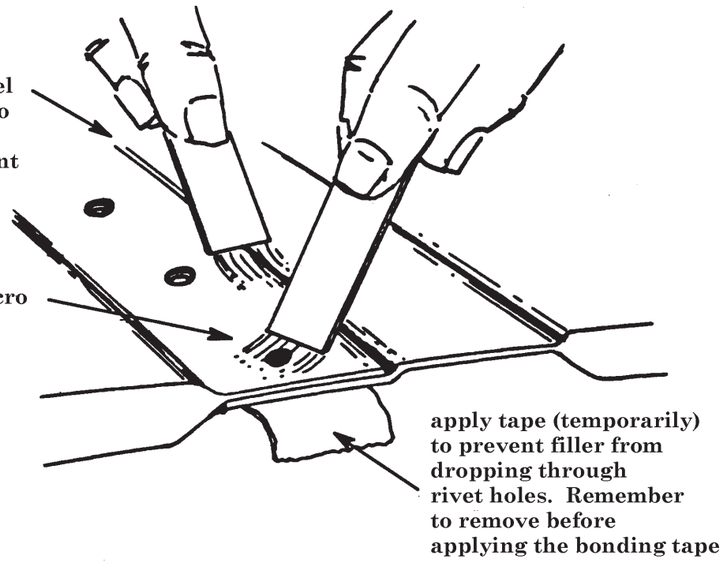
b. Fig. 1:P:1B shows pop rivets set into the other holes drilled 1" apart for the length of the seam.

c. Figure 1:P:1C shows the pop rivets after being compressed.

d. In figure 1:P:1D, the two clecoes have been removed and replaced with pop rivets awaiting compression.

e. Figure 1:P:1E displays the two parts, waiting patiently for the adhesive to cure.

Preparing Seam For BID Tape
Fig. 1:P:2

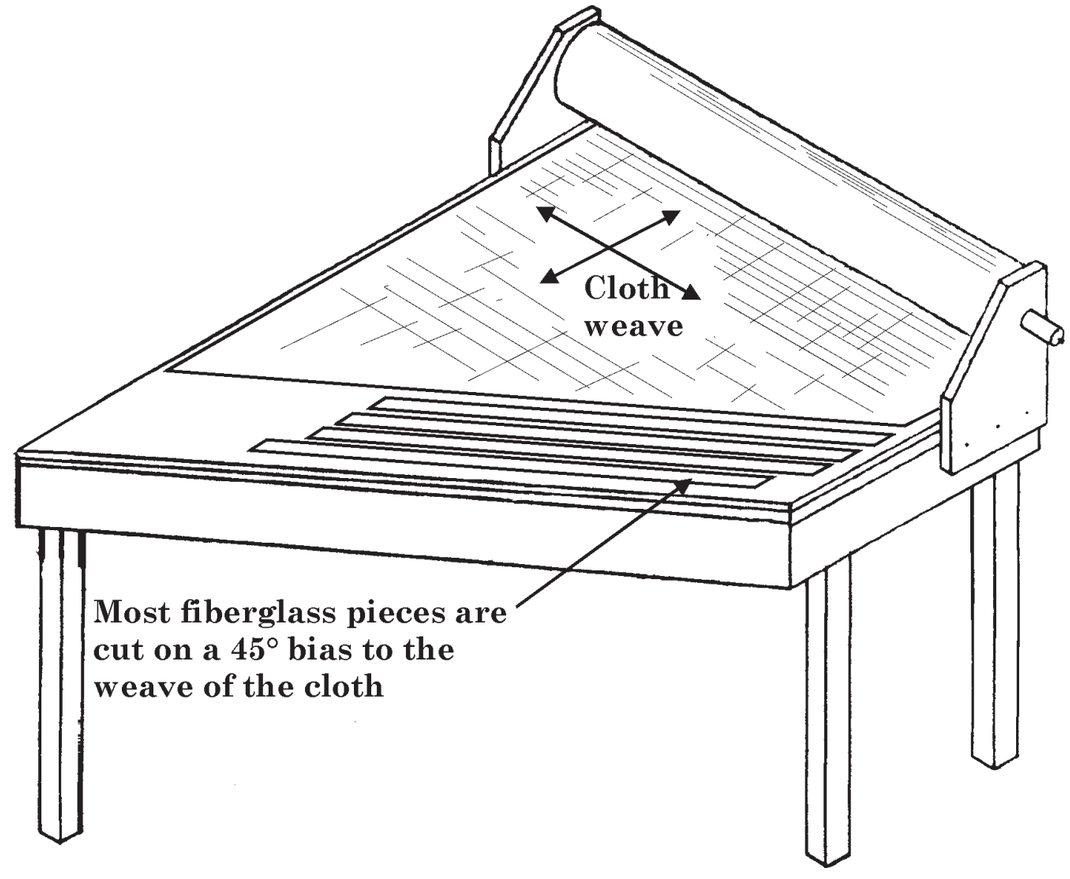


f. After the adhesive has cured, the pop rivets are drilled out, the holes filled with a 50/50 mix of flox and micro (see Fig. 1:P:2) and, without a need to wait for that to cure, a bid strip is being laid into place over the top of the joggles.

Q. CUTTING ON A BIAS

When cutting your cloth with that wonderful roller blade, please pay attention to the weave bias specified for the part you are glassing. There are very few fiberglass parts in the Lancairs that are cut on a 0° bias. Nearly every piece of fiberglass you apply will be cut on a 45° bias. The weave orientation arrows in the construction manuals are there for a reason, please use them.

Weave Orientation
Fig. 1:Q:1

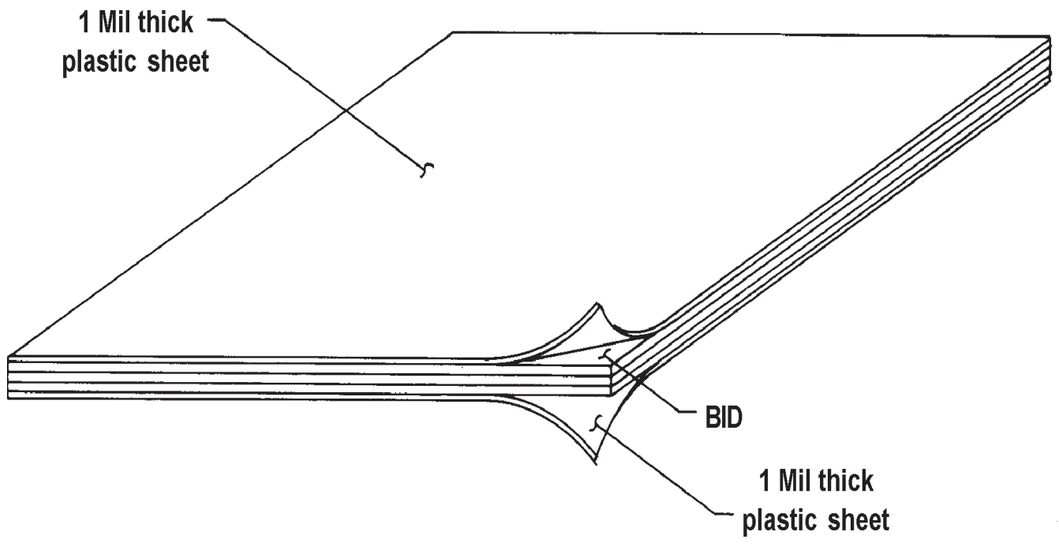


R. THE PLASTIC SANDWICH

This method of wetting out cloth is simple and invaluable. Many hours can be knocked off your project by using this technique.

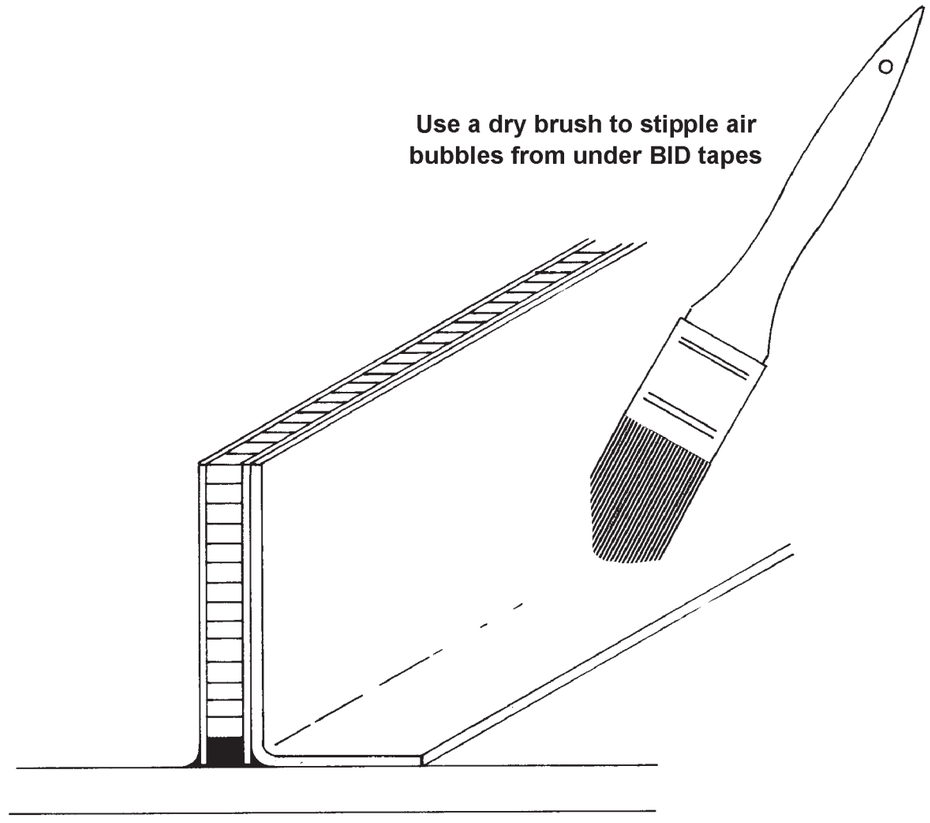
At the hardware store, buy a few rolls of 1 mil thick plastic drop cloths. Regular household garbage bags work well when cut along the edges with a roller blade. Cut two sections of plastic bigger than the piece of fiberglass you are about to apply. Tape one piece of the plastic to your fiberglass cutting table and lay the fiberglass piece (up to 4 BID thick) on the plastic. The cutting table provides an excellent surface for this technique. Wet out the fiberglass cloth with plenty of epoxy. Gravity is your friend, it will allow the epoxy to soak down through the layers of cloth. No need to stipple the BID with a brush, just lay the other piece of plastic over the wetted out cloth and roll the air bubbles and excess epoxy out of the laminate. See the next section for more information on rollers and rolling techniques.

Plastic Sandwich Method of Wetting Cloth
Fig. 1:R:1



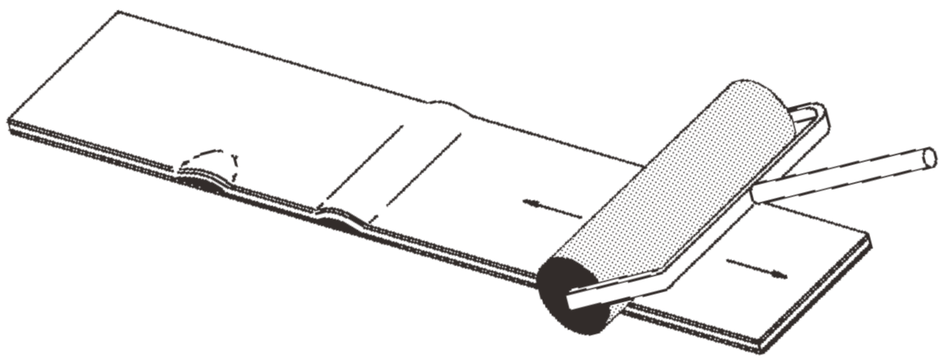
Using a roller blade, cut out the shape of the laminate you need. Remove the shape. See how easy the piece is to handle with the plastic on both sides? Peel the plastic off one side of the sandwich and lay the laminate in position (of course you've already prepared the surface by sanding, cleaning, and painting on a light coat of epoxy). **DON'T APPLY THE LAMINATE WITH THE PLASTIC SIDE DOWN, STRUCTURAL INTEGRITY WILL BE COMPLETELY LOST.**

Applying Plastic Sandwich Laminate



Stipple or roll against the side of the laminate still covered by plastic to squeeze the air bubbles out from underneath. Remove the remaining piece of plastic. You should now have a bubble-free laminate with a good epoxy content. A little extra stippling might be necessary if air bubbles were formed when you removed the plastic. Easy, right?

Using Rollers to Remove Air Bubbles
(and Excess Epoxy)
Fig. 1:R:3

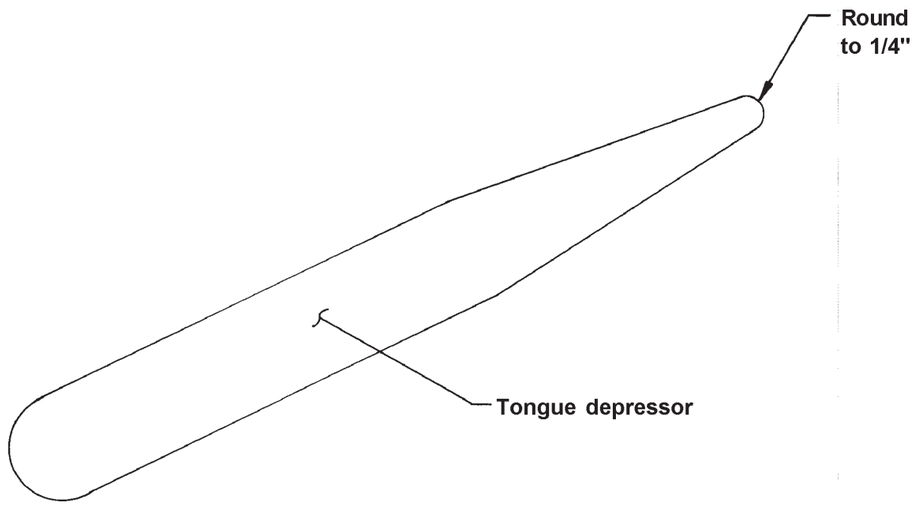


When using the plastic sandwich method of wetting out your fiberglass, simply roll out the bubbles from between the plastic and you have an air free laminate. Peel off one side of the plastic and apply the laminate to whatever you're working on. Before you peel off the second layer of plastic, use the roller to help push the air out from under the laminate.

S. TONGUE DEPRESSORS and MICRO RADII

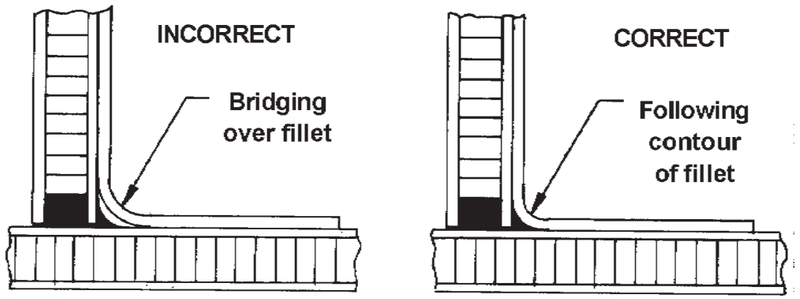
Someone asked me recently what was the most important tool in the Lancair shop. Let me think, the milling machine, the high capacity air compressor, the super-trick mini grinder? Naw, the tongue depressor. That's the most important tool. But not just any tongue depressor, the Lancair special modified tongue depressor.

Modified Tongue Depressor
Fig. 1:S:1



Developed in the late 1980's because of a demand for smaller microballoon radii, the Lancair tongue depressor is a necessary tool for any Lancair builder. You see, the problem with normal tongue depressors is the large radius on each end. If you were to use this radius for all your microballoon filling of joints, your Lancair will be heavier than one with proper joint radii, not by much but every pound counts, right? By sanding down the tongue depressor to a smaller radius, the micro joints on your ribs, bulkheads, etc., will look much more professional. Don't think that more micro will make the joint stronger, in fact it's just the opposite. Microballoons are not structural, so the more fiberglass tape you have bonding the actual part, the stronger the bond will be.
A word of caution. If you get carried away with smaller and smaller micro radii, the fiberglass will want to "bridge" over the microballoons, not bonding as it should. Bridging is fairly easy to detect, the air is visible under the laminate. A little practice will have your micro joints looking great.

Bridging Fiberglass Over a Radius
Fig. 1:S:2.

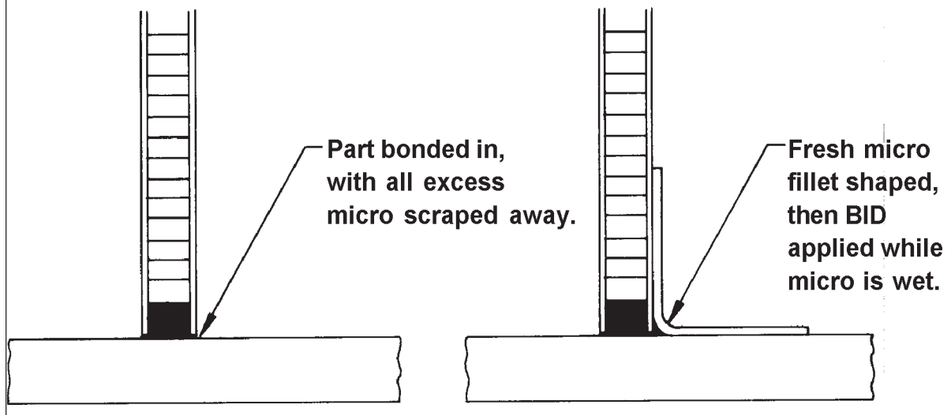


ABOUT THOSE MICRO RADII

The subject of how to best apply microballoon radii is a hotly debated topic around the shop (hey, we're bored sometimes, alright?). Eventually we settled on two methods:

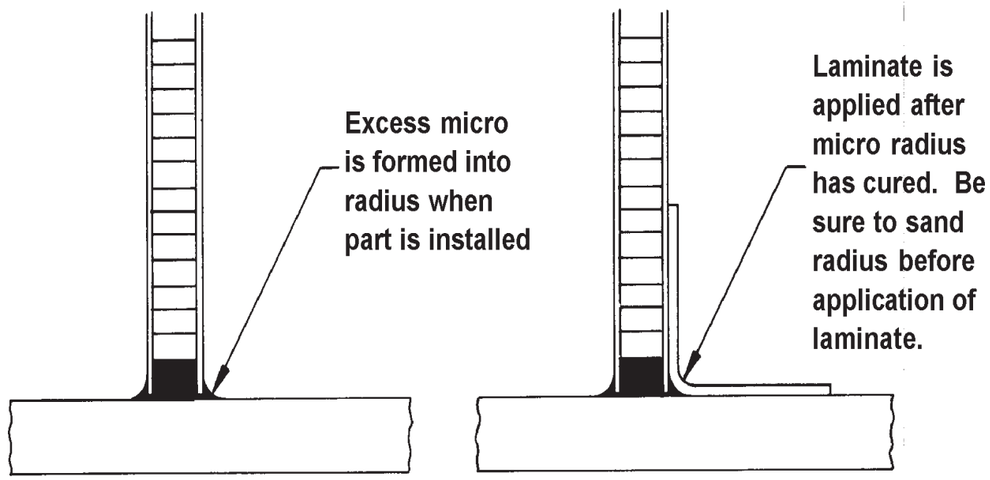
Method #1 - Some believe that the rib/bulkhead should be bonded in and all extra micro scraped away leaving no radius. After the rib/bulkhead is cured in position, another batch of micro can be used to make the radius and the BID tapes applied while this micro is still wet. This method makes application of the micro radius easier because the part is already held firmly in position, but when pure resin is painted onto the area where the BID tapes will be applied, the micro can sag and become runny. When this condition occurs, it is easy to get air bubbles trapped underneath the BID tapes.

Method #1 of Forming Micro Radii
Fig. 1:S:3



Method #2 - Others, like myself, believe that the micro radius should be formed when the rib/bulkhead is first installed. Care must be taken to hold the rib/bulkhead in its proper position while forming the radius with your modified tongue depressor. After curing, the BID tapes can be applied over a solid micro radius. I feel this method helps eliminate air bubbles forming under the BID tapes because the resin that is used to saturate the tapes will not dissolve the micro. Plus, you can stipple the air bubbles out from under the BID tapes without destroying your beautiful radius. Be sure to sand the areas, including the micro radius, where the BID tapes will be applied.

Method #2 of Forming Micro Radii
Fig. 1:S:4



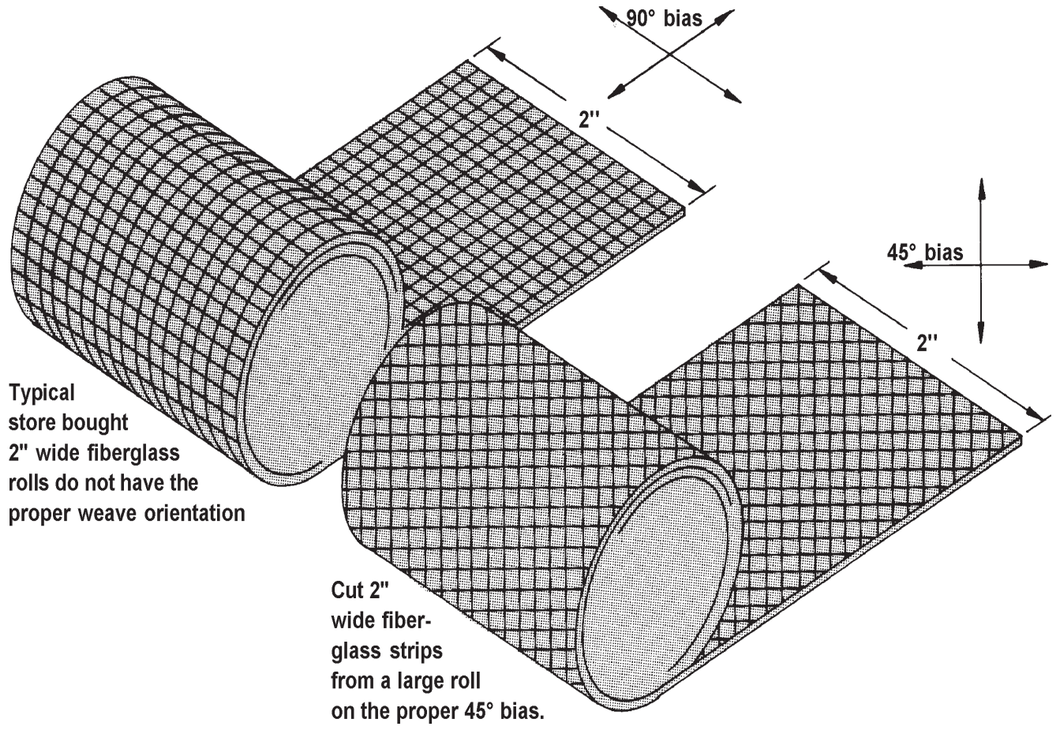
All this talk about something as simple as micro radii, you say? Well, you'll be making a lot of these buggers in the process of building your Lancair, and paying attention to details such as this will ensure confidence and pride in your aircraft. As for which method to use for applying micro radii and BID tapes, either will work, but the second method is safer to avoid air bubbles and get a good radius.

T. THOSE ANNOYING 2" WIDE BID TAPES

On the subject of glassing in ribs and bulkheads, we've received a few inquiries about using 2" wide, pre-cut fiberglass tape, such as available through Aircraft Spruce, instead of cutting your own out of the 50" wide roll provided in the kit. This is fine, as long as the cloth is cut on a 45° bias. THIS IS IMPORTANT! If you use cloth that is cut 90°, it will only be half as strong. Most commercially available tapes are cut 90° and unsuitable for structural areas such as ribs and bulkheads.

The safe way to glass is to cut your own. At Lancair we cut 20 or 30 tapes at a time, all on a 45° bias. Then we roll the tapes up, carefully so as not to shrink or expand the 2" width, and set them aside in a clean place to use as needed. If you do buy pre-cut tapes, be very sure they have a 45° cloth weave and are of the same strength of the fiberglass.

Difference in BID Tape Weave
Fig. 1:T:5



U. CARDBOARD TEMPLATES

In an early newsletter, it was suggested that the builder use cardboard to find the shape of ribs or bulkheads before cutting them out of Clark foam or prepreg. Since many of you are new builders, we thought this is worth repeating.

Simplicity and cost is why we use cardboard templates here at Lancair. The more complex the rib or bulkhead shape, the more a cardboard template will help. Plus, screwing up a piece of cardboard is much cheaper than a similar piece of prepreg.

V. Building Light

How much resin should I put on my laminates? The worst enemy to a light, high performance airframe is too much resin. Here at the Lancair factory, we wet out almost all our glass on 1 mil thick plastic, place another plastic sheet over the wetted cloth, and use a roller to squeeze out the excess resin (the plastic sandwich method). Use a fair amount of pressure when rolling to get a good squeezeout of resin. Not only will these BID tapes be much lighter than ones wetted out on the airframe, they will save lots of time and look very professional. And remember, when the call for BID is higher than two or three, you will save even more time (and weight) wetting the cloth out on plastic.

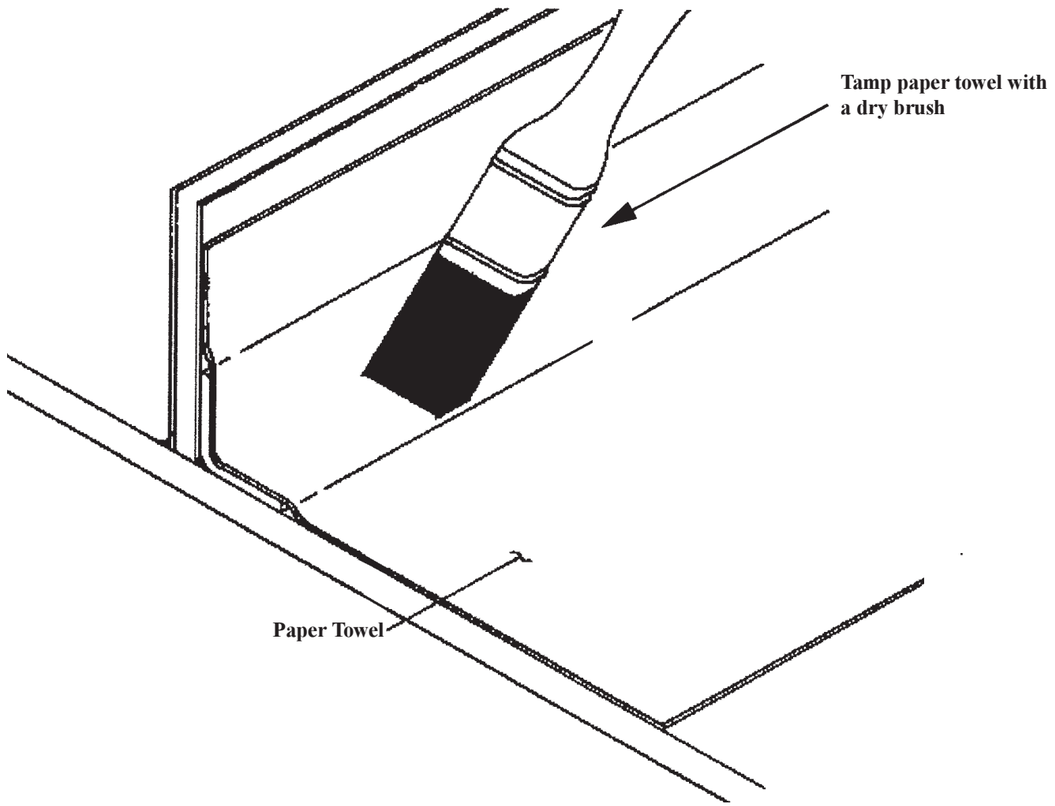
1. BID schedules

About those BID schedules, which are the number of fiberglass layers bonding a structure together. A homebuilder's natural instinct is to make his plane stronger. If the manual calls for 2 BID, three or four must be better, right? WRONG! If you increase the number of BID layers in your aircraft you are decreasing its strength. A heavier aircraft is quicker to build up G loads, has less payload, and is slower than the one built to spec. The Lancair was stress analyzed by Martin Hollmann, a leader in composite engineering, and fully tested. We've seen a Lancair with such a high empty weight that it is over gross as soon as the pilot steps into the cockpit, with no fuel! Think about it, and stick to the manual.

2. Paper towels

Enough preaching, want to save even more weight? Throw out that peel ply and use paper towels. That's right, paper towels. After pulling the plastic off a newly applied BID tape, place a paper towel directly on the wet glass and tamp it with a dry brush. The towel will soak up excess resin and the tamping will help push out those evil air bubbles. Remove the paper towels before cure.

Soaking Out Excess Resin With Paper Towel
Fig. 1:V:1



When the towel is soaked through, pull it off and look at the results. If the towel has pulled up or distorted the glass, tamp it with the dry brush further. Does the glass still look glossy, with an uneven resin content? Well, put another paper towel on it and tamp it again. So long as you don't make the laminate look white, meaning it's too dry, there will be plenty of resin in the glass. Try it, paper towels are cheap.

W. Building Straight

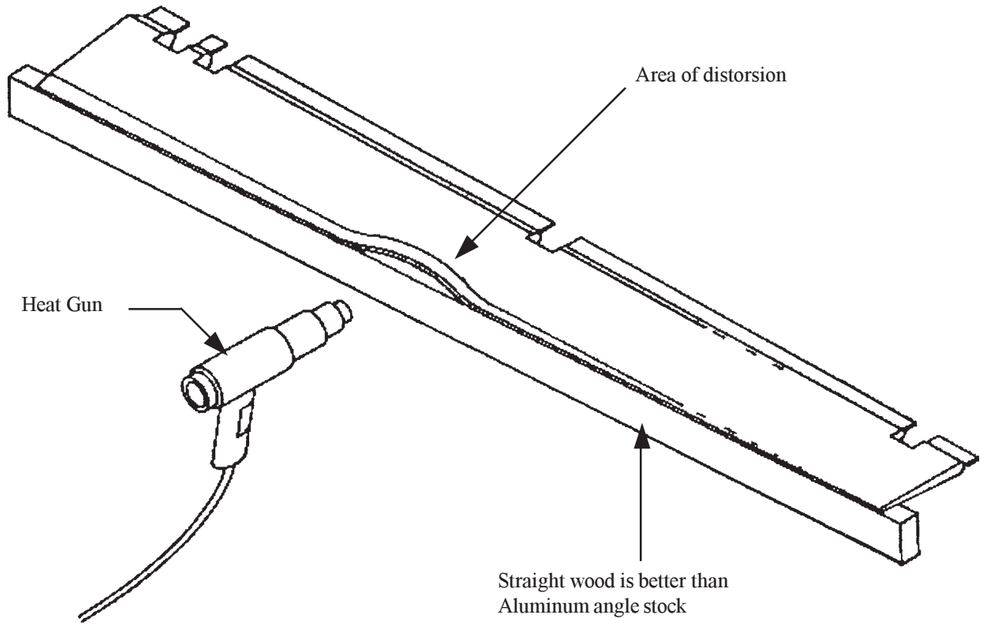
Keeping the airframe straight is also important in a good flying aircraft. Your pristine Lancair might weigh in nice, but if it corkscrews through the air in giant barrel rolls when you let go of the stick, you haven't built a straight airplane. Building your plane according to plans and following the advice given in the construction manual, your Lancair should fly straight and true (in Oz.). Back in Kansas and the rest of the world, it seems that one wing is always a tad heavy, or a trailing edge is wavy. Our prototypes never come out exactly straight and true, so we can't expect any of you builders to perform this miracle. Here's some tips that might help.

Straight Trailing Edges

Now let's pretend that you've jigged your wings perfectly, leveled and attached the horizontal stab, and plumb bobbed the vertical stab and bonded it on. The trailing edges of your Lancair should be straight so the control surfaces can travel freely with a consistent gap. As is usually the case with the plans of all good mice or men, sometimes things aren't quite perfect.

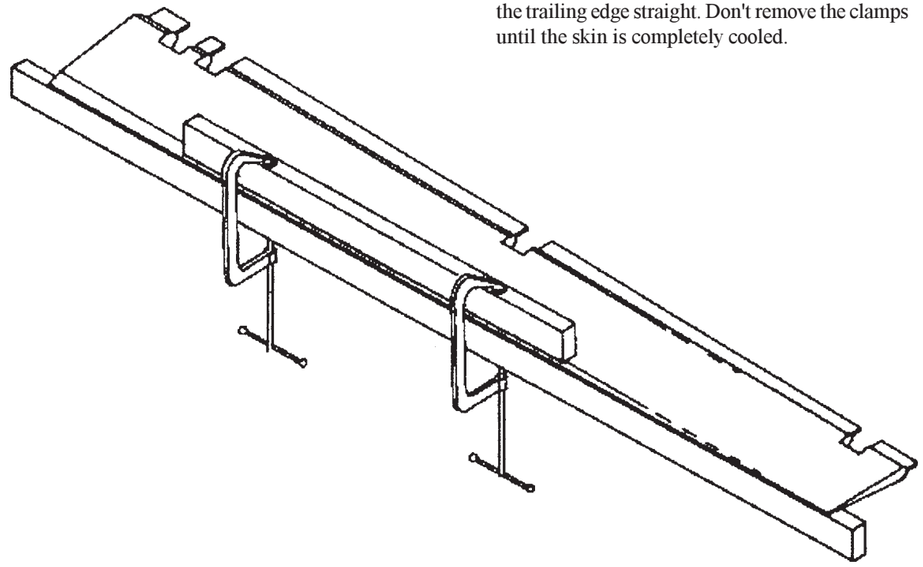
If your wing or tail trailing edge has a slight warp in it, heat the area with a heat gun until it's just too hot to touch. Be very careful not to burn or scorch the fiberglass or carbon fiber. Try heating an extra piece of prepreg material first, just to see how much heat is required to burn it. A piece of straight wood or aluminum angle (the wood is better, because it will cool slower than the aluminum and tend to prevent re-warping the edge) can be clamped to the edge to keep it straight while cooling. Be sure to heat the angle, also. Otherwise the cold aluminum will cool the edge too quickly and the warp will remain. Heat at least an inch forward of the edge and don't discolor or burn the fiberglass (or wood). If the warp still remains, try finding a 1x2 or 2x4 board with the right curvature to warp the edge the opposite way when clamped tight. Heat the edge and let it cool with the board clamped in position. With any luck, the part will spring back nice and straight when the board is removed. See the figures on the next two pages.

Straightening Trailing Edges
Fig. 1:W:1



Straightening Trailing Edges
Fig. 1:W:2

After heating the distorted area, use clamps to hold the trailing edge straight. Don't remove the clamps until the skin is completely cooled.



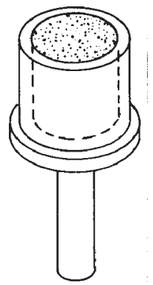
X. CONTROL SYSTEMS

Pushrod Tips

a. After cutting the pushrod tube to length, don't immediately rivet the rod end in position. It is better to test the pushrod in the system (flap, aileron, elevator) by temporarily securing the rod ends to the pushrod with instant glue. Use only a few drops of glue to secure the rod end or the bond may become more than temporary. Don't cover the rod end with glue then slide it into the pushrod, the bond would be impossible to break free. Once you determine the tube is the proper length, you can break the rod ends free, clean them up, and rivet them in place.

b. Fill the rod ends with a 50/50 micro/flox mixture. This will allow the drill to track straight through the rod end when drilling for the rivets. The solid rod end will also prevent rivets from buckling when they are set in place.

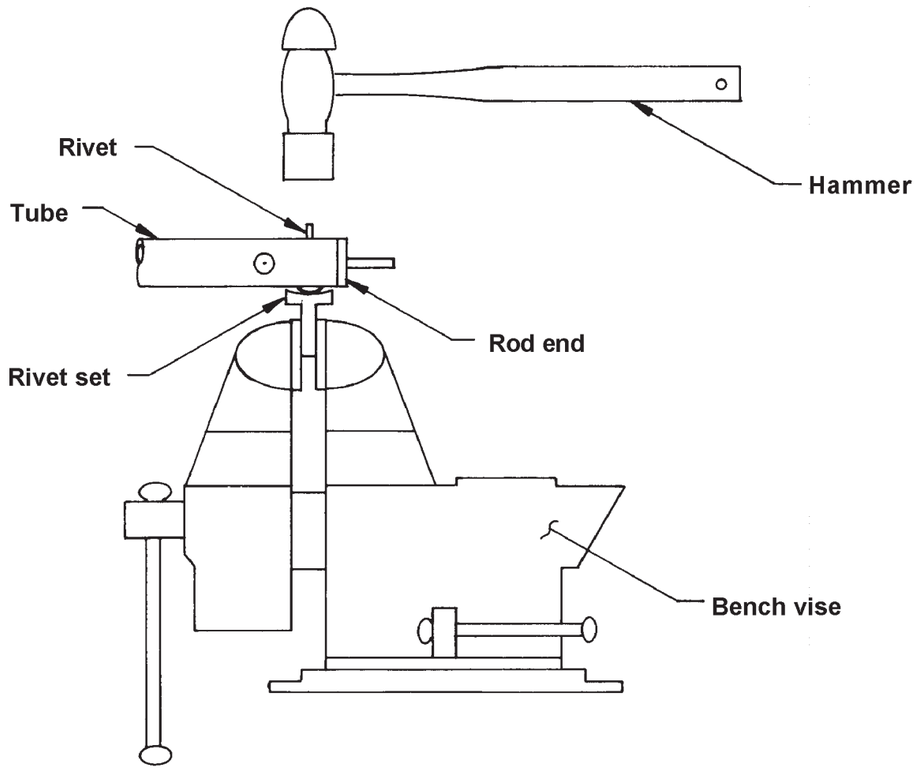
Filling Rod Ends With Micro/Flox Mixture
Fig. 1:X:1



c. When sliding the rod ends into the pushrod tube for the last time (before riveting), coat them with Loctite™ to prevent slippage or vibration wear.

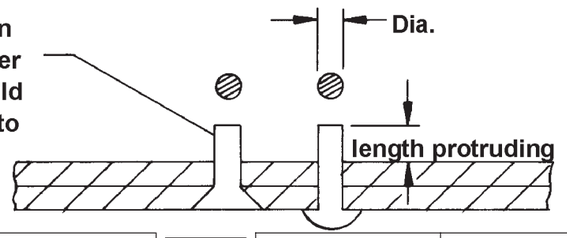
d. A rivet gun is the best method of setting the rivets that secure the rod end. In a pinch, we've used a hammer to lightly tap and expand the rivets. Hit the rivet lightly and accurately to avoid mashing the rivet end to one side. A rivet squeezer is not recommended for pushrod rivets because the rivets may buckle in the center of the pushrod.

Setting the Rivets in the Rod End
Fig. 1:X:2



Rivet Rule

RIVET RULE:
The correct length of protrusion is equal to 1.5 times the diameter of the rivet, i.e., a 1/8" rivet should extend 3/16" from the material to be riveted.

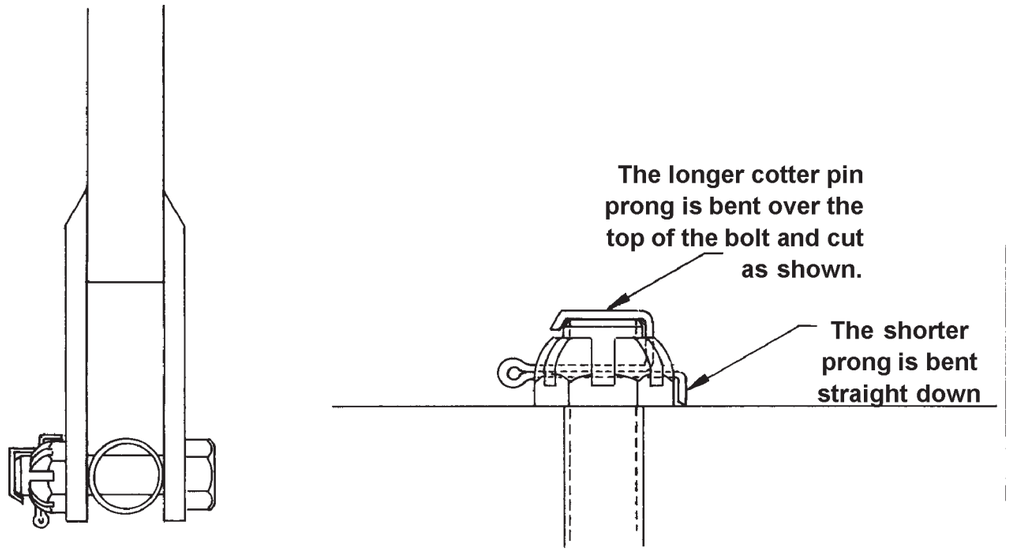


1. **Painting pushrods**
At Lancair we usually spray paint our pushrods with one coat of Zinc Chromate and one coat of color. Hardware store spray cans are fine for the color coat and you can choose from all kinds of nifty colors.

2. **Castle nuts and cotter pins**
One common error in the Lancairs we have inspected is mis-bent cotter pins and castle nuts without cotter pins.

Castle nuts are commonly called for items in the Lancair control systems. A castle nut is only used on drilled bolts and MUST be secured with a cotter pin. Castle nuts are usually snugged down, not tightened like an elastic locknut and the cotter pin will prevent the nut from loosening!

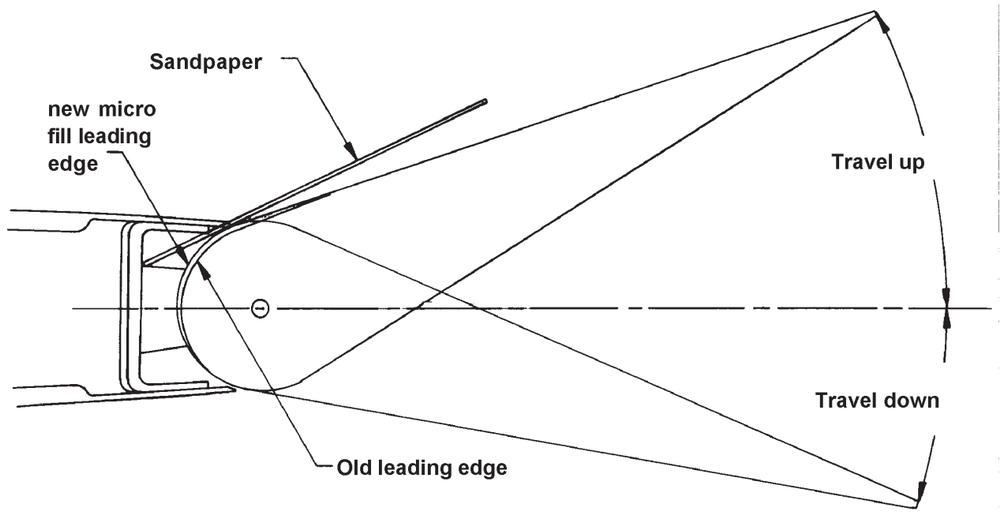
Properly Pinned Castle Nut
Fig. 1:X:3



The standard method of bending and securing cotter pins is shown above. Many builders simply bend the two cotter prongs around the bolt and call it done. Without cutting the prongs to proper length, the prongs could grab a stray piece of upholstery or wire, possibly jamming the system.

3. **Control surface gaps**
If you'd like to get a closer gap on your control surfaces, try this method. No matter how good the mold, the leading edges of the elevators, ailerons, flaps, and the rudders never seem to fit the trailing edge of the wings and stabs just right. If you have this problem on your elevator, for example, mount the elevator to the horizontal stab and make sure you have at least 1/16" gap between the elevator leading edge and the stab trailing edge. Mark on the elevator where the gap is too great or fairly close and remove the elevator. Now add a micro layer, mixed thick, to the areas marked "too great" and shape a rough radius (a little sculpting skill is helpful).

Gapping Control Surfaces
Fig. 1:X:4



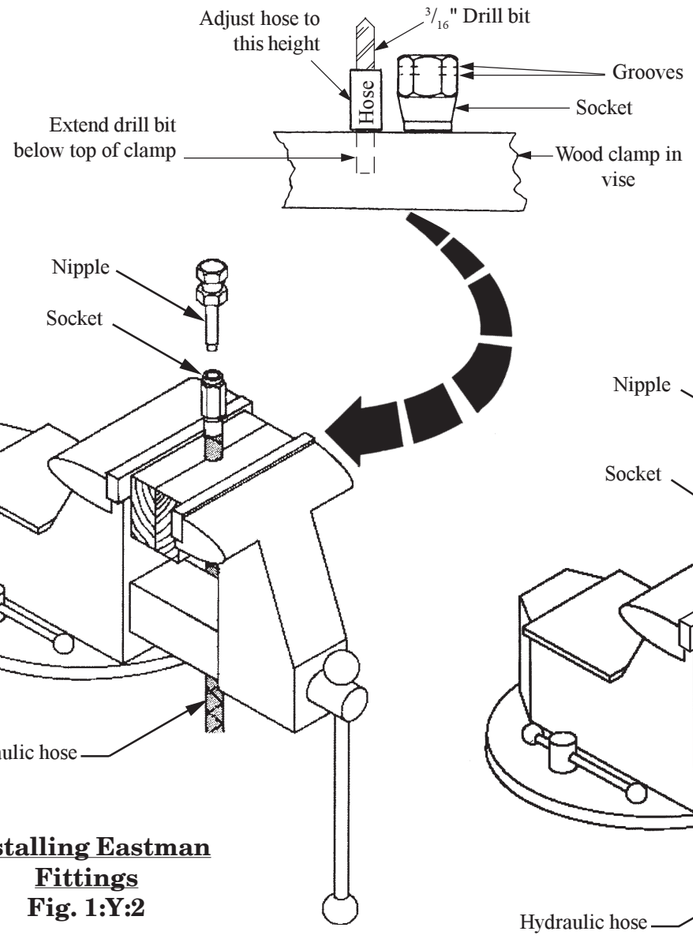
After the micro cures, sand it so the elevator will just fit back into the stab, and sand the stab trailing edge straight, parallel to the hingeline. Got all that? Now take one strip of sandpaper, 3M or Norton 40 grit longboard sheets work best, and run it back and forth between the elevator and the stab, sanding the micro on the elevator. Another pair of hands is very helpful in this process to hold the elevator stable while you work the sandpaper. Have your helper raise or lower the elevator slightly when you feel the resistance on the sandpaper decrease. Slowly work the elevator through its full range of travel. Now you should see a consistent gap between stab and elevator when the elevator is moved through its travel range.

Y. Hydraulic systems

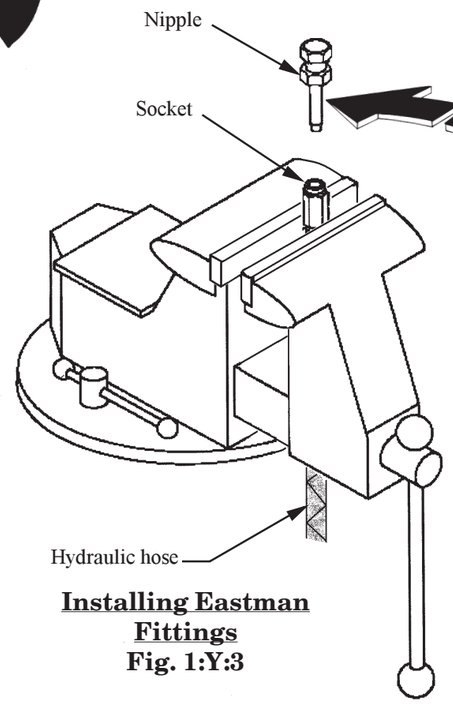
1. Eastman hydraulic 3/16" hose and fittings

Construct a wood hose clamp, drill a 3/8" hole through a 1" x 2" piece of 3/4" plywood, then cut in two. Use this to clamp the hydraulic hose in a vise . The outside of the socket has two rings of small grooves in the corners of the hex.

Clamping Eastman Hose
Fig. 1:Y:1



Installing Eastman Fittings
Fig. 1:Y:2



Installing Eastman Fittings
Fig. 1:Y:3

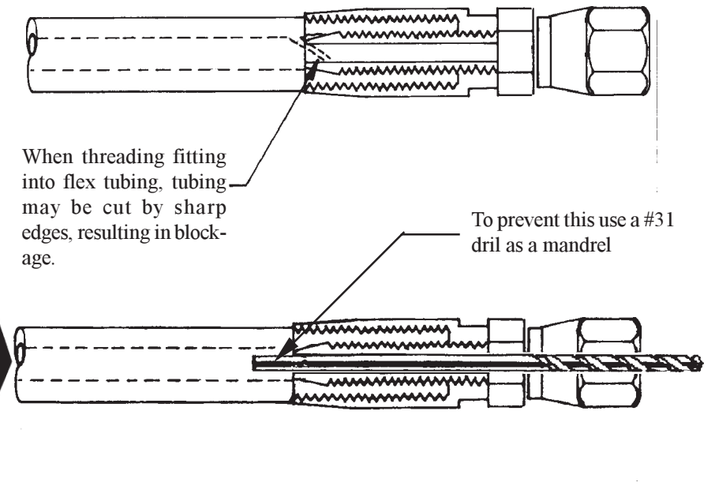
Using the two groves on the socket as a gauge, position the end of the hose between them above the wood clamp, push the shank end of a 3/16" drill bit into hose, so it extends below the wood clamp.

Lubricate the hose and socket with anti-seize or if available "Hoseze-oil" turn the socket counter clockwise on the hose until it touches the wood clamp. Keep turning don't stop and start. If hose twist kinks, or suddenly seems to be easier to turn, cut off hose and start over. (see Fig. 1:Y:2)

Remove hose and socket from wood clamp, and clamp the socket in the vise. Use the shank end of a # 31 drill bit as a mandrel, be sure that it protrudes through the hose end of the nipple. this will prevent the end of nipple from stripping material for inside of hose. (see Fig. 1:Y:3)

Lube the threads on the nipple and turn the nipple into the socket and hose. Bring the hex on the nipple into snug contact with socket but don't tighten further.

Hose Blockage
Fig. 1:Y:4

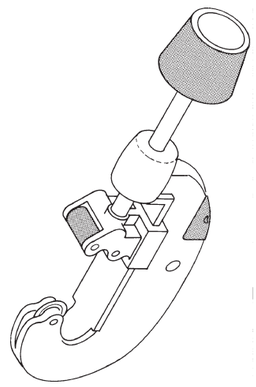


Tighten the nipple into the socket and hose, just bring it up snug to the socket don't overtighten! Remove the # 31 drill bit and blow through the line in both directions to be sure there is no flap at the end of the nipple. Clean the line with solvent.

2. Cutting hydraulic lines

Most Lancair hydraulic lines are made from 1/4", 5052 aluminum tubing. A tubing cutter is the standard, and best, tool for cutting the aluminum tubing to length.

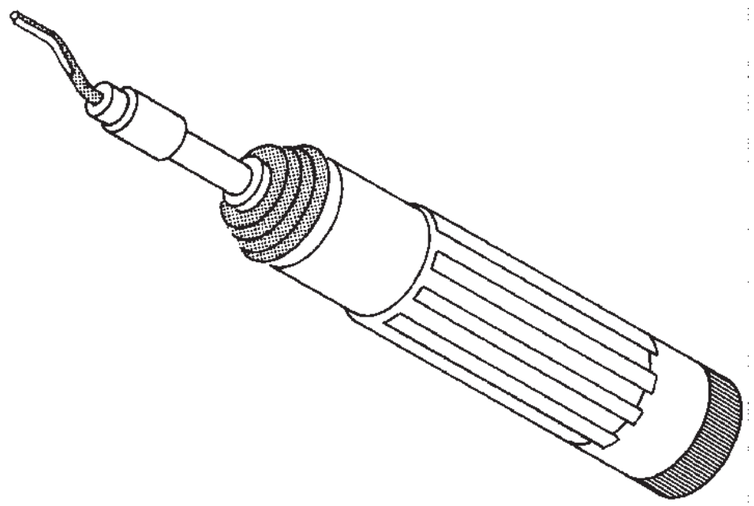
Tubing Cutter
Fig. 1:Y:5



We use a small cutter because it's much easier to handle. Simply roll the cutter around the tube, tighten the handle slightly, then roll it around the tube again, etc., etc...

After every cut you must debur the inside of the aluminum tube. A small deburring tool makes quick work of this.

Deburring Tool
Fig. 1:Y:6



WARNING: Only debur what is necessary to achieve a smooth edge. Excess use of a deburring tool will remove too much material and potentially weaken the subsequently flared end.

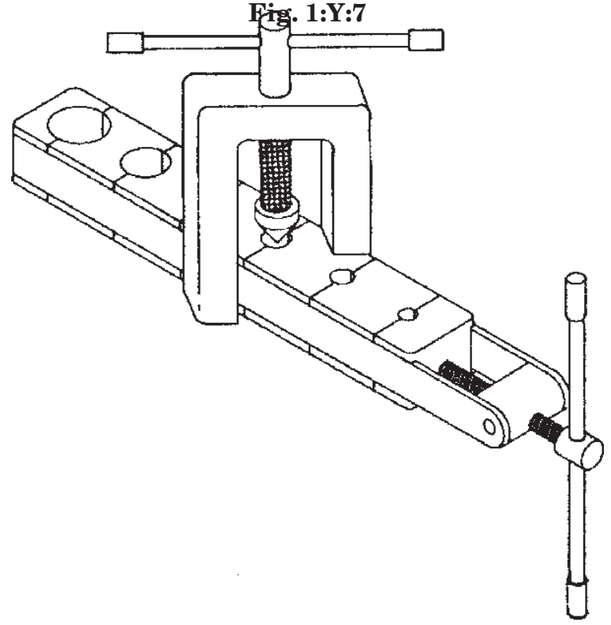
Tony Bingelis has much more information on tubing cutting and deburring in his Sportplane Builder books and Sport Aviation columns. These books are extremely helpful to the home builder. Get them and read them!

Tube flaring

Here's another area of construction where you need a specialized tool, the flaring tool.

The tube must be deburred, as described in the previous section, in order to get a clean flare. Otherwise you could score the inside of the tube when flaring. The tube may not seal properly in this condition.

Flaring Tool
Fig. 1:Y:7



We usually grease the cone shaped part of the flaring tool so it will not gouge the tube.
Don't flare the tube too much, the expanding aluminum may crack. The cracks are visible if you look closely.
Experiment and learn how to use your flaring tool. Again, the books by Tony Bingelis contain a lot of valuable info on these sorts of specialized jobs.

Typical Methods for Securing Hydraulic Lines

Fig. 1:Y:8

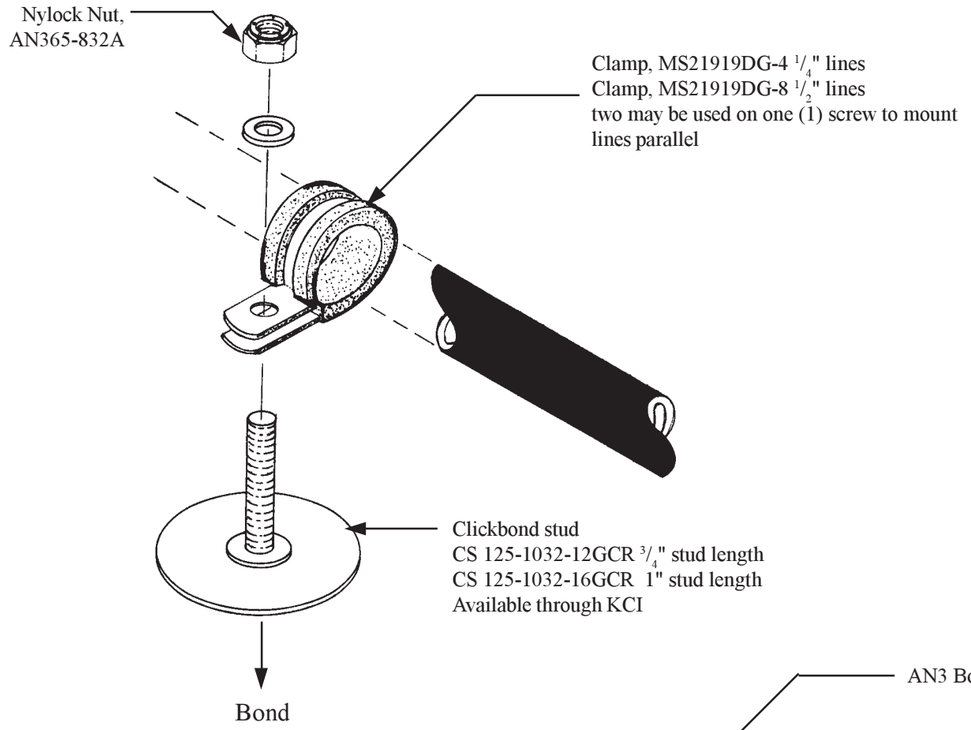


Fig. 1:Y:9

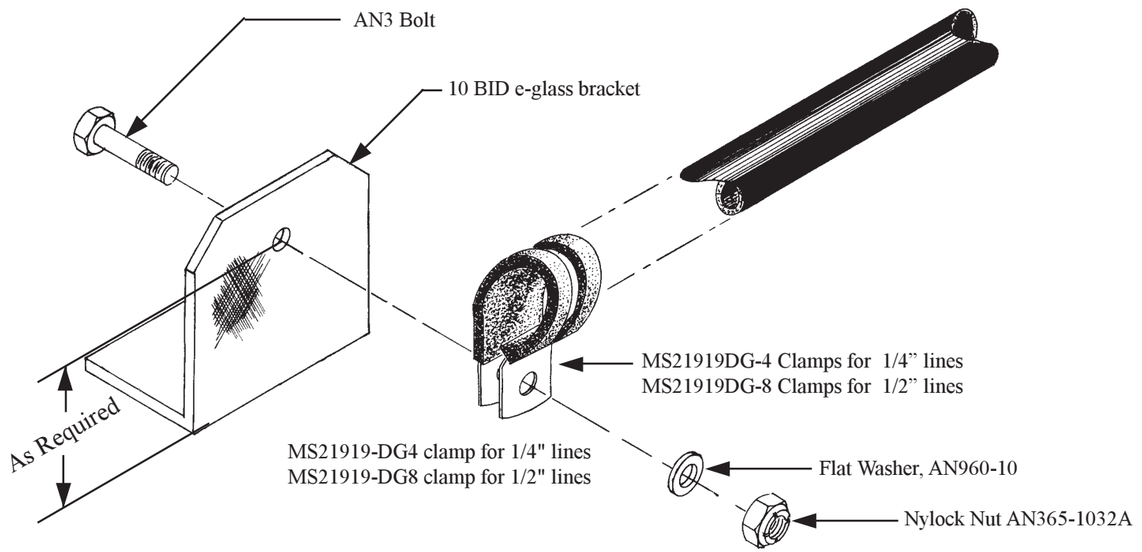
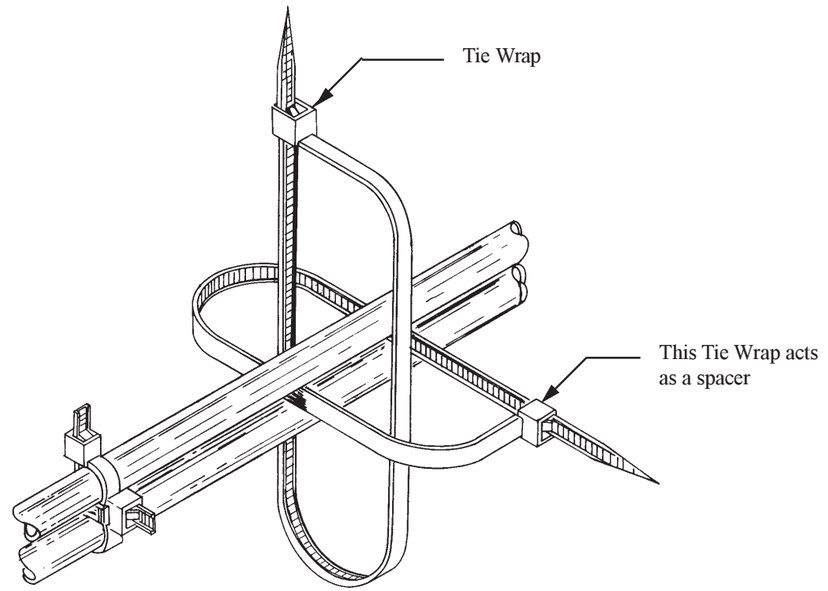


Fig. 1:Y:11



Z. PAINTING

In the last year, the Lancair shop has prepared and painted Lancair prototypes. In the process, we've learned a few basic painting tips and rules you may find interesting, or even helpful.

Painting is a disgusting, dirty, tedious, boring, stressful, sometimes toxic process that you will do once and swear never to attempt again. Lock up all your weapons because with one slip of the spray gun, one little mistake, you might feel like ending it all. Bet you can't wait to get started on your paint job now, huh?

Seriously though, if you take your time and don't try to produce a flying Mona Lisa, a good looking paint job is fairly easy to produce. Here's the basic flow chart that we follow for preparation and painting of our Lancairs.

1. Clean all surfaces
2. Sand all surfaces with 80 grit
3. Prime with featherfill
4. Sand with 100 grit
5. Paint with normal primer
6. Sand down to 220 grit
7. Fill pinholes
8. Prime with normal primer
9. Sand down to 360 grit
10. Clean for color coat
11. Paint your favorite color!

Now let's get more detailed, step by step:

Step 1. Before the initial sanding of your surfaces, and before each primer and color coat, you MUST clean the area to remove any contaminants that would affect the paint. We use DuPont Prep-Sol cleaner for this purpose.

Step 2. After you've Prep-Soled your bare fiberglass or carbon fiber surface, scuff up the surface with 80 grit so the primer can bond properly. We use a dual action (DA) sander to make short work of this step.

Step 3. Clean your surfaces with Prep-Sol again in preparation for the first primer coat. We use the polyester based Featherfill primer as a first coat. It may sound strange, but we actually apply the Featherfill with a paint brush. We find brushing on the first coat of primer fills the pinholes much better than spraying does. Don't worry about making this first coat pretty, most all of it will be sanded off anyway.

Step 4. The goal of the Featherfill was to fill the weave of the material and the scattered pinholes. Now you can sand most of the Featherfill away with 100 grit. Use a longboard sanding block or one of the sanding blocks that use 1/2 sheet of sandpaper. If there are low spots in the surface, here is where you'll start to see them.

Step 5. Blow off the surface with an air nozzle and clean with Prep-Sol. This next coat of primer should be the same brand as your color paint. Be sure of compatibility! We've found a few really good primers. The WLS system is a great primer, we used it on the Lancair IV prototype, but the white WLS paint we applied over it isn't sticking worth a darn, especially on the leading edges (We just tell people that the paint tends to burn off during reentry into the earth's atmosphere). We just tried the Superflite primer on the 320 and we're very happy with it's application and sanding properties. Whatever brand you use, spray on a good, thick coat.

Step 6. Sand the primer smooth with 180 grit. We usually wet sand at this point, the sandpaper is much more efficient when wet. This is where many builders start to run into trouble. They begin to paint on coat after coat of primer, only to sand off each coat they apply. They complain about the huge amount of time required to get a good finish on their planes. Well of course it takes a long time if you sand off every bit of primer you put on. They might as well use watercolors, it'd come off real quick when wet sanding. Anyway, you don't have to sand all the way through the primer coat you just applied. Sand until it's smooth and that's all. On the bottom of your plane, you may not want to apply any more primer if this coat has sanded smooth without sanding through. In this case, simply switch to 320 grit and finish it off, ready for the color coat.

Step 7. This is the best time to look for pinholes in your surfaces. Use the air nozzle to blow the dust off the smoothly sanded surface and out of the pinholes. We use Evercoat polyester glazing putty to fill pinholes, chips, and other boo boos. The lacquer glazing putties tend to shrink too much with age, as does Bondo. Use a putty knife, or squeegee, to force the putty into the pinholes. Lightly re-sand the pinhole-covered areas after filling.

Step 8. Now clean all your surfaces and spray on what should be your last coat of primer. Use the same brand of primer as the previous coat. Use your judgement to decide if you need a thinner or thicker primer coat (usually this last coat is applied thinner). This primer coat should look pretty good, very evenly applied and few, if any, sandpaper scratches visible.

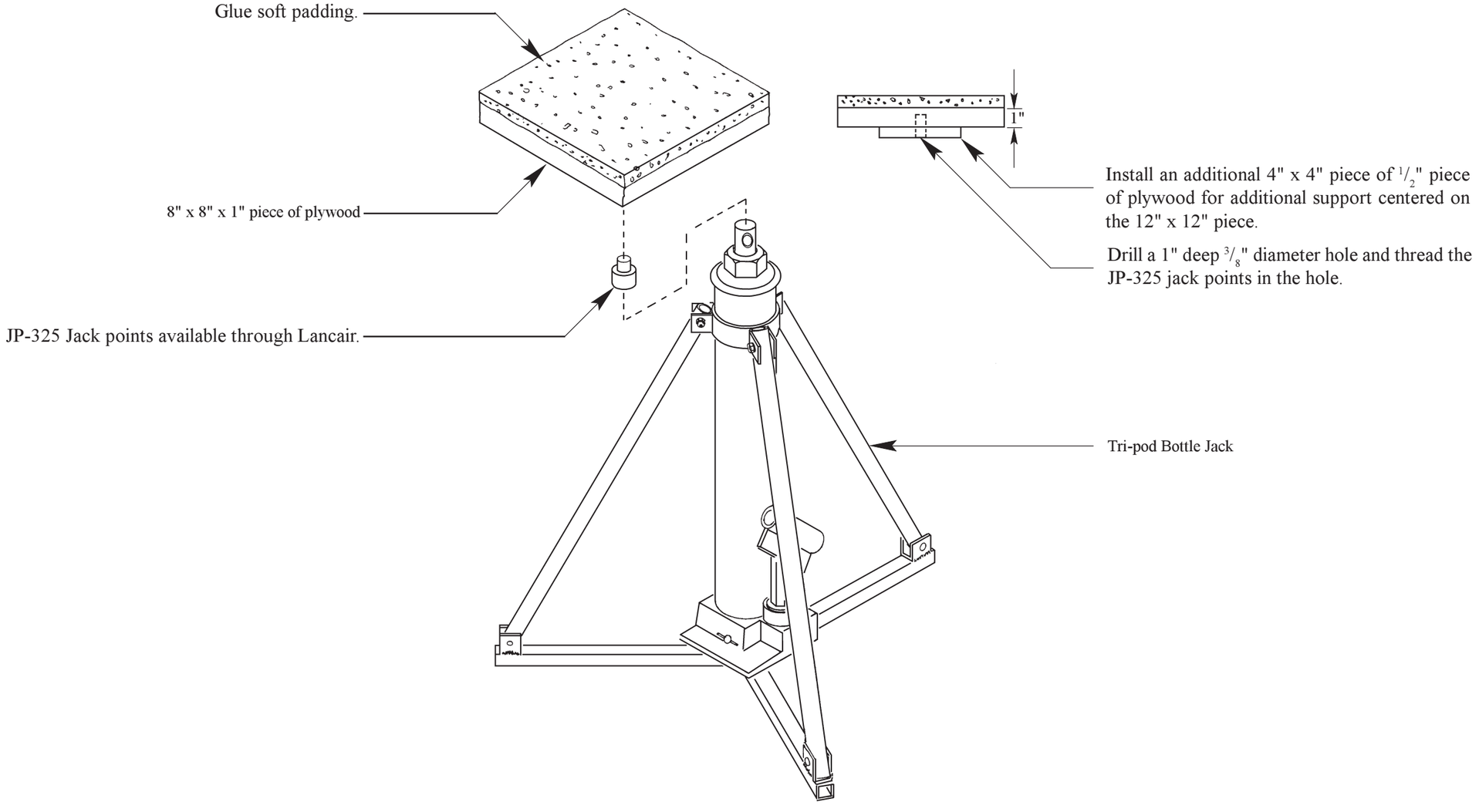
Step 9. Wet sand this last coat of primer with 360 grit. Some builders would cringe at this, saying that the last primer coats should be sanded down to at least 400 grit. We've found that 400 grit sands the surface just a bit too smooth, the paint doesn't have anything to grab onto. The last grit we used on the Lancair 320 repaint job was 320 grit (easy to remember, 320 on a 320) and the gray color coat did not show any scratch marks.

Step 10. This is it! Blow off and clean all your surfaces thoroughly with Prep-Sol. Fill any remaining, pesky pinholes now or forever hold your peace. Use a tack rag, available at all automotive paint stores, to remove the dust and dirt from the surfaces. Congratulations, you're ready to paint.

Step 11. The best advice we can give you about painting the color coat on your aircraft is DON'T, at least not if you don't have the proper facility, tools and training. We convinced ourselves here at Lancair that spraying the color coat on during the early dawn or dusk hours, with the pavement wetted down and no wind, would produce a lovely finish suitable for framing. It just doesn't work that way. Shooting the primer coats on in your back yard with a lousy spray gun is one thing, but getting a dust free, no runs, color coat is another. Seriously consider taking your plane to a paint shop. The Lancairs are perfectly suited for this because you can take the wings off and roll them anywhere. Having a professional shoot the color coat is not as expensive as you think IF you do all the preparation yourself. All the painter will have to do is shoot the color.

If you absolutely must spray the color on yourself, seek advice and assistance from a painter who could probably tell you ten times more than we could about painting.

Again, we're not saying this is the best, or even a standard process for finishing your Lancair, but it works for us. Sure, some of the parts may need an extra coat of primer, some edges may have to be puttied up and reprimed, but these are part of the joys of building your own plane, aren't they?



2. PARTS LIST

#	PART NO. (P/N)	QTY	DESCRIPTION	OPTIONAL ITEM (not included with propjetkit) supplied w/ retro fit option
TURBINE SUPPLEMENT				
1)	5106	1	Construction Supplement	
FIREWALL RETROFIT INSTALLATION				
1)	5015	1	Firewall Retrofit	**
2)	5101	1	Retrofit Blueprint	**
3)	282	2 Yards	Cloth	**
ENGINE MOUNT INSTALLATION				
1)	5102	1	Firewall Reinforcement Blueprint	
2)	5600	1	Engine Mount	
3)	5601	4	Washer, Conical	
4)	5600-01	1	Upper Center Link	
5)	5600-02	1	Upper Center Link	
6)	5000B	1	Lower Cowl	
7)	5000T	1	Top Cowl	
8)	AN7-17A	4	Bolt, Undrilled	
9)	AN6-12A	2	Bolt, Undrilled	
10)	912090A528	2	Bolt, Socket Head	
11)	91290A546	4	Bolt, Socket Head	
12)	FFB-04	1	Firewall Flame Blanket	
13)	94560A100	6	Locknut	
14)	AN363-624A	2	Locknut	
15)	AN365-720A	4	Locknut	
16)	RTV-106	1	High Temperature Sealant, Silicon	
17)	AN970-7	4	Washer, Flat	
18)	AN960-616	3	Washer, Flat	
19)	91166A280	8	Washer	
20)	91100A170	1	Washer	
ENGINE INSTALLATION				
1)	5600-01	1	Upper Center Link	
2)	5600-02	1	Upper Center Link	
3)	5600	1	Walter Turbine Engine Mount	
4)	912090A528	1	Bolt, Sockethead	
5)	91290A546	4	Bolt, Sockethead	
6)	AN6-12A	2	Bolt, Undrilled	
7)	AN363-624A	2	Locknut	
8)	KHM0092	5	Locknut	
9)	94560A100	1	Locknut	
10)	5601	4	Washer, Conical	
11)	KHM0093	4	Washer, Flat	
12)	AN960-616	4	Washer, Flat	
13)	AN970-6	1	Washer, Flat	
14)	KHM0094	4	Washer, Flat	

#	PART NO. (P/N)	QTY	DESCRIPTION	OPTIONAL ITEM (not included with propjetkit) supplied w/ retro fit option#
COWLING INSTALLATION				
1)	5000T	1	Upper Cowling	
2)	5000B	1	Lower Cowling	
3)	MS24694-S51	53	Machine Screws	
4)	K1000-3	53	Nutplates	
5)	MSC-32	106	Rivets	
BELLY TANK INSTALLATION				
1)	5104	1	Blueprint, Bellytank Supports	
2)	5555	1	Mounting Plate	
3)	AN834-4D	1	Fitting, Tee	
4)	PH 250-12 x 35	2	Phenolic Support 1/4” Thick	
5)	C5515 x 8 x 10	1	Fitting	
6)	MS2001	1’	Piano Hinge (Cut into 2” pieces)	
7)	K1000-3	10	Nutplate	
8)	AN426A3-5	35	Rivet	
9)	AN3-4A	10	Screw	
10)	AN960-10L	10	Washer	
NOSE WHEEL ASSEMBLY				
1)	4720	1	Over center Link Weldment	
2)	4722	2	Bushing	
3)	5500	1	Retract Yoke	
4)	5510	2	Nose Gear Door Arm	
5)	5512	2	Threaded Rod	
6)	5513	2	Bushing	
7)	5516	1	Aluminum	
8)	AN5-22A	2	Bolt, Undrilled	
9)	Poly - 1.25 x 6	1	Delrin Block	
10)	MS21042-08	2	Nut	
11)	MS21042-08L	2	Nut	
12)	MS21042-3	2	Nut	
13)	AN363-516	2	Nut	
14)	MS24694-S7	2	Screw	
15)	AN525-832R10	2	Screw	
16)	MS24694-S7	2	Screw	
17)	381K103	2	Spacer	
18)	AN516-960L	2	Washer	

#	PART NO. (P/N)	QTY	DESCRIPTION	OPTIONAL ITEM (not included with propjetkit) supplied w/ retro fit option
NOSE GEAR DOORS				
1)	5510-01	1	Nose Gear Door Actuator Arm (Left)	
2)	5510-02	1	Nose Gear Door Actuator Arm (Right)	
3)	5511	4	Spacers	
4)	5514	1	Support, Nose Gear Door Rails	
5)	5516	2	Support Rails, Nose Gear	
6)	5517	2	Filler Strip	
7)	AN-xxxx	2	Bolt, Undrilled (for support to mount)	
8)	GM-318-01	1	Gear Door, Nose	
9)	GM320-36	38”	Gear Door, Stiffner	
10)	MS2001-5	38”	Hinge, Extruded Piano	
11)	AN363-1032	4	Nuts, Nylock	
12)	K1000-3	?	Nutplates	
13)	AN426A3-5	?	Pop Rivets	
14)	AN426A3-4	?	Rivets	
15)	MS24694-S53	2	Screw, Machine	
16)	MS24694-S7	18	Screw, Machine	
17)	AN525-R16	4	Screw, Machine	
18)	AN960-10	2	Washer, Flat	
19)	AN960-10L	2	Washer, Flat	
FIREWALL LAYOUT				
1)	5100	1	Firewall Blueprint	
2)	5101	1	Firewall Blueprint (Retro)	
OIL COOLER				
1)	L8538233	1	Oil Cooler	
2)	5007	1	Oil Cooler Shroud	
3)	M6015141-9	1	Fitting	
4)	C5355 x 8	1	Fitting	
5)	M6015011-7	1	Fitting	
6)	8-16-F50X	1	Fitting	
7)	65356 x 8	1	Fitting	
AIR INTAKE PLENUMS				
1)	5002L	1	Air Inlet Plenum	
2)	5002R	1	Air Inlet Plenum	
3)	5003L	1	Air Inlet Plenum Upper	
4)	5003R	1	Air Inlet Plenum Upper	
5)	5004	1	Extension, Rear Engine Baffle	
6)	5008-01	1	Engine Cover, Top	
7)	5008-02	1	Engine Cover, Bottom Right	
8)	5008-03	1	Engine Cover, Borrom Left	
9)	5009	1	Flange, Front Engine Baffle	
10)	5010	2	Seal Retainers	
11)	5103	1	Blueprint, Bulkhead Modifier	

#	PART NO. (P/N)	QTY	DESCRIPTION	OPTIONAL ITEM (not included with propjetkit) supplied w/ retro fit option
ENGINE CONTROLS				
Engine Controls - Propeller Assembly				
1)	5568	1	Cable, Prop Control	
2)	5570	1	Pivot Pin	
3)	5617	1	Turbine Pivot Arm	
4)	5618	1	Bracket	
5)	AN315-1032	1	Checknut	
6)	31509	1	Clamp	
7)	xxxx	1	Cotter Pin	
8)	SP 565	1	Spacer	
Engine Controls - Condition Lever Assembly				
1)	5567	1	Cable, Condition Lever (Fuel Cut-off)	
2)	5621	1	Fuel Cut-off Bracket	
3)	5619-01	1	Pivot Arm	
4)	5619-02	1	Pivot Arm Spacer	
5)	AN-xx	2	Bolt, Undrilled	
6)	31509	1	Clamp	
7)	AN363-1032	5	Locknuts	
8)	SP-565	1	Spacer	
9)	AN960-10	12	Washers	
10)	HFC-3	1	Rod End	
11)	AN3-5A	1	Bolt, Undrilled	
Engine Controls - Power Lever Assembly and Power Return Line				
1)	5615	1	Power Control Bellcrank Arm	
2)	5616	1	Support, Power Lever Bellcrank	
3)	5616-01	1	Stud	
4)	5634	1	Threaded Rod	
5)	5569	1	Cable, Throttle (Power)	
6)	SP-565	1	Spacer	
7)	AN 363-1032	4	Nut	
8)	90591A154	1	Nut, 7mm x 1	
9)	AN960-10	3	Washers	
10)	AN970-10	3	Washers	
11)	AN3-??	?	Bolt, Undrilled	
12)	31509	1	Clamp	
13)	AN315-3	1	Checknut	
14)	HFC-3	2	Rod End Bearing	

#	PART NO. (P/N)	QTY	DESCRIPTION	OPTIONAL ITEM (not included with propjetkit) supplied w/ retro fit option
THROTTLE QUADRANT				
1)	xxxxxxxxxxxx	x	xxxxxxxxxxx	
INSTRUMENT PANELS				
1)	xxxxxxxxxxxx	x	xxxxxxxxxxx	
FUEL SYSTEMS				
1)	5550	1	Fuel Selector Valve	
2)	5555	1	Mounting Plate	
3)	AN821-4D	2	Fitting	
4)	AN832-4D	2	Fitting, Bulkhead	
5)	C5515 x 8 x 10	1	Fitting, Straight thread O-Ring 90° elbow	
6)	AN822-8D	2	Fitting, Elbow	
7)	51205K137	1	Fitting, Nipple	
8)	LUN7691.04-8	1	Filter, Fuel	
9)	3B7-4	1	Pump, Fuel	
10)	AN924-4D	2	Check Nut	
11)	AN818-8D	5	Nut Coupling	
12)	AN819-8D	5	Sleeve	
13)	FU7-2	2	90° Strainer	
RUDDER CONTROLS				
1)	5020	1	Premolded Center Bearing Mount Support	
2)	RDB 410-02	2	Bearing Mounts	
3)	AN3-17A	3	Bolts, Undrilled	
4)	AN3-26A	4	Bolts, Undrilled	
5)	RDB 410-01-T	2	Center Bearing Supports	
6)	4080	2	Engine Mount Supports	
7)	AN-1032A	4	Nuts, Nylock	
8)	K-1000-3	3	Nutplates	
9)	MSC-32	6	Rivets	
10)	RD 413-01/02	2	Rudder Pedal Crossovers	
11)	AN960-10	11	Washers, Flat	

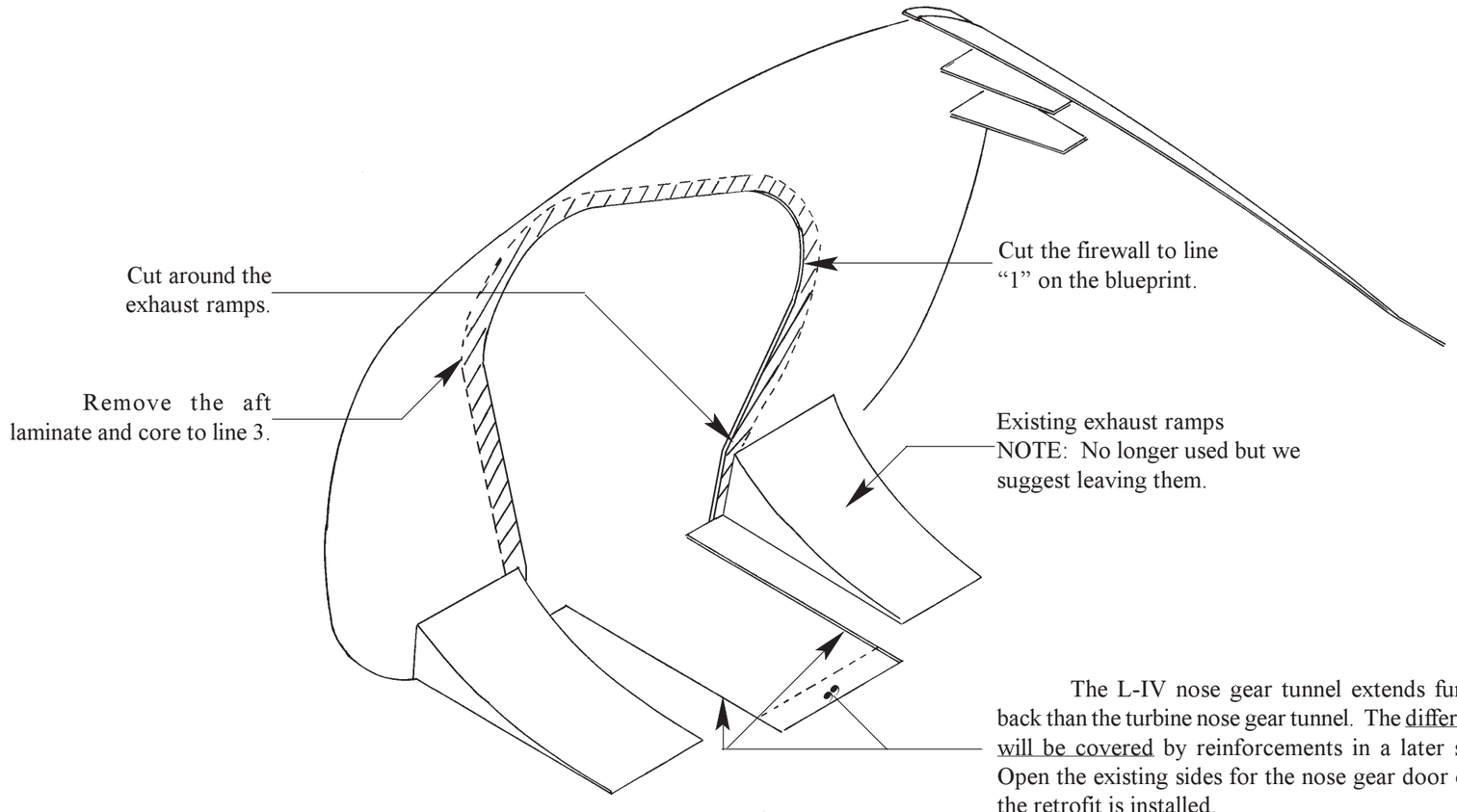
#	PART NO. (P/N)	QTY	DESCRIPTION	OPTIONAL ITEM (not included with propjetkit) supplied w/ retro fit option
BATTERY INSTALLATION				
1)	xxxxxxxxxxxx	x	xxxxxxxxxxx	
PRESSURIZATION SYSTEM				
1)	5035	1	Plenum Intercooler	
2)	5036	1	Flange Plenum Intercooler	
3)	5633	1	Flange Bleed Air Turbine	
4)	5634	1	Valve Bleed Air Turbine	
5)	5635	1	Intercooler Press.	
6)	585	1	Adapter, Cabin Heat Valve “T” Small	
7)	AN3-6A	4	Bolt, Undrilled	
8)	MS21919-DG20	4	Clamp, Adel	
9)	5416K15	10	Clamp Hose SS 13/16” to 1-1/2”	
10)	5416K23	2	Clamp Hose 2.5” O.D.	
11)	KND0111	1	Naca Duct Composite	
12)	AN365-1032A	4	Nut, Elastic Stop 10-32	
13)	SCAT-10	2’	Tubing Scat 2.5” ID	
14)	SCEET-5	11’	Tubing Sceet Hi Temp 1-1/4”	
15)	SCEET-6	2’	Tubing Sceet Hi Temp 1-1/2”	
16)	AN960-10	4	Washer, Flat	

3. CONSTRUCTION PROCEDURE

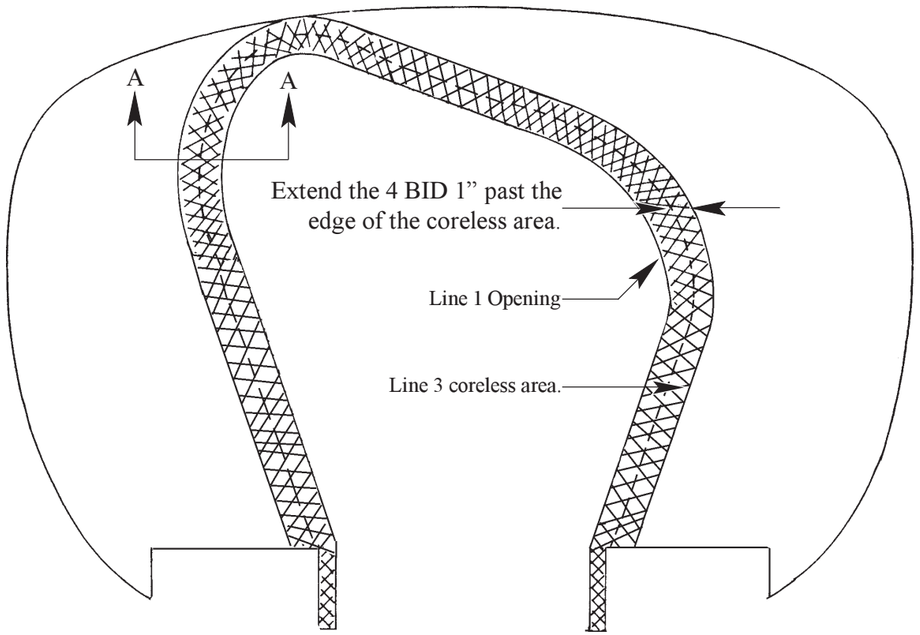
A. FIREWALL RETROFIT INSTALLATION

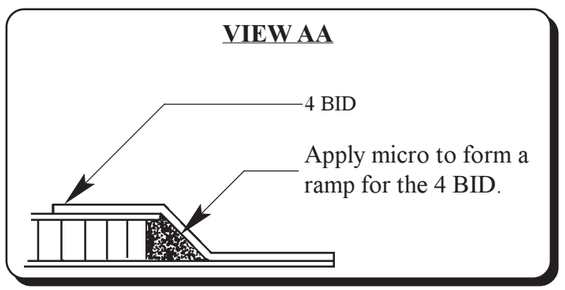
1. Cut out the existing firewall using the supplied template 5101.
   a. The aircraft should be leveled in the roll axis for this step.
   b. Fit the blueprint to the firewall and level it to the "HORIZONTAL REFERENCE LINE".
   c. Cut the firewall out to line "1" as labeled on the blueprint. Remove the nose gear tunnel of your existing firewall.
   d. Remove the inner laminates and core following line 3 of the print. Also refer to Figure A:2. We suggest that you consider all the other coreless areas of the firewall at this point and remove the core at the same time.

Firewall Cutout
Fig. A:1



Firewall Reinforcement
Fig. A:2

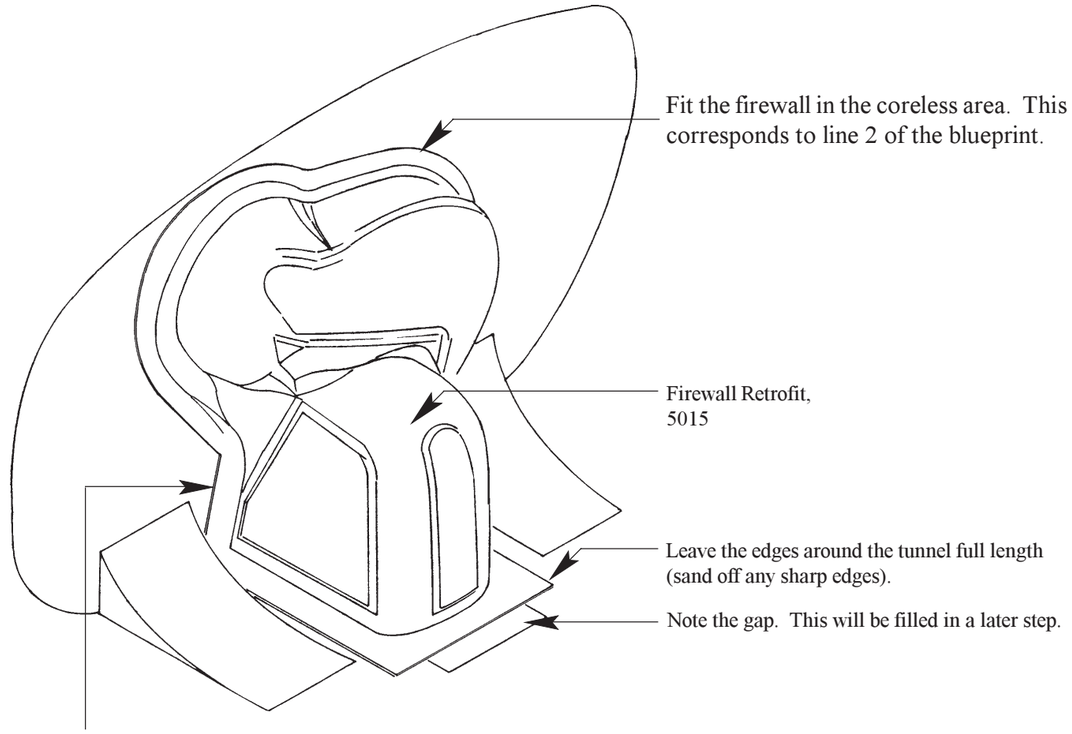




e. Install a 4 BID reinforcement.

Fitting Firewall Retrofit
Fig. A:3

f. Fit and trim the firewall retrofit. The retrofit should fit nicely onto the coreless area. Trim around the exhaust ramps as required. Verify with the blueprint (P/N 5101) the alignment (see note 1). Once satisfied with the alignment drill for clecoes every 3 to 5 inches for aligning the firewall insert for the bonding process.



Trim firewall retrofit to fit around exhaust ramps.

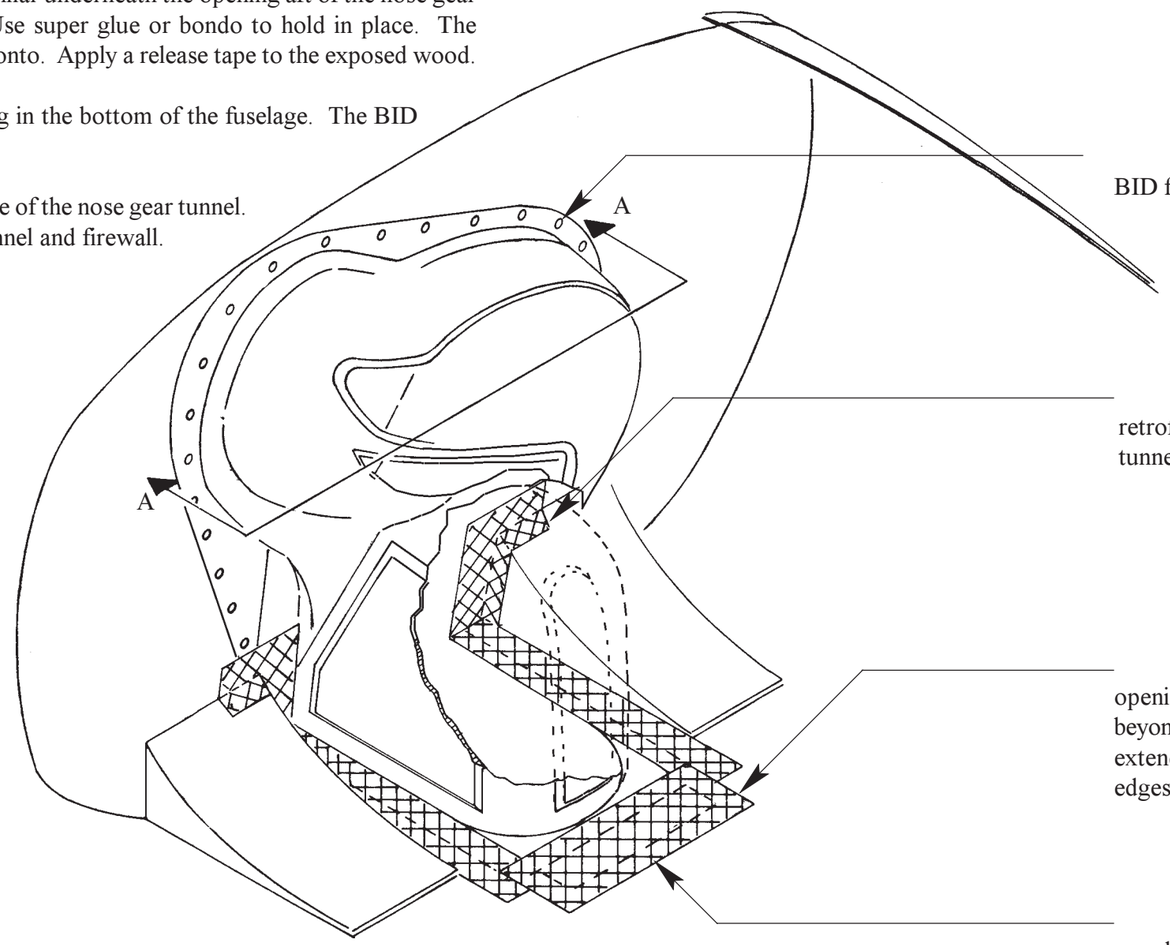
Bonding In Firewall Retrofit
Fig. A:4

g. Bond the firewall retrofit in place using epoxy/flox using approved bonding procedures. (Sand all bonding surfaces thoroughly and clean. Wet out both surfaces prior to applying the epoxy/flox to the firewall retrofit. Mound the epoxy/flox in a "V" shape). Use clecoes to hold in place.

h. Temporarily install a piece of flexible 1/8" plywood or similar underneath the opening aft of the nose gear tunnel. Install so that it contours nicely to fuselage. Use super glue or bondo to hold in place. The purpose of the wood is to create a surface to lay the BID onto. Apply a release tape to the exposed wood.

i. Apply the 10 BID reinforcement to close out the opening in the bottom of the fuselage. The BID must extend 1-1/2" onto the existing structure.

j. Apply the 4 BID reinforcement along the left and right side of the nose gear tunnel. Also apply 4 BID onto the area between the exhaust tunnel and firewall.



The cleco holes will be covered by BID from the outside.

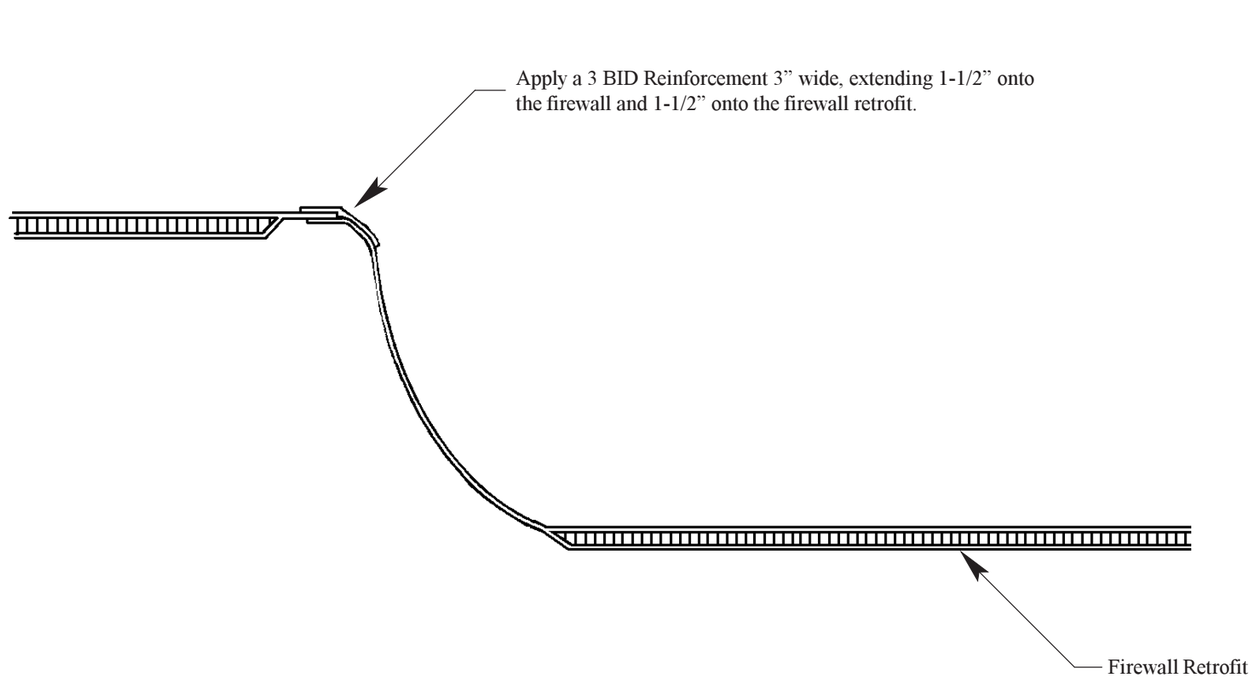
3" wide 4 BID securing the firewall retrofit to the fuselage around the nose gear tunnel and the exhaust ramps.

10 BID reinforcement covering the opening where the L-IV firewall extended beyond the retrofit opening. The 10 BID must extend 1-1/2" beyond the opening along all edges.

Temporarily install a flexible piece of wood on the bottom of the fuselage to form a surface to lay the BID on.

BID Reinforcement, Front of Firewall
Fig. A:5

VIEW AA



K. Reinforce the front side of the firewall with a 3 BID 3” wide around the perimeter of the opening.

B. ENGINE MOUNT INSTALLATION

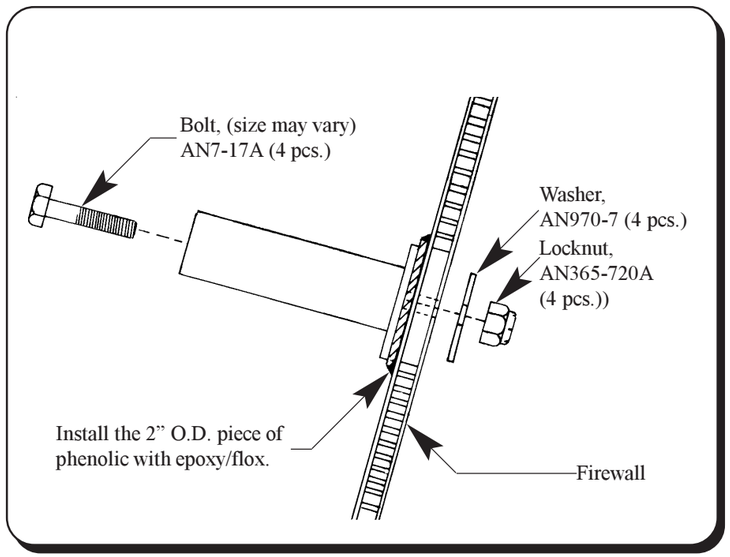
In this section we will first install 1/8" phenolic spacers on the firewall. The phenolic spacers are bonded in with epoxy/flox. These are not required unless the firewall is uneven under the mounts.

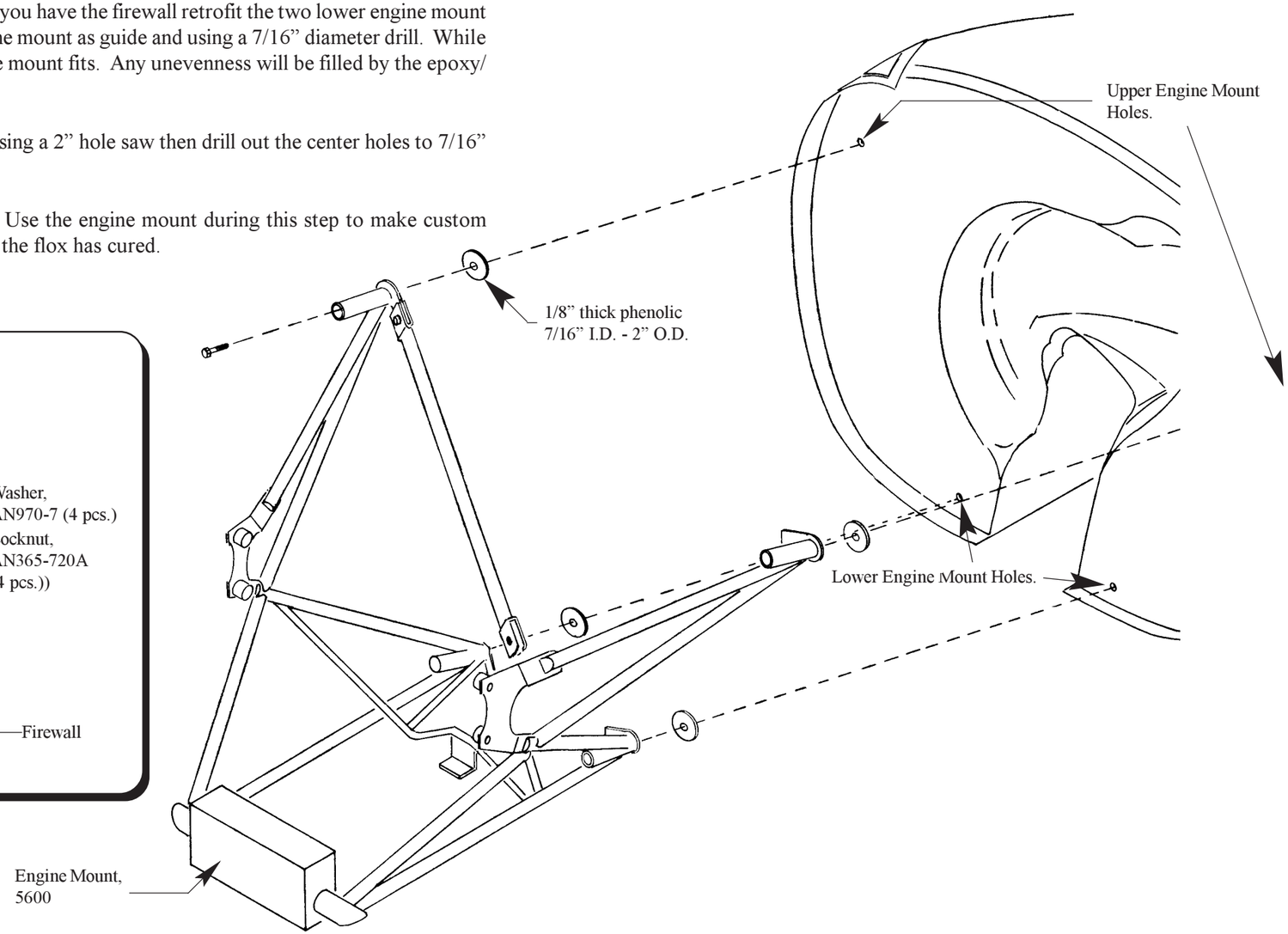
B1. Temporarily hold the engine mount in place. If you have the firewall retrofit the two lower engine mount holes are not drilled yet. Drill the holes using the mount as guide and using a 7/16" diameter drill. While holding the mount in place note how the engine mount fits. Any unevenness will be filled by the epoxy/flox used to install the phenolic with.

B2. Make the 1/8" phenolic spacers. We suggest using a 2" hole saw then drill out the center holes to 7/16" diameter. Prep the bonding surfaces.

B3. Install the phenolic spacers using epoxy/flox. Use the engine mount during this step to make custom flox pads for the mount. Remove mount after the flox has cured.

Engine Mount Installation
Fig. B:1

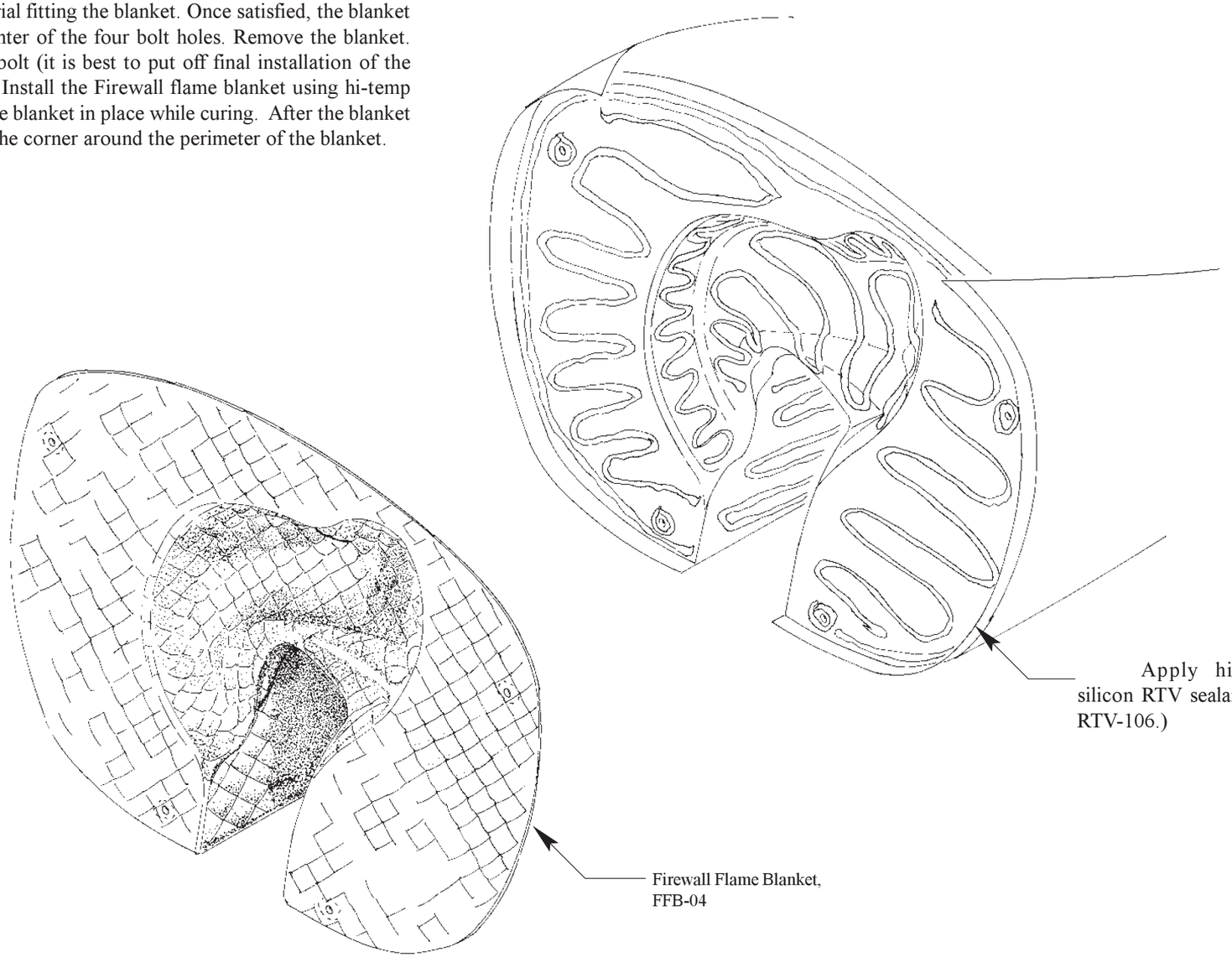




Installing Firewall Flame Blanket
Fig. B:2

B4. Install the Firewall flame blanket. Start by trial fitting the blanket. Once satisfied, the blanket is aligned as good as possible, mark the center of the four bolt holes. Remove the blanket. Using a hole punch, make the hole for the bolt (it is best to put off final installation of the blanket until all items have been installed). Install the Firewall flame blanket using hi-temp silicon RTV sealant. Use the bolts to hold the blanket in place while curing. After the blanket is bonded apply a smooth radius of RTV in the corner around the perimeter of the blanket.

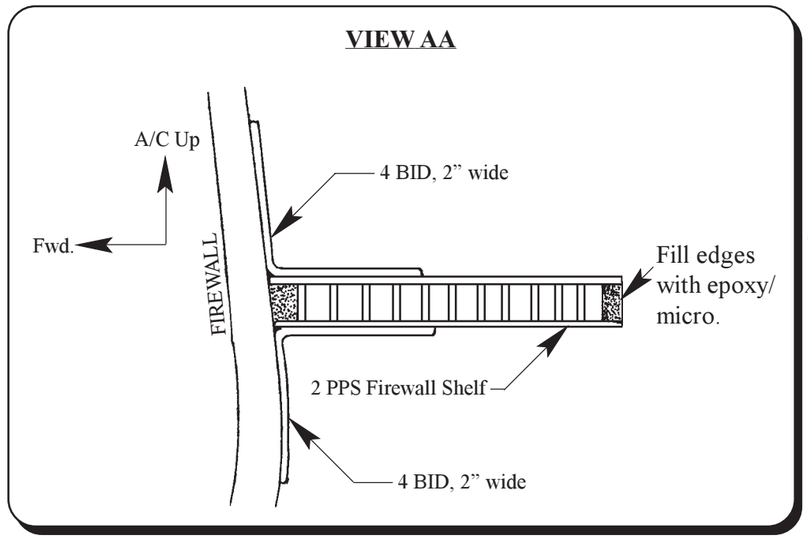
B5. Install the Engine mount.



Firewall Reinfocement Shelf
Fig. B:3

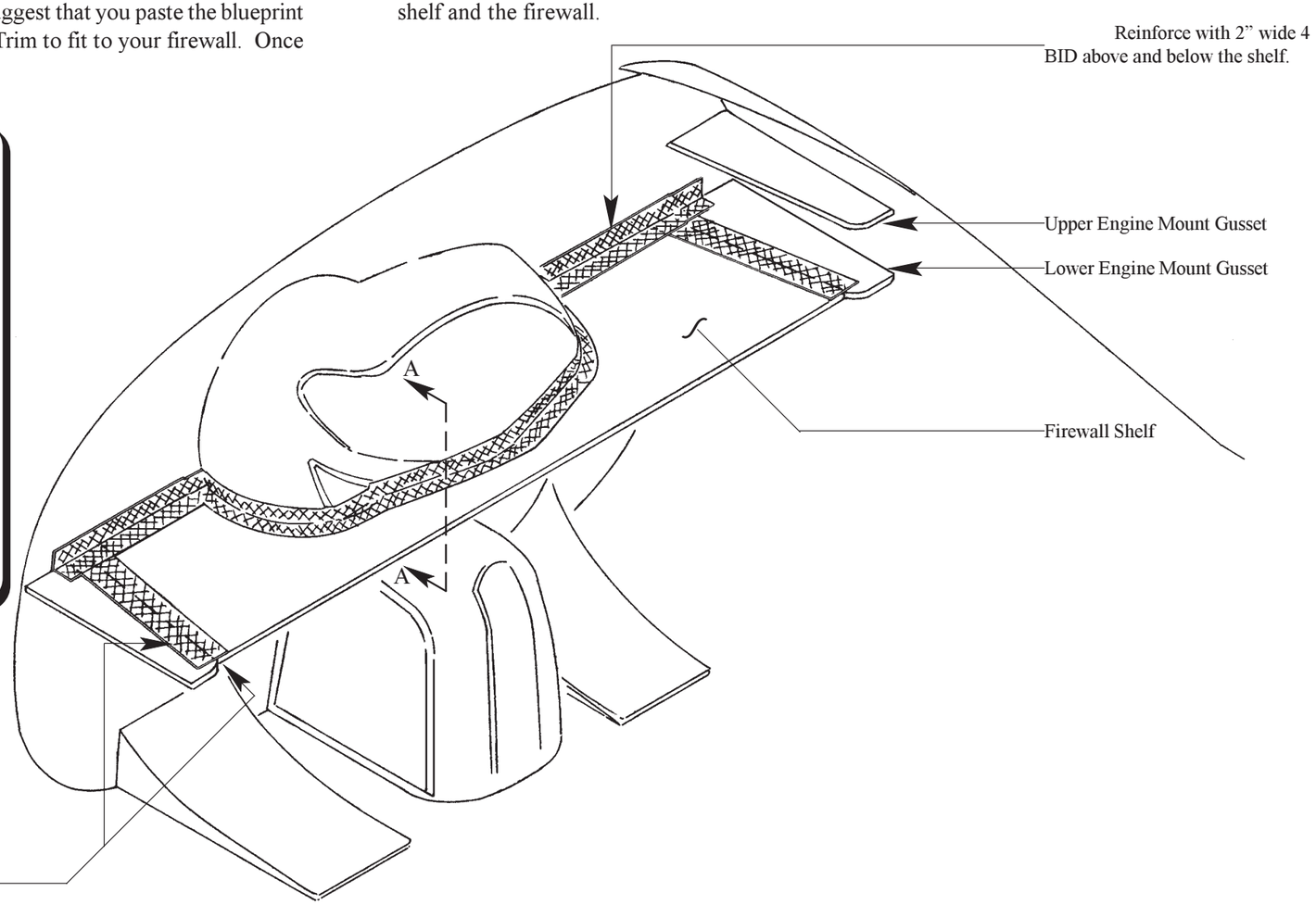
The purpose of the firewall shelf is to reinforce the firewall as well as provide a mounting surface for equipment. The brace is made from 2 PPS e-glass.

B6. Cut out firewall shelf from 2 PPS prepreg using blueprint # 5102. We suggest that you paste the blueprint on a piece of cardboard. Initially cut the cardboard pattern oversize. Trim to fit to your firewall. Once satisfied with the pattern cut the prepreg.



B7. Check the fit of the shelf and make final adjustments. Remove 1/4" of core along the perimeter of the shelf.

B8. Prepare all bonding surfaces and bond the piece in using epoxy/flox. Form a micro radius between the shelf and the firewall.



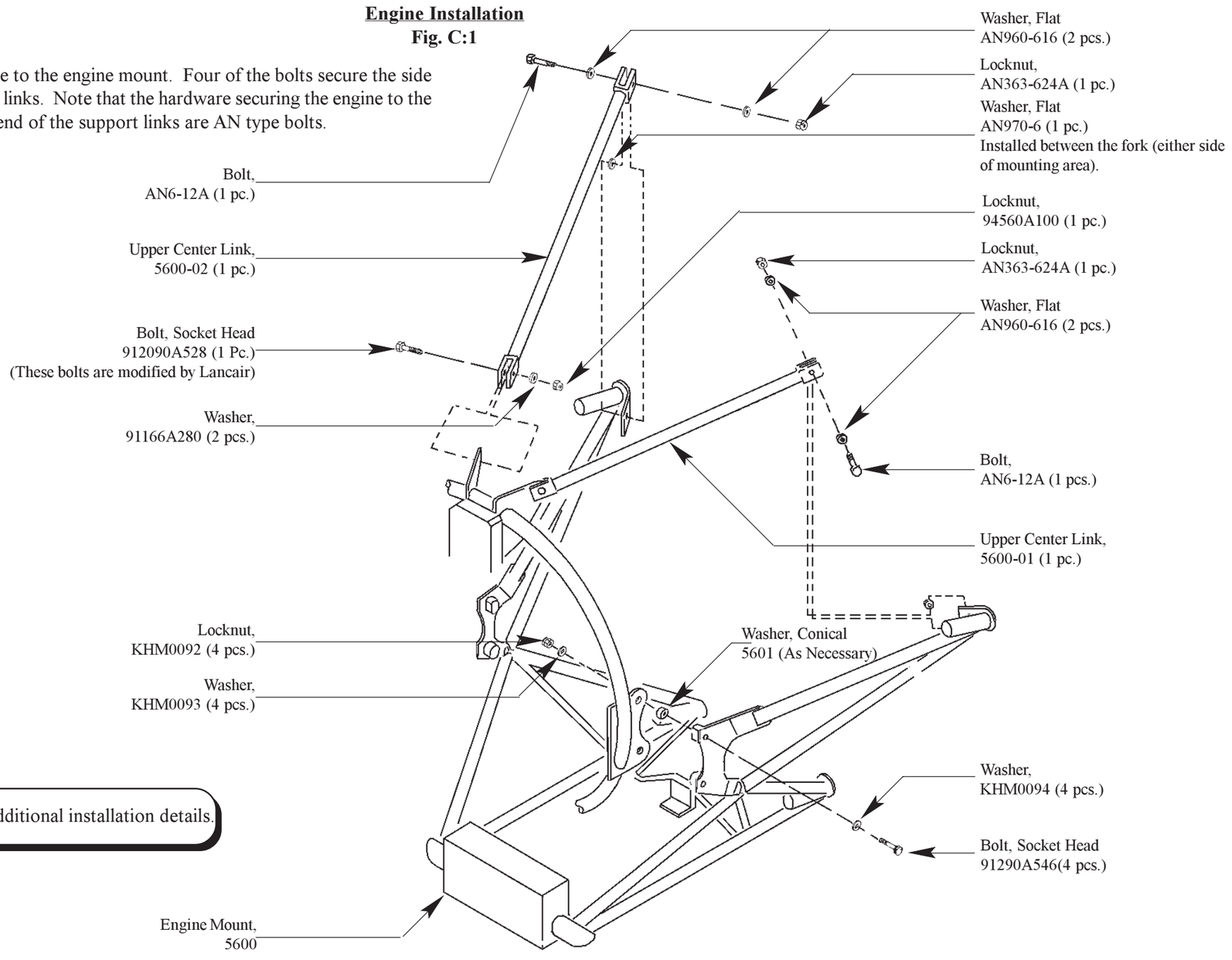
B 9. Secure the shelf with 2" wide 4 BID. The BID installs above and below the shelf onto the gussets and to the firewall as shown in the figure.

C. ENGINE INSTALLATION

C 1. Install the engine using the hardware shown.

In summary there are 6 bolts securing the engine to the engine mount. Four of the bolts secure the side of the engine and two bolts in the upper support links. Note that the hardware securing the engine to the mount is all metric. The bolts securing the aft end of the support links are AN type bolts.

Engine Installation
Fig. C:1



Refer to the engine maintenance manual for additional installation details.

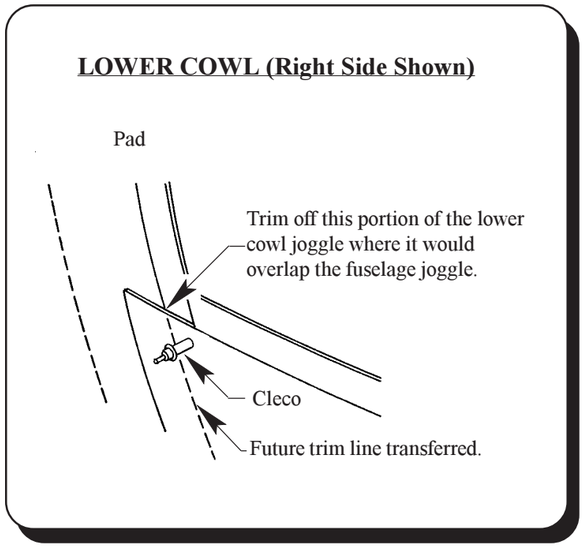
D. COWLING INSTALLATION

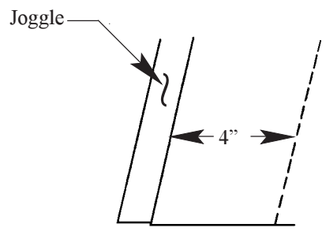
Fitting Cowling
Fig. D:1

D 1. Install the propeller and backplate. We suggest you leave the spinner off for now to protect it from scratches. The spinner backplate must be on for reference to set the cowling.

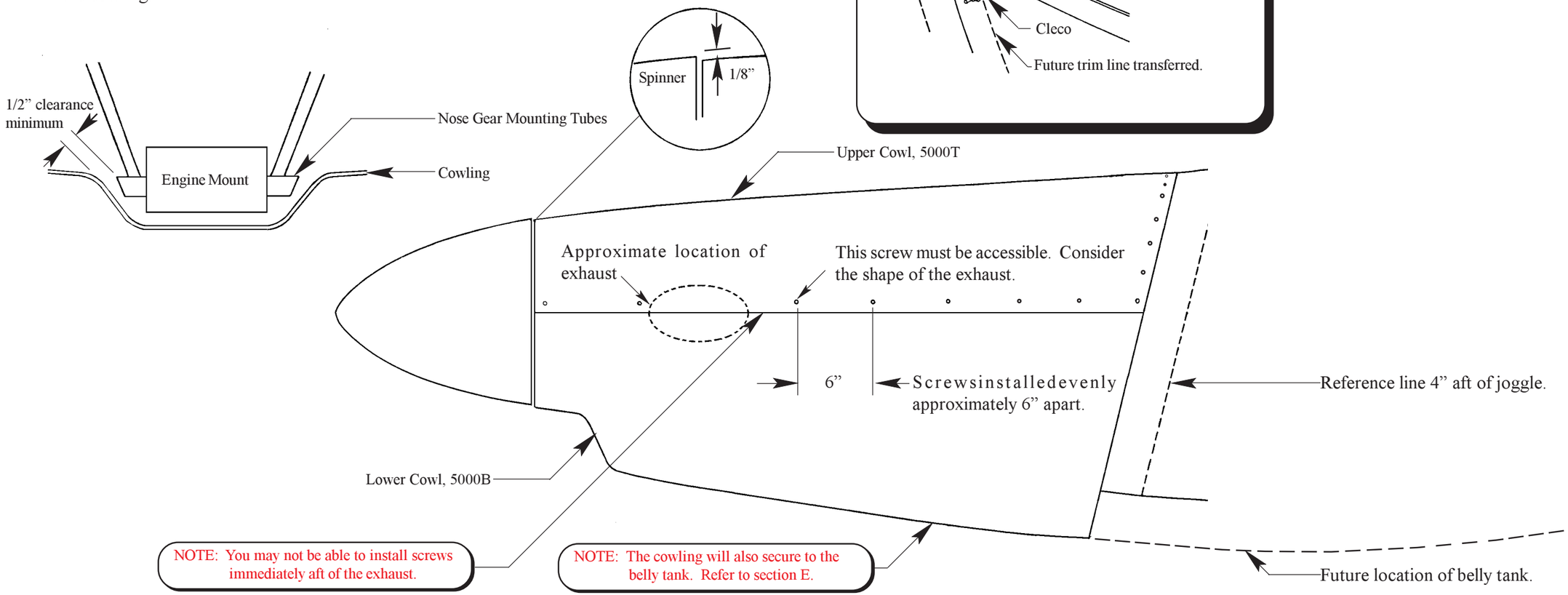
D 2. Fit the cowling. Start by fitting the lower cowling. Due to variations in the choice of spinners the size of the forward cowl radius can be adjusted by trimming the forward edge of the cowl to the desired diameter. There is approximately 1-1/2" of extra material on the aft side of the cowl to move forward as necessary. Check the motor mount for at least a 1/2" clearance between the sides of the mount and the cowling. Trim the engine mount nose gear mounting tubes if necessary.

Once the cowl is aligned install a couple of clecoes for future alignment purposes. Note that the exhaust protrudes through the split line of the cowling. There should be 1/2" clearance between the exhaust and the cowling.



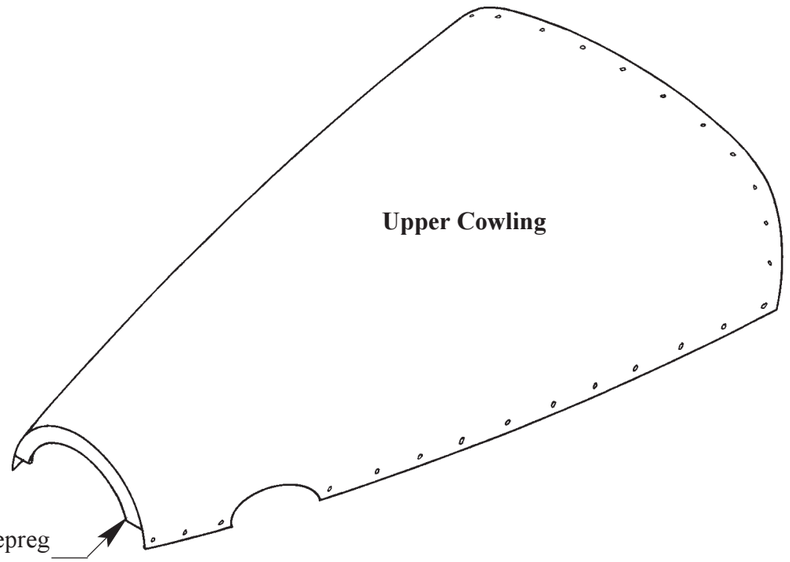


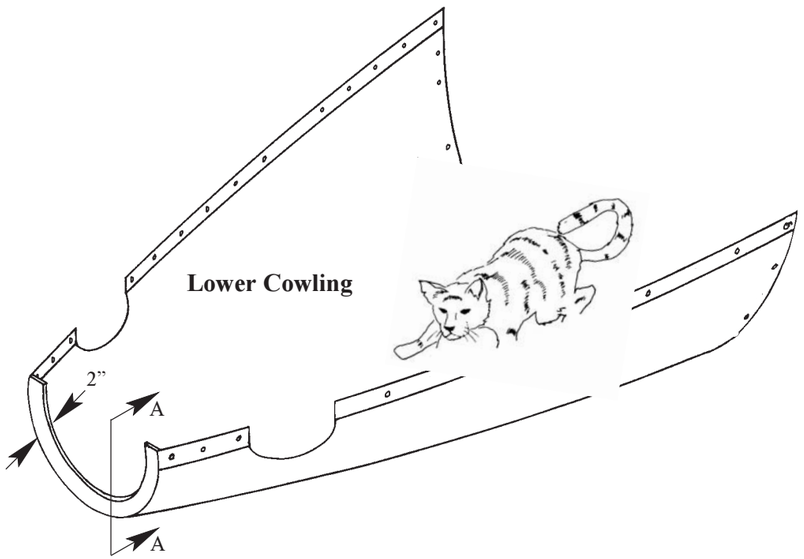
Hint: Make a 4" reference mark aft of the joggle.



Installing Forward Cowl Bulkhead
Fig. D:2

D 3. Fit and install the forward cowl bulkhead. The bulkhead is 2 PPS and is shaped to conform to the spinner. Install with epoxy/micro and secure with 2 BID on the inside and 1 BID on the outside.

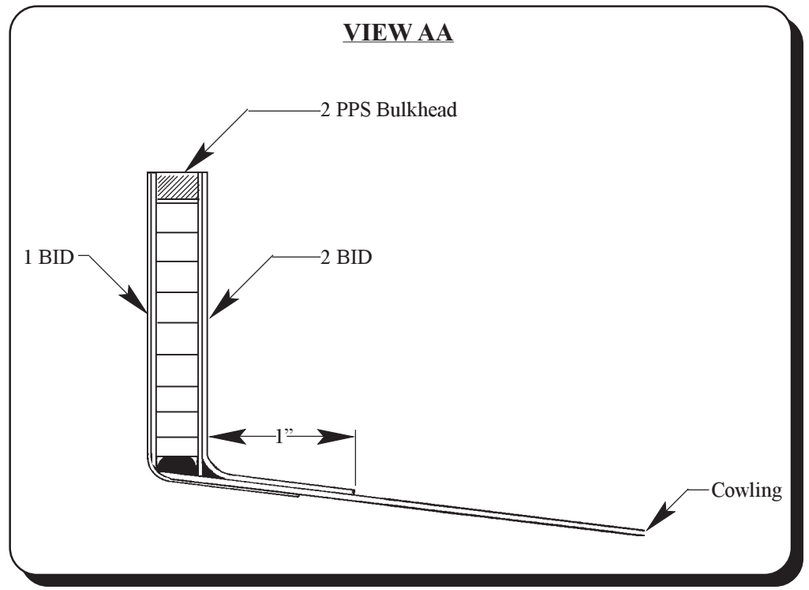




D 4. Install the cowling nutplates.

Note: The nutplates can be installed at any time. You may wish to take advantage of the cleco holes for a while for ease of installing and removing the cowling prior to installing nuplates. We typicaly use K1000 nutplates installed with MSC-32 rivets.

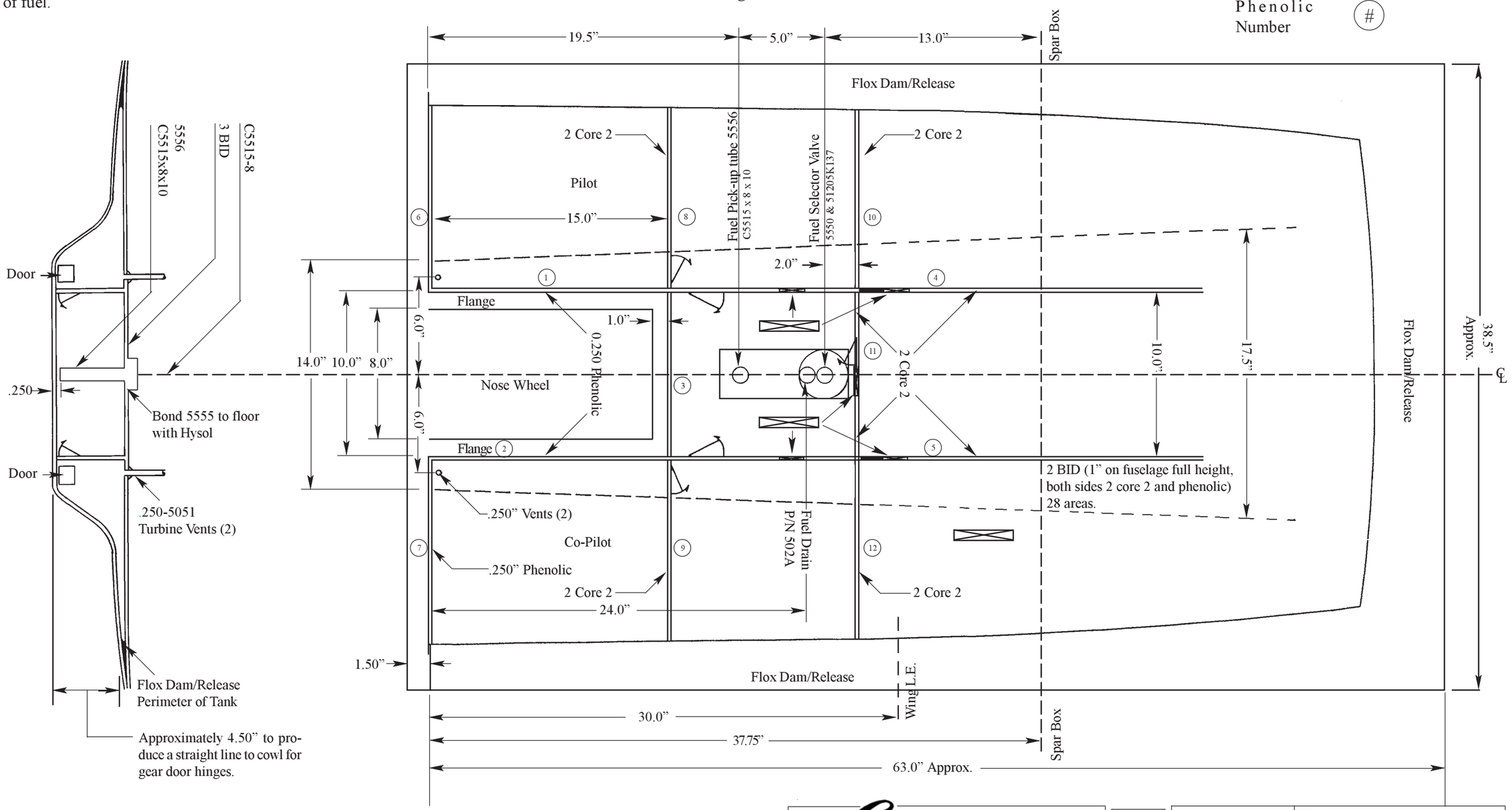
D 5. Remove the engine



E. BELLY TANK INSTALLATION

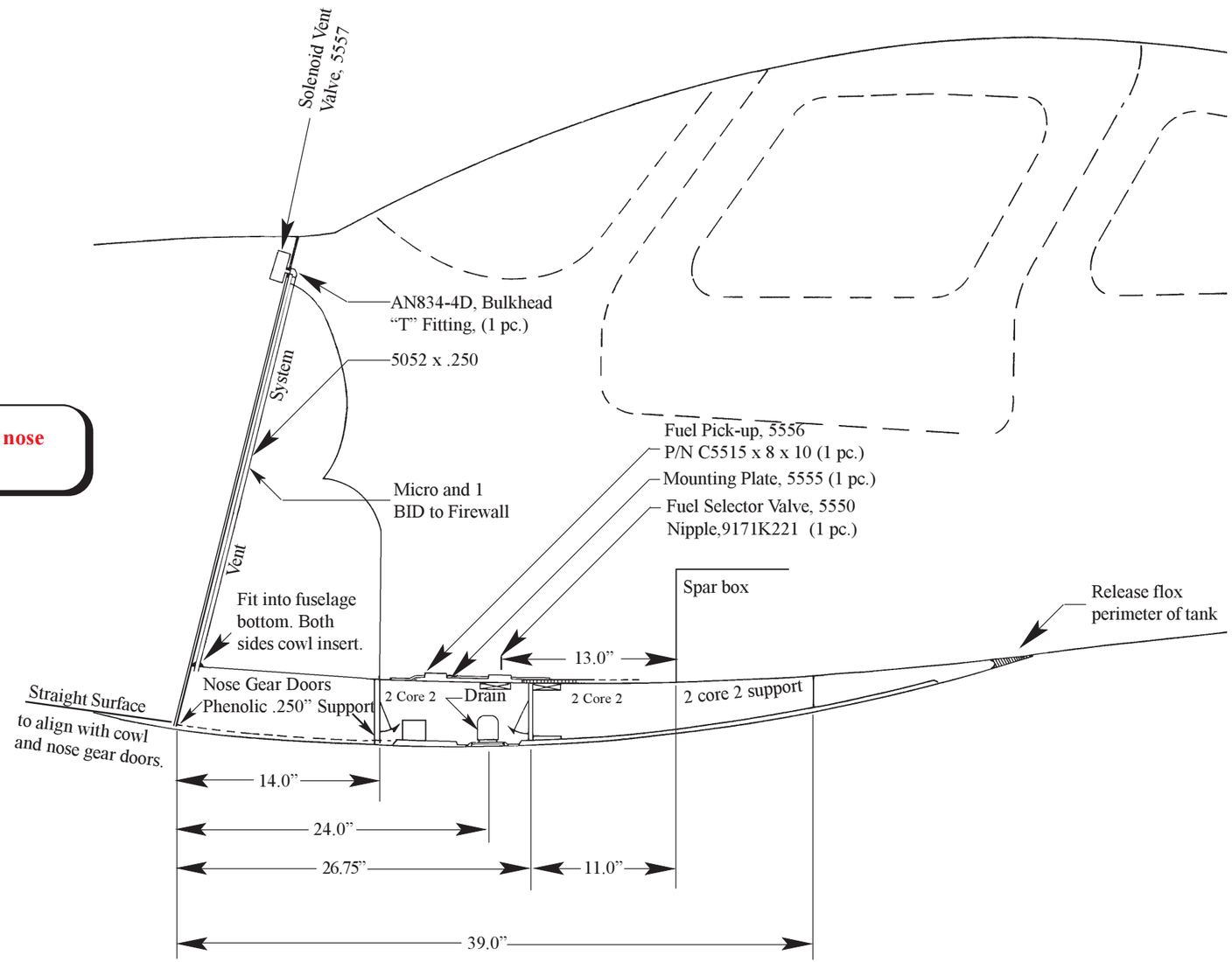
The belly tank fairs into the cowling. It also carries approximately 10 gallons of fuel.

Top View, Fuselage
Fig. E:1



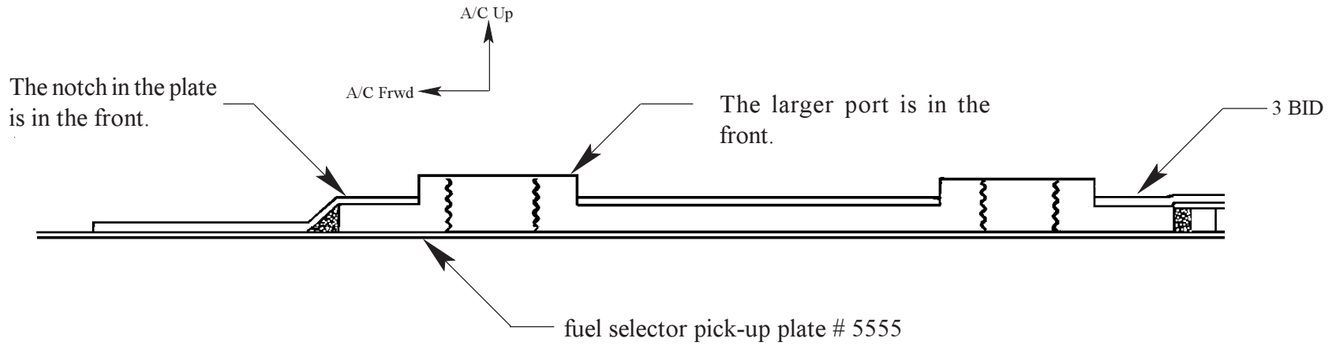
Side View, Fuselage
Fig. E:2

Note: Use a straight edge to insure that the nose gear doors will have a flat surface.



Fuel Selector / Pick-up Plate
Fig. E:3

E 1. Remove the inner skin and core from the bottom of the fuselage to accommodate the fuel selector/pick-up plate # 5555 using drawing E:1 to locate. Use Hysol/flox to bond the plate to the floor with the 1/2" NPT threaded hole to the rear. Fill the gap between the core and plate with micro and cover the plate with 3 BID fiberglass (except the raised threaded bosses) overlapping the core by 2".



E 2. Drill 2 each 1/4" holes about 1/2" aft of the firewall and about 1/2" outboard of the nose gear tunnel (in the corner of the motor mount reinforcing bracket). These are vent holes and must enter the fuel tank. (Refer to figure E:2, side view of fuselage).

E 3. Form a length of 5052 x .25" tubing to fit from each of the vent holes around the aft side of the firewall/ nose gear tunnel junction to a AN834-4D bulkhead "T" fitting at the top center of the firewall about 1.5" below the top. When satisfied with the location and fit put the 1/4" tube into the vent holes. Form a micro radius on each side of the tubing and cover with 1 BID fiberglass.

Fitting the Cowl to the Belly Tank
Fig E:4

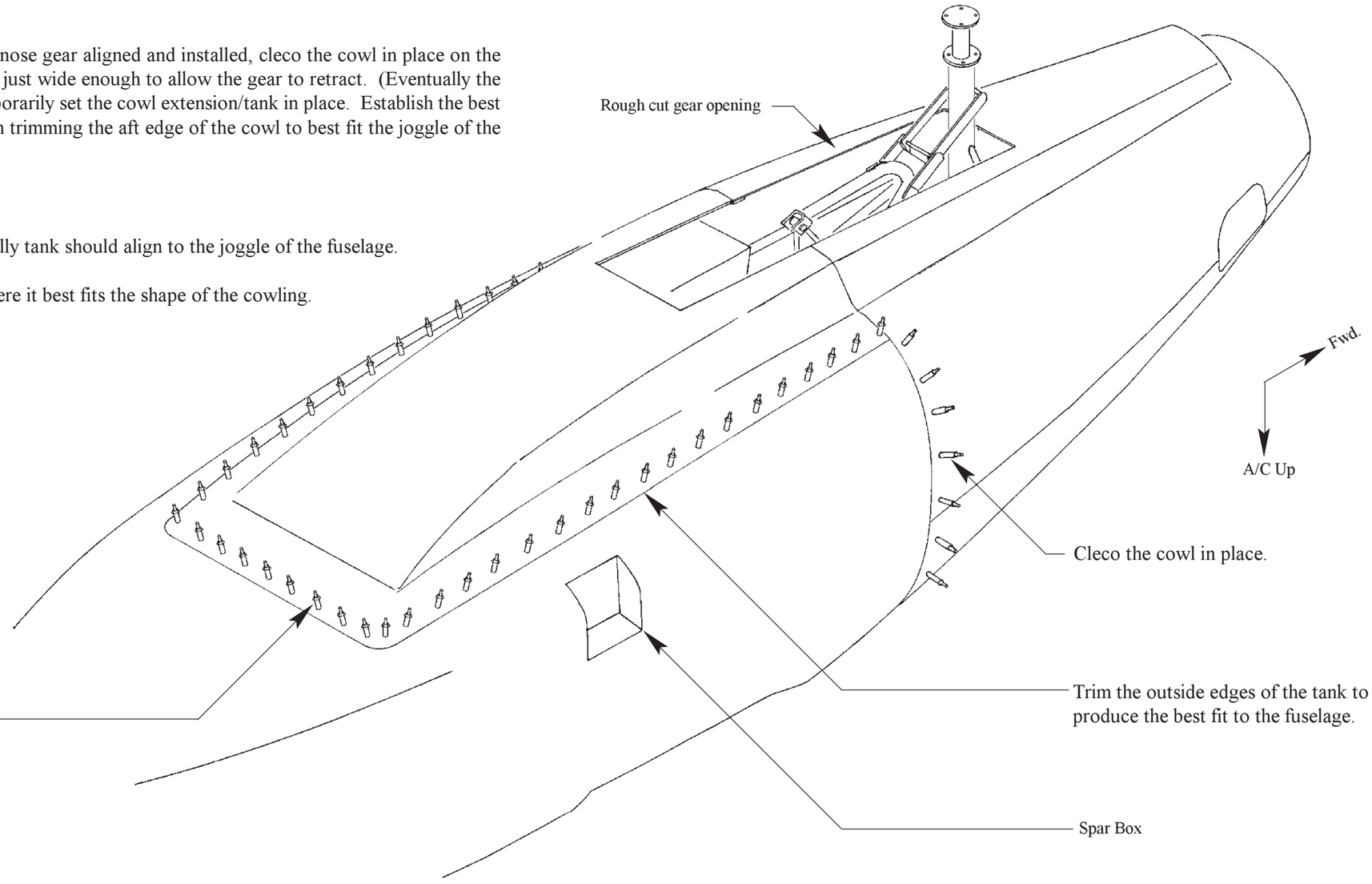
E4: Fitting the Cowl to the Bellytank

a. With the engine mount installed and the nose gear aligned and installed, cleco the cowl in place on the fuselage. Cut out the nose gear opening just wide enough to allow the gear to retract. (Eventually the gear door hinges will be 8" apart). Temporarily set the cowl extension/tank in place. Establish the best fit location relative to the cowl and finish trimming the aft edge of the cowl to best fit the joggle of the belly tank.

E5: Initial Fit and Alignment of Belly Tank

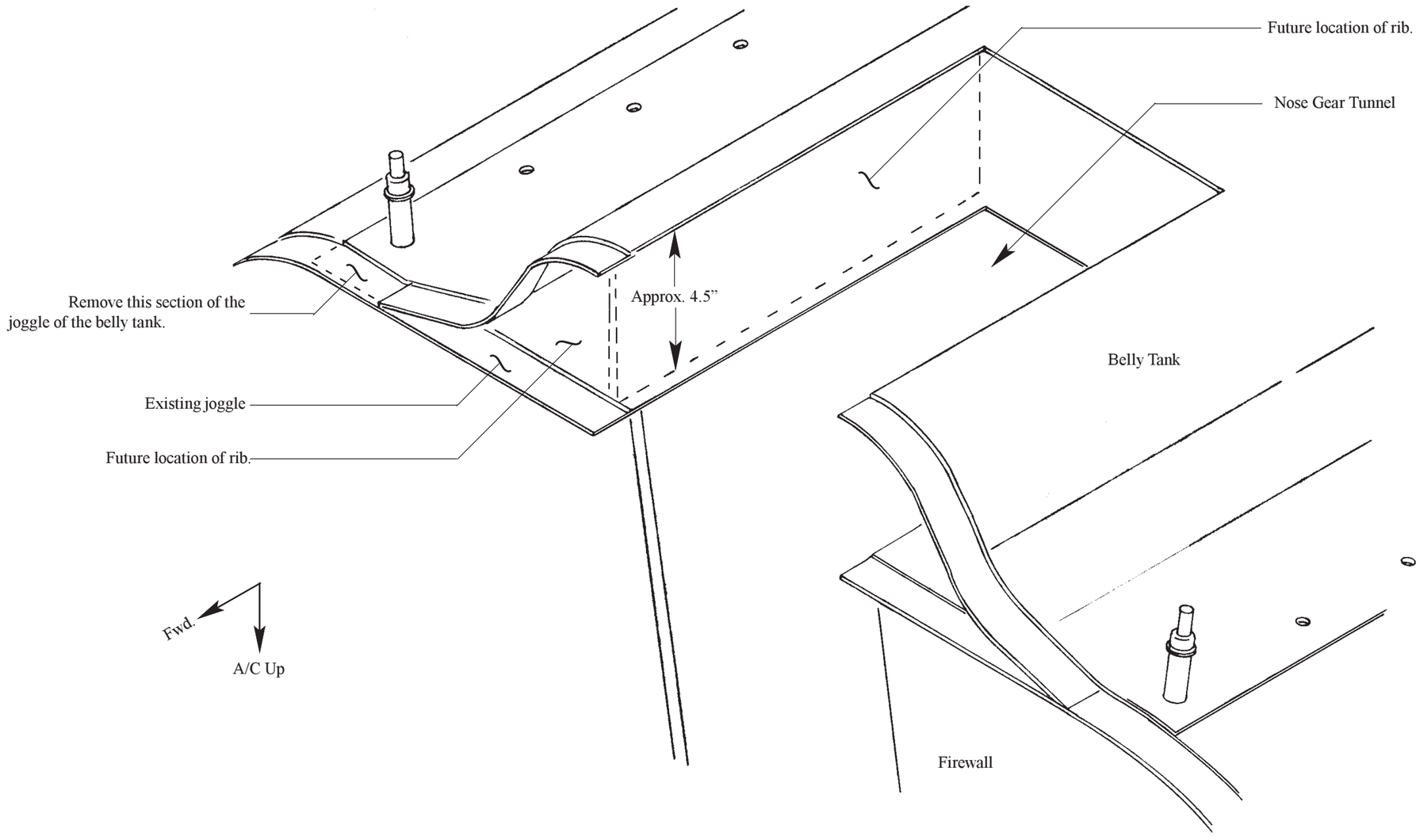
a. Fore/aft alignment: The joggle of the belly tank should align to the joggle of the fuselage.

b. Left/right: Position the belly tank to where it best fits the shape of the cowling.



Once fitted install clecoes every 6 inches around the perimeter of the tank. The clecoes should be 1" inboard of the edge.

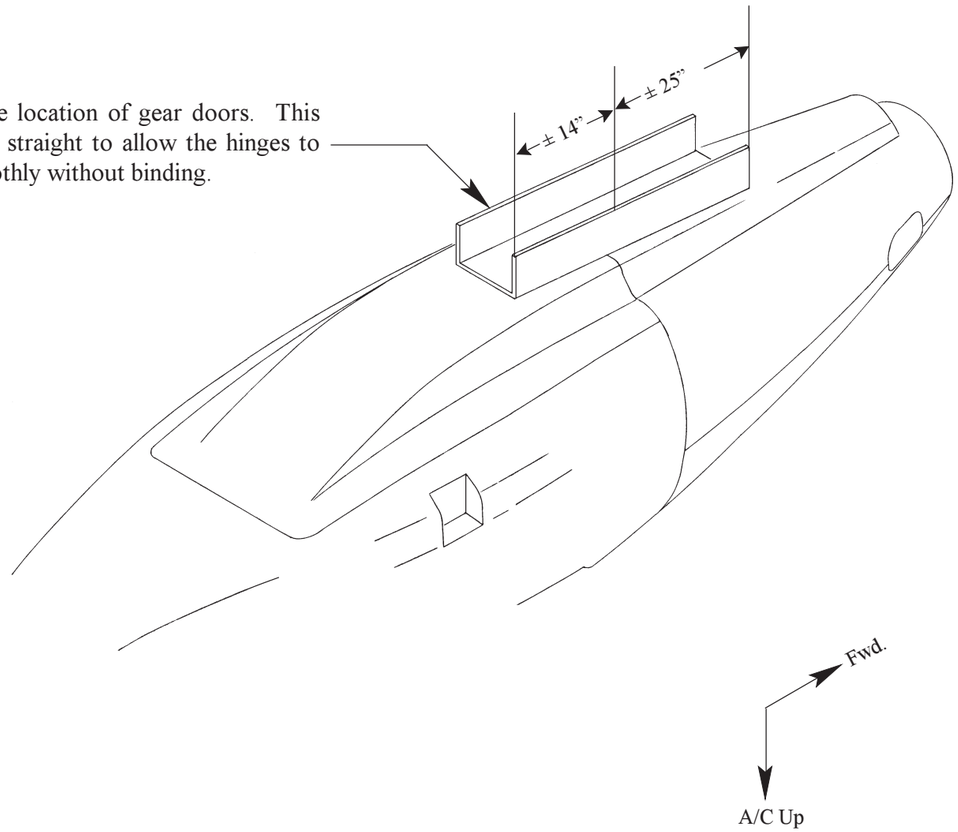
Trimming the Joggle of the Belly Tank
Fig E:5



Establishing a Straight Line for the Nose Gear Doors and Hinges
Fig E:6

E 6. Adjust the back portion of the Cowl and the front portion of the tank to produce a straight line for the nose gear doors and hinges. (doors are 39" long with approx. 25" on the cowl and 14" on the tank, see section G). Measure the inside dimension from the fuselage bottom to the tank skin. Use weight, straight edges, and clamps as necessary to keep straight throughout the construction of the belly tank.

Future location of gear doors. This area must be straight to allow the hinges to operate smoothly without binding.

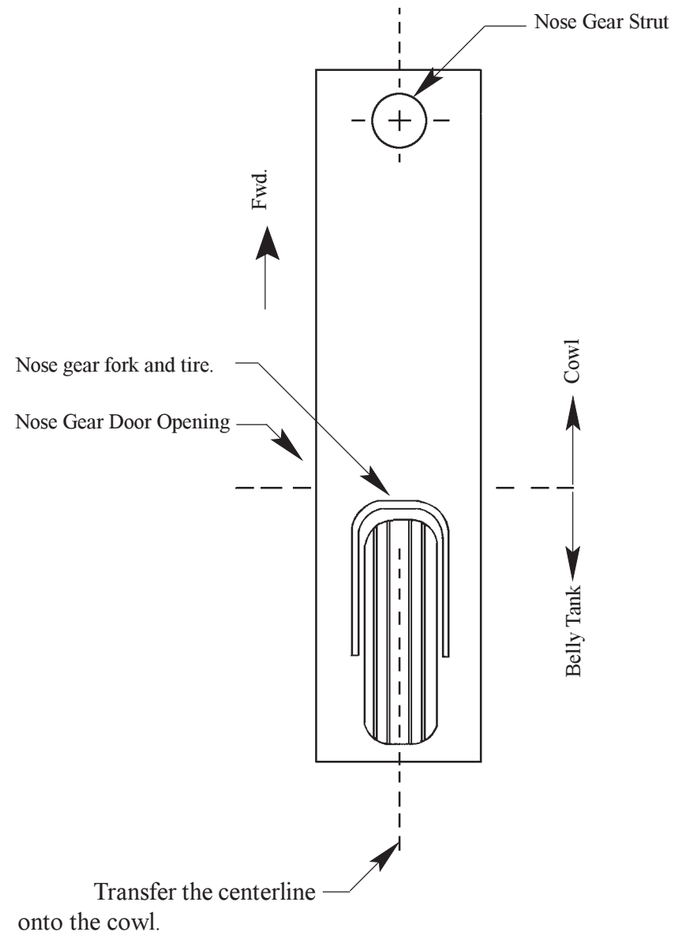


Establishing a Centerline for the Nose Gear Doors
Fig E:7

In Front: Transfer the center of the nose gear strut onto the cowiling.

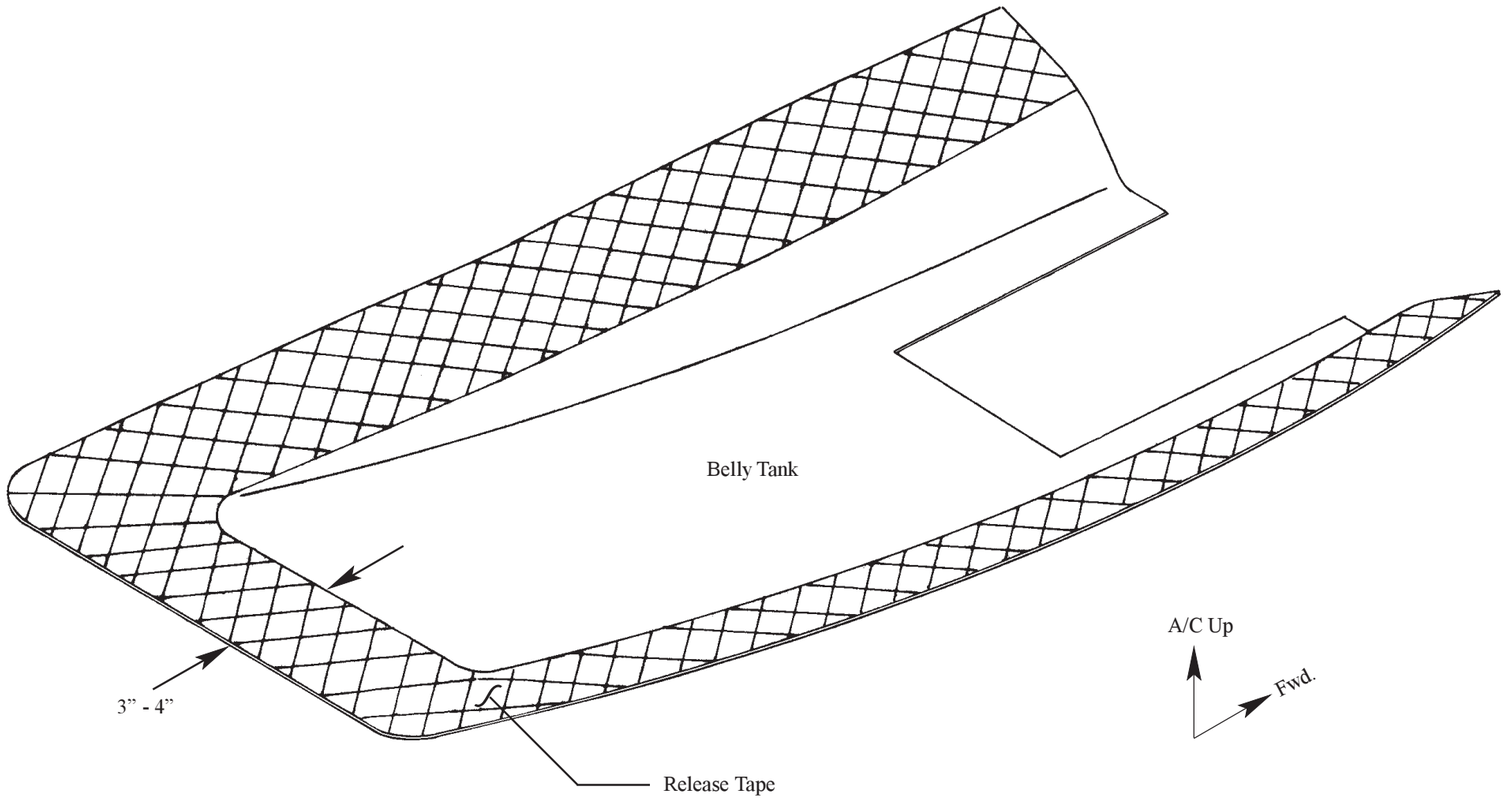
Aft: Retract the nose gear. Use the center of the tire or the fork to transfer a center line onto the belly tank**.**

BOTTOM VIEW



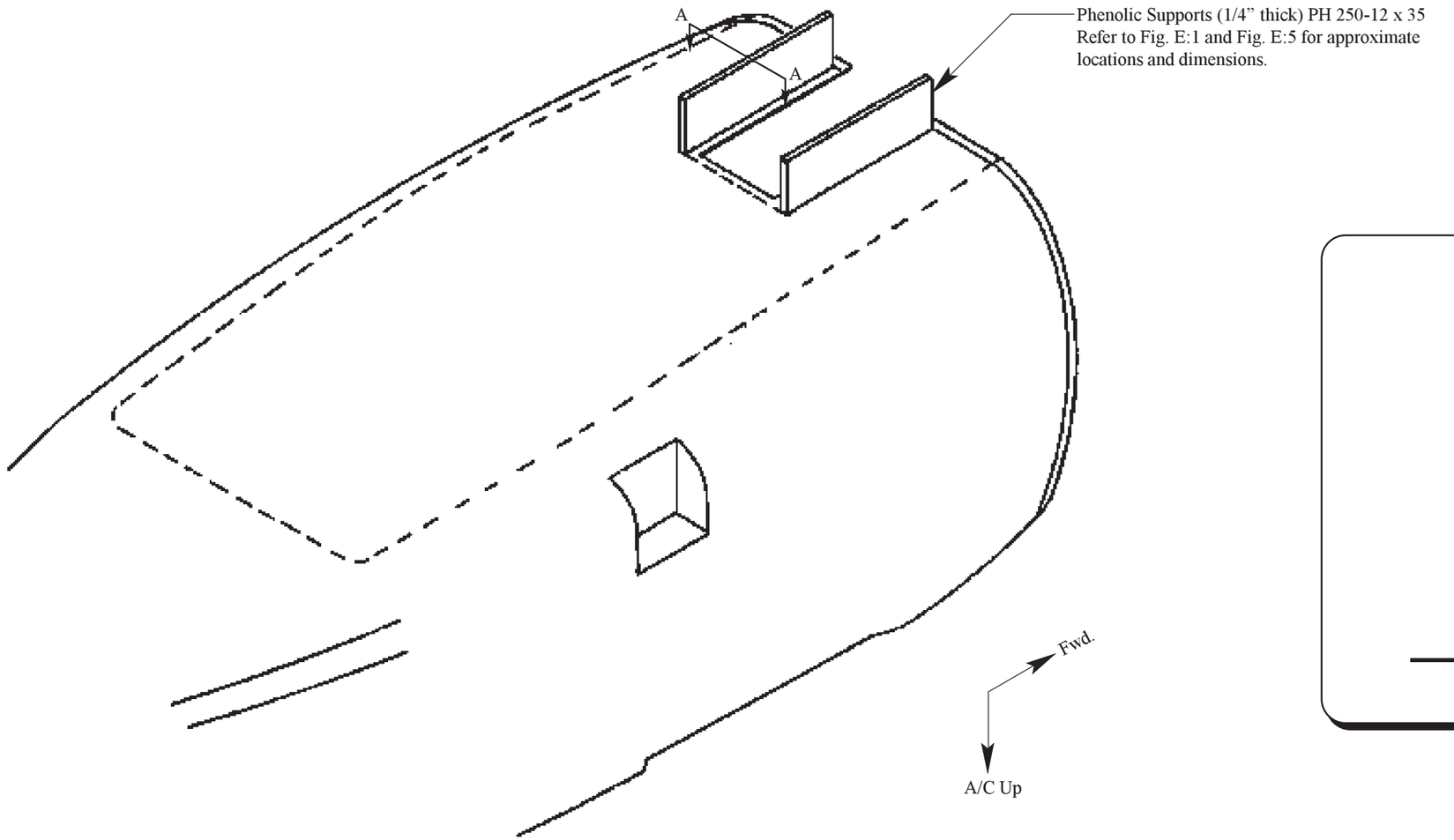
Application of Release Tape
Fig E:8

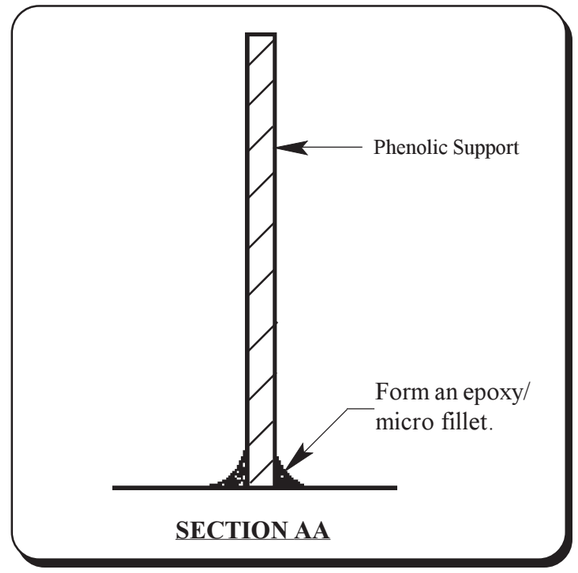
E 7. Remove the tank. Release tape the tank's fuel side surface from the edge to beyond the anticipated band area. Wax the taped surface. (Use clear tape or duct tape).



Forming the Sides of the Nose Gear Tunnel
Fig E:9

E 8. Shape two phenolic supports that will form the sides of the nose gear tunnel. They will be about *14" long by approx. 4.5" (see step E6)* you measured above to produce the straight line for the nose gear doors. We have provided blue print number 5104 as a reference. We suggest that you glue the patterns to cardboard. Custom fit the pieces of cardboard before you start cutting the actual ribs and supports. Once fitted, install with epoxy/micro using approved bonding procedures.

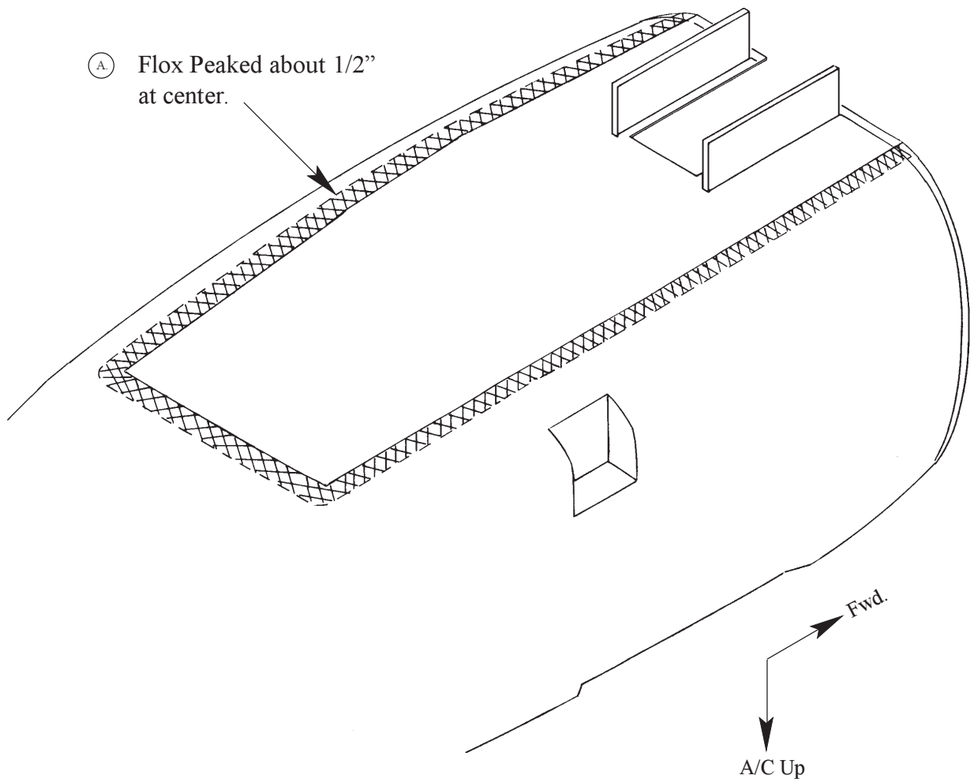




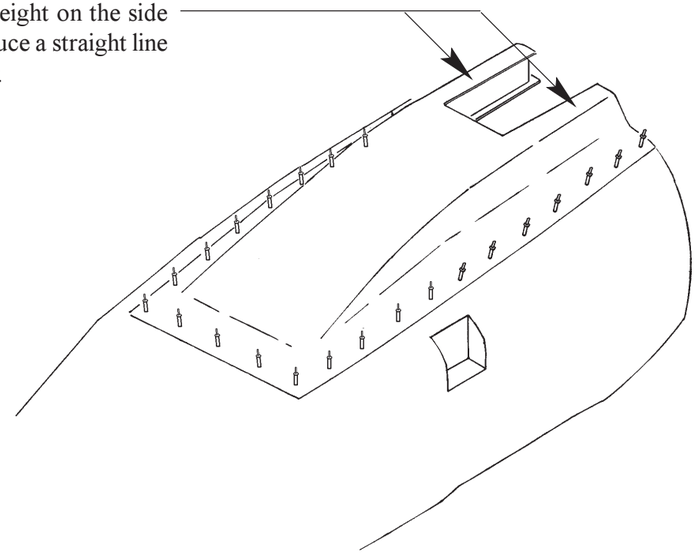
SECTION AA

Producing a Uniform Bond Surface
Fig E:10

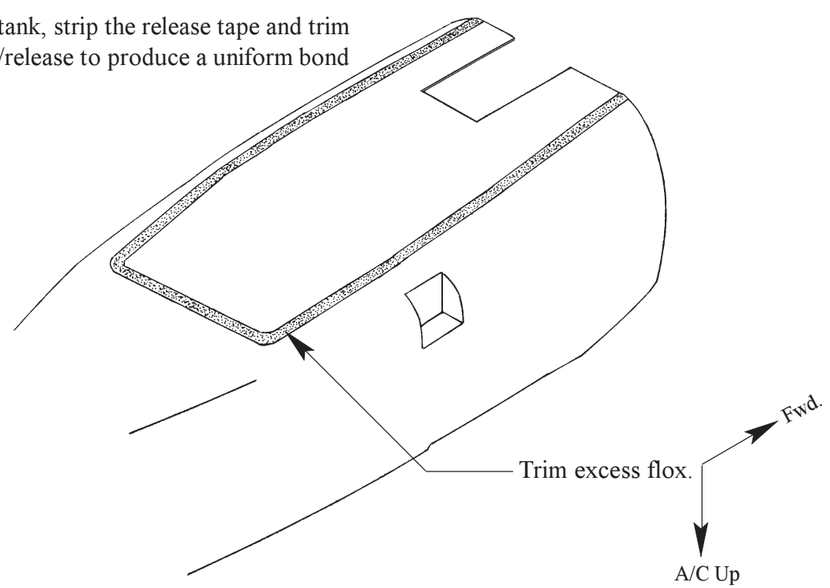
E 9. Prep the fuselage/tank bond area. Obtain adequate help and have all necessary tools and supplies near by. Quickly apply flox to the bond area (from the tank edge mark inboard about 2") Peaked about 1/2" thick at the center. Set the tank in place on the fuselage. Attach it with clecos and apply enough weight on the side supports of the nose gear tunnel to produce the straight line for the nose gear door (see fig. E:10). Let it cure.



B. Apply enough weight on the side supports to produce a straight line for the nose gear.

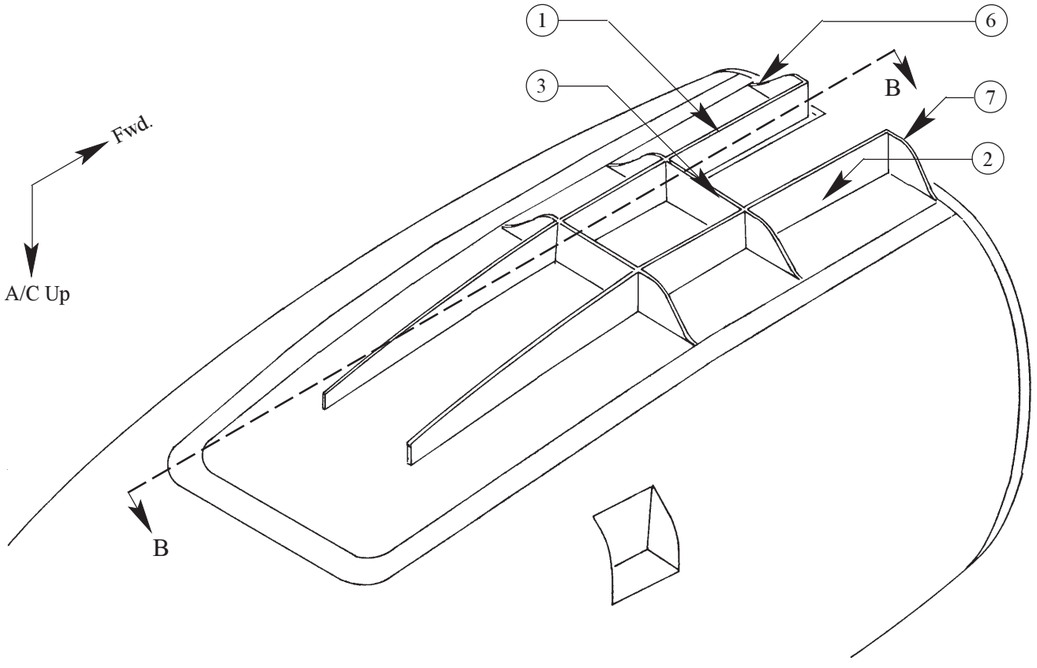


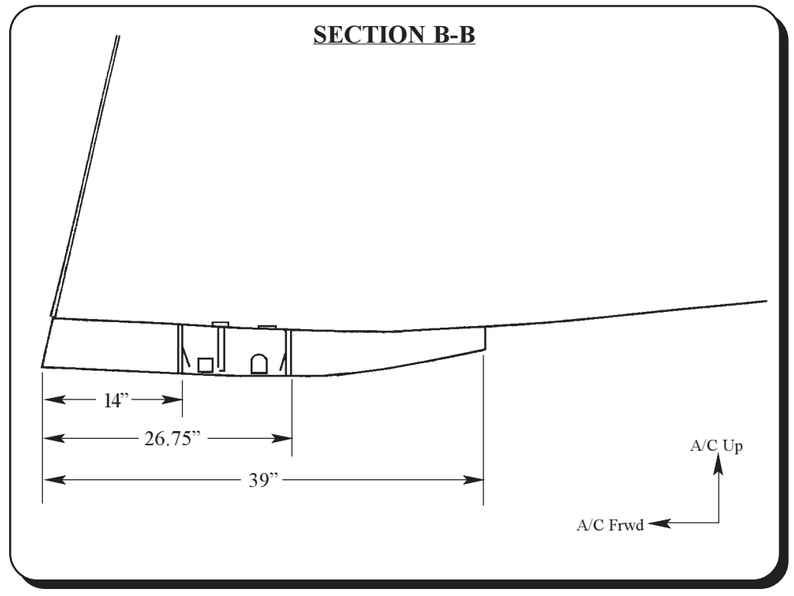
C. After cure, remove tank, strip the release tape and trim the excess flox dam/release to produce a uniform bond surface.



Forming the Nose Gear Tunnel
Fig E:11

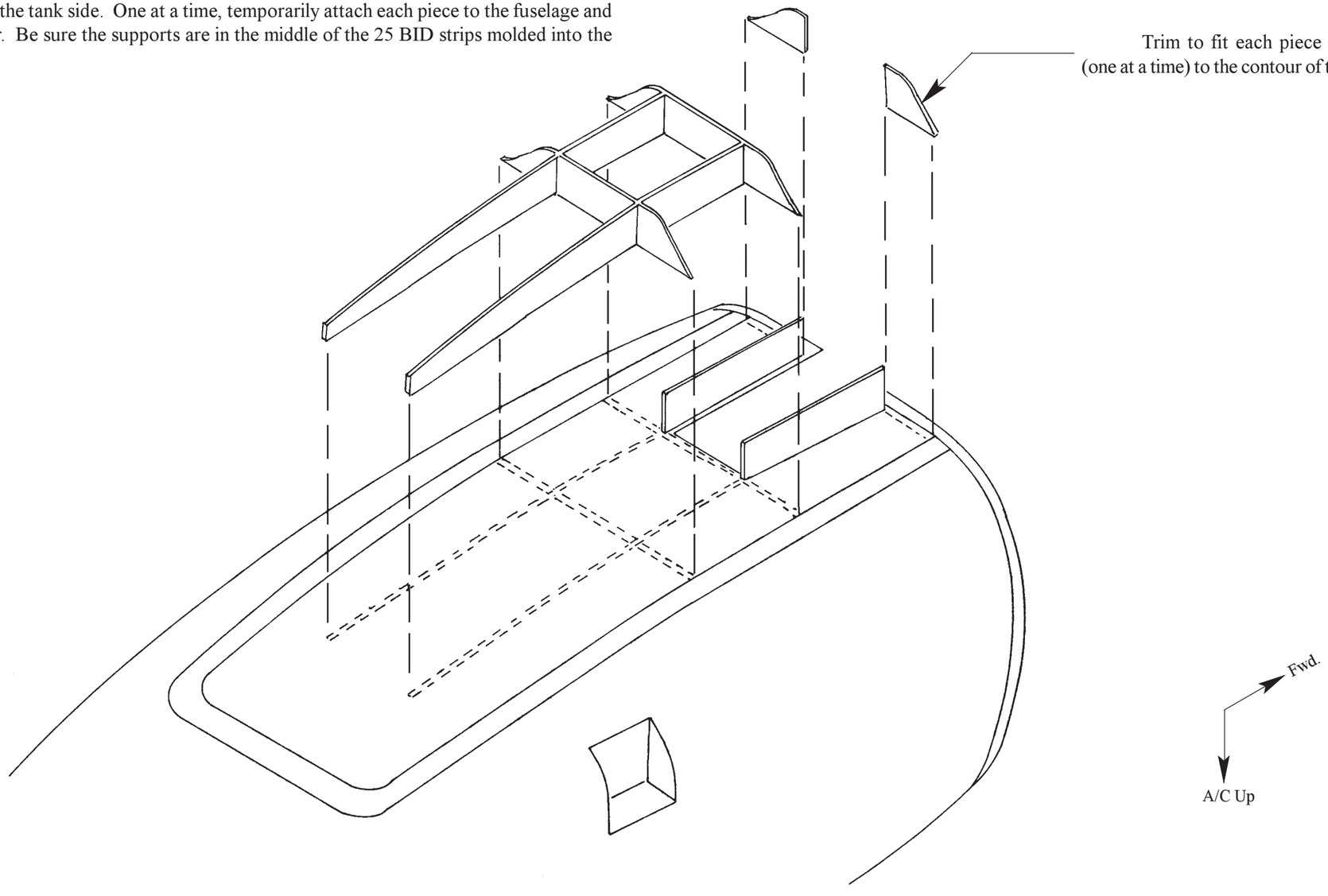
E 10. Refer to Drawing 5104 and figure E:1. Fabricate the ribs (crosswise) and supports (lengthwise). The pieces forming the front of the tank (6 and 7); the sides of the nose gear opening (1 and 2); and the back wall of the nose gear opening (3); are 1/4" phenolic. All others are 2 core 2 prepreg panel (P/N 1026B).





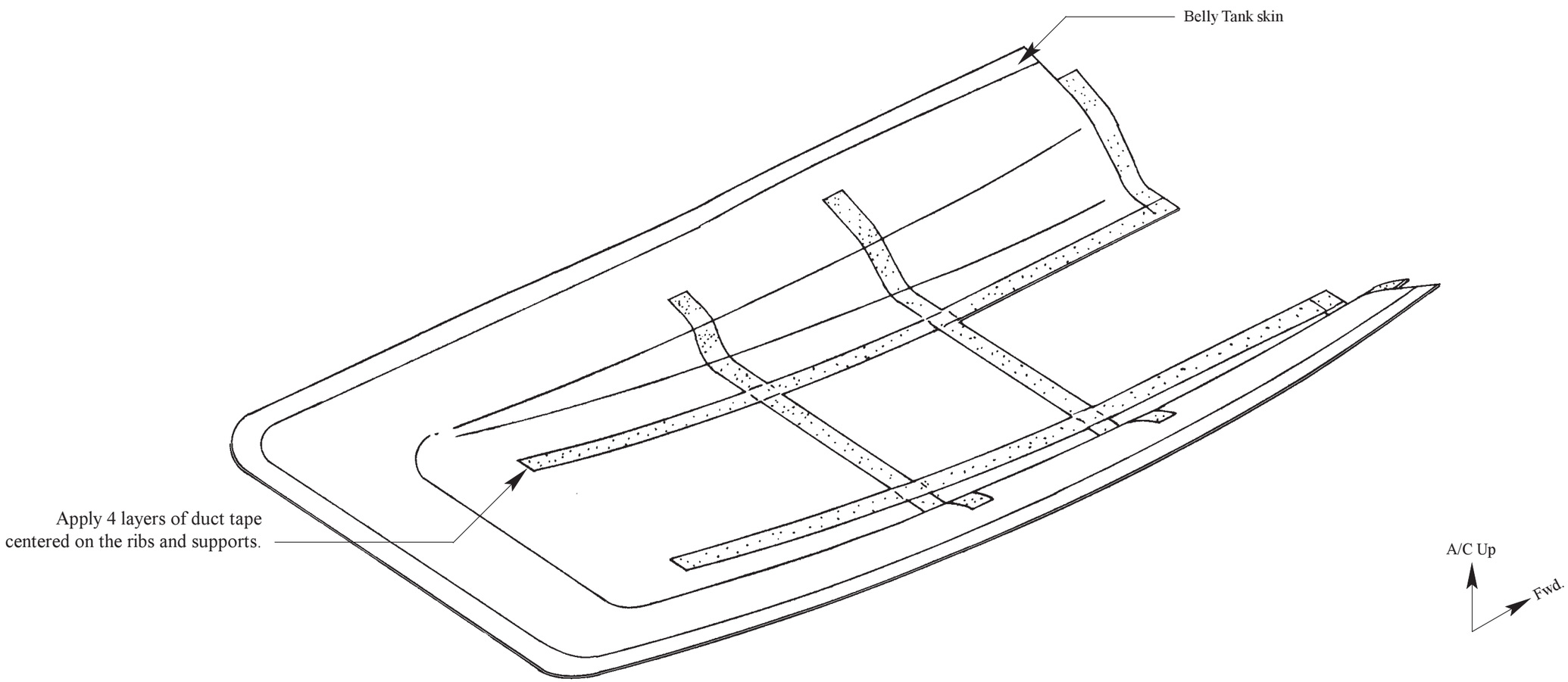
Shaping the Supports and Ribs
Fig E:12

E11. Refer to figure E:1 and drawing 5104. Trim the fuselage side of these pieces to fit the fuselage shape leaving excess material on the tank side. One at a time, temporarily attach each piece to the fuselage and trim to fit the tank contour. Be sure the supports are in the middle of the 25 BID strips molded into the tank skin.



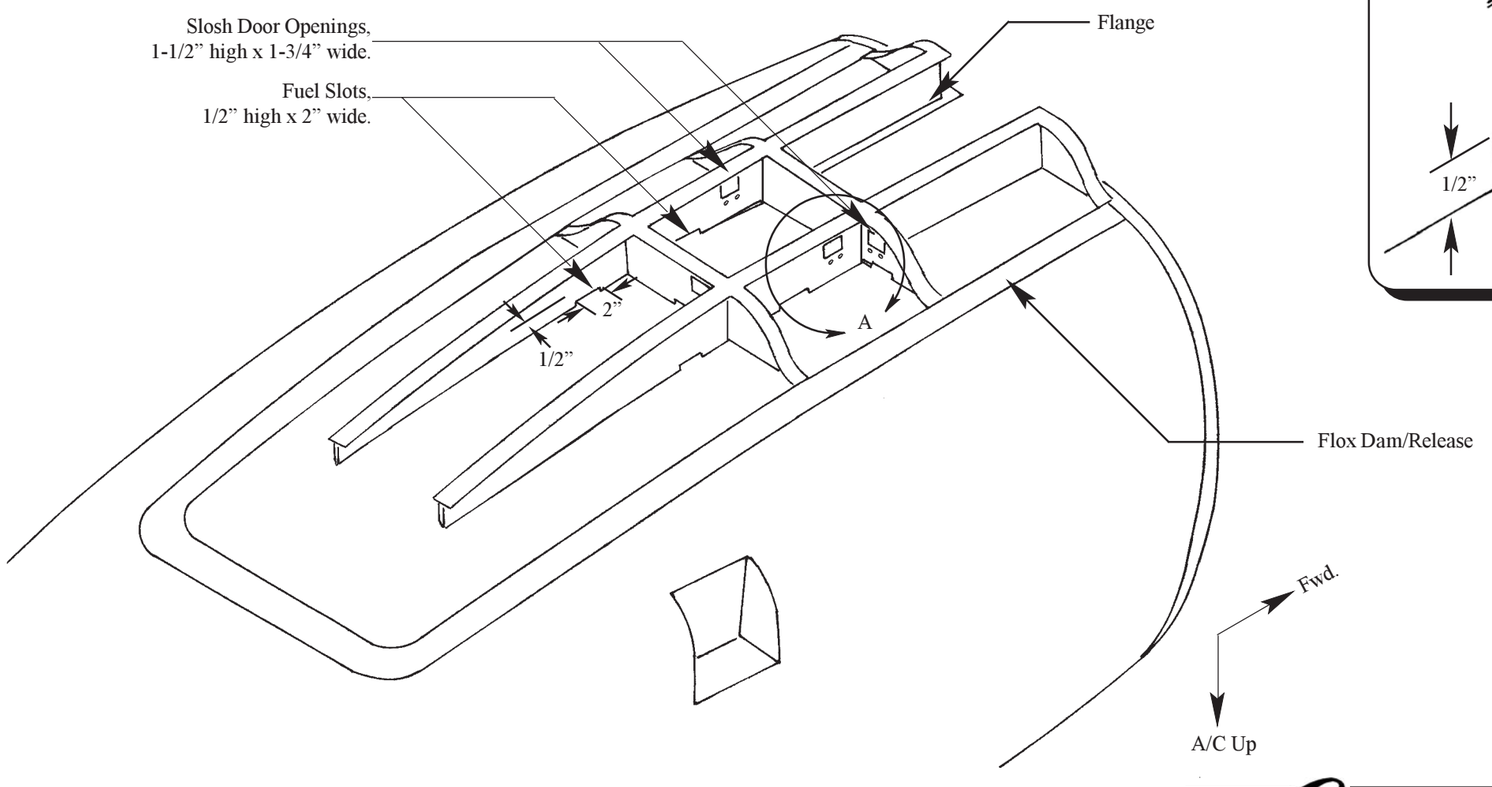
Preparation for Future Cap Strips and Bonding
Fig E:13

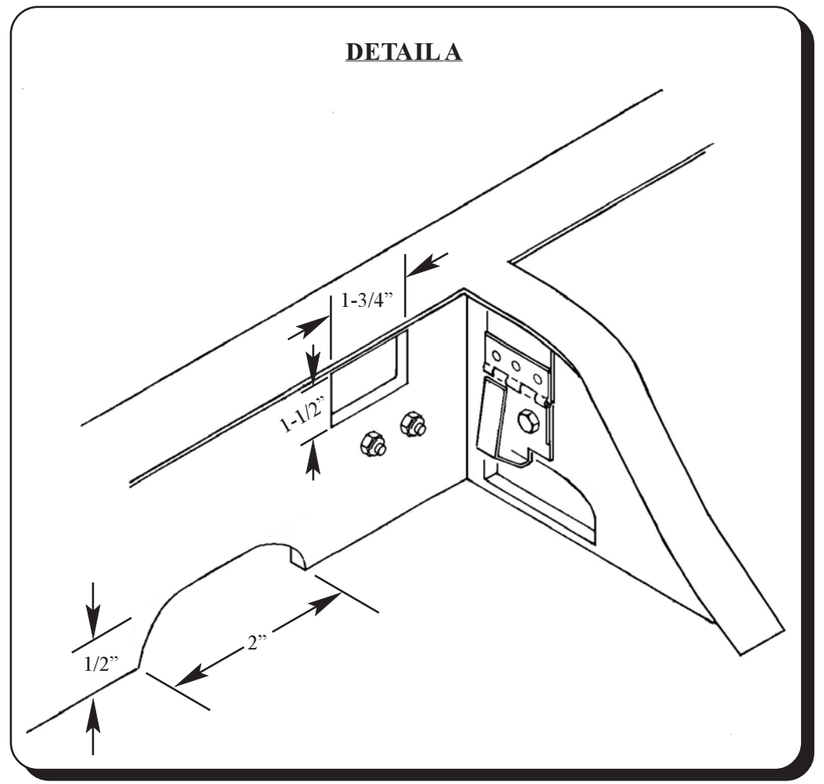
E 12. Apply 4 layers of duct tape to the inside of the tank at each rib or support location to allow for the future cap strips and bonding. Lay the tank on and mark and trim the pieces to the tank contour.



Cutting the Slosh Doors and Fuel Slots
Fig E:14

E 13. When the ribs and supports are properly shaped, mark fuel slots and slosh door holes as shown in figure E:1. The slots should be about 2" x 1/2" and the slosh door openings 1-1/2" high x 1-3/4" wide. Cutout and seal with micro only the fuel slots that will be at the upper edge of the ribs (top of tank).

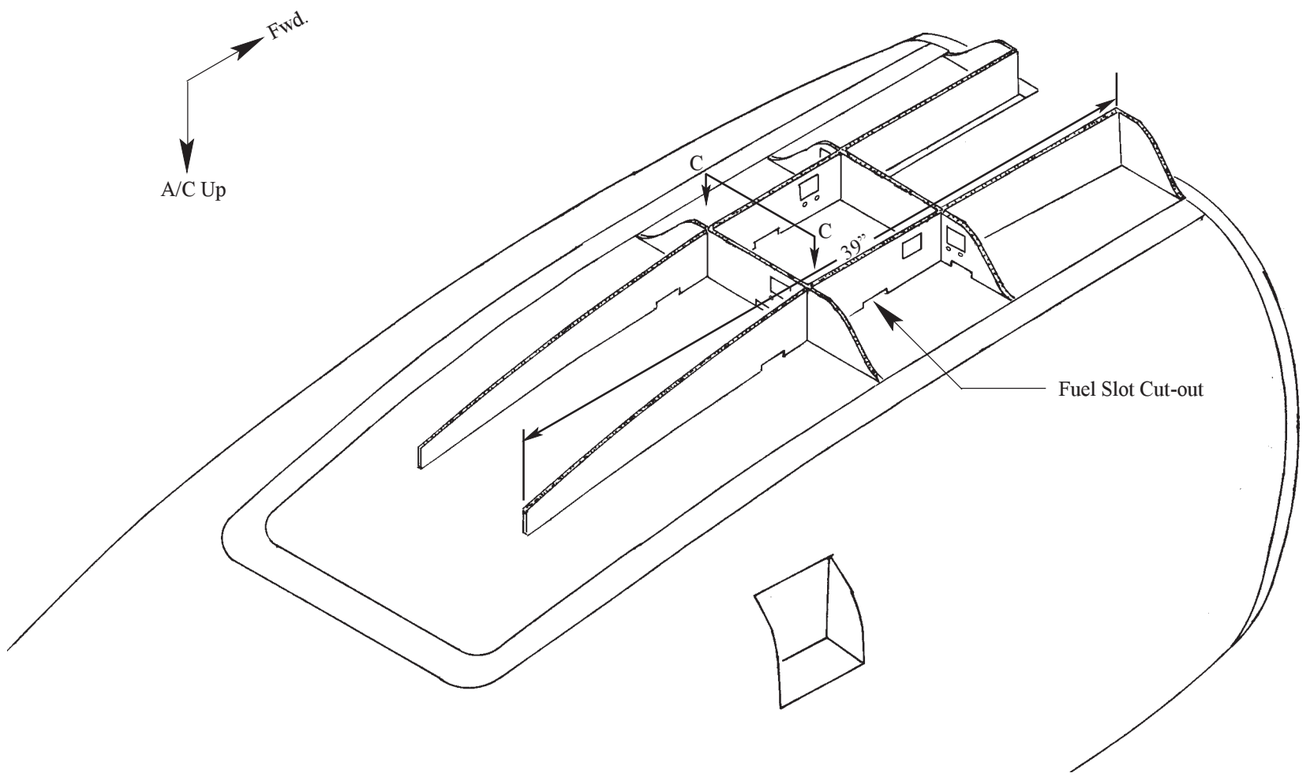




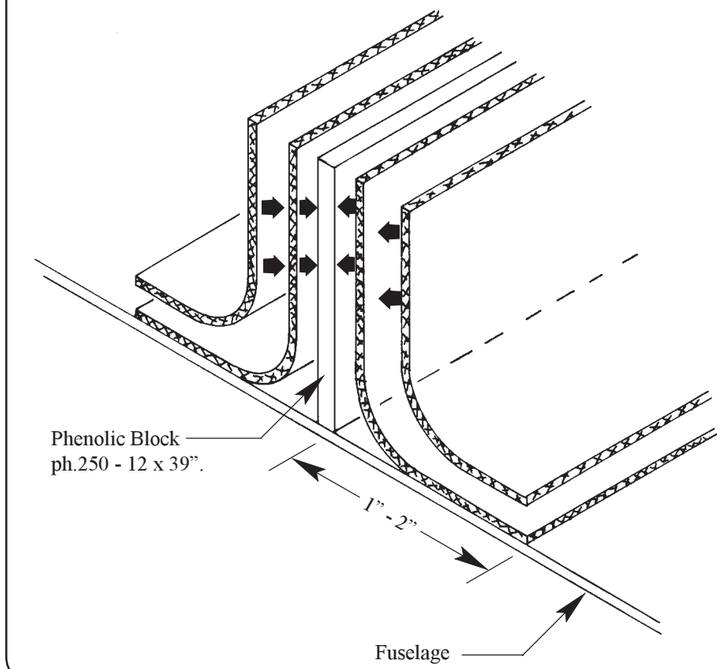
Bonding of Ribs and Supports
Fig E:15

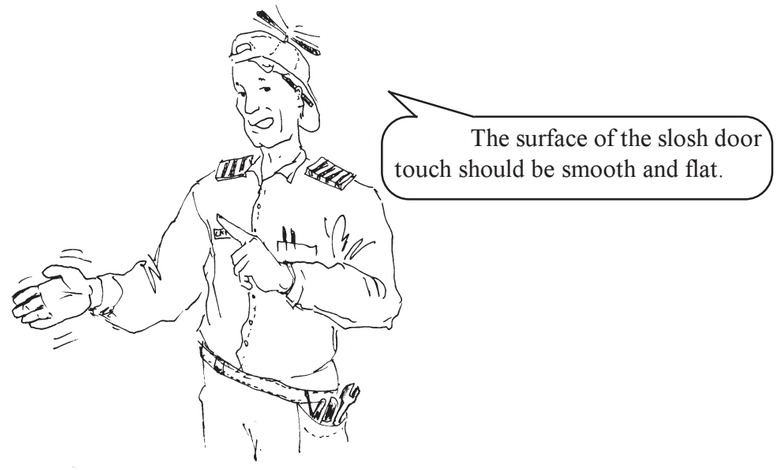
E14. Bond all ribs and supports to the fuselage. Apply 2 BID layups to both sides of all pieces, 1" - 2" onto the fuselage and the full height of the piece. Ensure that the surface of the slosh doors touch is smooth and flat.

E15. Remark and cut out the fuel slot and slosh door openings. Cut back the exposed core about 1/4" on all prepreg ribs and supports. Seal the fuel slots and slosh door openings with micro.



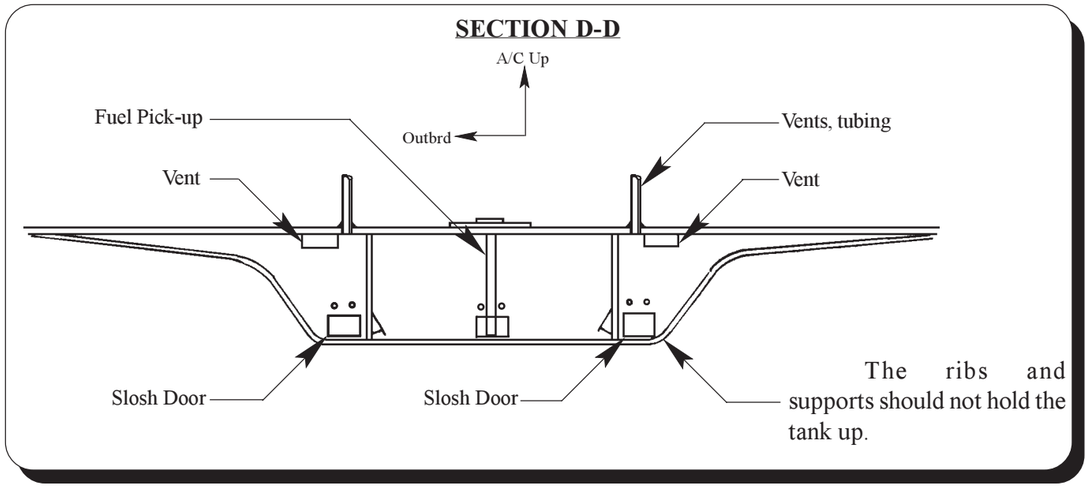
SECTION C-C

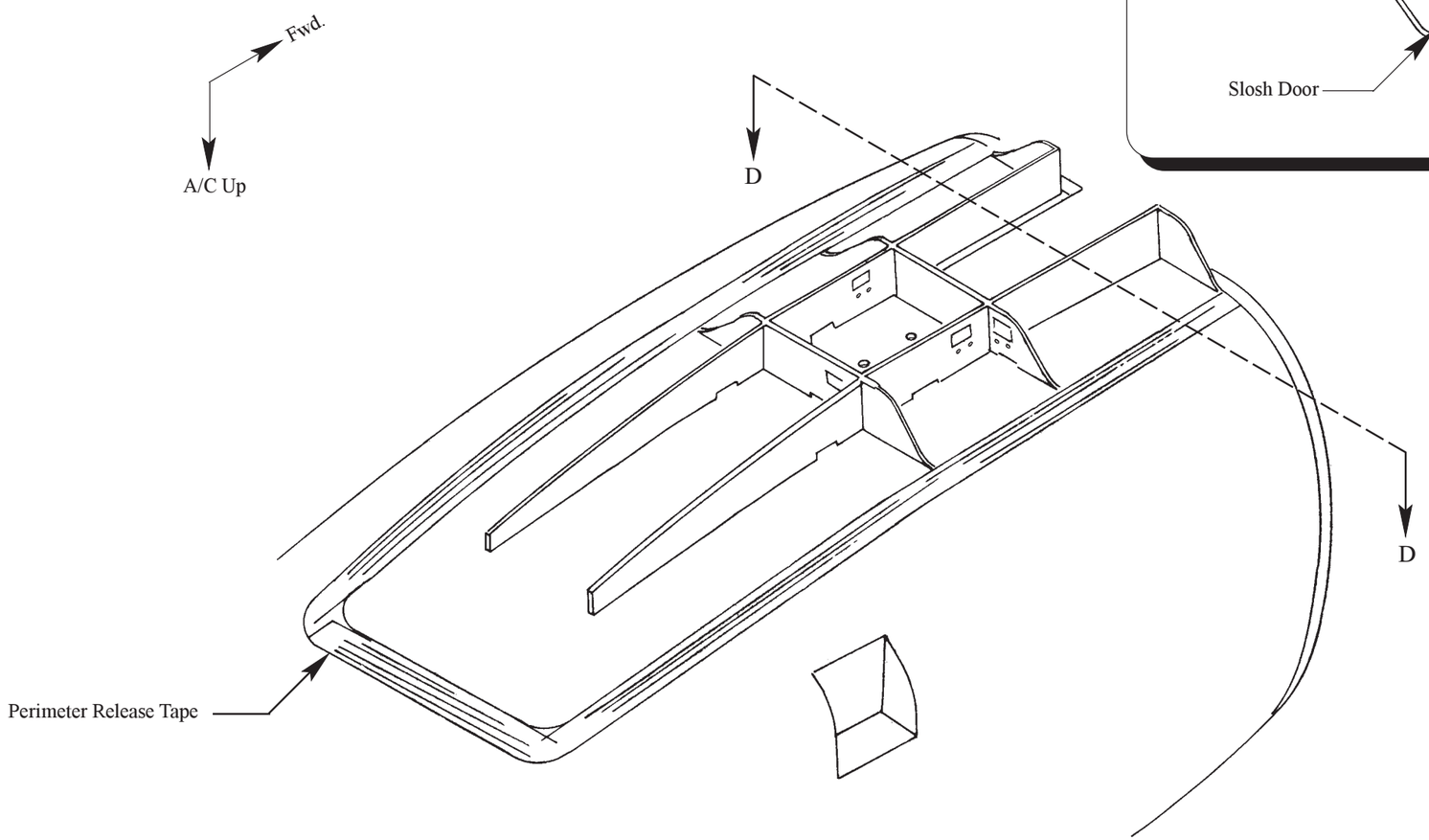




Checking the Belly Tank Fit
Fig E:16

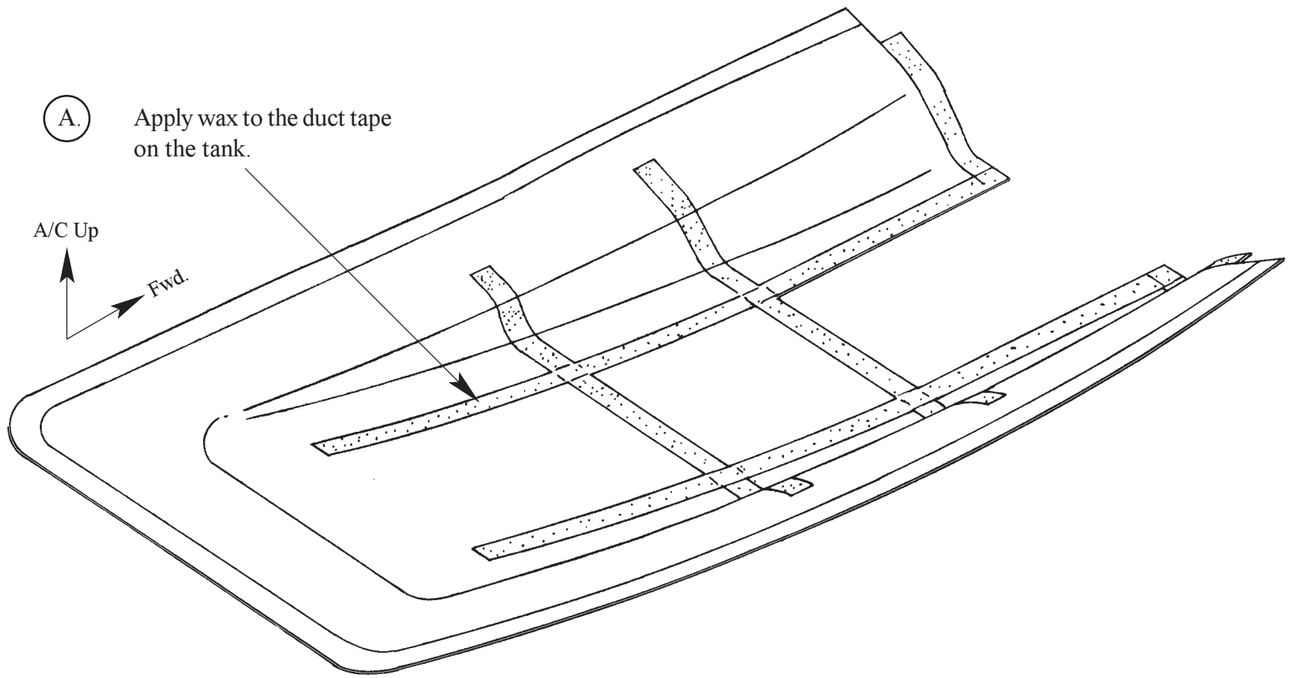
E16. Check, and re-tape if necessary, the tank at the cap strip locations (4 layers of duct tape) and the perimeter release tape. Lay the tank on and re-check the fit to make sure the ribs and supports don't hold the tank up.

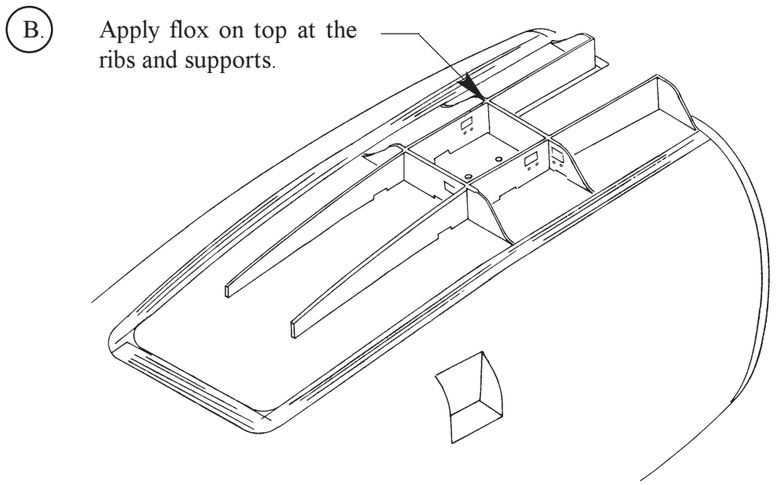


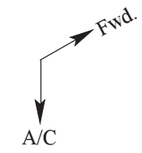


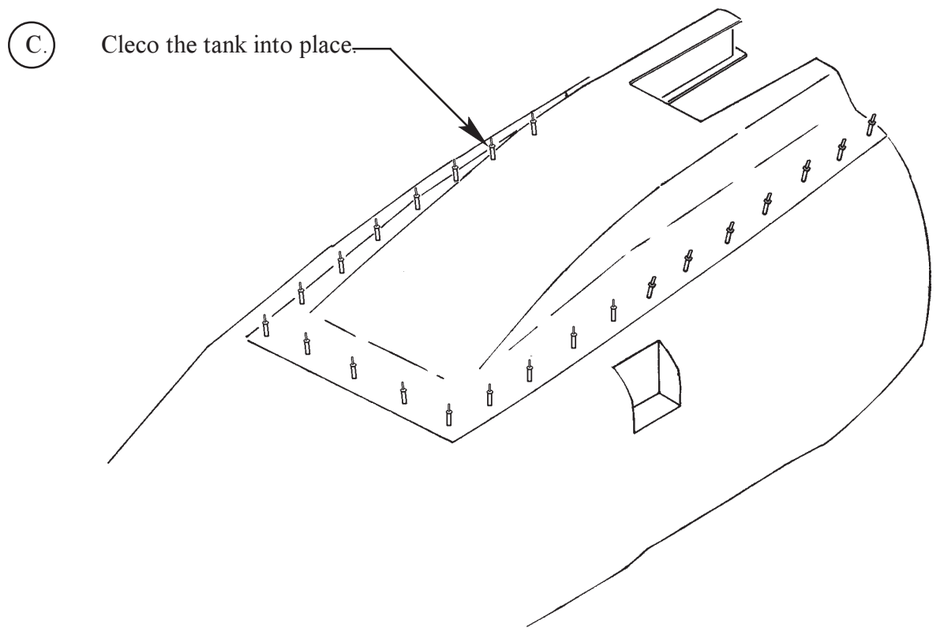
Belly Tank Installation
Fig E:17

E17. Wax the duct tape on the tank. Pile flox on the top of the ribs and supports. Lay the tank on and cleco in place. Use weights as necessary to produce the straight gear door mount area. Let the tank cure.



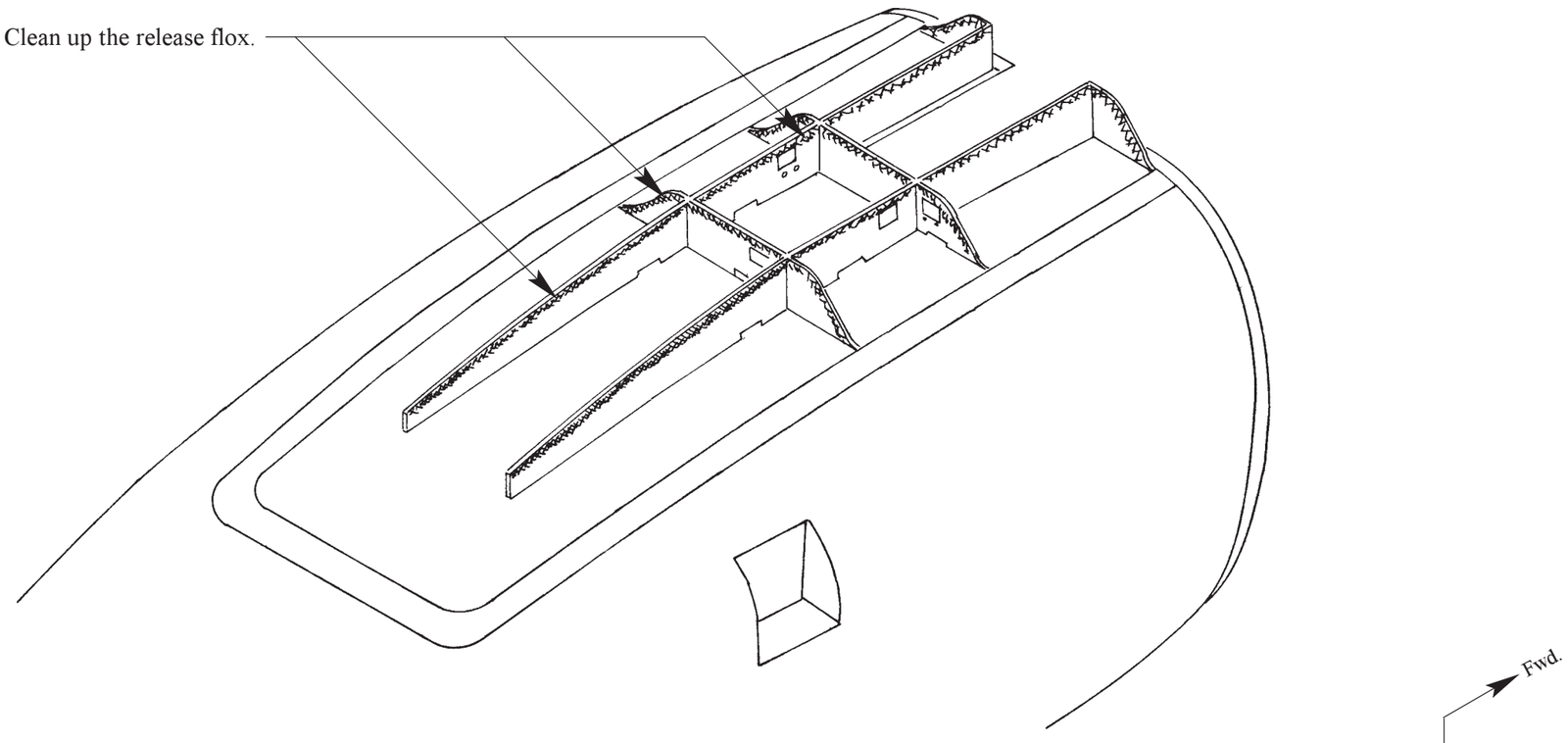






Cleaning Up the Release Flox
Fig E:18

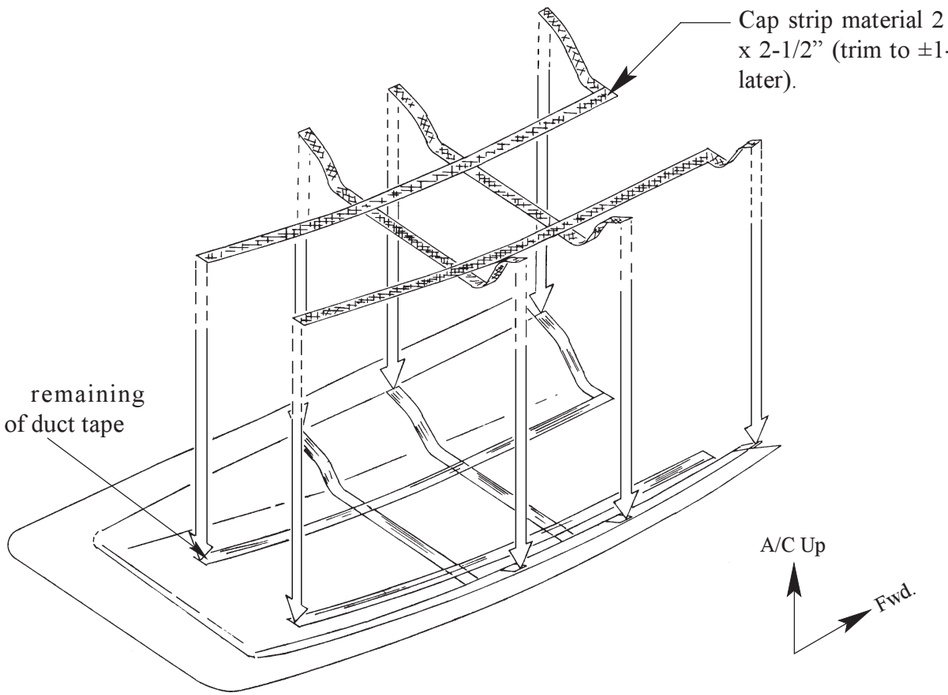
E18. Remove the tank. Clean up the release flox by sanding the squeeze out parallel to the sides of the ribs and supports.

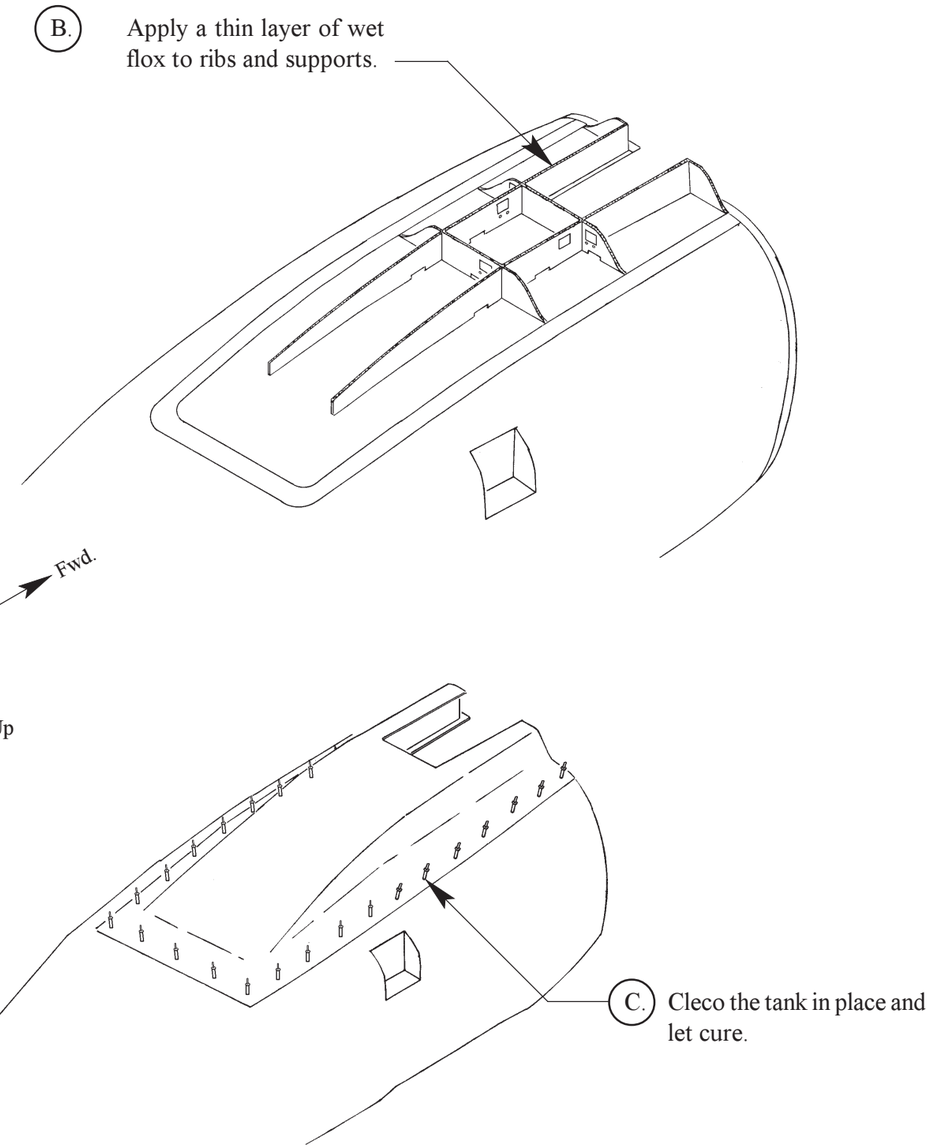


Fabricating Cap Strips
Fig E:19

E19. Remove all but one layer of duct tape on the tank. Wax the remaining layer of tape. Make up cap strips of 2 BID x 2-1/2" (trim to ±1-1/2" later) enough to cover all ribs and suports. Apply the cap strip material to the taped surface of the tank.

Let the capstrips cure. Sand the capstrips to prepare for bonding to the ribs. Apply a thin layer of wet flox to the ribs and supports. Cleco the tank in place and let cure.

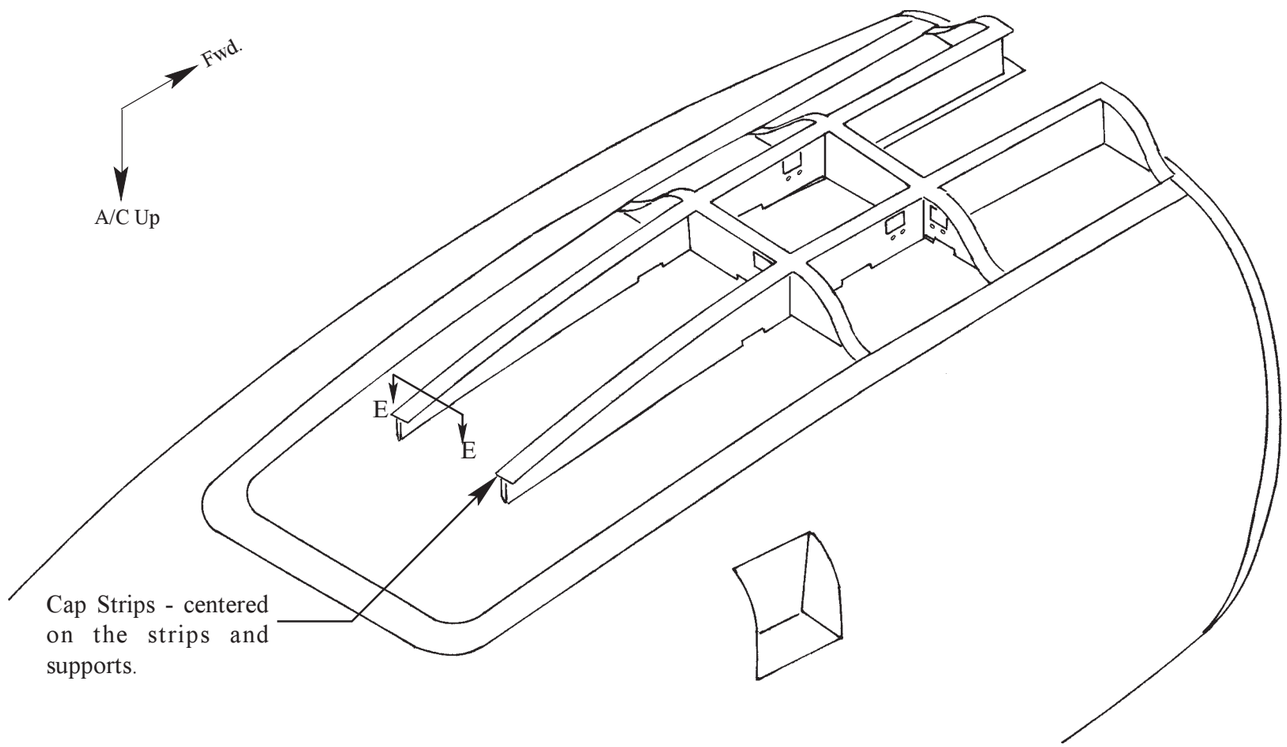




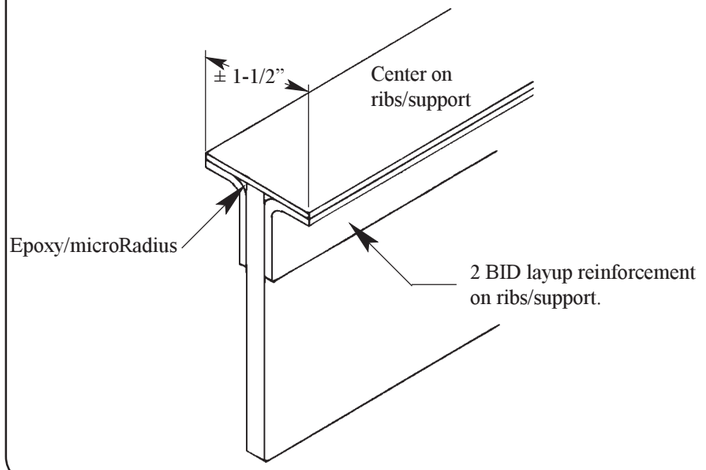
Applying Cap Strips to Ribs and Supports
Fig E:20

E20. Remove the tank. The cap strips should now be bonded to the ribs and supports.

E21. Apply a micro radius to the underside of the cap strips and apply a 2 BID layup on both sides of the ribs and supports onto the cap strips. Trim cured cap strips to ±1-1/2" wide centered on the ribs.

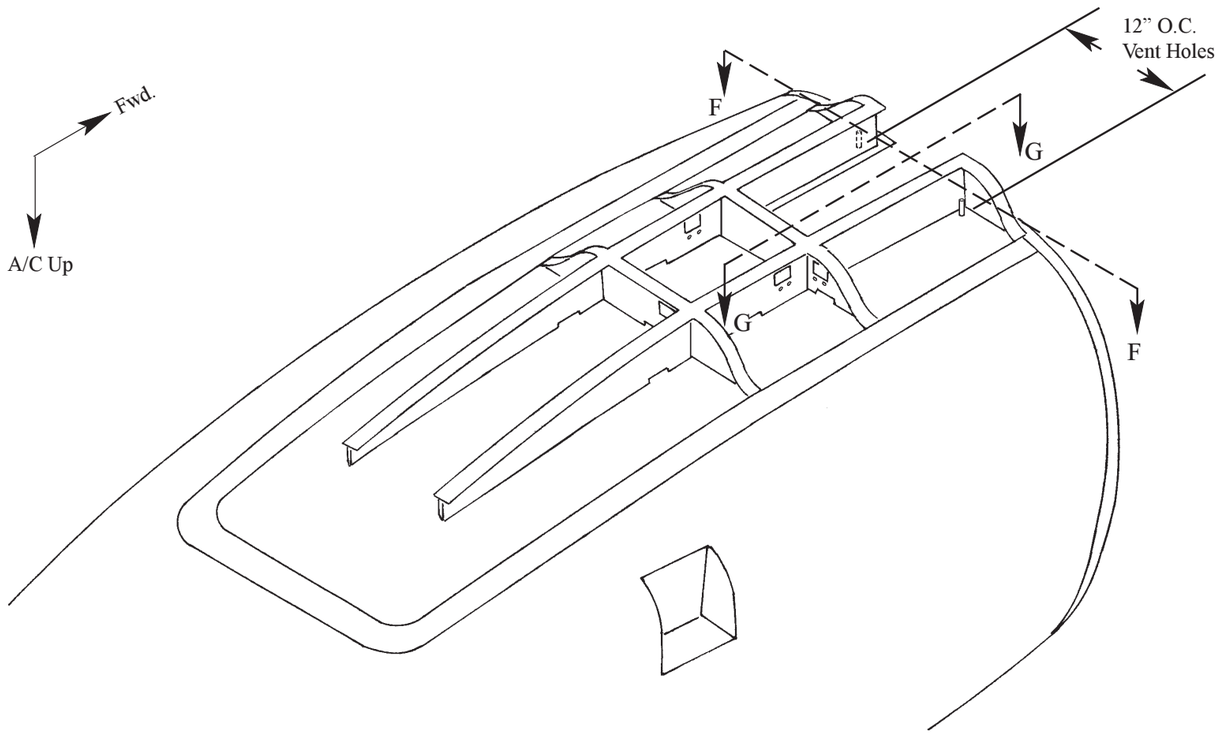


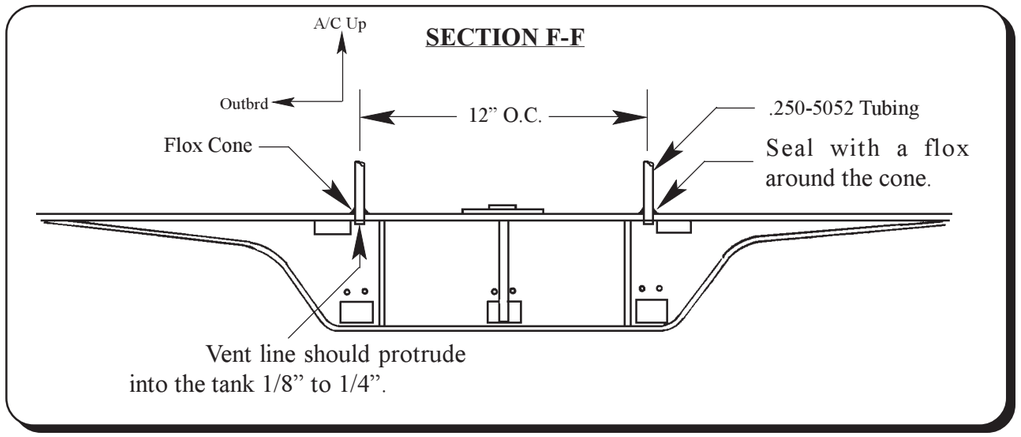
SECTION E-E

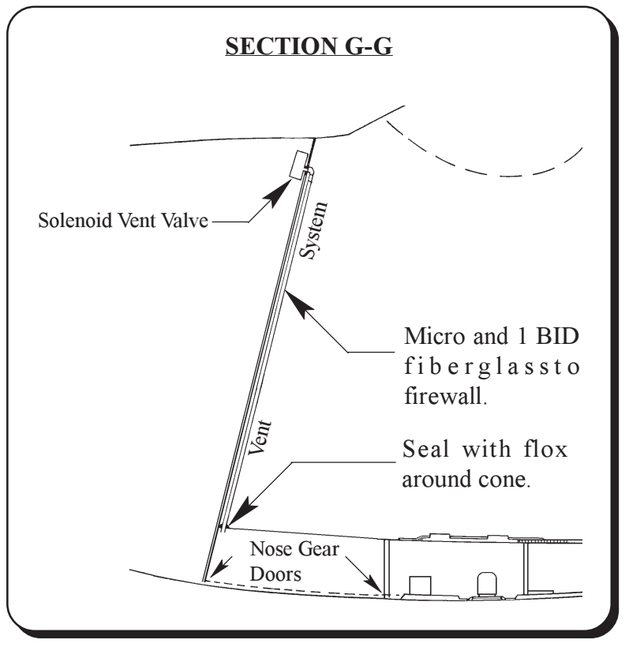


Vent Holes - Vent Tubing
Fig E:21

E22. Verify that the 1/4” vent holes have been drilled and the vent lines are installed and protrude into the tank about 1/8”-1/4” and are bonded with flox.



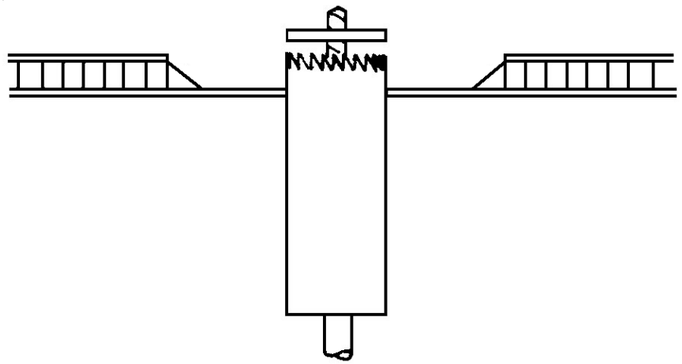




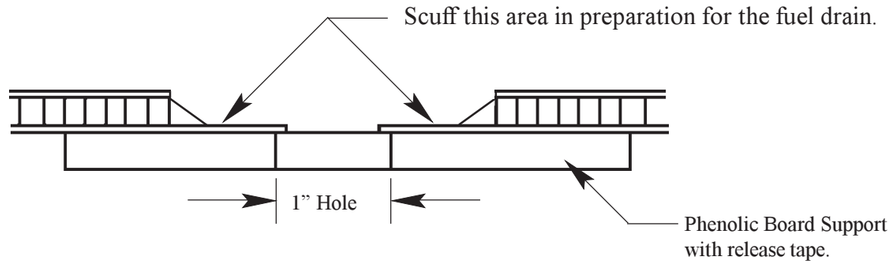
Fuel Drain Installation
Fig E:22

E23. The fuel drain valve is located centerline on the fuel tank, and 24” aft from the phenolic pieces forming the front of the tank. Locate the fuel drain valve in the center of the decored area of the fuel tank skin.

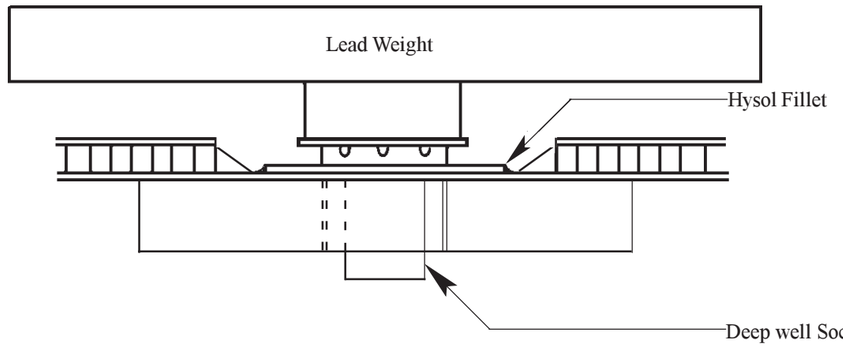
(A.) Drill a 7/8” hole through the skin from the outer side. Drilling from the outside makes a cleaner hole.



(B.) Use a small piece of bondo to hold particle board in position for supporting skin.



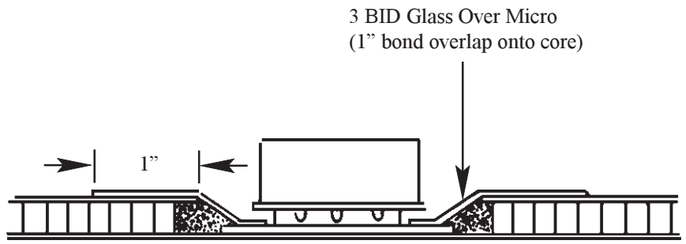
(C.) Attach the fuel drain, P/N 502A, with hysol, Use a deep well socket with electrical tape wrapped around it to hold the fuel drain in position. Weight the drain with an aileron lead weight.



3 BID Attachment
Fig E:23

D. Check the position of the fuel separator parts and mark the best location for drilling a hole between the ports. Later, a safety wire will be installed in the hole. Measure 1/10" from the edge of the indentation, to the center of the hole to be drilled. Using a #54 drill bit, drill through the bottom skin and into the fuel separator just enough to leave the impression of a drill bit tip. Then, starting inside of this hole, drill a #60 hole at a 45° so that the drill bit comes out inside the indentation of the separator. Check to make sure that the hole hasn't broken through the inside of the separator. If this has happened, remove the fuel separator using a heat gun to soften the adhesive. Clean the area and replace with a new separator.

Complete the installation of the fuel drain with 3 BID over micro.



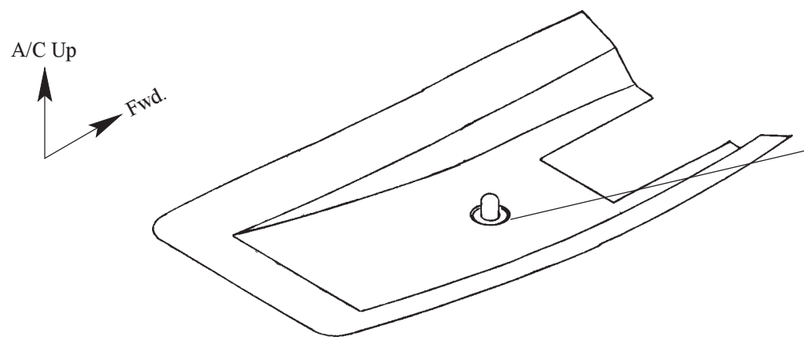
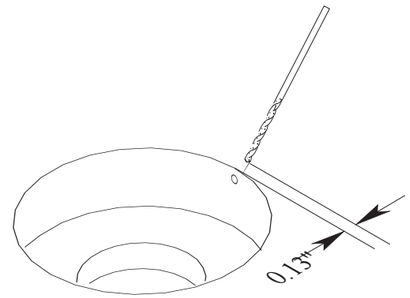
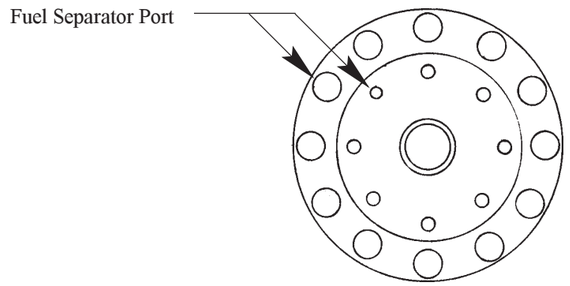


Fig E:24
Fuel Drain Assembly
(Drilling for the Safety Wire Attachement)

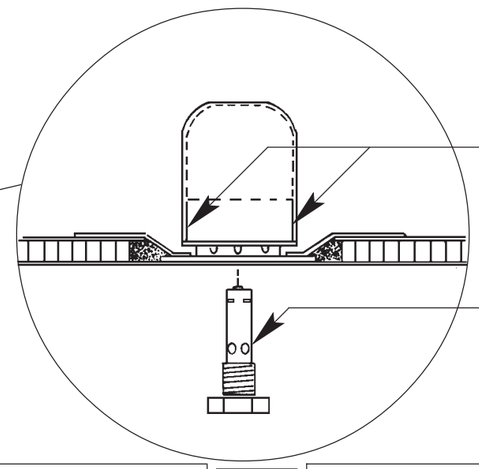


Start a small counter sunk area with a #54 drill bit and drill through the skin and just into the separator.

Tilt a #60 drill bit to 45° and drill through the edge of the separator only into the area wher the F391-18 inserts



Drain Attachment
Fig E:25



Install with Hysol. Putthe Hysol on the base and not the bell so that the excess does not collect internally.

Flush Fuel Drain.
P/N F391-18

Sealing The Fuel Tank
Fig E:26

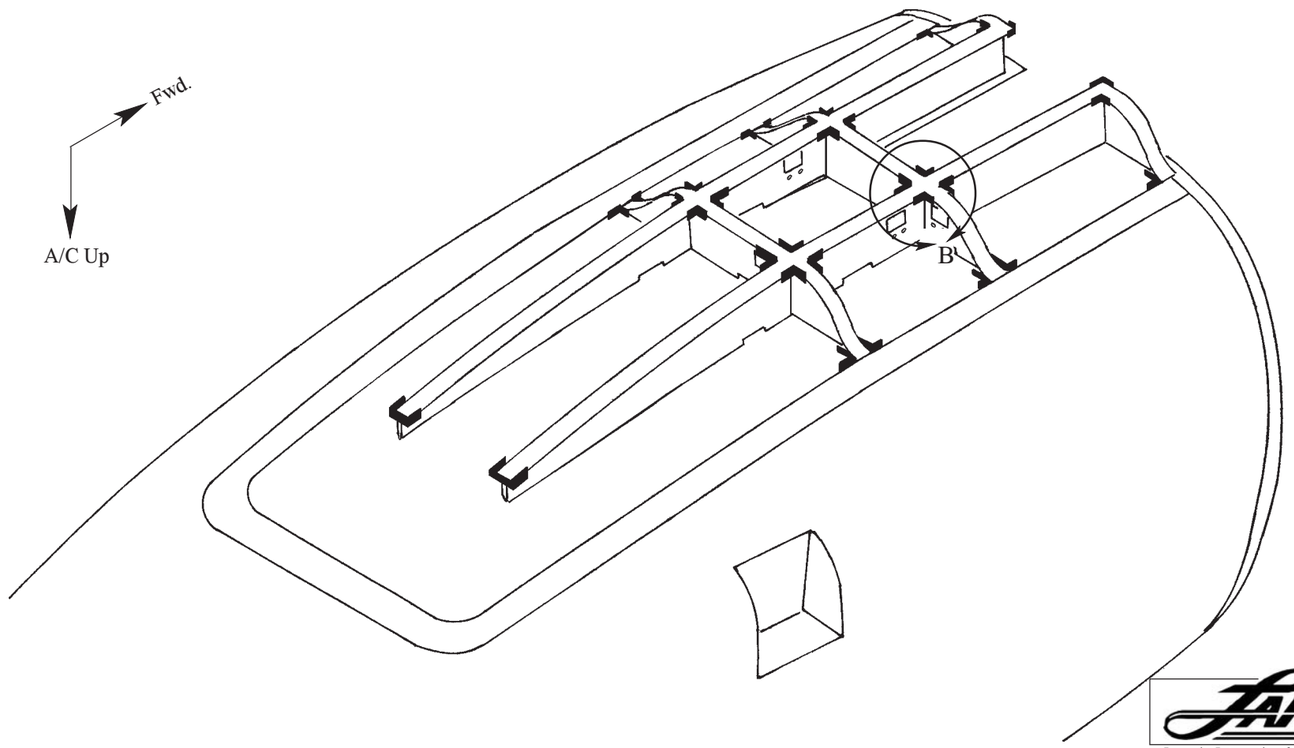
E24A. An accurate outline of the capstrip locations must be made on the inside of the fuel tank skin. This is easily accomplished by gluing small (about 1/4" x 3/8") pieces of tongue depressors in every corner where a capstrip meets a support/ rib intersection. See figure below for specific locations. Tack glue these wood pieces in place with instant glue so they stick up from the capstrips about 1/8".

Mound up some micro on the top edges of the wood pieces. Obviously, this will not require much micro.

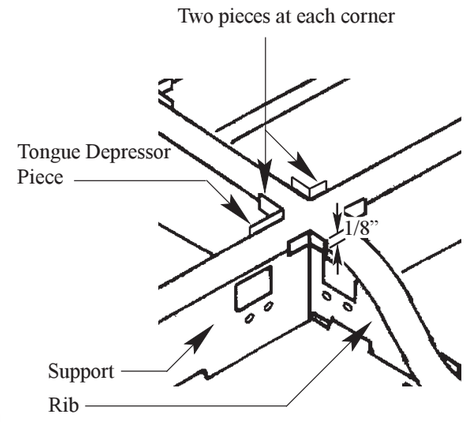
Now carefully lower the fuel tank skin into position so the micro contacts the inner surface. Remove the fuel tank skin.

Now you should have an impression on the inside of the fuel tank skin in all pertinent corners. Connecting these corners with a felt marker will give you the capstrip outlines in the fuel bays. Clean off the micro from the bottom fuel tank skin and remove the wood pieces from the capstrips. Paint the marked area of the fuel tank with 2 coats of jeffco 9700 FCR.

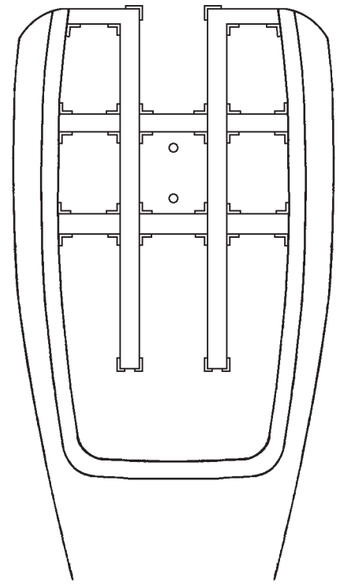
E24B. Alternate method: Carefully lay masking tape with the adhesive side up and the edge of the tape flush with the edge of the capstrip. Carefully lay the skin in place and apply pressure to force the tape to stick to the skin. This can be done in multiple steps for each rib.



DETAIL B



BOTTOM, TOP VIEW



E25. To reduce fuel sloshing during uncoordinated maneuvering, five one-way slosh doors are mounted in the supports and ribs. In step E13 of this section you cut out the 2 core 2 prepreg panel for the fuel slots and slosh door openings. In this step you will install the slosh doors at the slosh door locations.

A. Cut the hinge wire 1/2" longer than the actual hinge. Bend 3/8" of each wire 90 degrees at one end.

B. Drill two #12 holes through one half of the hinge and bracket 1-3/16 apart. Be sure the bracket ends just short of, but does not cross, the hinge line.

C. Align the door so it lies 1/16" from the bracket and does not cross the hinge line.

D. Drill three #40 holes through the hinge and door. Countersink the hinge and secure the door and hinge together with AN426A3-5 rivets.

E. Align the slosh door assemblies in the respective glass to glass areas and position the door 1/8" away from the cap strip as shown.

F. When satisfied with the fit of the slosh door, use the hinge and bracket as a guide to drill two #10 holes through the rib/support.

G. Cut through the rib/support to give the slosh door 1/8" of flange to seal against all around the perimeter.

H. Drill a 1/16" hole through the rib for the bent hinge wire to slide through, thus securing its position.

I. Micro release the door. Before you permanently mount the slosh door assembly, a good seal must be achieved between the door and rib. Cover the outboard surface of the door with packaging tape to function as a release. Tighten the slosh door assembly in position and apply a small amount of micro to the flange area under the slosh door. Close the slosh door against the micro and leave until cured. Be sure you have not permanently closed the slosh door with excess micro.

J. After cure, remove the doors and the release tape door and clean up any sharp micro edges.

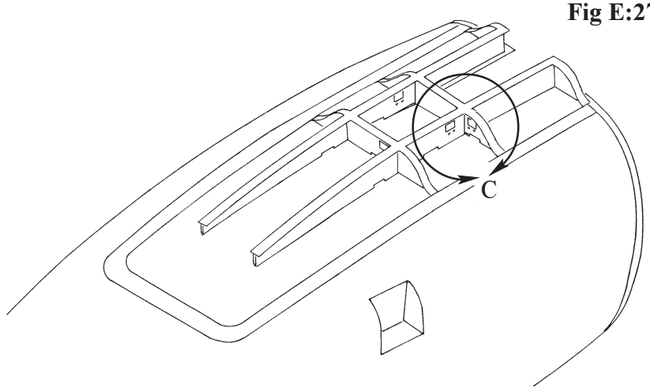
K. Verify all fuel vents and drains and prepare the tank for fuel sealant.

Note: Make sure there is no chance that the slosh door will get stuck in the closed postion.

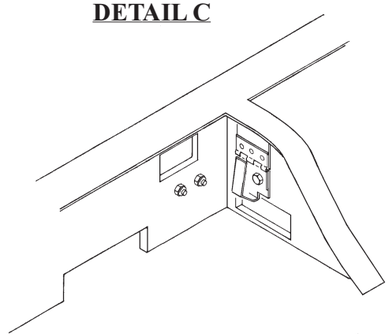
L. Verify all fuel vents and drains and prepare the tank for fuel sealant.

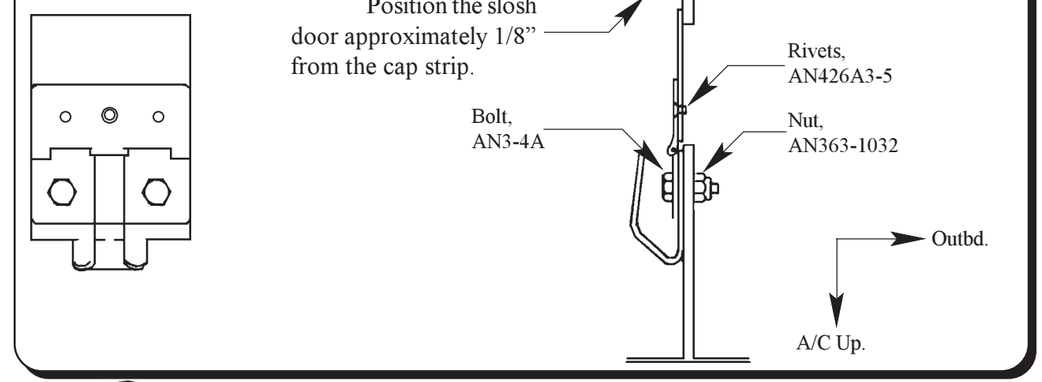
M. Re-drill with a number 12 bit and re-install the fuel doors.

Slosh Door Assembly/Installation
Fig E:27



DETAIL C



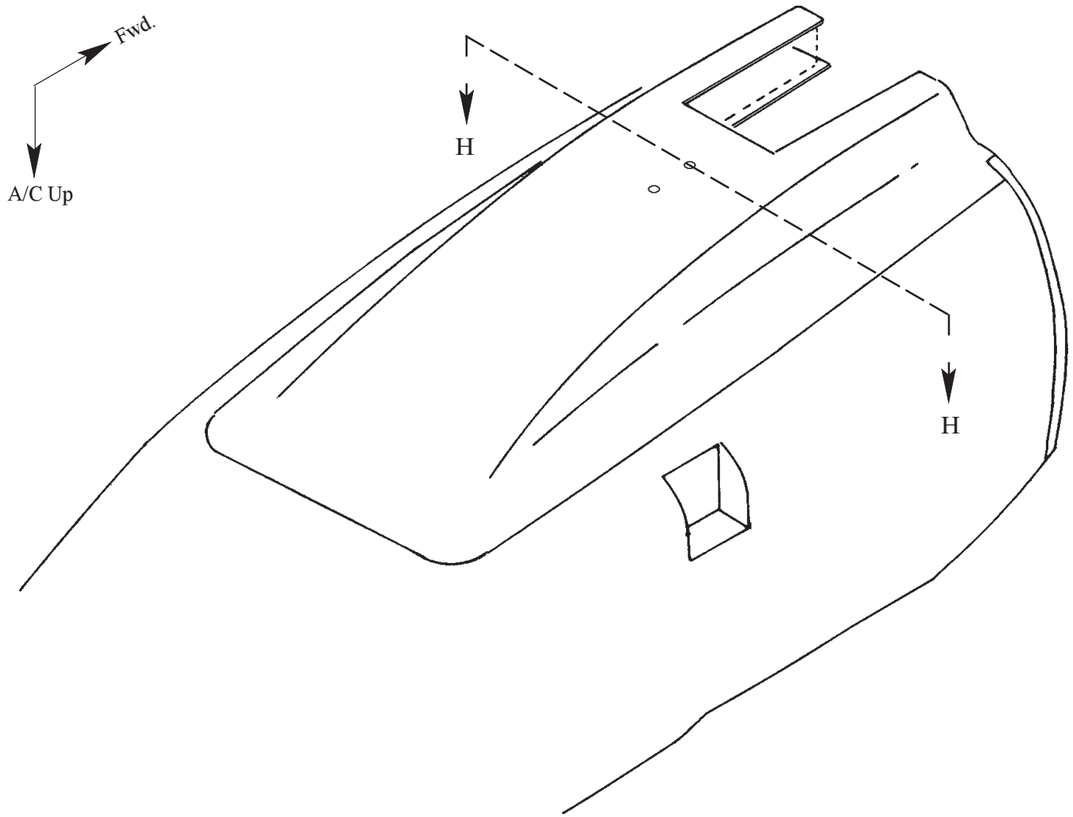


Cutting Pick-up Tube to Length
Fig E:28

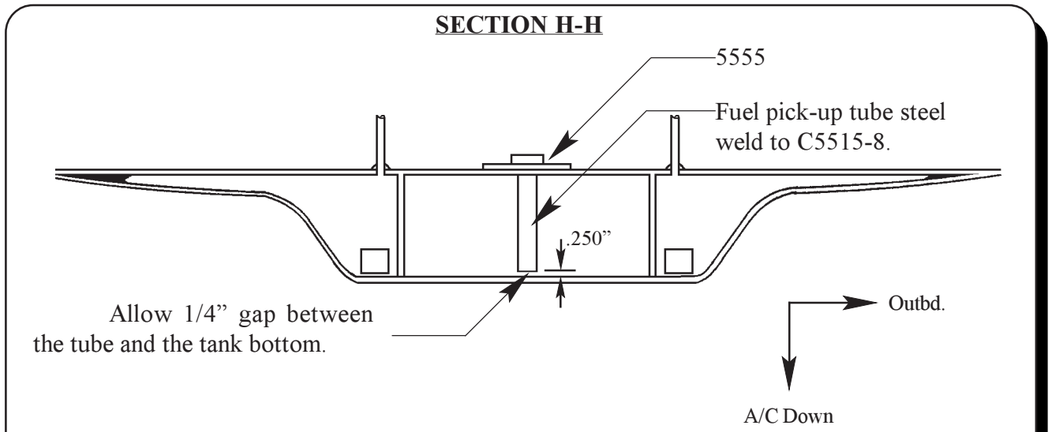
E26. Bond the tank in place with Hysol/Flox or Epoxy/Flox and let cure.

E27. After waiting at least 1 week, plug all holes and openings and conduct a low pressure (1/2 lb. or less psi) test.

E28. Measure the distance from the fuel valve plate (#5555) to the bottom of the tank. Cut the pick-up tube to allow 1/4" gap between the tube and the tank bottom when installed in fitting C5515 x 8" x 10" installed in plate #5555 at its midpoint. Weld or solder the tube to the fitting.



SECTION H-H



F. NOSE WHEEL ASSEMBLY

Place the half of the rim without the valve stem hole on a bench with the outboard race of the rim down.

Insert the 5.00 x 5 tube into the tire. Inflating the tube with a very small amount air (just enough to unfold it) helps ease assembly.

Place the tire and tube onto the rim you have set on your bench. Push the tire down onto the rim, always avoiding pinching the tube. You will not push the tire all the way onto the rim, the tire will be seated with air pressure.

Place the other half of the rim onto the tire, aligning the valve stem hole and the three bolt holes. Pull the valve stem through the rim as you work the rim down. Here is where most people damage the tube. If you're not careful when pushing the rims together, you can easily pinch the tube or stem between the rims. Instant leak! This problem can be avoided by just being careful and aware of the danger.

Secure the rim halves together with the bolts and nuts provided with the wheel. Again, be careful to avoid pinching the tube and/or valve stem.

Inflate the tire to 28 - 30 psi. Do not inflate the tire over 32 psi.

Note: Early Lancair IV kits used a Condor brand nose gear tire. Later kits were shipped with a Goodyear tire. Both tires are 5.00 x 5 size and are interchangeable.

Grease the two wheel bearings with a quality grease. Be sure the grease is pushed all the way through the bearings.

Place the bearings into the races of the wheel. After the bearings are placed into the race, a seal consisting of two thin steel washers and a felt washer is secured with a retainer ring. The seal and rings retain the bearings in the wheel.

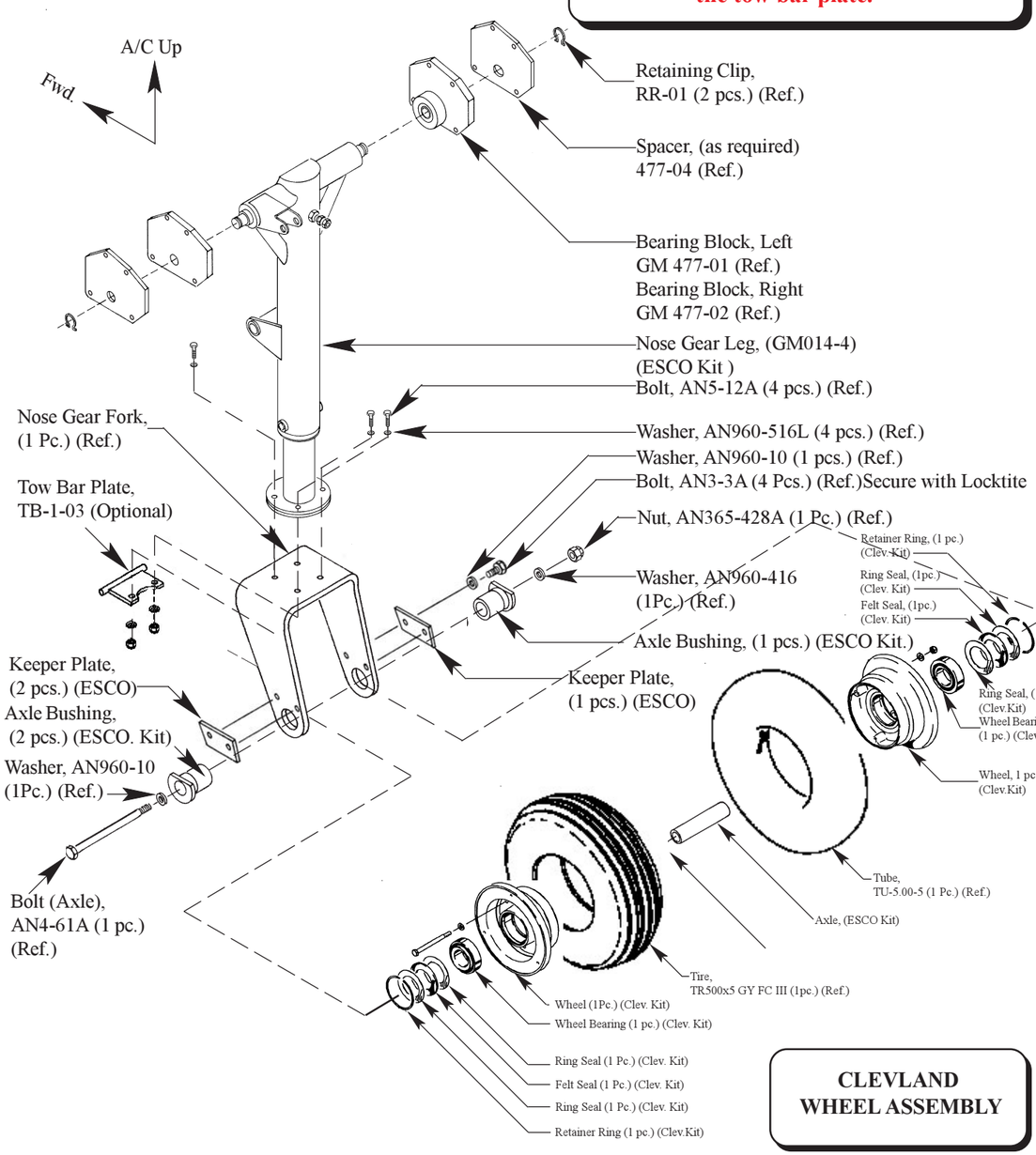
Slide an AN4-61A bolt through the entire nose wheel assembly and tighten with an AN960-416 washer and AN365-428A locknut. Tighten the locknut only enough so when the tire is spun by hand, it will only complete one revolution. This is easier when the fork in mounted to the nose gear strut).

Note: To aid the rotational positioning of the axle bushings, first position the keeper plate on the fork and draw a line, in pencil, on the sides of the fork. This provides a visual guide for the flats on the side of the bushings.

Secure the nose wheel and fork to the nose gear strut with AN5-12A bolts, AN960-516 washers, and AN365-524A locknuts.

Nose Wheel Assembly
Fig. F:1

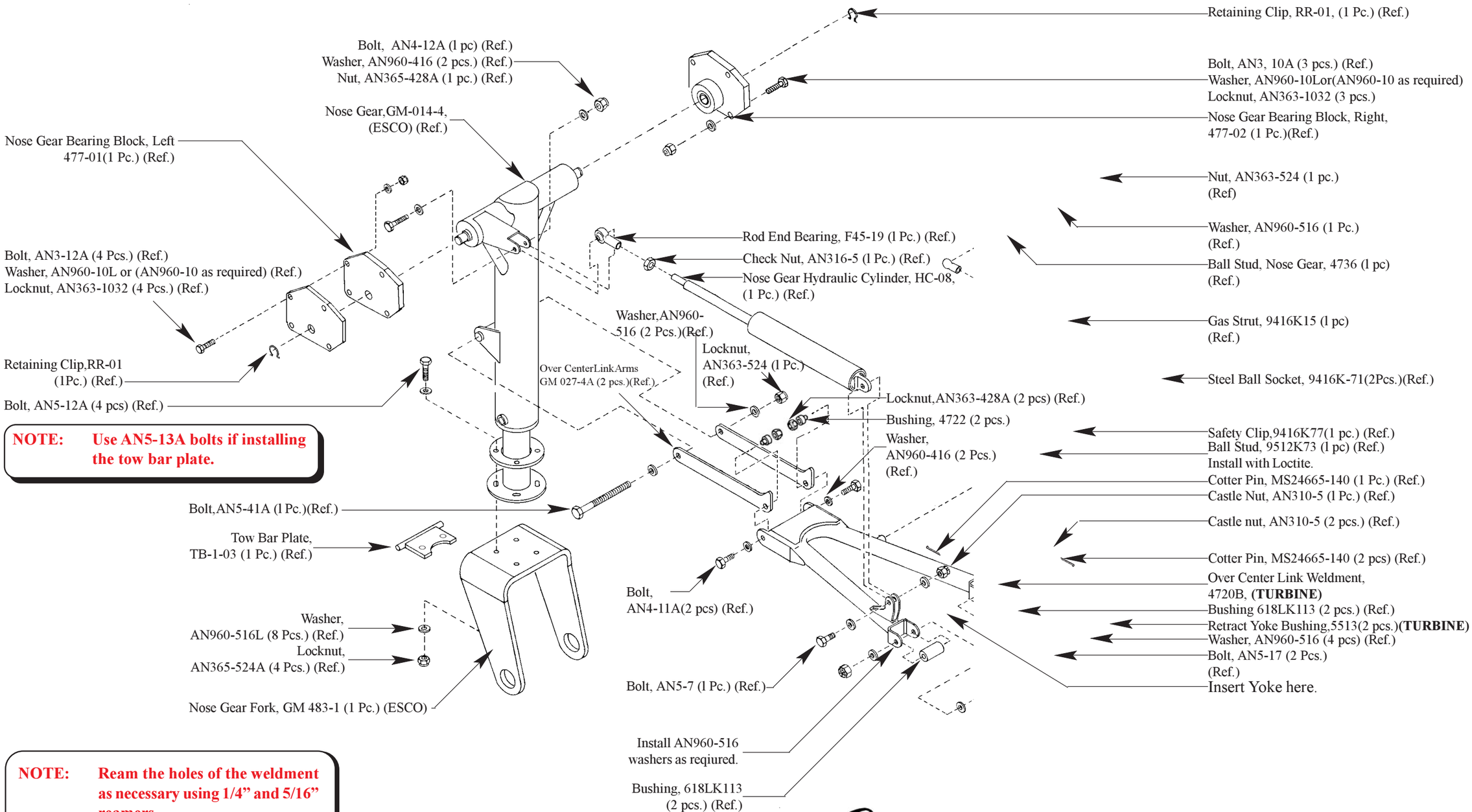
NOTE: Use AN5-13A bolts if installing the tow bar plate.



CLEVLAND WHEEL ASSEMBLY

Assemble - Install the assembled linkage on the engine mount.

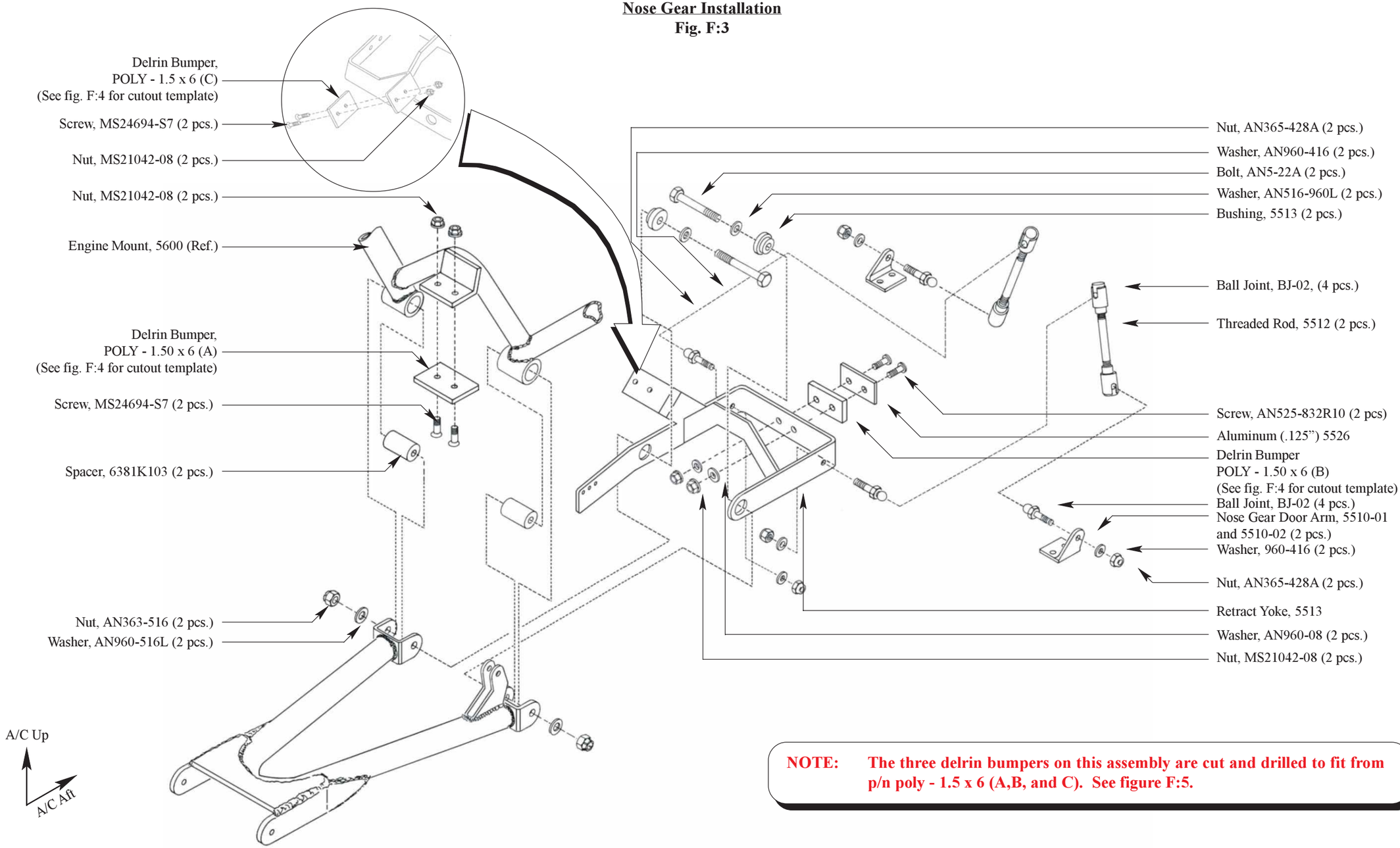
Nose Gear Assembly Exploded View
Fig. F:2



NOTE: Use AN5-13A bolts if installing the tow bar plate.

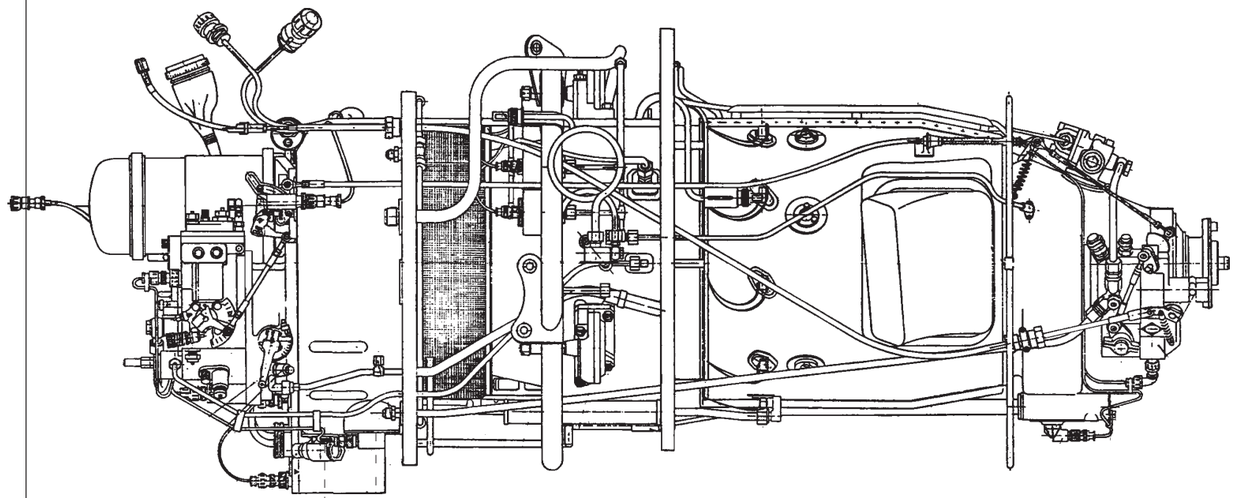
NOTE: Ream the holes of the weldment as necessary using 1/4" and 5/16" reamers.

Nose Gear Installation
Fig. F:3

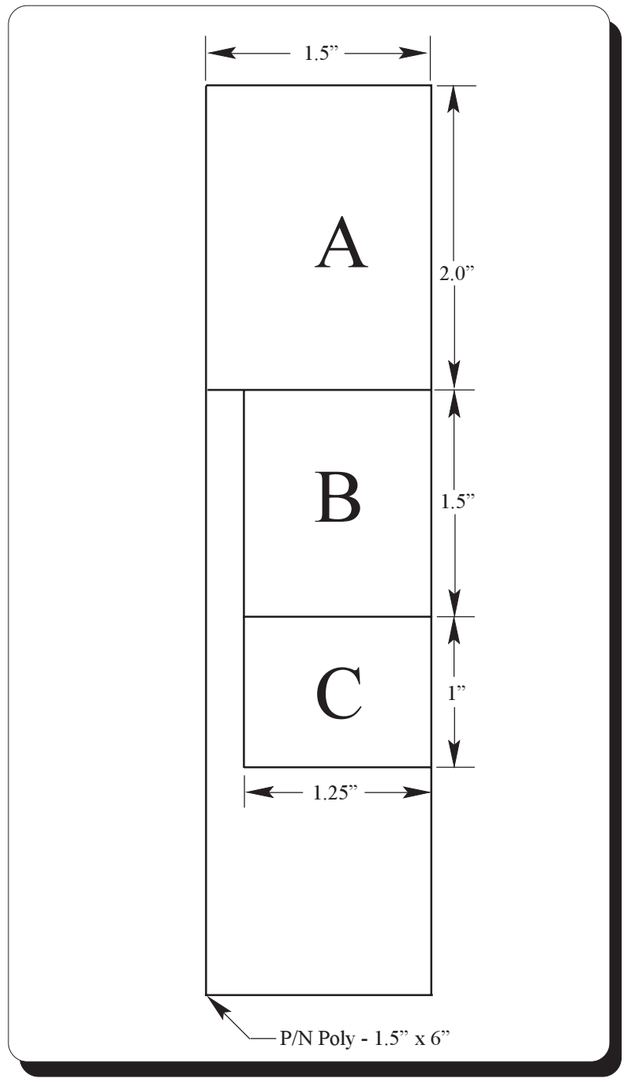


NOTE: The three delrin bumpers on this assembly are cut and drilled to fit from p/n poly - 1.5 x 6 (A,B, and C). See figure F:5.

Door Yoke Spring Installation
Fig. F:4



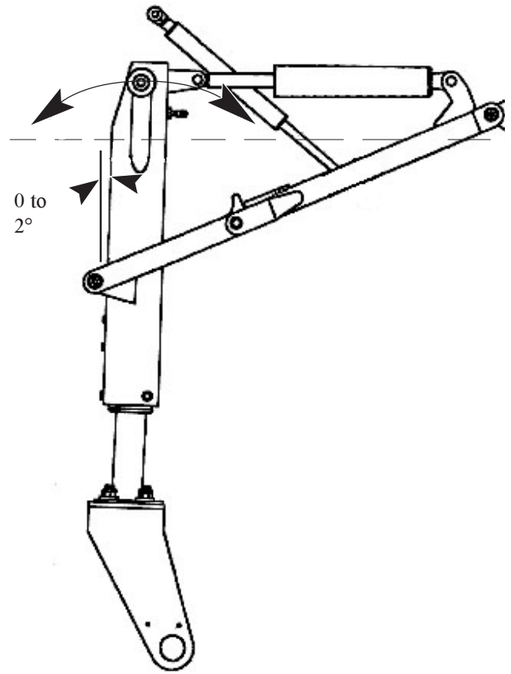
Delrin Bumpers
Fig. F:5



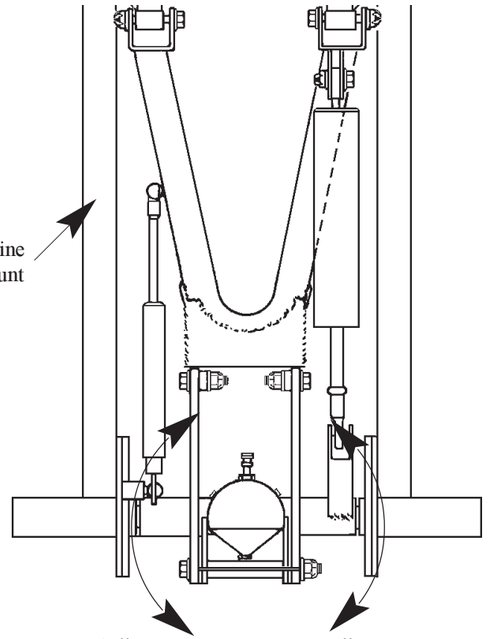
Aligning Nose Gear to Mounting Pads
Fig. F:6

LEFT SIDE VIEW

Adjust the rake of the nose gear between 0 to 2 degrees forward. The final location is determined by where the nose gear bearing blocks fits the mount within the specified angle range.



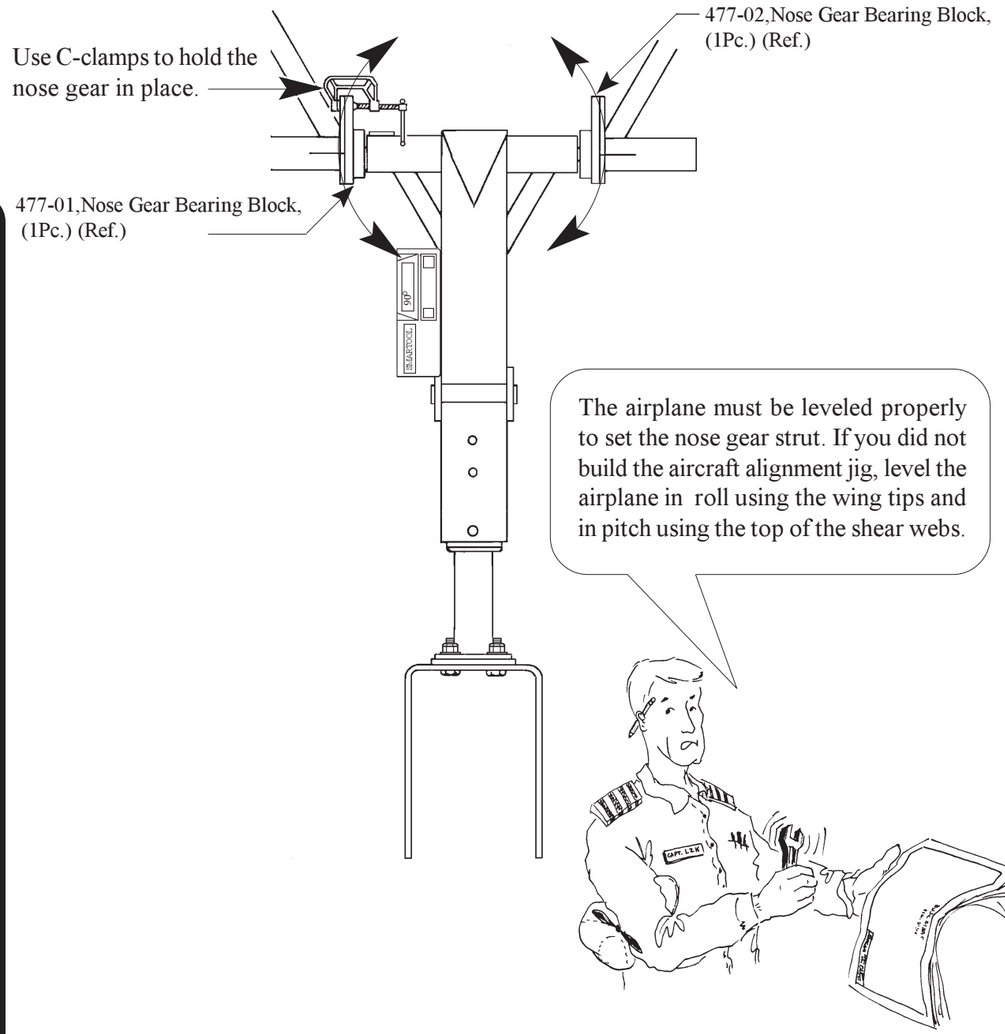
TOP VIEW



Adjust as necessary to align over center link arms. (will align by itself if assembled)

FRONT VIEW

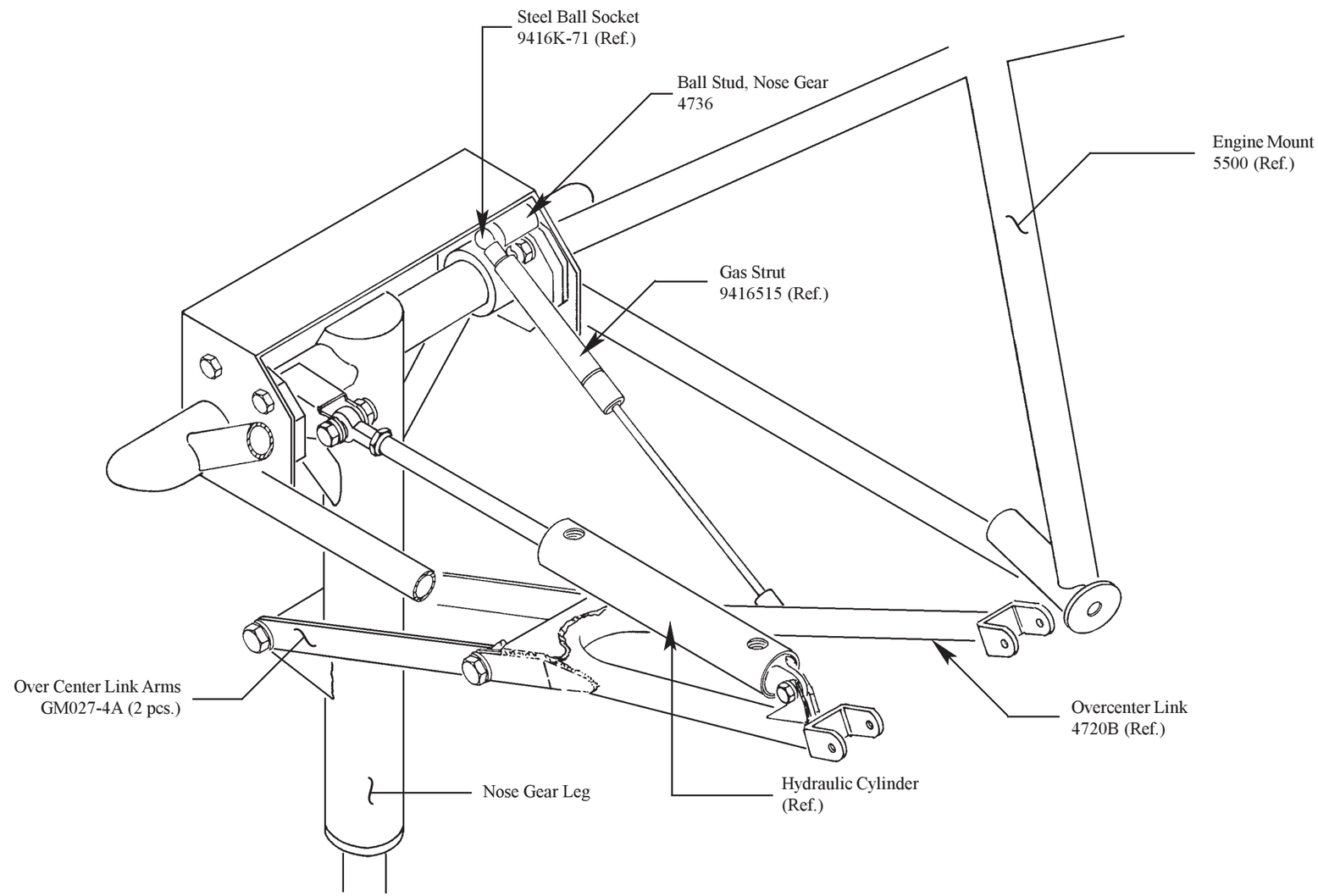
Adjust as necessary to set strut vertical.



D 2. Align the strut as shown in side view, top view and front view. Clamp as shown.Retract the gear to check for any binding.

D 3. Once aligned, drill holes through the bearing blocks.

Mounting Nose Gear to the Engine Mount
Fig. F:7



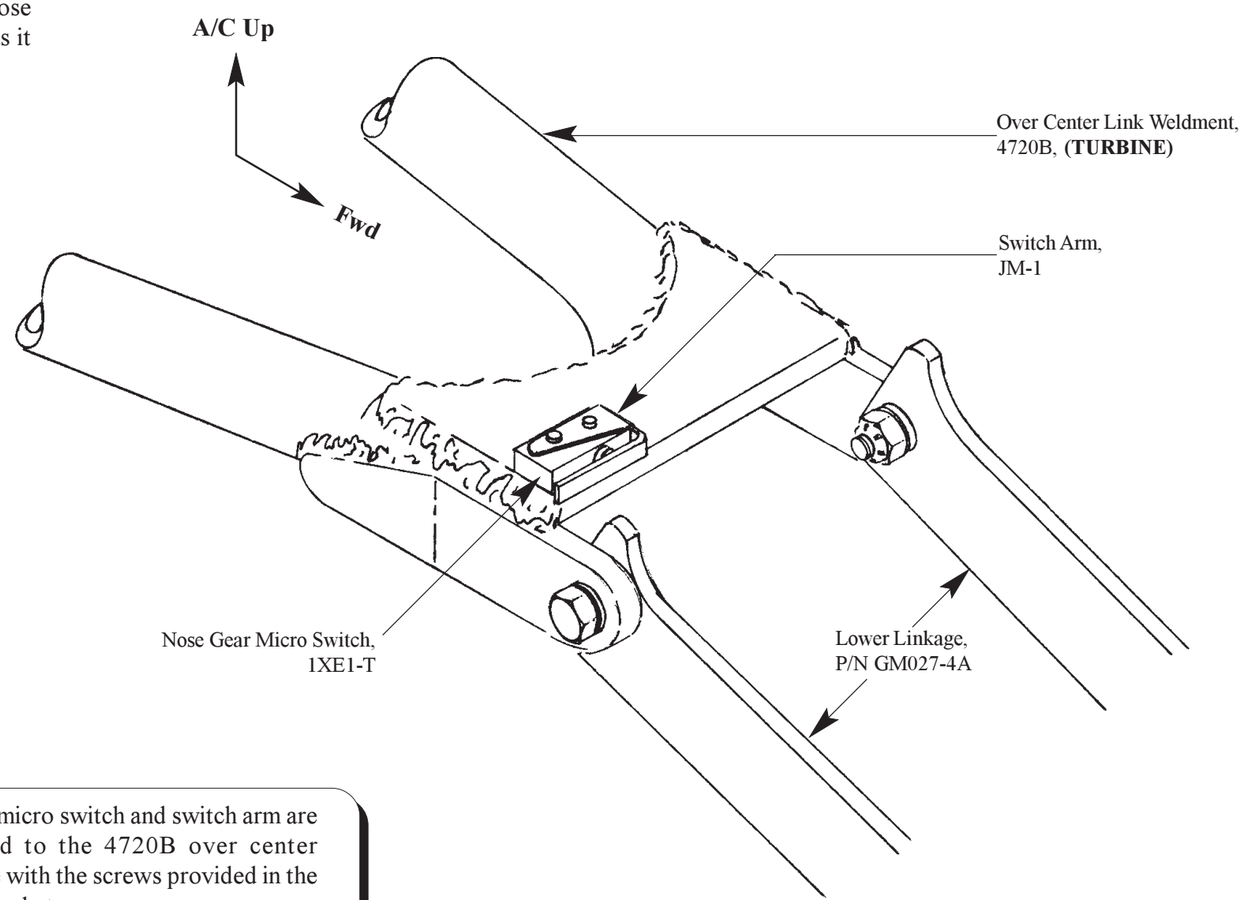
NOSE GEAR DOWN SWITCH

A micro switch is mounted to the 4720B over center linkage to indicate if the nose gear is down and locked. The switch is activated by the GM027-4 lower over center linkage.

Use the hardware supplied in the JM-1 packet to secure the 1XE1-T micro switch to the 4720 upper over center linkage. Two switch mounting holes are predrilled in the linkage for this purpose. The nuts and lock washers should be on the bottom of the GM027-4A linkage. Use a drop of Loctite on these nuts just to be sure of a good hold.

The right, GM027-4A over center linkage should press the switch arm when the nose gear is locked in the down position. You should be able to hear the “click” of the switch as it contacts and releases.

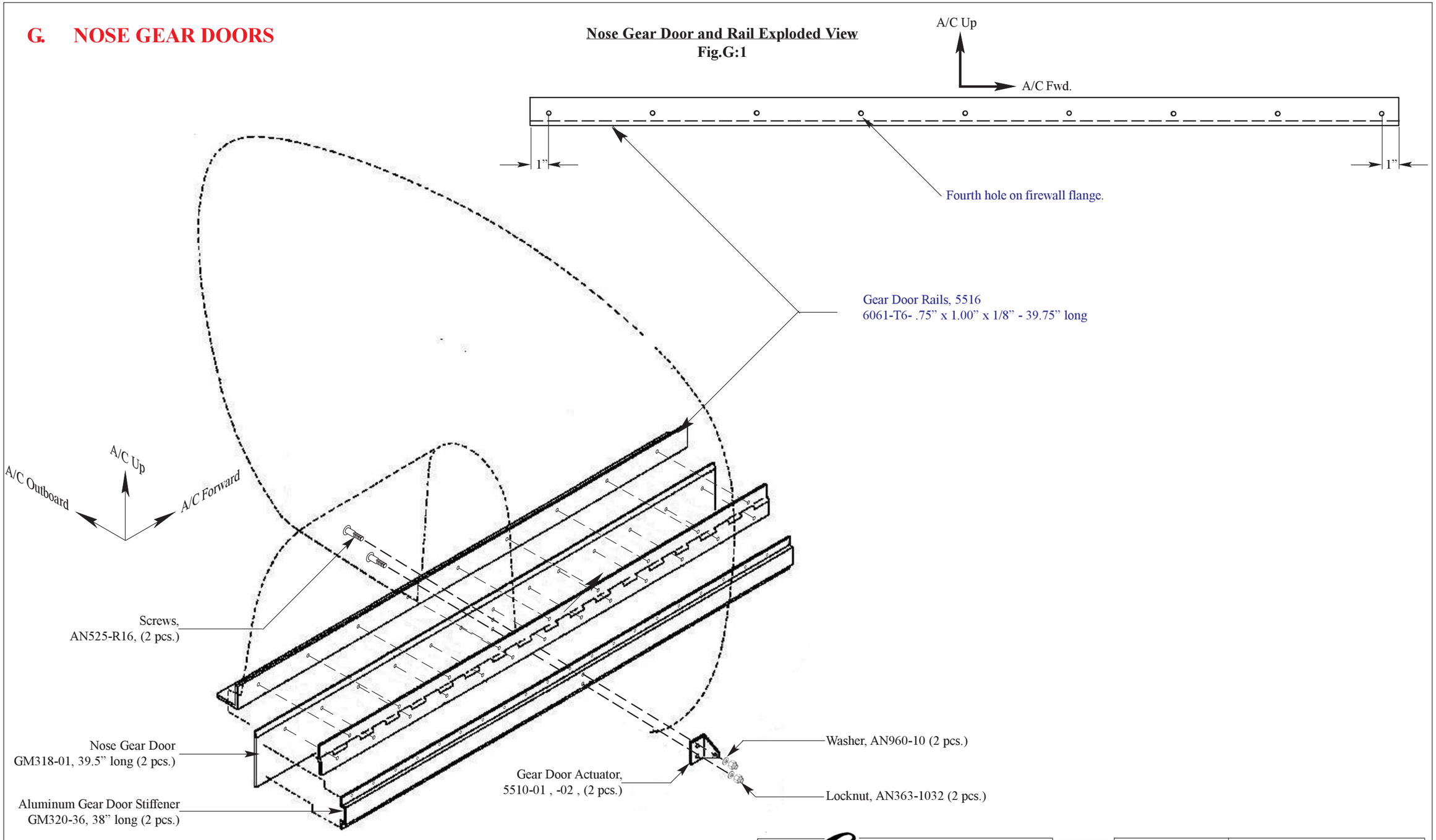
Nose Gear Micro Switch
Fig. F:8



The micro switch and switch arm are secured to the 4720B over center linkage with the screws provided in the JM-1 packet.

G. NOSE GEAR DOORS

Nose Gear Door and Rail Exploded View
Fig.G:1

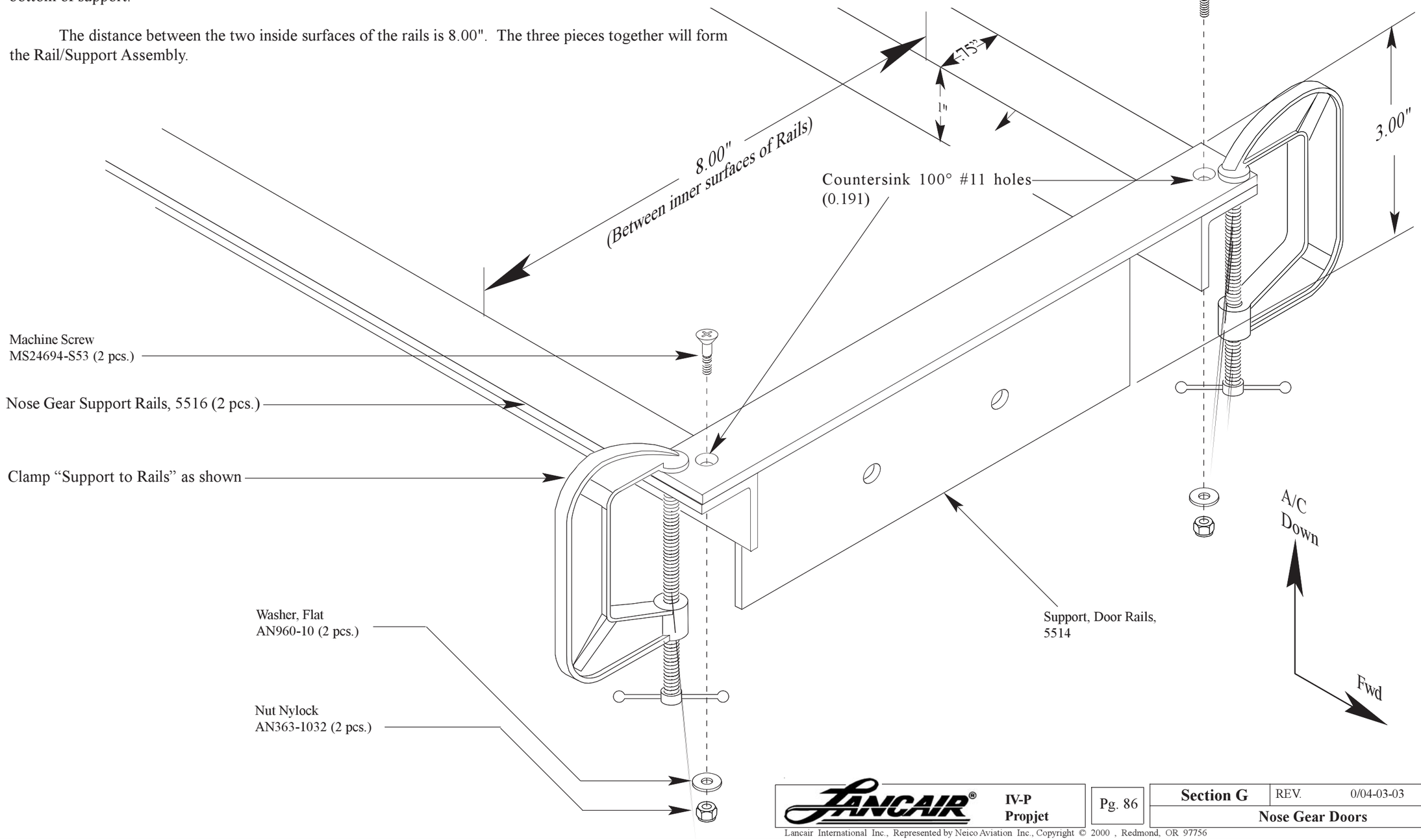


Forming Rail/Support Assembly
Fig. G:2

NOTE: The .75 side of the rails is horizontal.

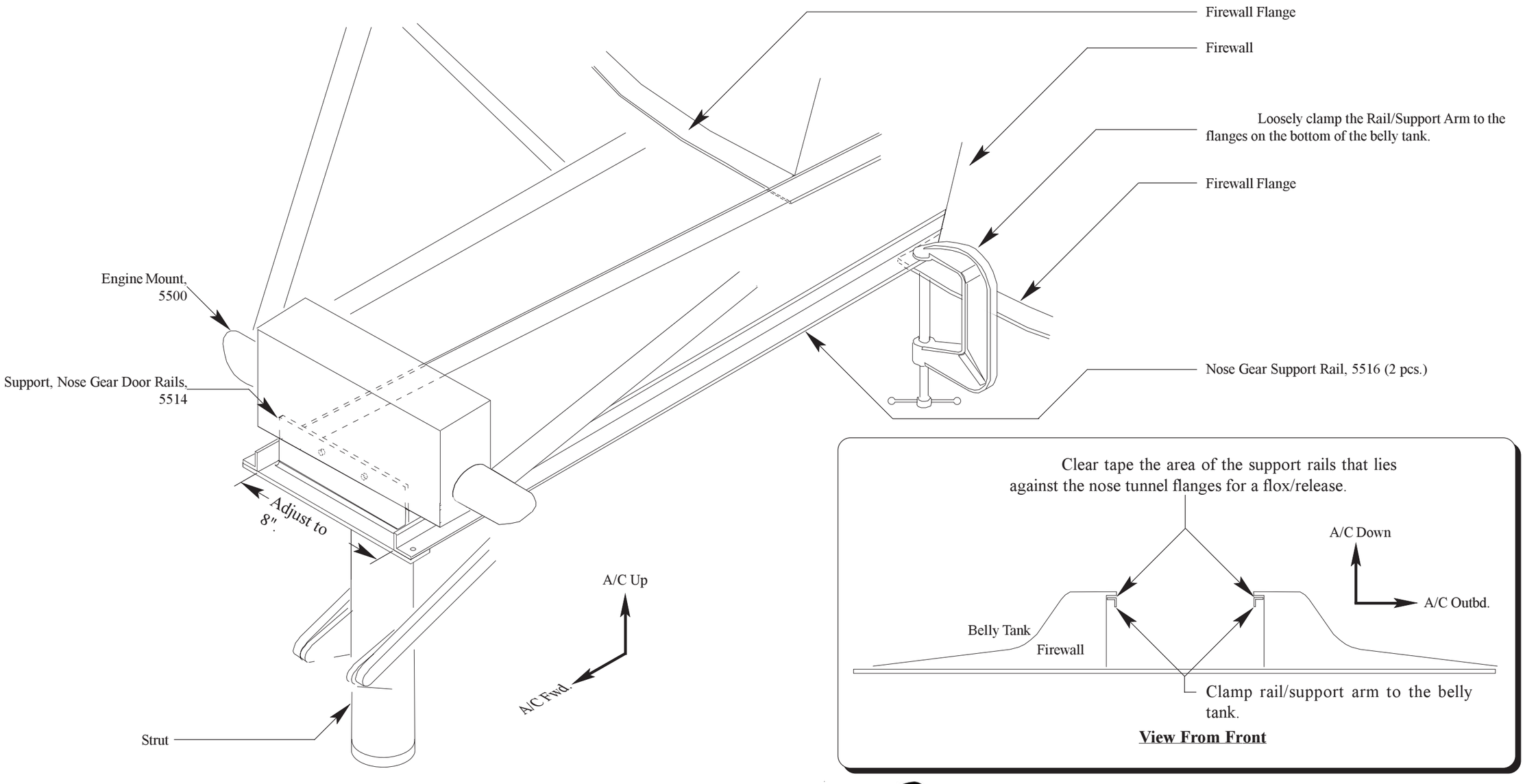
Clamp support (P/N 5514) to Rails (P/N 5516) as shown and drill #11 (0.191) holes and countersink bottom of support.

The distance between the two inside surfaces of the rails is 8.00". The three pieces together will form the Rail/Support Assembly.



Nose Gear Installations
Fig. G:3

Be sure to keep a distance of 8" for the inside dimension of the Support Rails (P/N 5516). Clear tape the area of the support rails that will come in contact with the flange that is part of the turbine nose gear door tunnel.

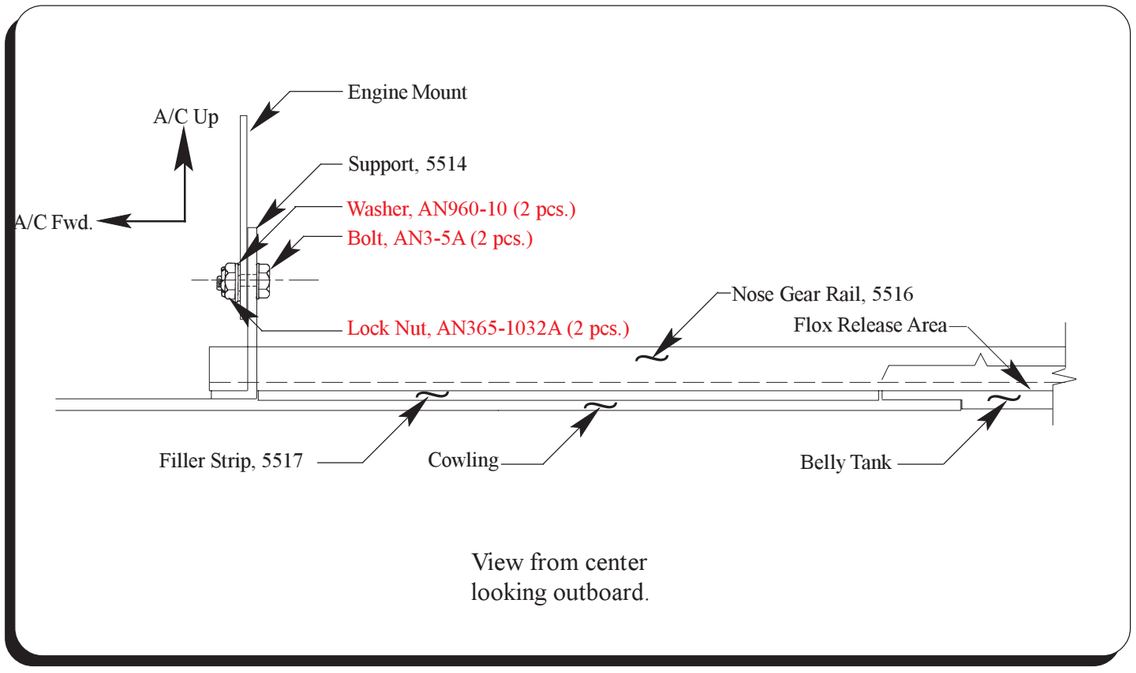


View From Front

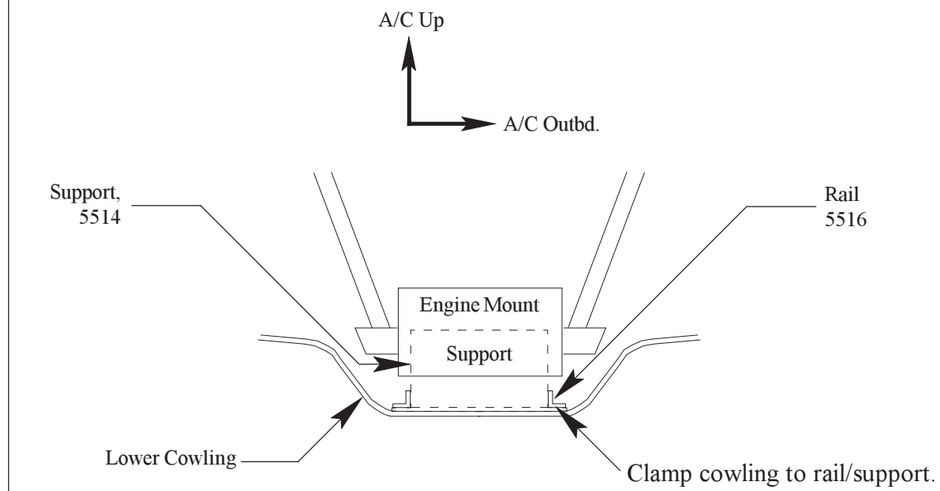
Checking Cowling, Bellytank and Gear Door Rails Alignment
Fig. G:4

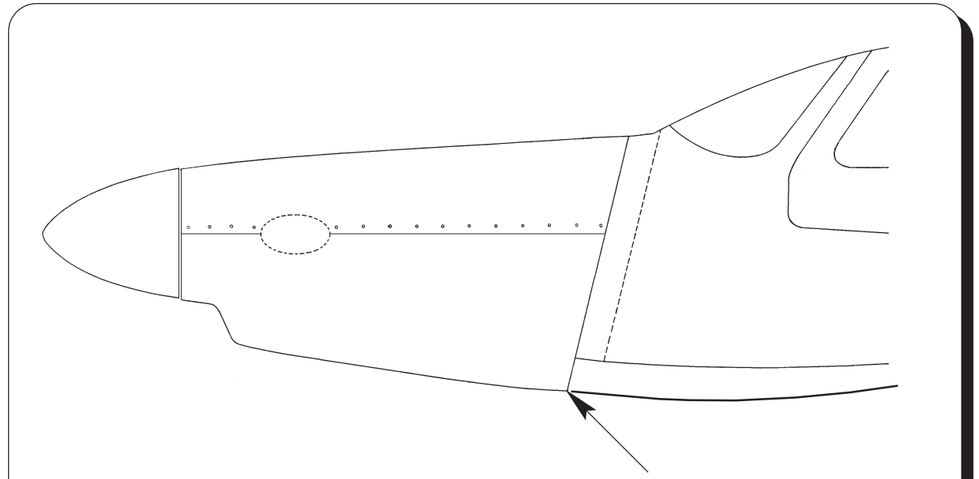
Install the lower cowling and clamp it to the rail/support assembly as far forward as possible.

To determine if the cowling is properly aligned to the belly tank, use a straight edge to check for straightness. If the cowling is not aligned with the tank, small adjustments can be made. Be sure to check that the rails are straight forward and aft. After the rails are clamped to the cowling they should remain straight and not bent by the pressure from the clamps.



View from center looking outboard.





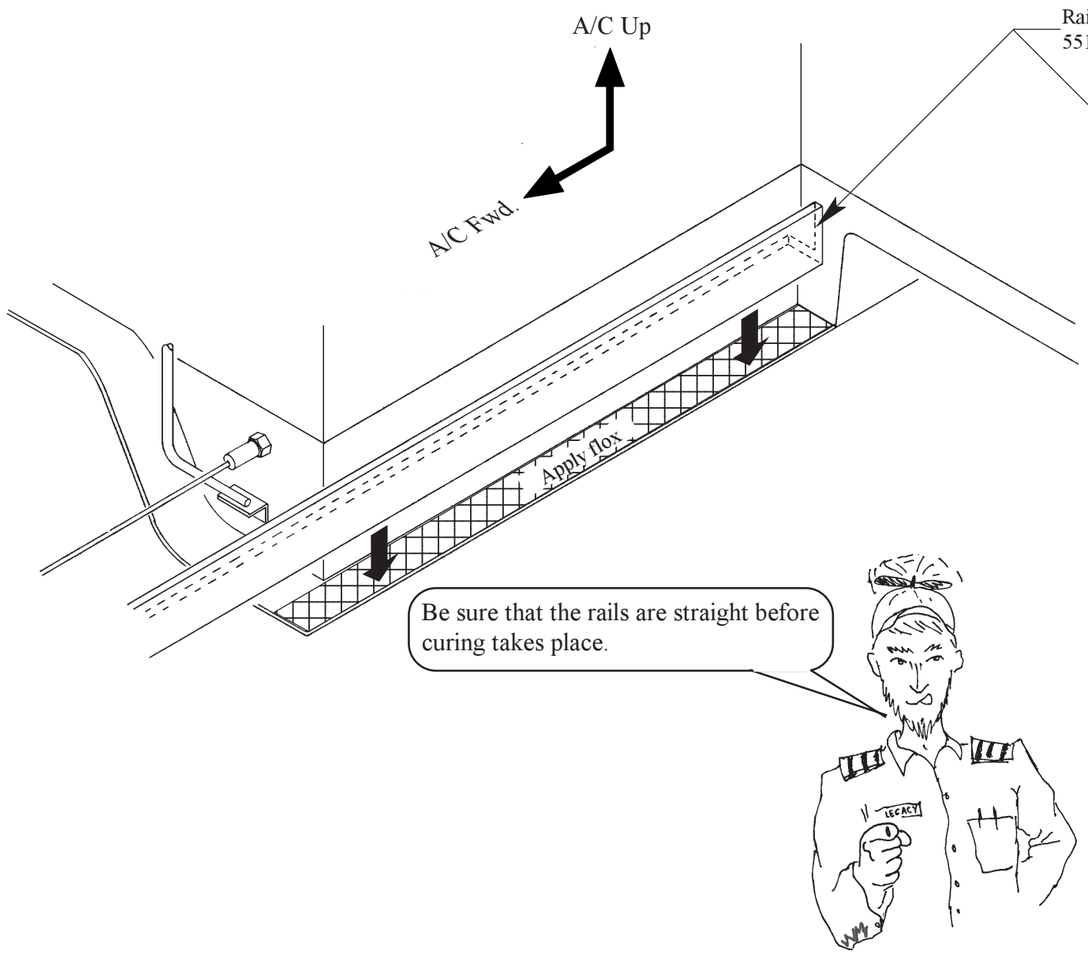
NOTE: Use a straight edge along the cowl and belly tank to check straightness.

Next, you will release the support rails to the bellytank. First, remove the support and rails from the airplane. After this, apply flox to the bellytank where the rails will seat. Now, reinstall the assembly.

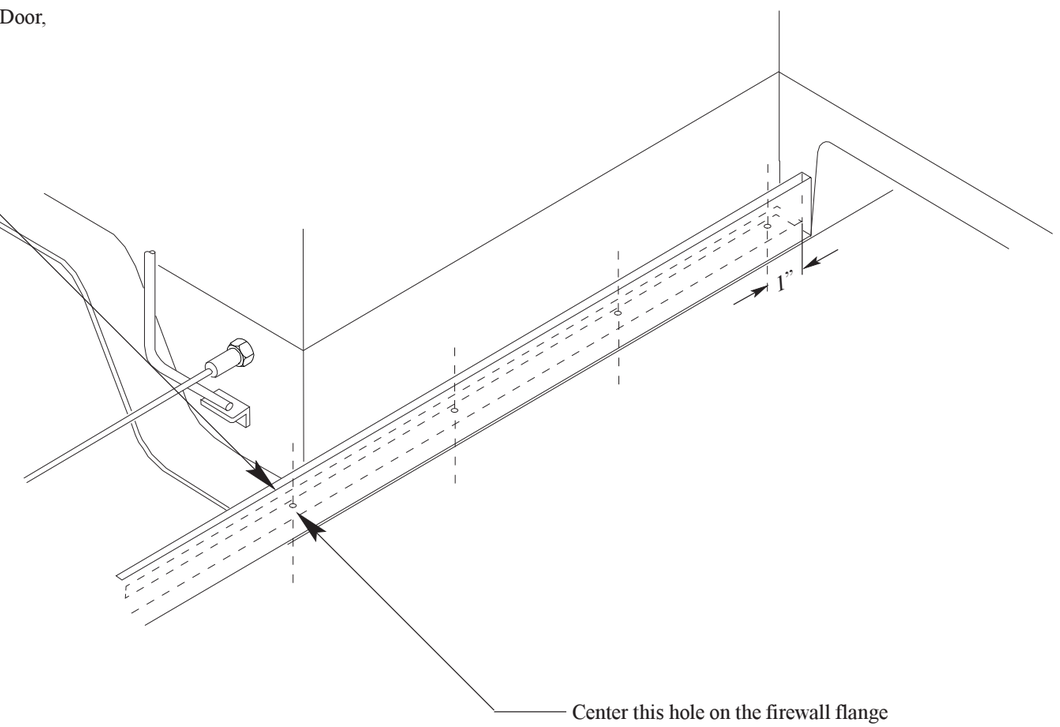
Tighten the clamps just enough to allow the rails to contact the cowling and seat on the bellytank while remaining straight. Clean off any excess flox squeeze out. See figure G:5.

After the release has cured to the belly tank flange, drill a 0.191diameter (#11 drill) thru the belly tank flange and the nose gear door rails, for attaching MS24694-7screws. See figure G:6.

Releasing the Support Rails to the Bellytank
Fig. G:5

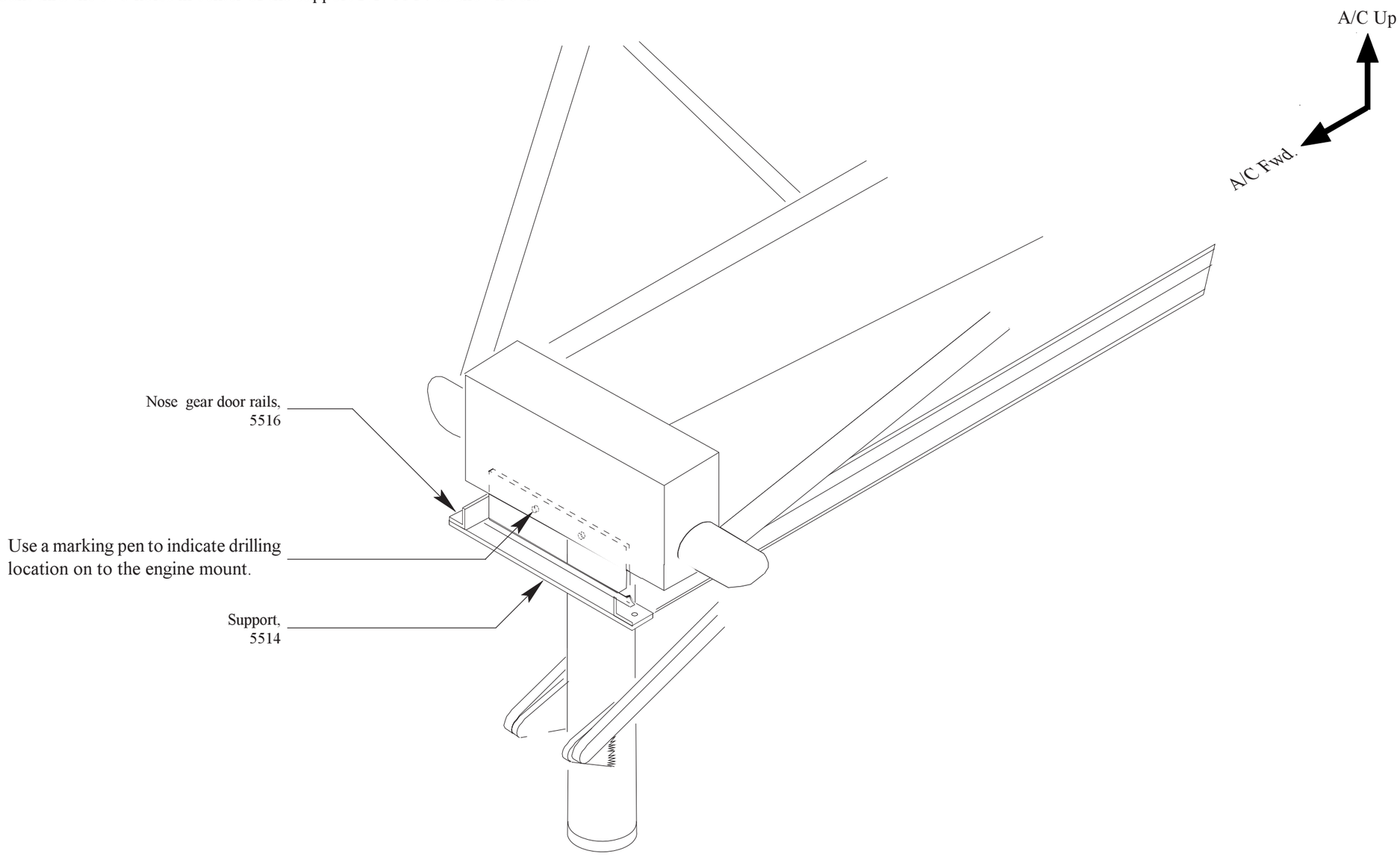


Drilling throughSupport Rails and the Belly Tank Flange
Fig. G:6



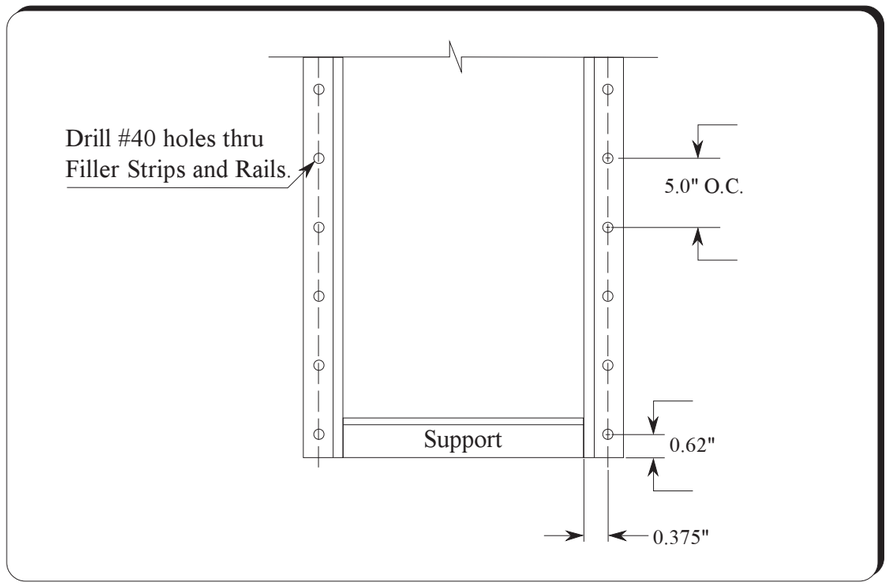
Marking Holes for Support Installation
Fig G:7

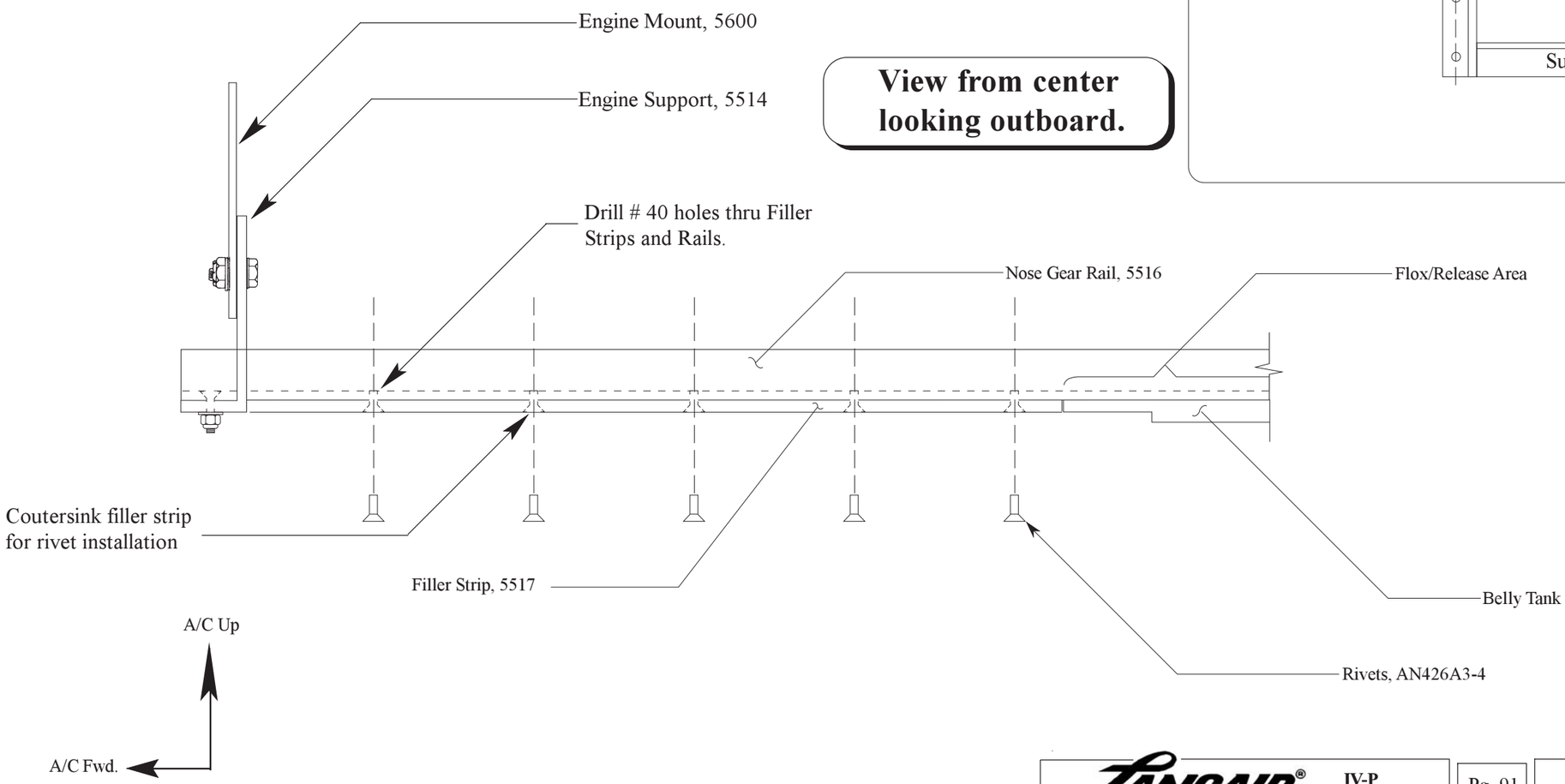
Mark the engine mount thru the two holes in center of the support P/N 5514 as shown below.



Filler Strip Installation
Fig. G:8

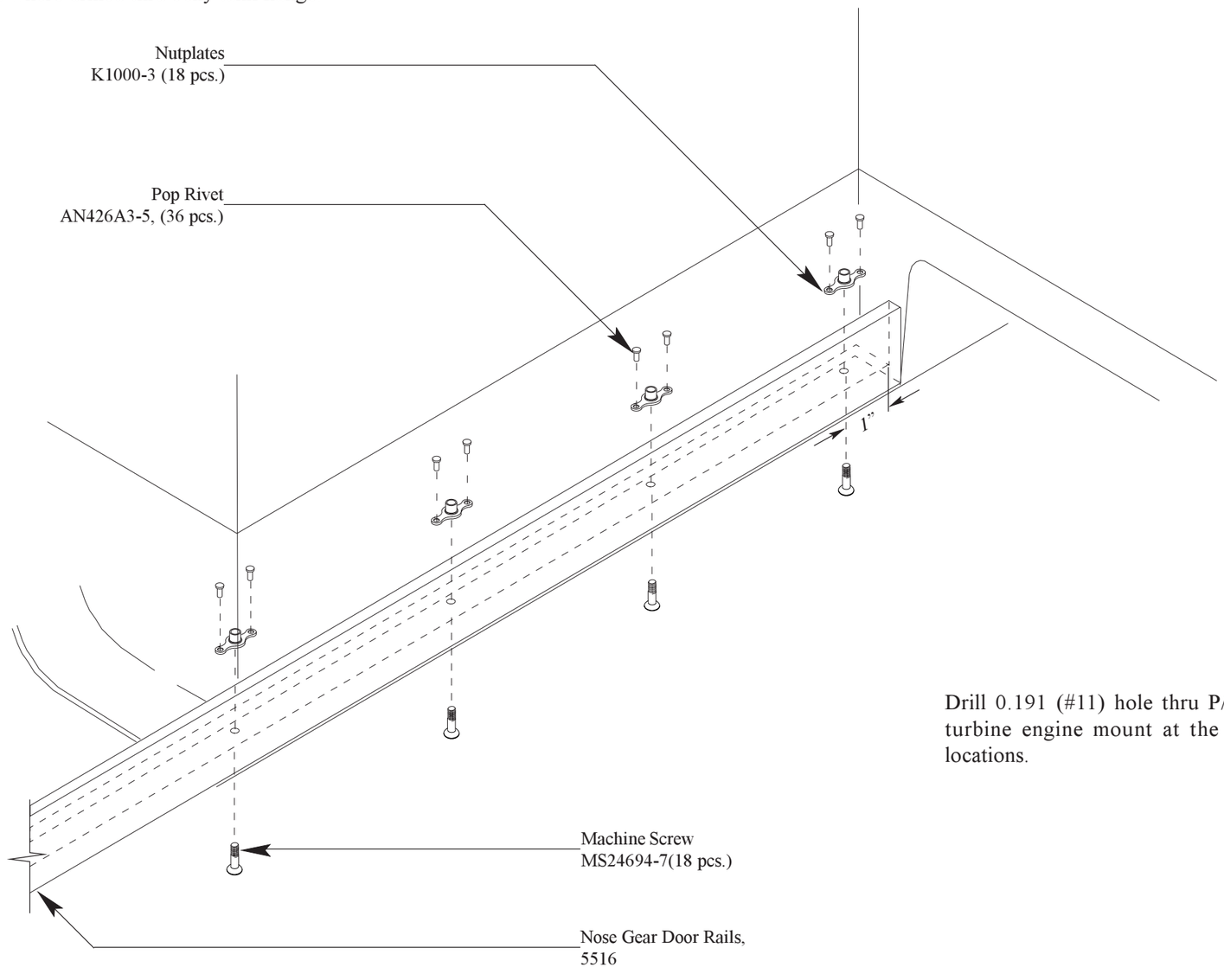
Position Filler Strips on bottom of Rails between Belly Tank and Support. Drill # 40 holes thru Filler Strips and Rails and rivet together with AN426A3-4. Remember where these rivets are located, as you will be drilling thru in this vicinity for cowl attach screws later.

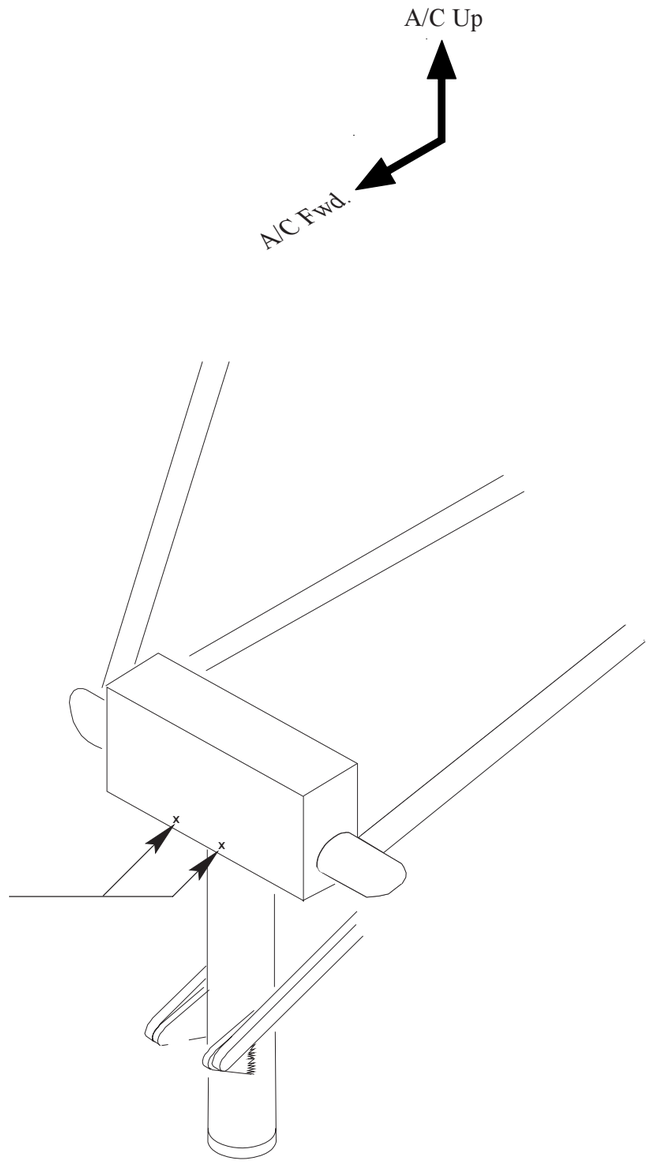




Installing Nutplates on Rails-Drilling Marked Mount
Fig G:9

Remove the support/rail assembly. Drill the engine mount where marked. Install nutplates (K1000-3) on rails where drilled thru belly tank flange.





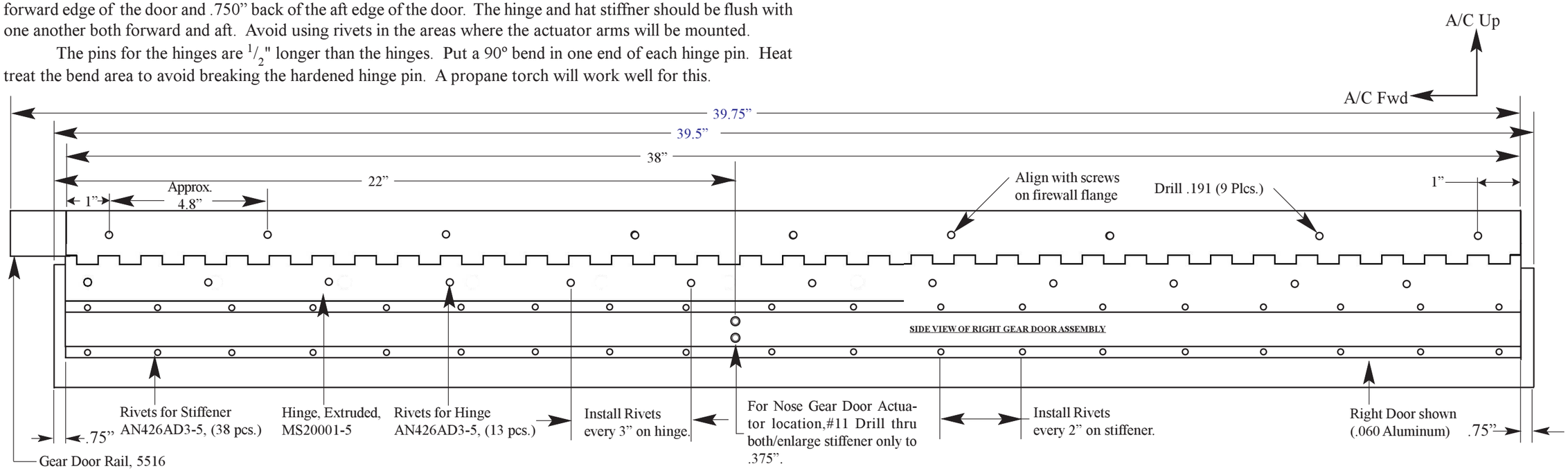
Drill 0.191 (#11) hole thru P/N 5500 turbine engine mount at the marked locations.

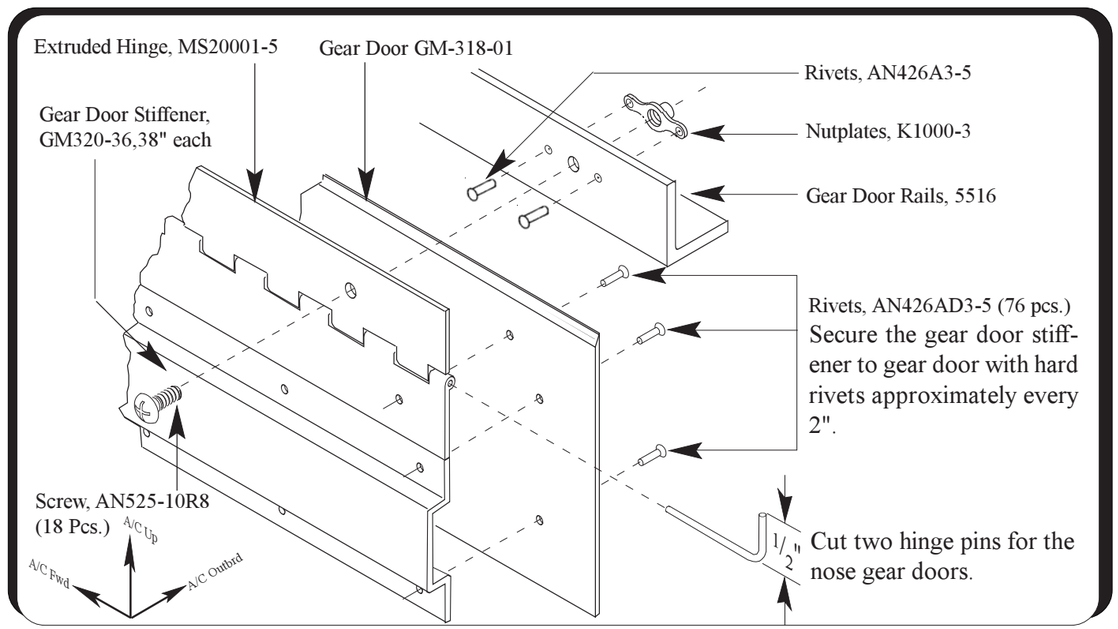
Securing Hinge and Stiffener to Nose Gear Door

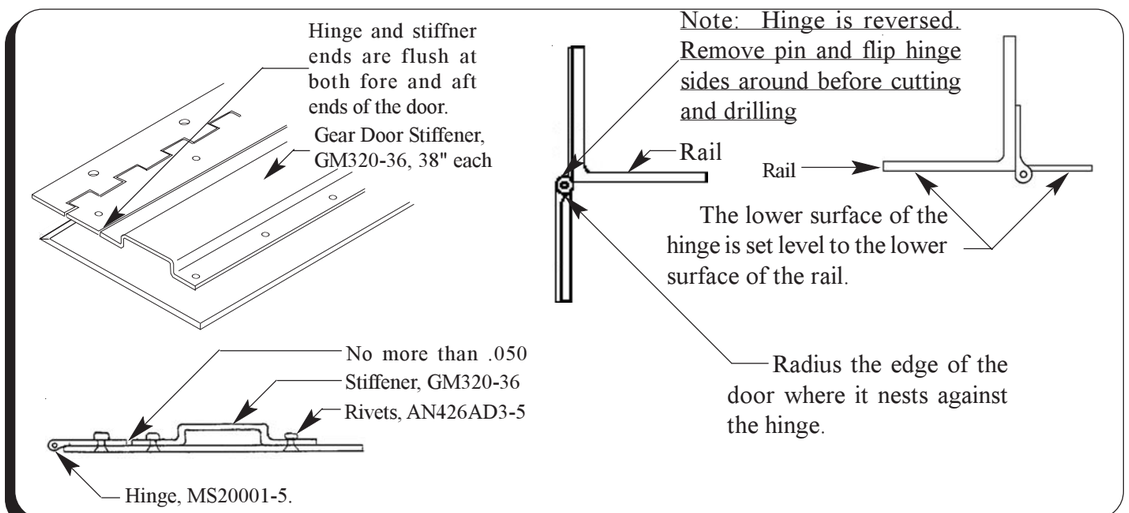
Fig. G:10

Assemble the gear door stiffener and hinge to the gear doors. Move the hinge and stiffner to .750” back of forward edge of the door and .750” back of the aft edge of the door. The hinge and hat stiffner should be flush with one another both forward and aft. Avoid using rivets in the areas where the actuator arms will be mounted.

The pins for the hinges are $^{1}/_{2}$" longer than the hinges. Put a 90º bend in one end of each hinge pin. Heat treat the bend area to avoid breaking the hardened hinge pin. A propane torch will work well for this.

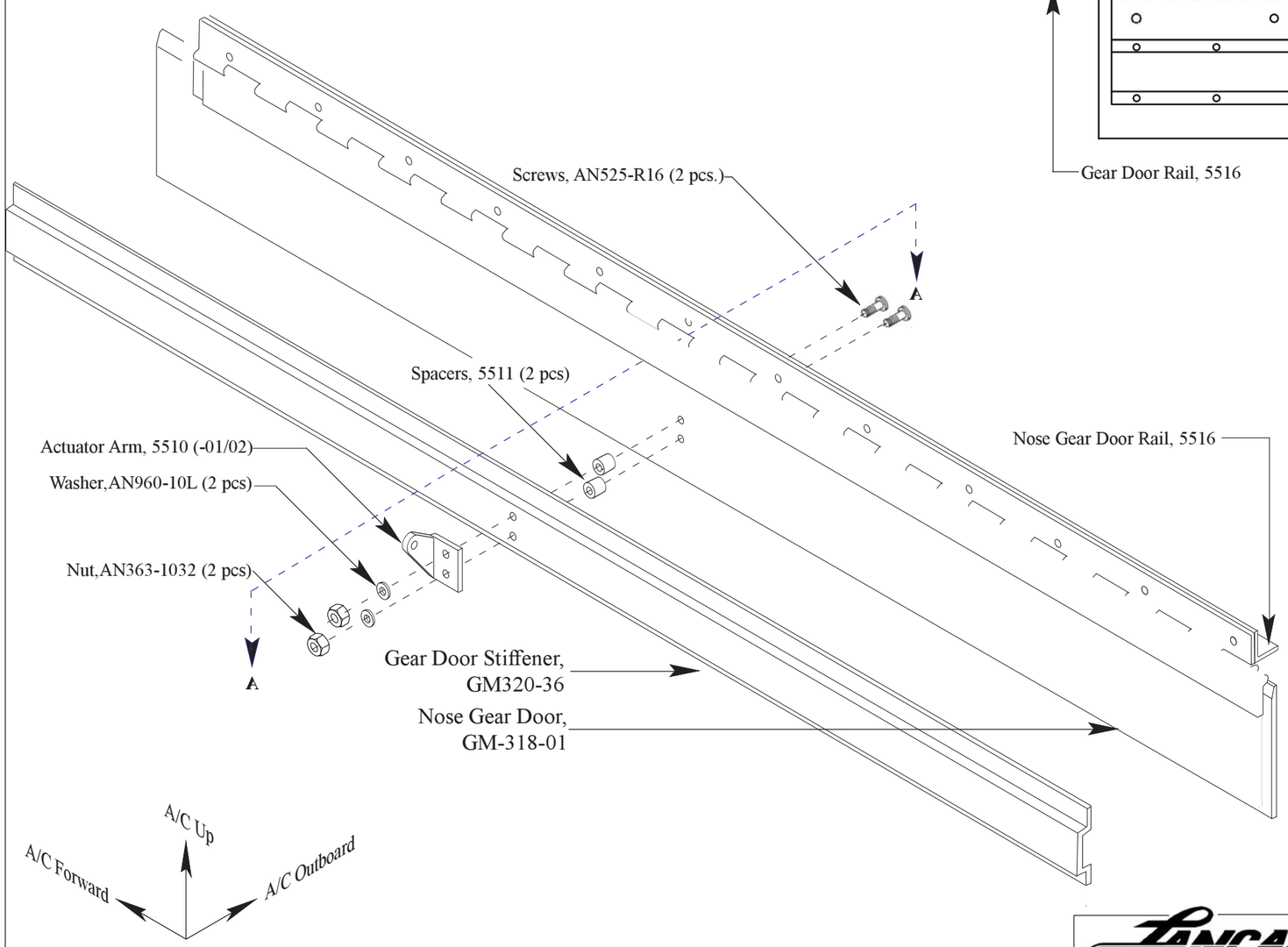


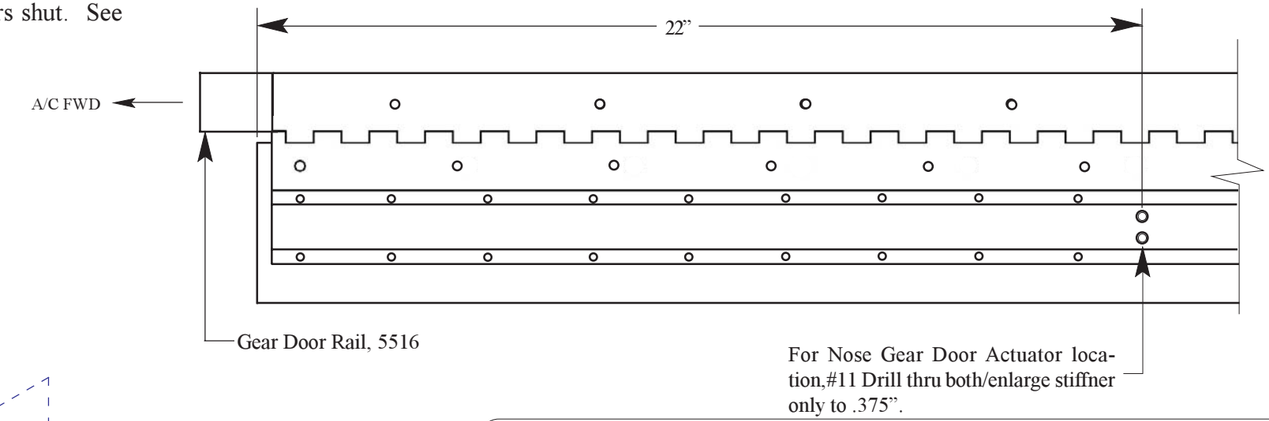




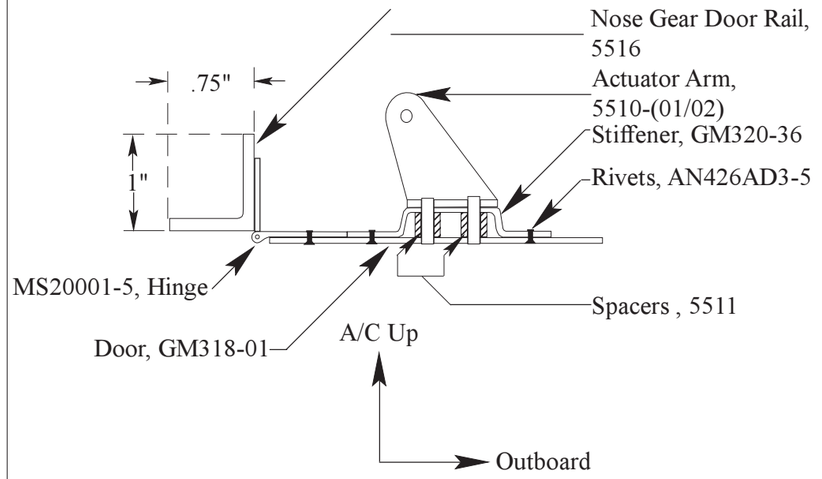
Installing the Nose Gear Doors Actuator Arms
Fig.G:11

Two actuator arms (p/n 5510-01 and 5510-02) are needed to pull the nose gear doors shut. See figures below for installation instructions.



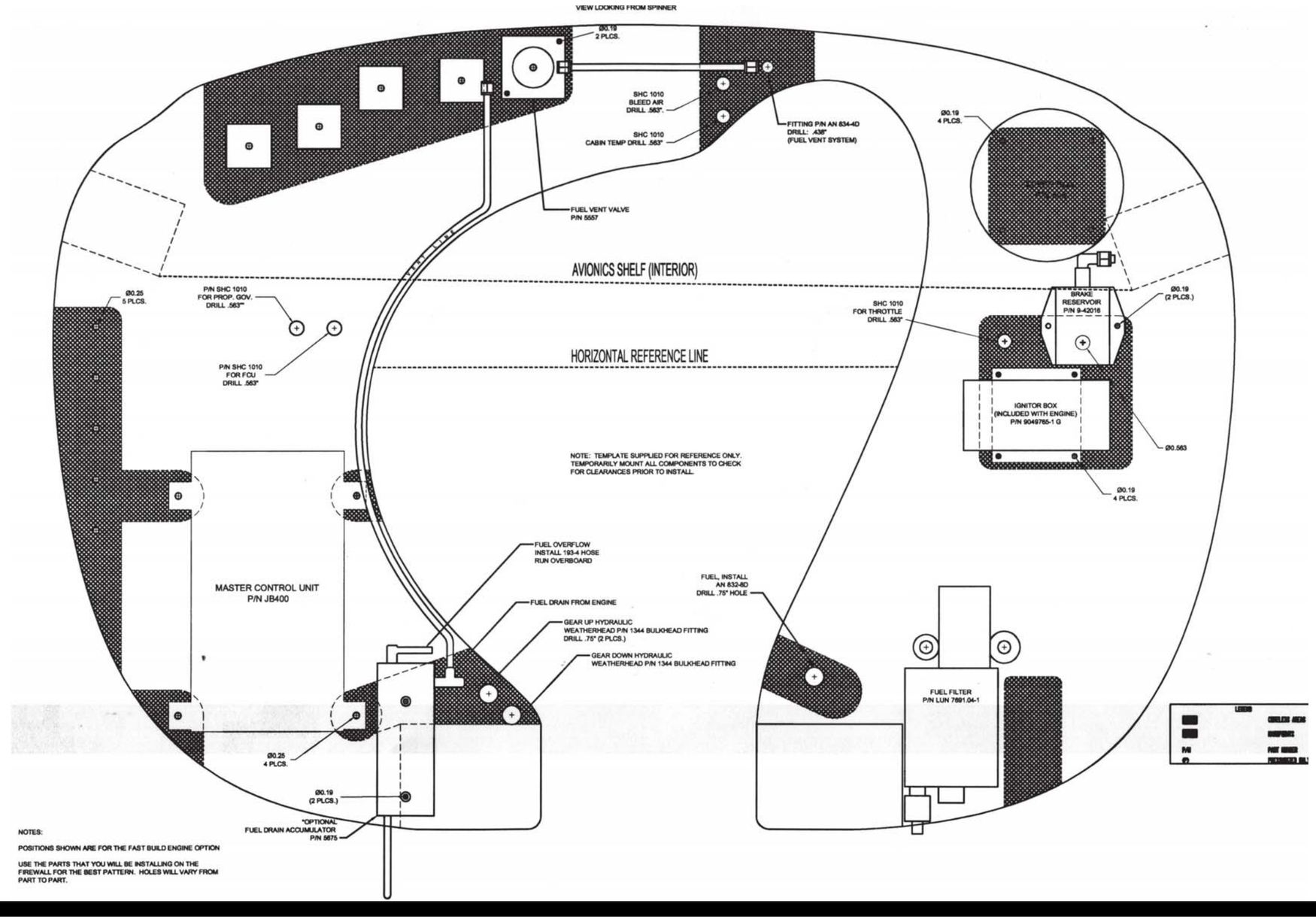


Section A-A
Gear door in Closed Position



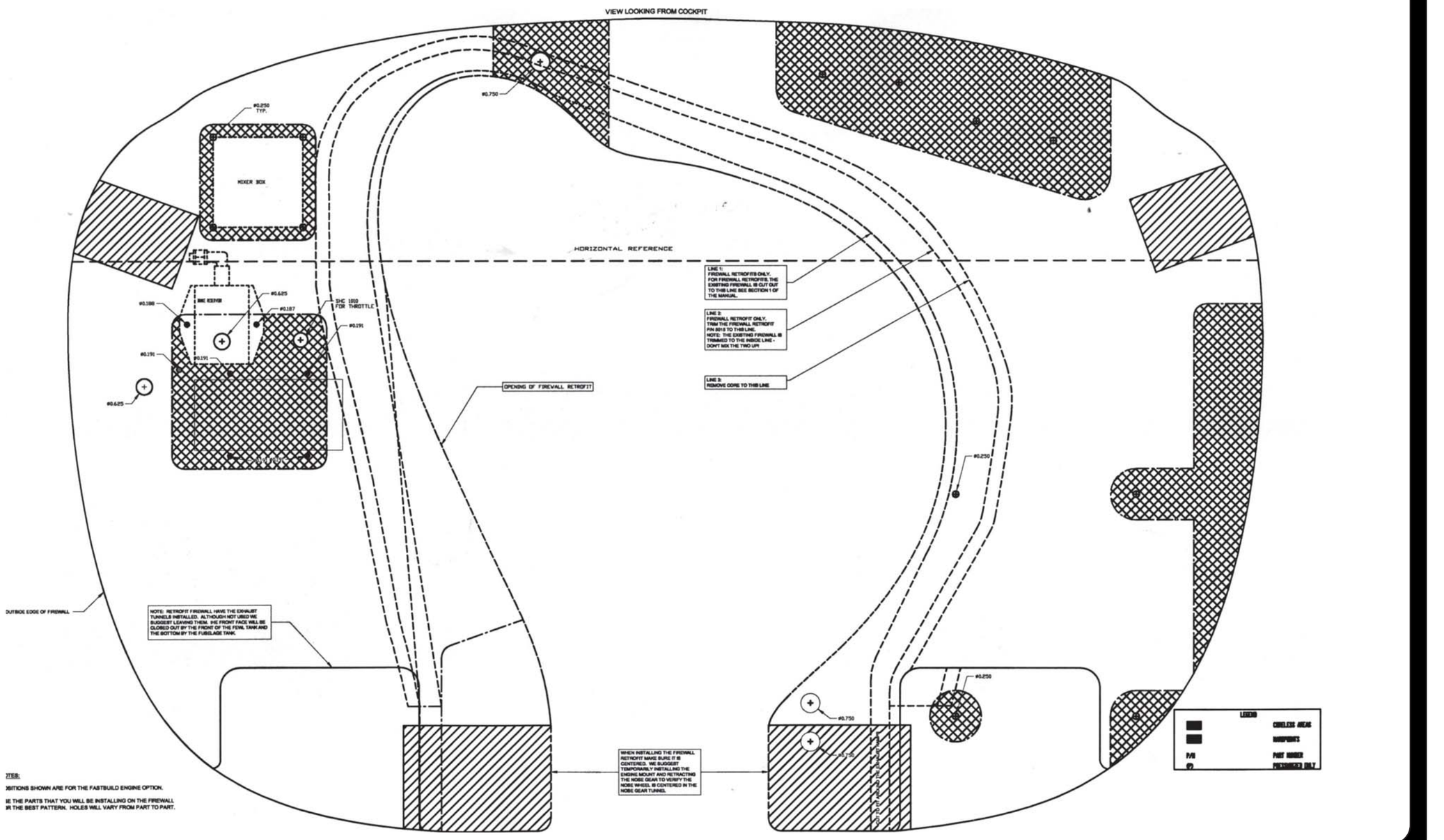
H. FIREWALL LAYOUT

5100 Turbine Firewall Blueprint
(1:1 blueprint is included with kit)



5101 Turbine Firewall Blueprint - Retro fit

(1:1 blueprint is included with kit)

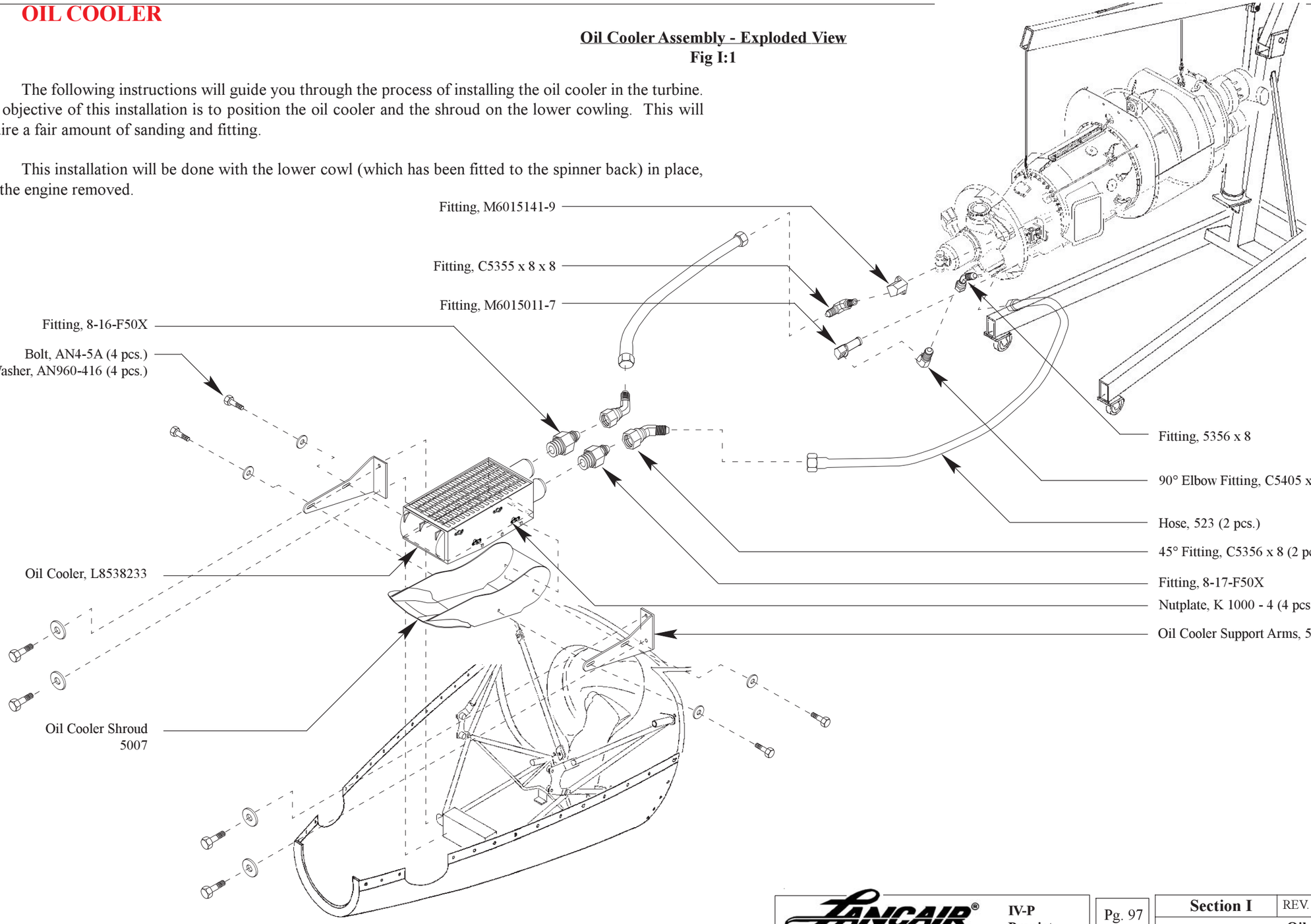


I. OIL COOLER

Oil Cooler Assembly - Exploded View
Fig I:1

The following instructions will guide you through the process of installing the oil cooler in the turbine. The objective of this installation is to position the oil cooler and the shroud on the lower cowling. This will require a fair amount of sanding and fitting.

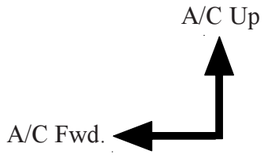
This installation will be done with the lower cowl (which has been fitted to the spinner back) in place, and the engine removed.



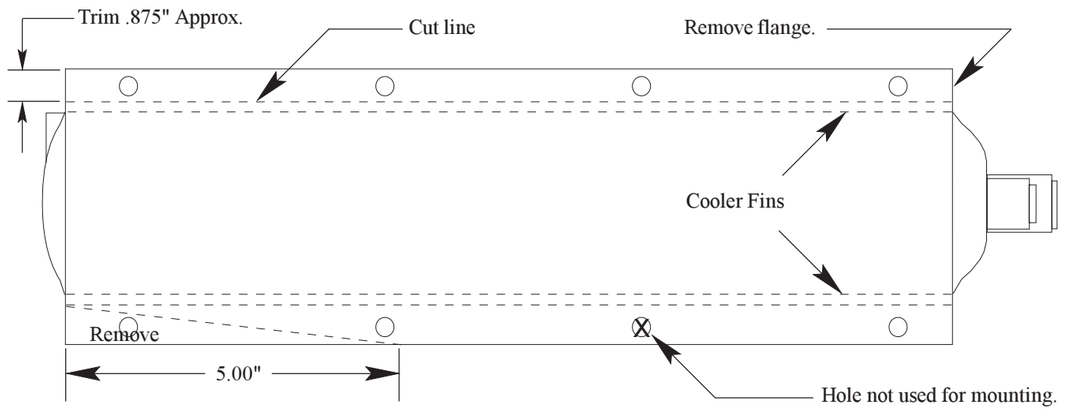
Trimming Oil Cooler Flange
Fig I:2

If your oil cooler has not yet been cut, you will need to do this according to the figure below before installations.

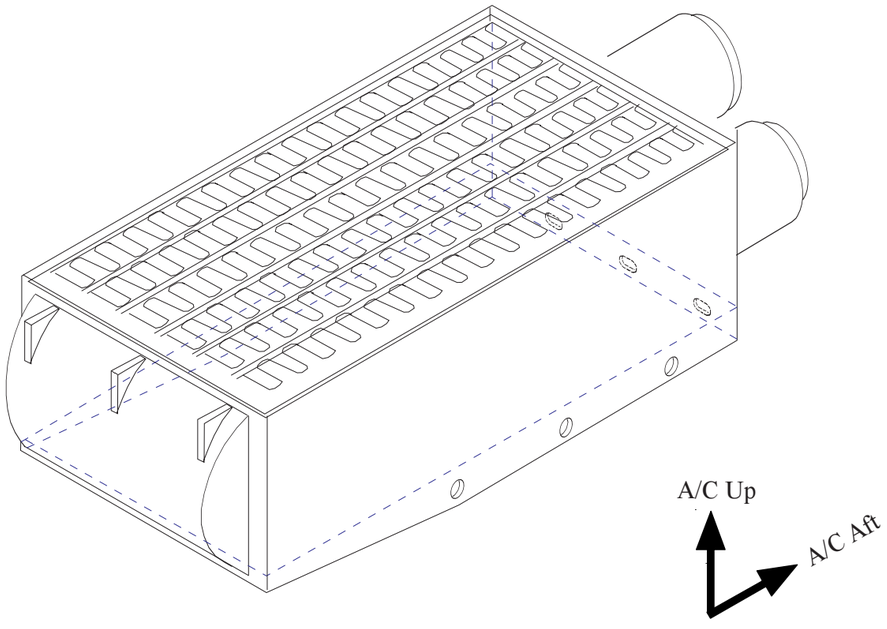
Use a piece of cardboard to cover the cooler surface and set as a guideline so as not to cut into the cooler fins (very expensive!). The best tool for this procedure is a large bandsaw with a metal cutting blade. Remove the entire top flange and part of the lower flange as shown.



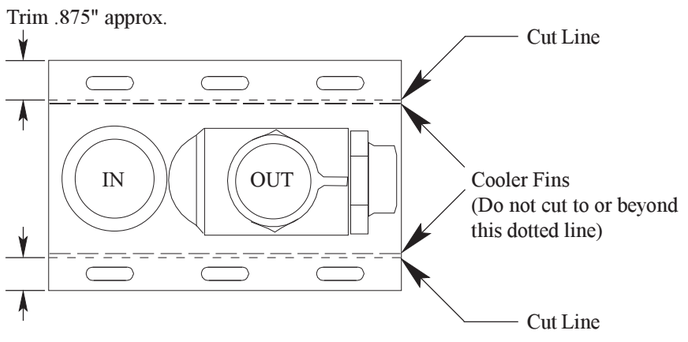
Oil Cooler Side View

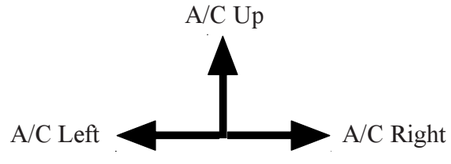


Trimmed Oil Cooler



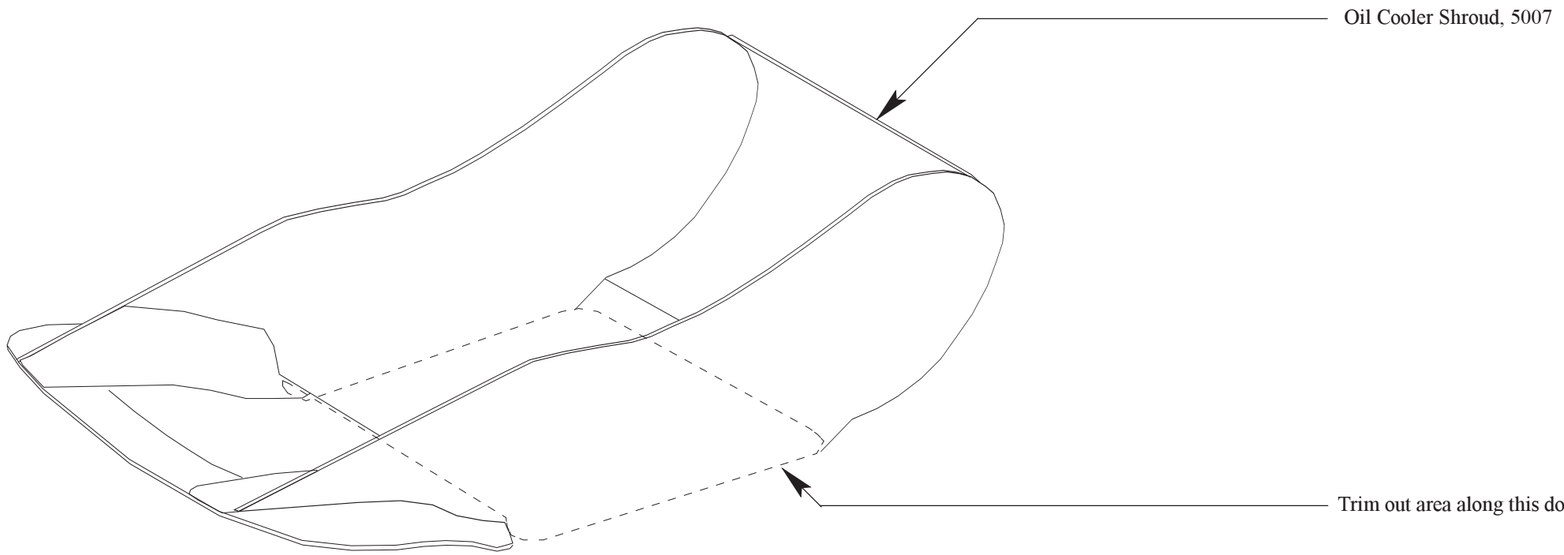
Oil Cooler Side View

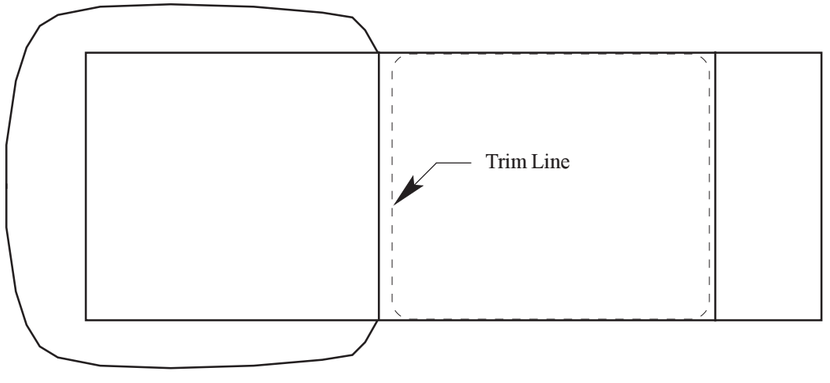




Trimming The Oil Cooler Shroud
Fig I:3

Trim the oil cooler shroud as shown in the figure below.

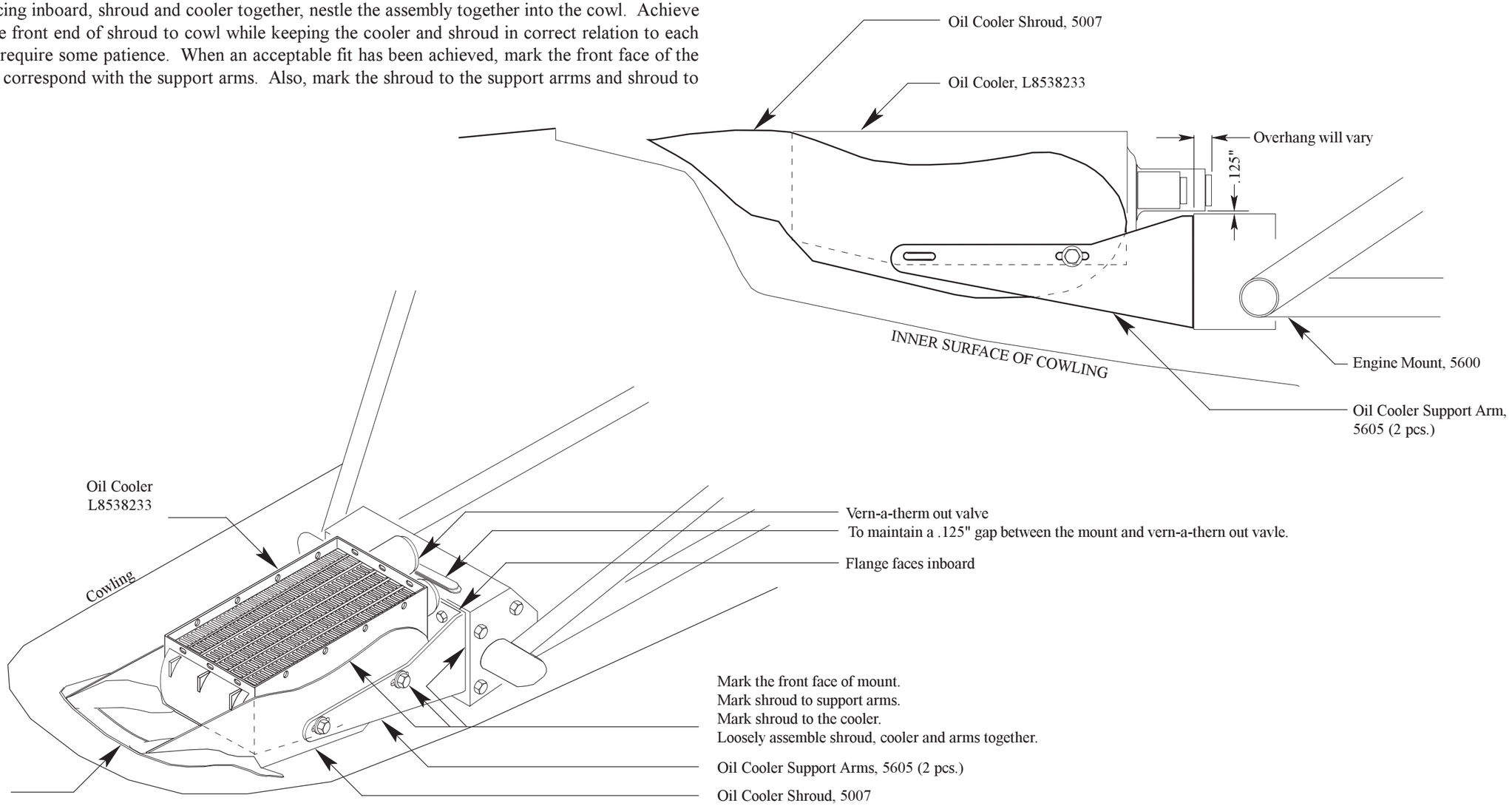




Mounting The Oil Cooler Shroud
Fig I:4

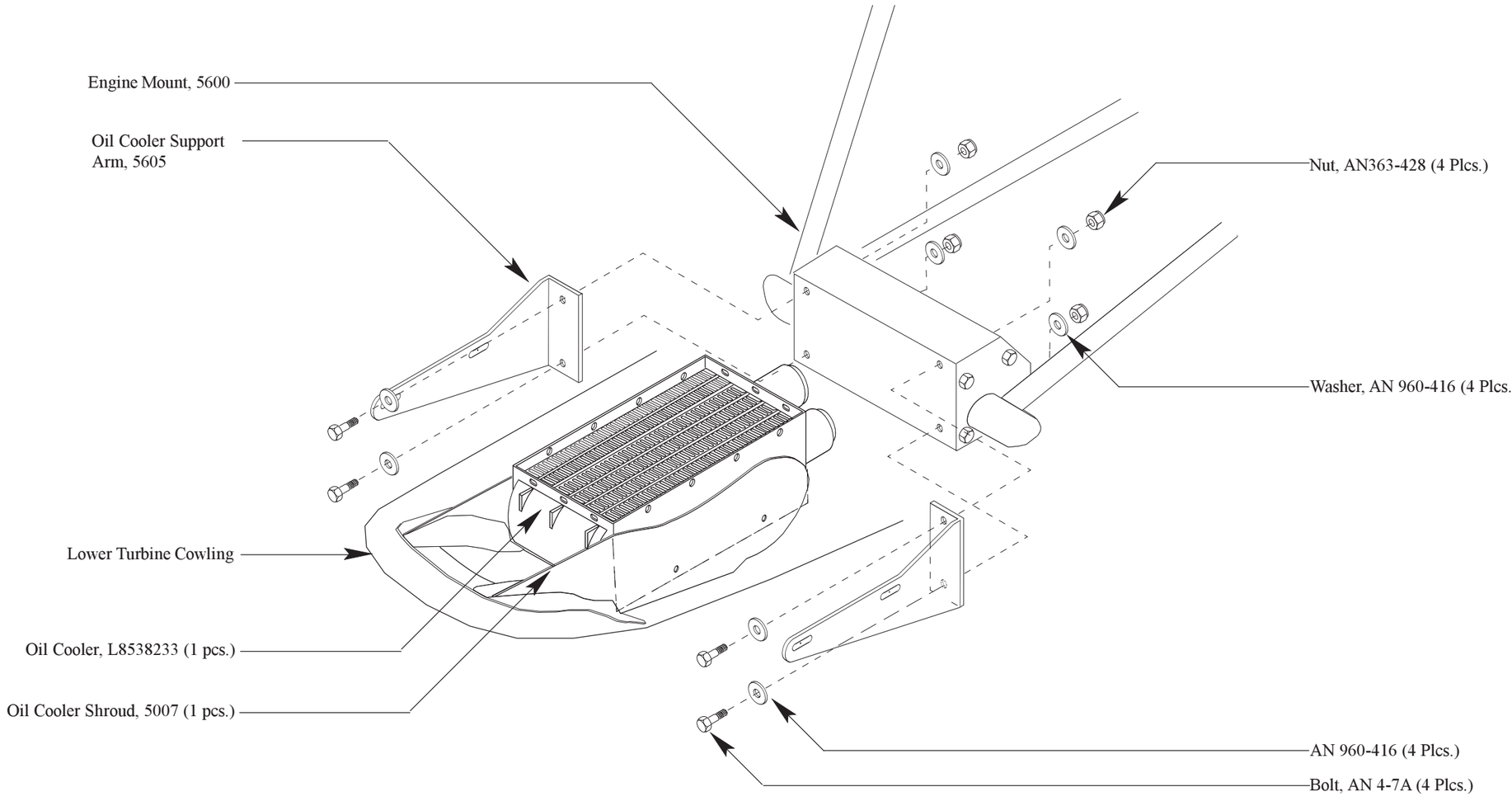
For the next step it will be necessary to have the lower cowling of the turbine installed.

The cooler shroud will mount captured between the support arms and cooler, so loosely assemble the arms (flanges facing inboard, shroud and cooler together, nestle the assembly together into the cowl. Achieve the best fit of the front end of shroud to cowl while keeping the cooler and shroud in correct relation to each other. This will require some patience. When an acceptable fit has been achieved, mark the front face of the engine mount to correspond with the support arms. Also, mark the shroud to the support arrms and shroud to cooler.



Installing Support Arms to Mount
Fig I:5

Drill the engine mount and support arms where marked and bolt in place.

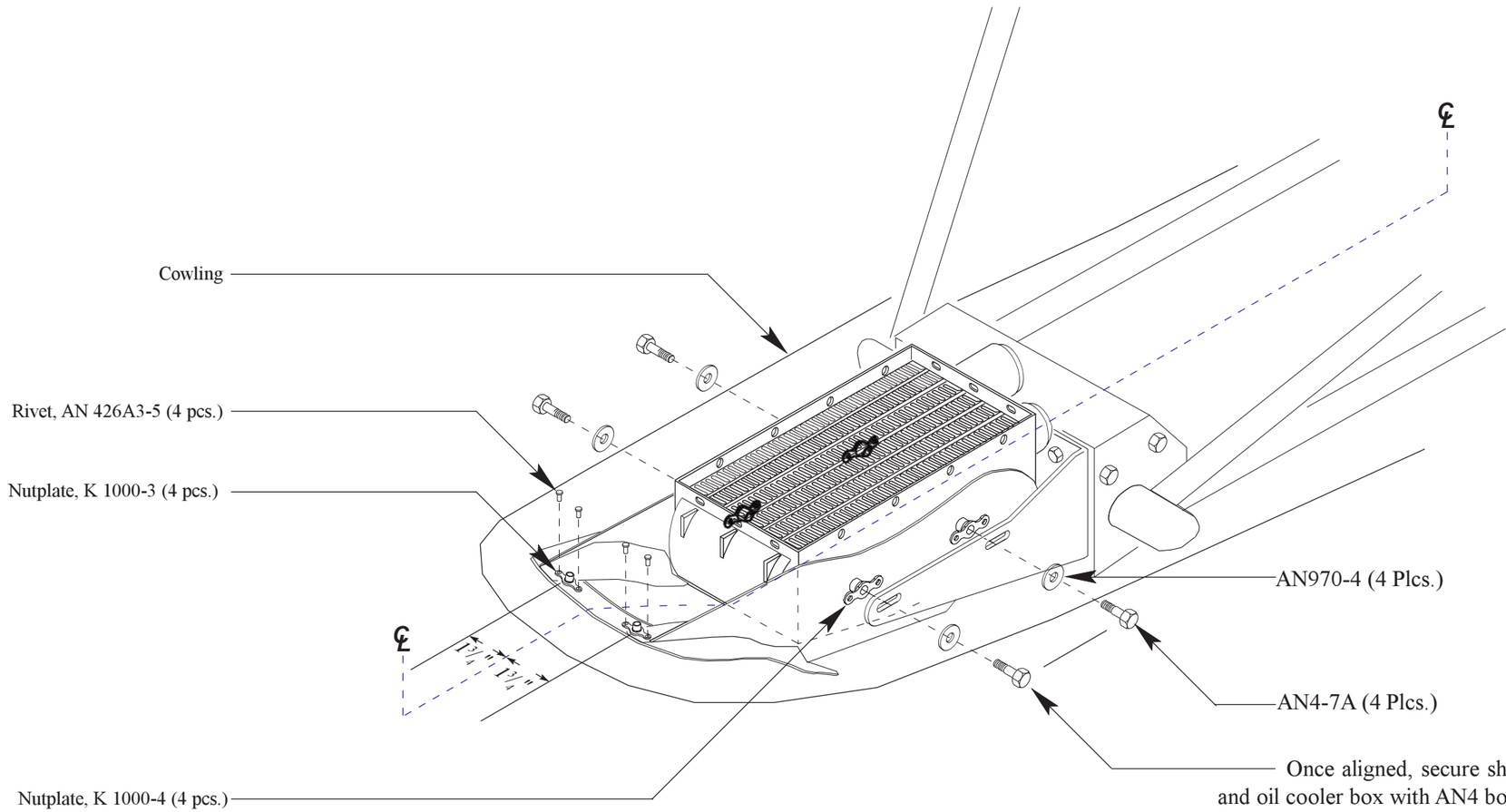


Securing Oil Cooler and Oil Cooler Shroud
Fig I:6

With the cooler removed and the support arms in place, fit the front of the shroud to cowl, and check your markings, making sure that they are reasonably close.

Once the shroud is properly aligned, drill the shroud through the slotted holes in support arms (5605). Put the oil cooler in place. Align the holes with nutplates on the oil cooler with the drilled holes in shroud and slots in the support arms.

Drill two #2 holes in the forward flange of the housing approximate $1^{3}/_{4}$" right and left of center. Drill the holes through the lower cowl as well. Rivet #10 nutplates to the cooler housing.

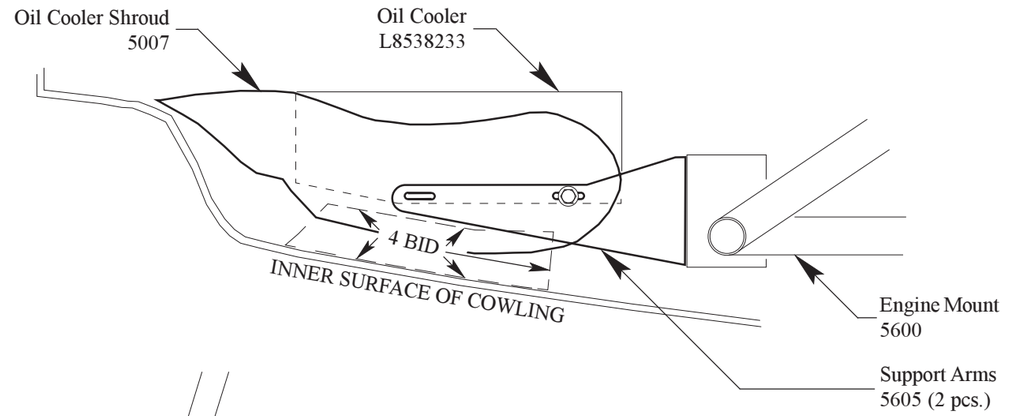


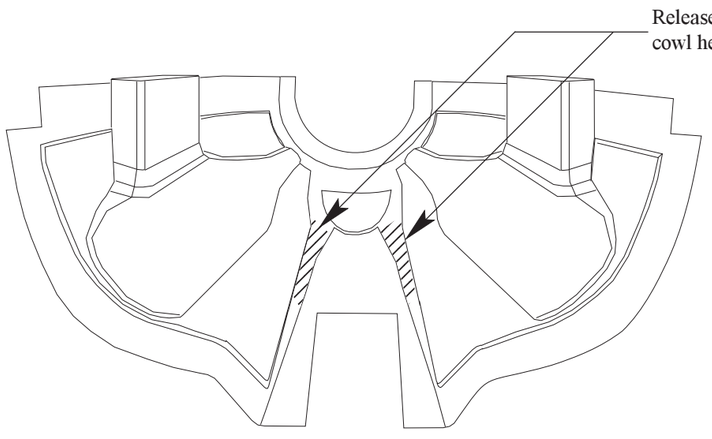
Bonding Oil Cooler Shroud to Cowling
Fig I:7

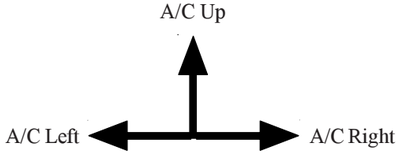
Once the oil cooler shroud and oil cooler have been fitted, remove the cooler leaving the shroud in place.

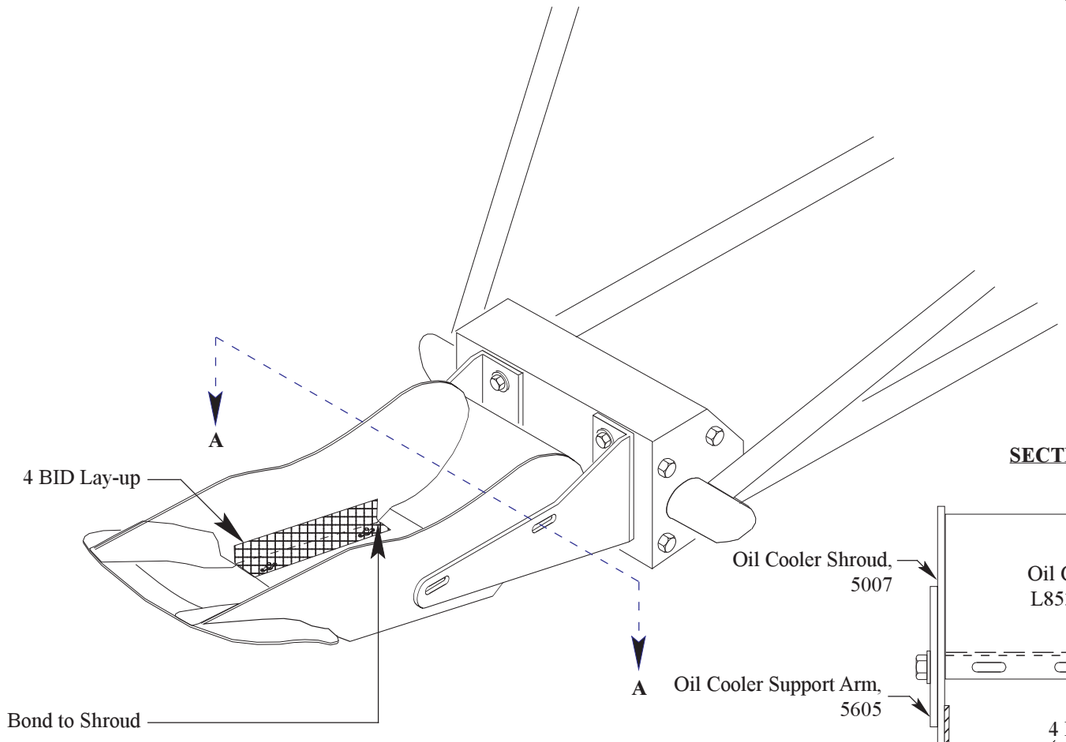
Release tape the cowl, and do a 4 BID lay-up from the inside bottom of the shroud to the cowling, forming a flange that will be nutplated, and will seal the sides and back of shroud to the cowling.

There will be 2 screws of the very front of the shroud and 2 on each side, to the cowl. These attachments will also serve as forward cowl support.

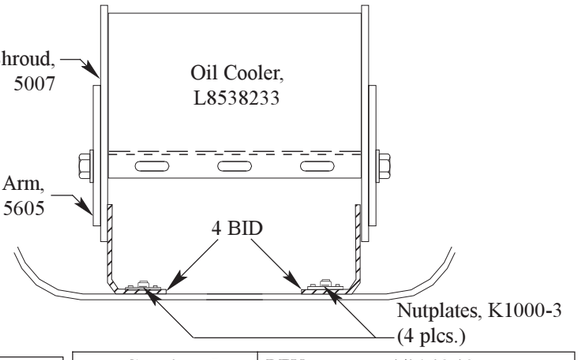








SECTION AA



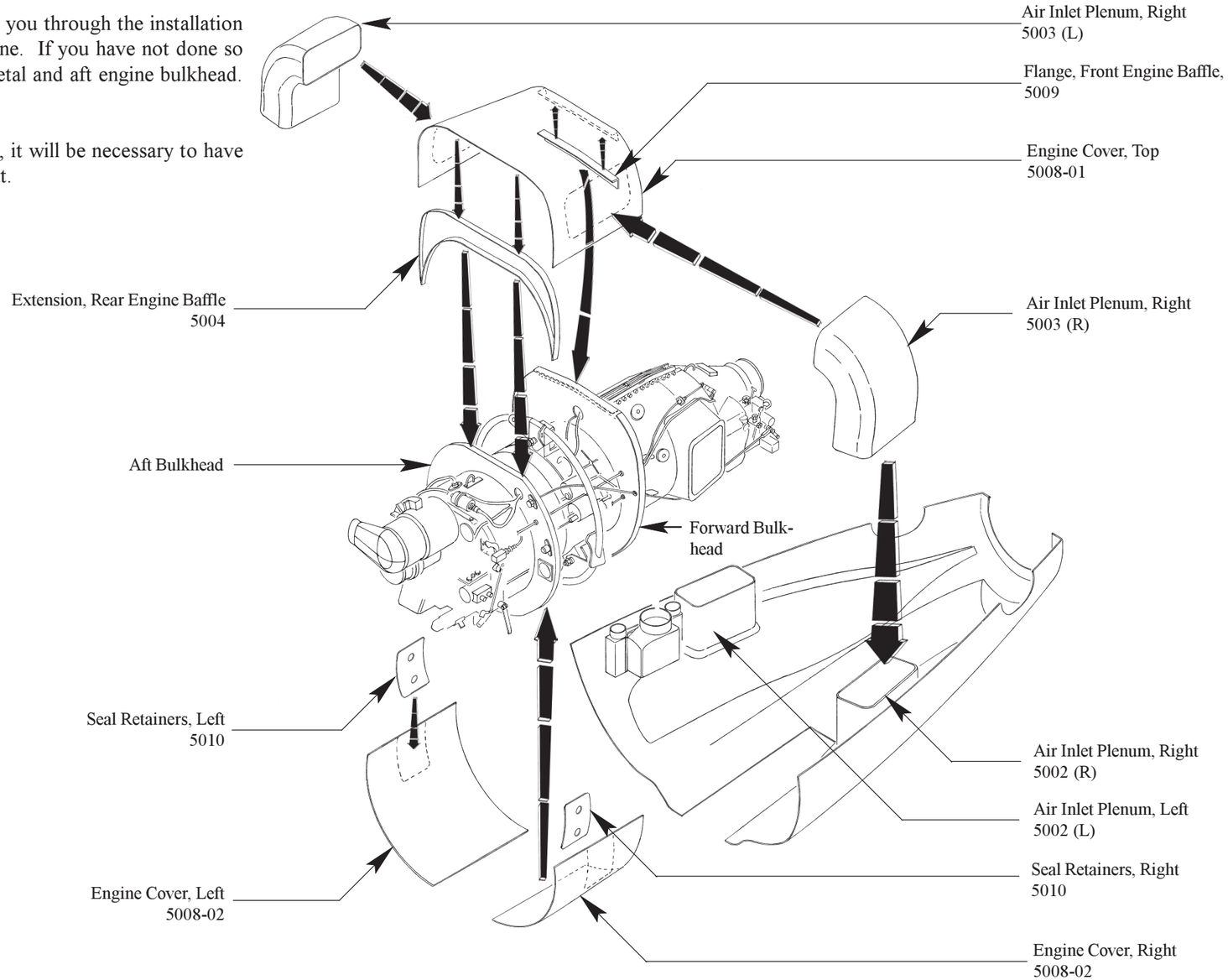
J. AIR INTAKE PLENUMS

J 1. Air Intake System Installation:

The following instructions will assist you through the installation of the baffling system for your Walter Turbine. If you have not done so already, mark, trim, and drill the forward metal and aft engine bulkhead. See Figures J:2 and J:3.

For the installation of the baffling kit, it will be necessary to have the engine suspended off of the engine mount.

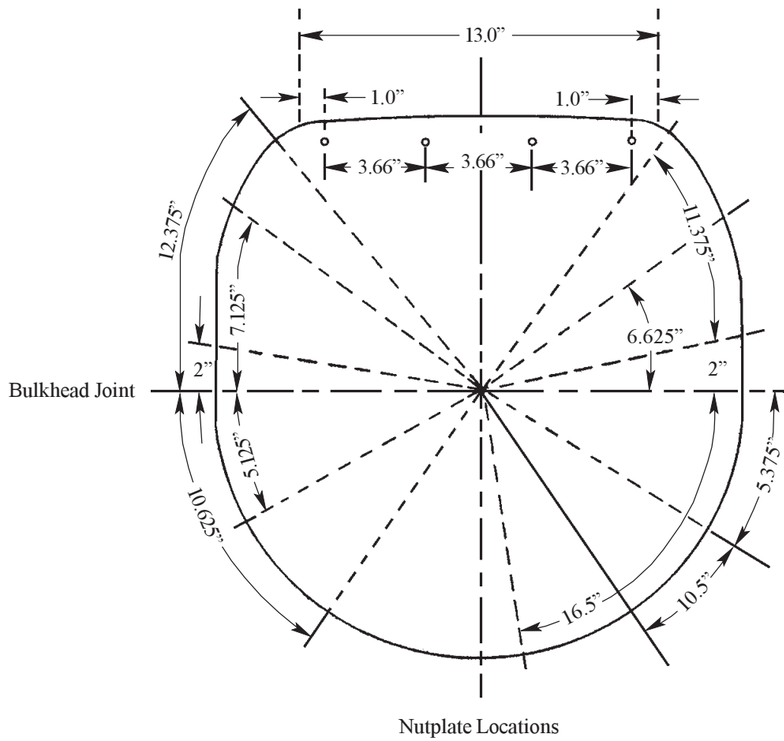
Exploded Baffling Kit for Turbine
Fig. J:1



Locating and Drilling the Forward Metal and Aft Engine Bulkhead
Fig. J:2

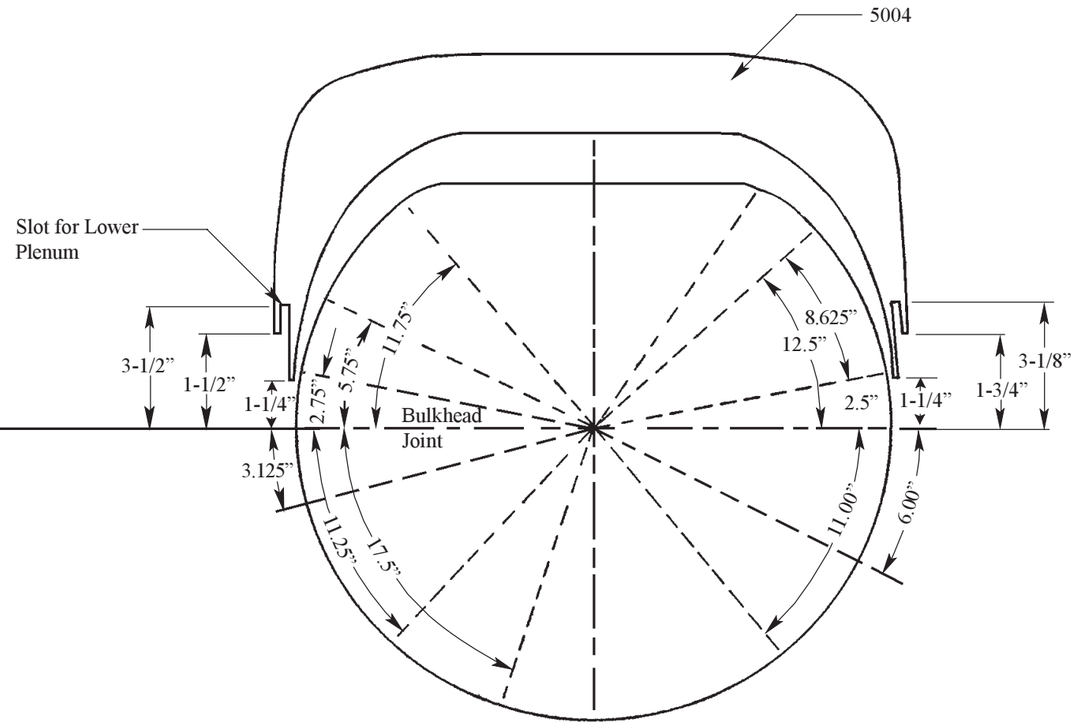
Intake Plenum Measurement is on Bulkhead Surface.

Front Bulkhead View
Prop / Aft



Nutplate Locations

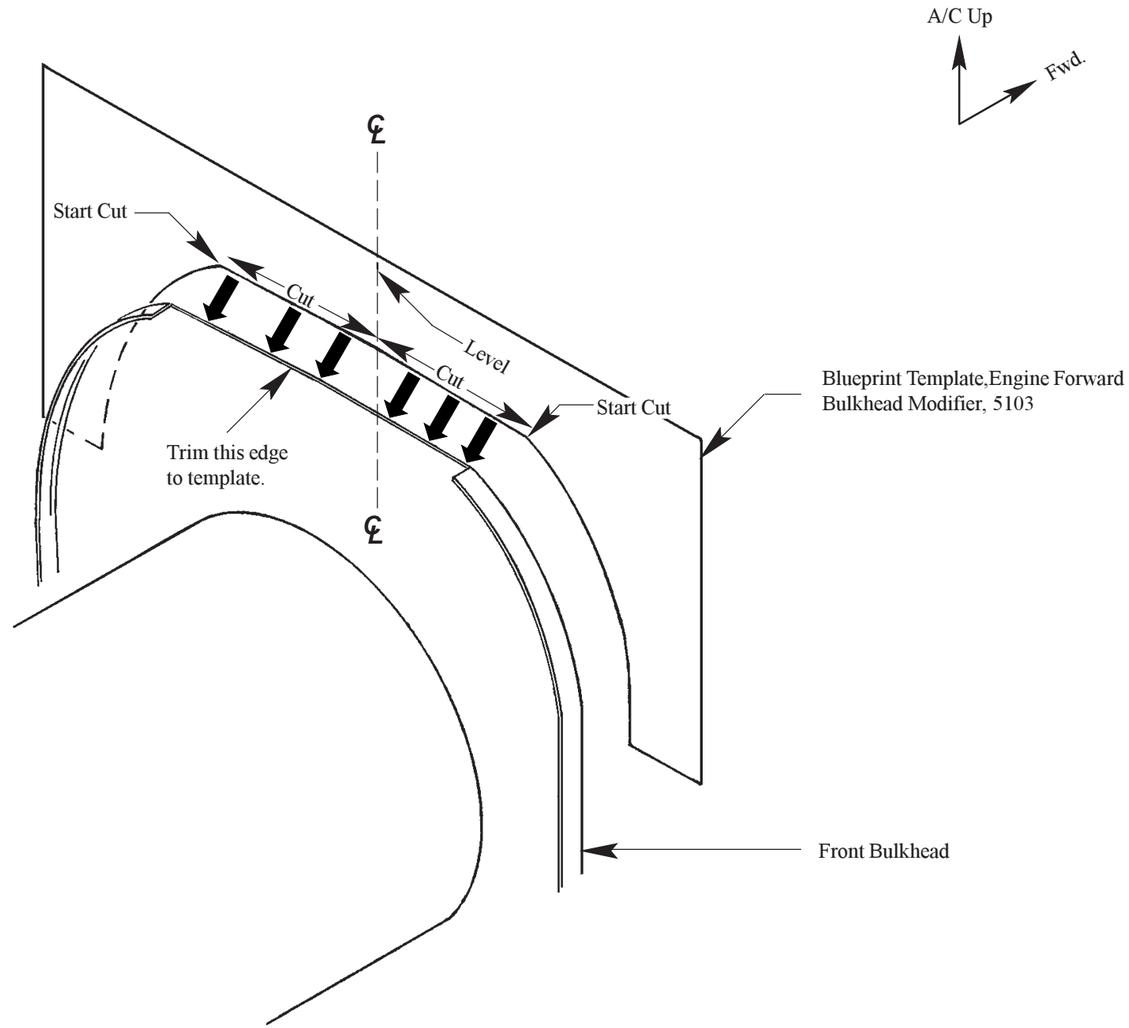
Rear Bulkhead View
Prop / Aft



Nutplate Locations

Trimming The Forward Bulkhead
Fig. J:3

Using blueprint 5103, trim the front bulkhead. This will ensure a proper fit for the top engine cover P/N 5008-01.

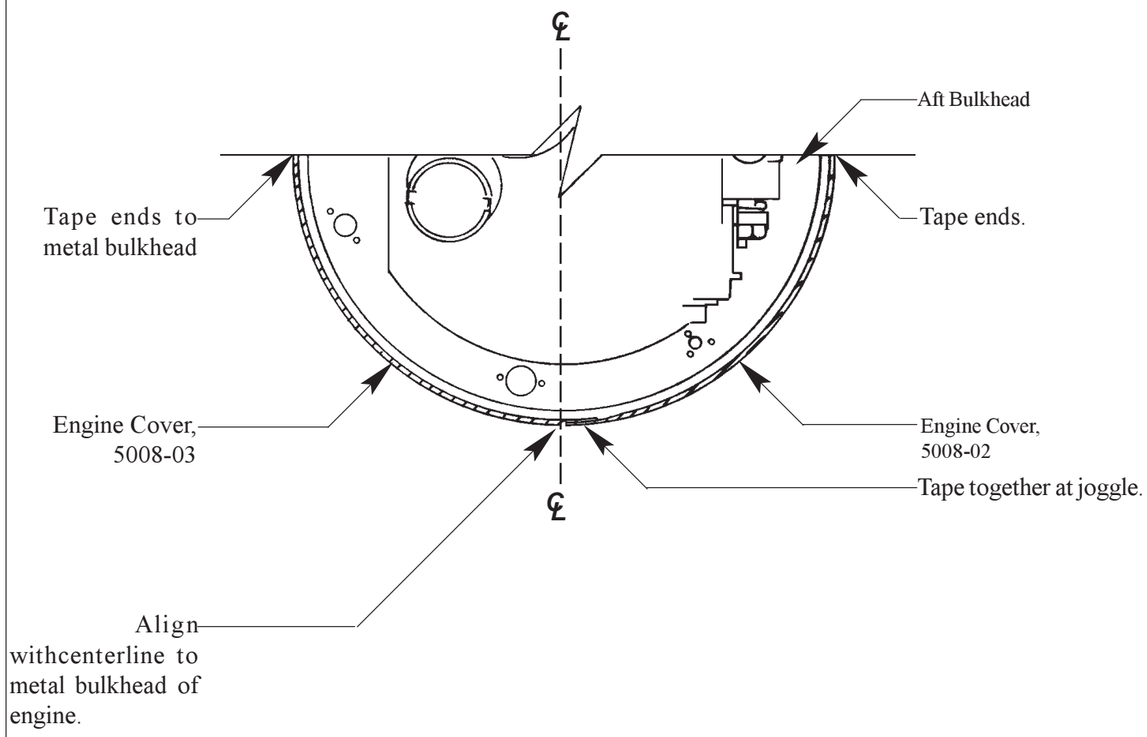


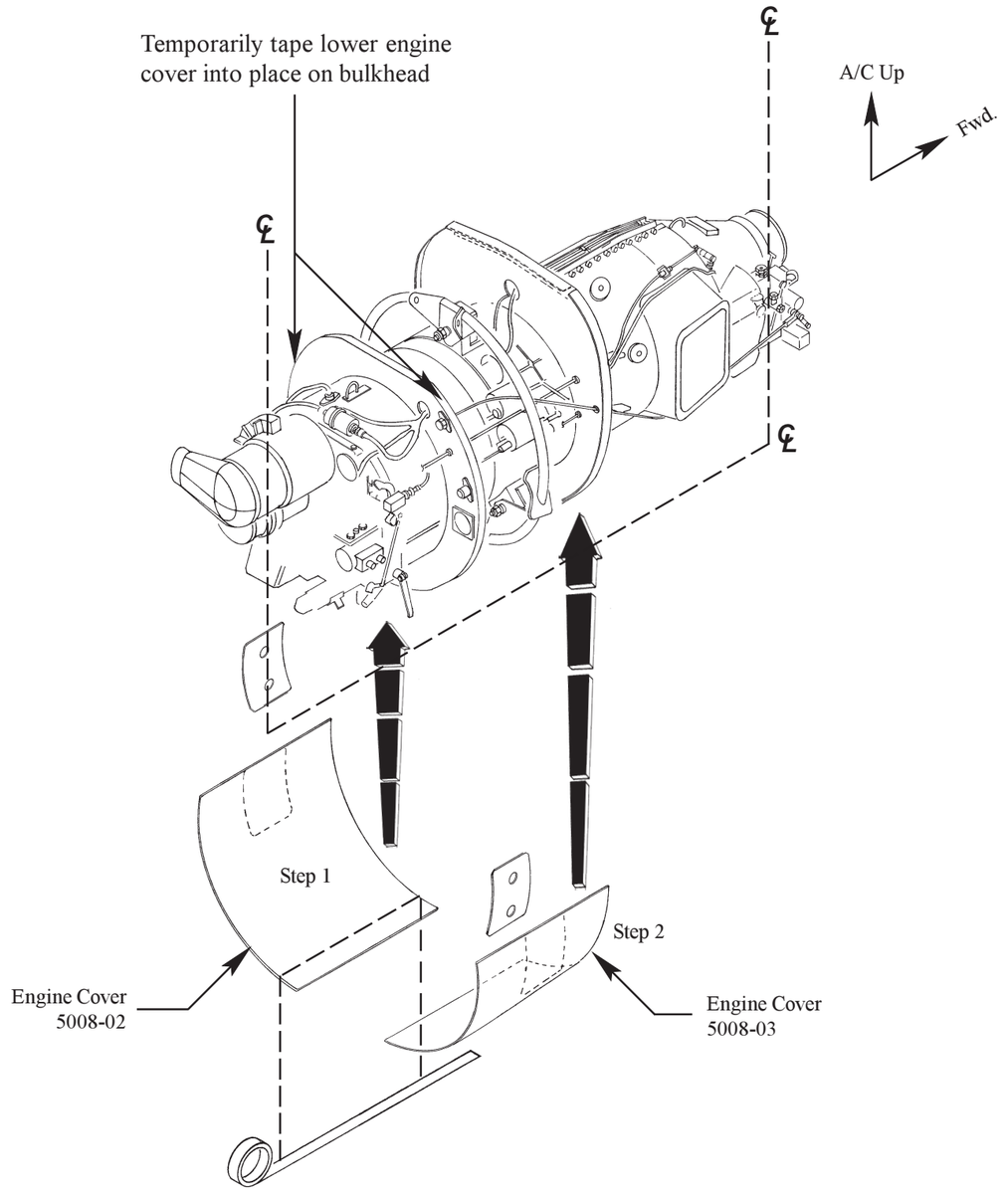
Fitting Lower Engine Covers

Fig. J:4

Each individual piece of the Turbine Baffling Kit will include scribe lines. When trimming to these lines, it is important to leave 1/8" to 1/4" of excess material. Once the covers are fit to the engine, they may be cut back to these lines if needed.

To start the installation, the left and right lower engine covers will be fitted. The side with the joggle (P/N 5008-02, Left) should be placed into the lower aft and forward bulkheads and (P/N 5008-03, Right) should follow. Tape the two pieces together at the joggle with masking tape. The joggle should be on center with the centerline of the engine. The ends that extend upward should be taped to the metal bulkheads.





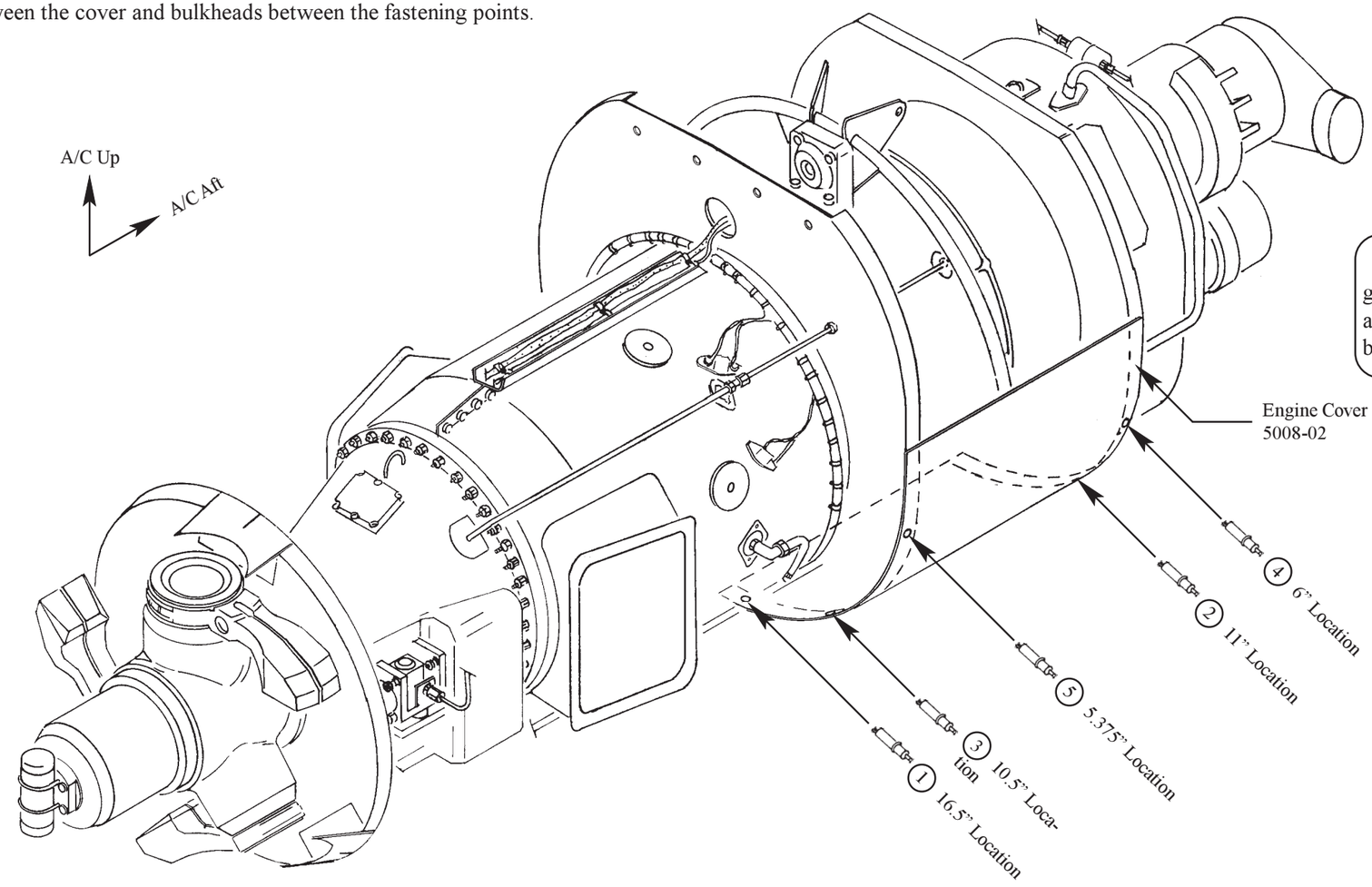
Drilling Lower Engine Covers (Left Side)

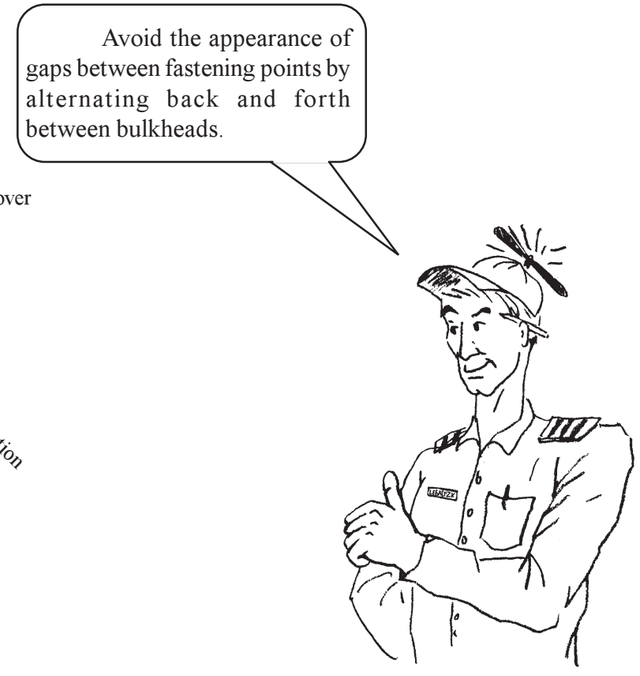
Fig. J:5

To start, the lower left engine cover, (5008-02) should be marked and clecoed into place first. To do this measure and mark the forward bottom most pre-drilled hole in the bulkhead flange onto the cover. Using a 1/8" inch drill bit, drill the first hole and insert a cleco through the cover and into the bulkhead. Repeat this for the other bottom most hole on the opposite bulkhead. See Fig. J:2 for exact drilling locations.

Work your way up the skin alternating back and forth between the forward and aft bulkheads so as not to distort the skin. The idea is to keep the skin as tight as possible to the bulkheads. Try to avoid the appearance of gaps between the cover and bulkheads between the fastening points.

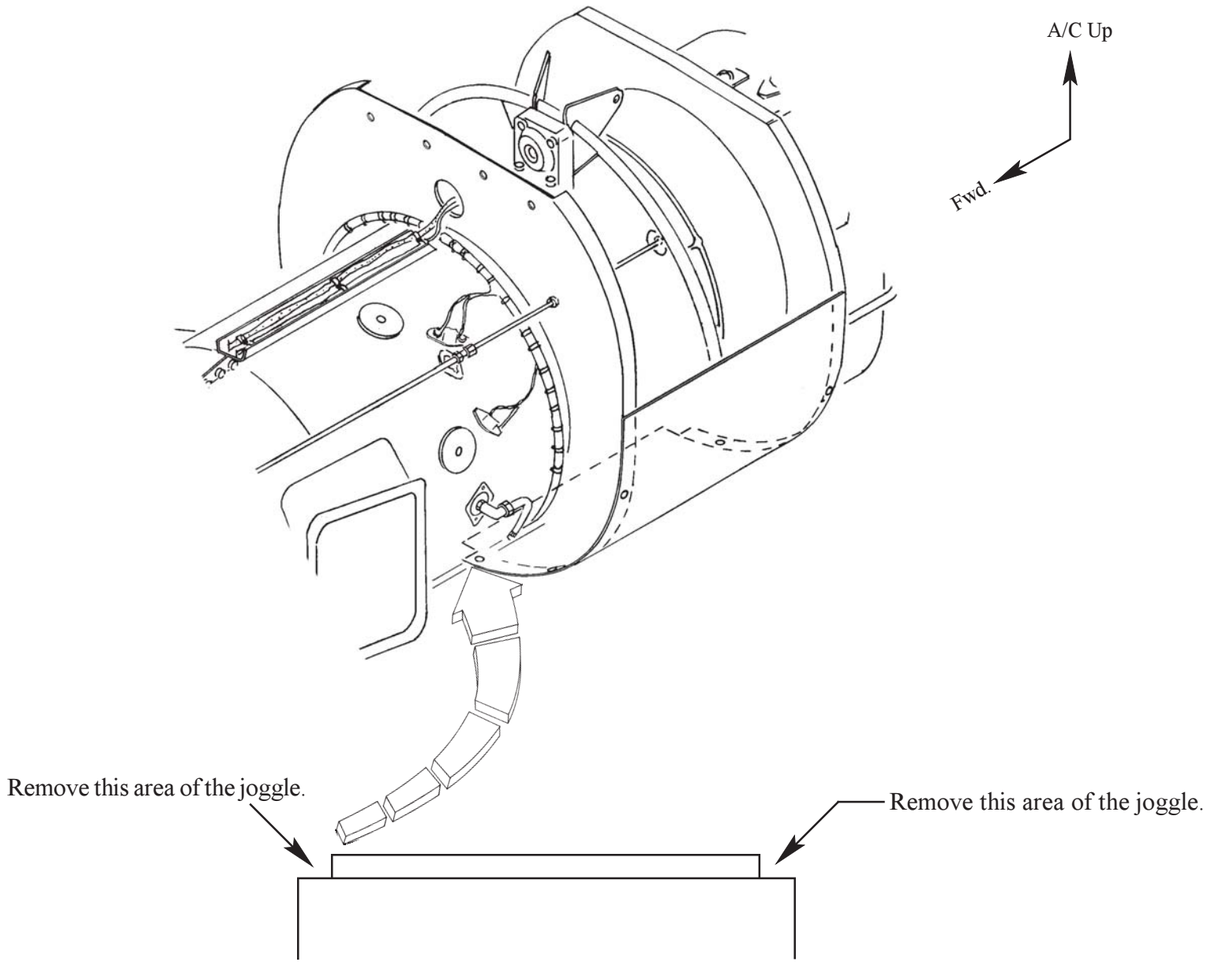
NOTE: Using a bright penlight or flashlight on the inside of the engine covers will help in locating the exact locations of where to drill from the outside. The light will shine through the cover easily enough to make a reference mark on the outside of the cover.



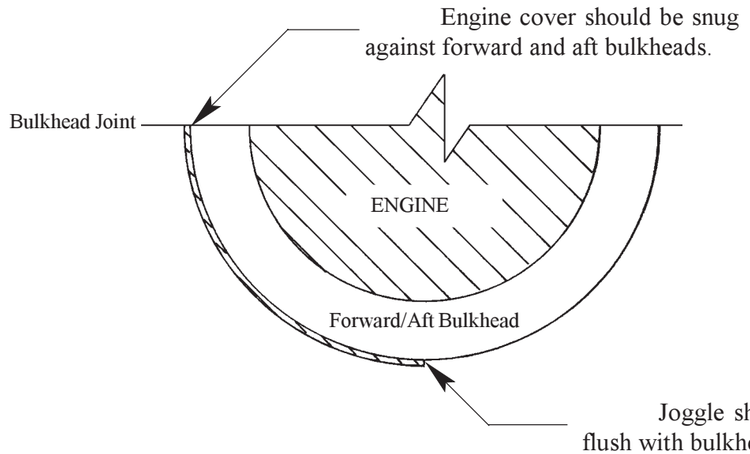


Trimming The Joggle Of Lower Left Engine Cover
Fig. J:6

Once the left lower engine cover is secured with clecos, you will need to scribe the areas where the joggle rest on the forward and aft bulkheads. These marked sections of the joggle will be removed in order to allow the engine cover to sit flush with the forward and aft bulkheads. Smooth out any remaining bevel that is left on the joggle with a sanding block and make sure that the outer surface edge of the joggle is clean and flat.

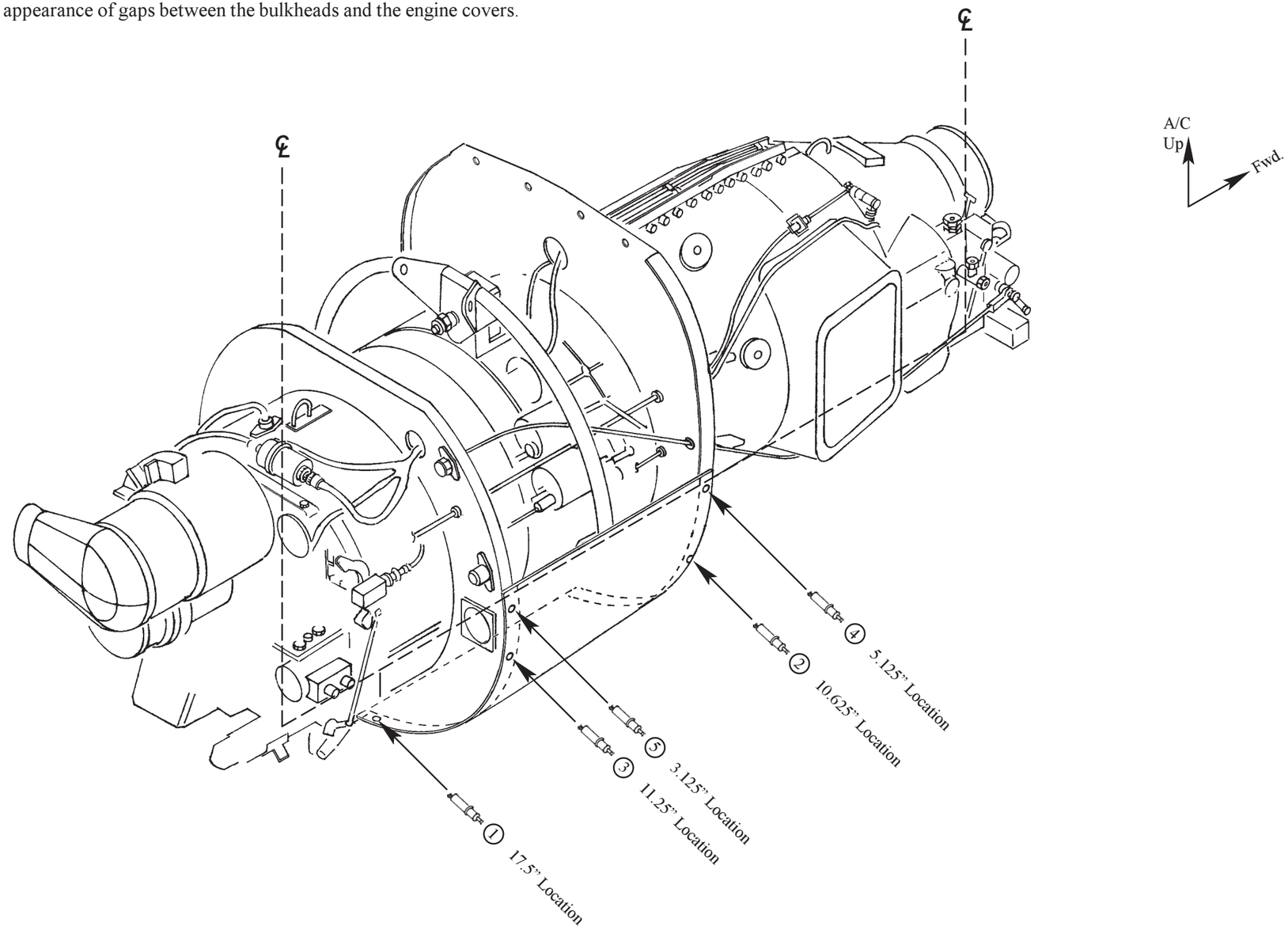


Looking Forward



Drilling Lower Engine Covers (Right Side)
Fig. J:7

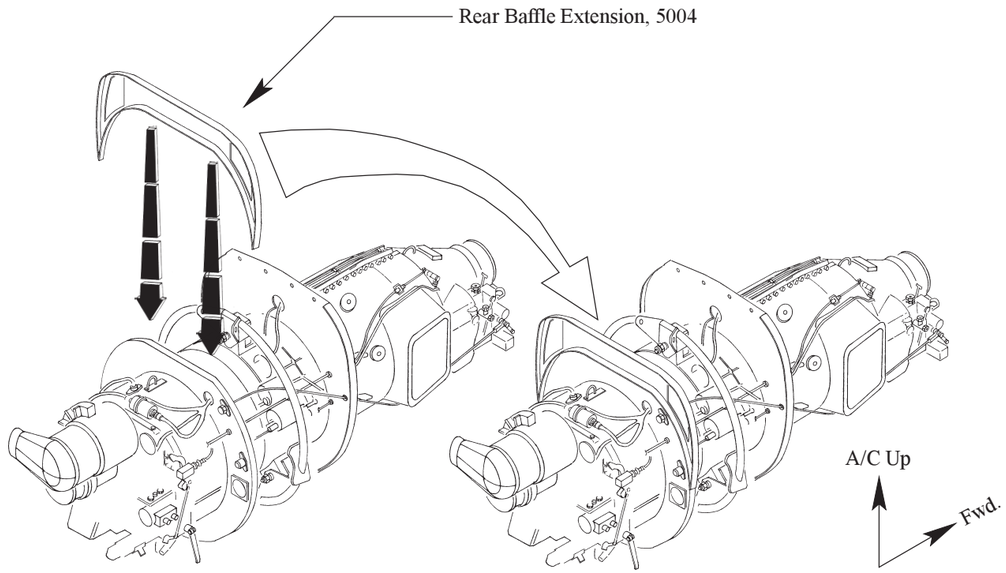
For the lower right side cover, use the same procedure used on the left side. Remember to alternate back and forth between bulkheads, to eliminate the appearance of gaps between the bulkheads and the engine covers. Refer to Fig. J:2 if necessary.



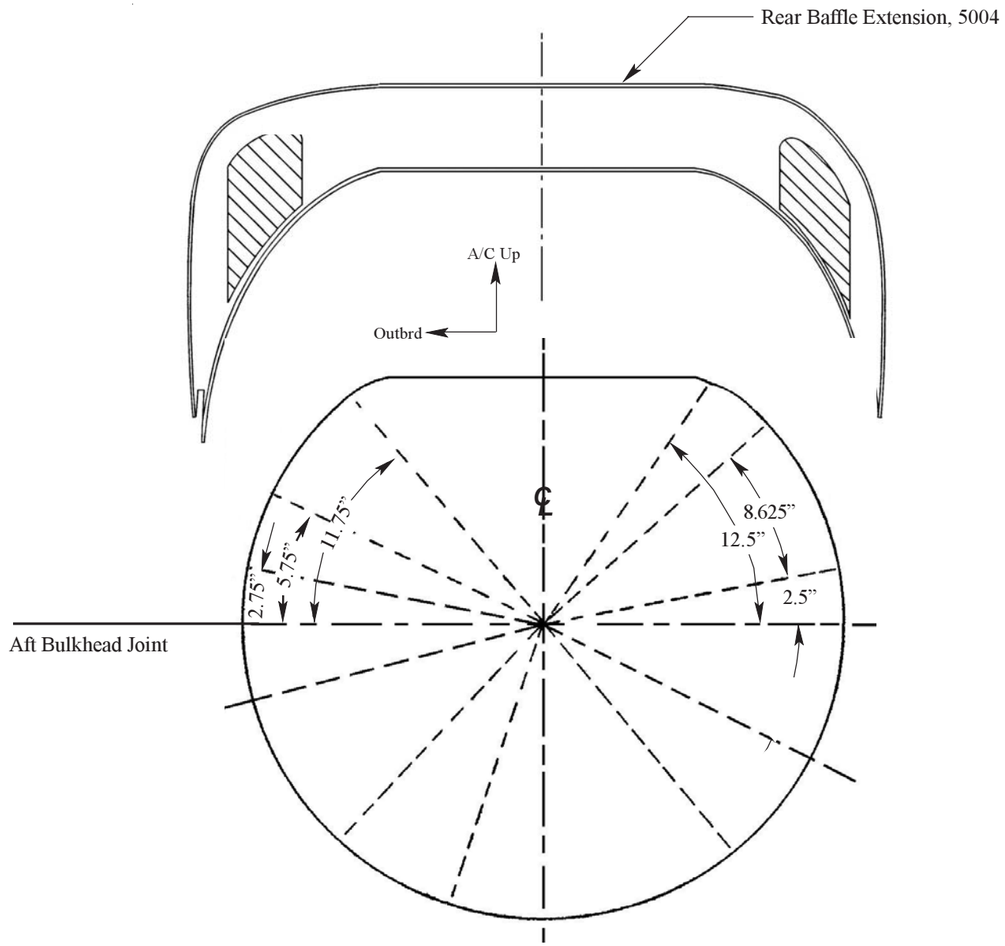
Installation of the Aft Engine Baffle Extension
Fig. J:8

To start, be sure that the smooth flat side of the Aft Engine Baffle Extension (5004) faces towards the front of the engine. (see drawing below, left)

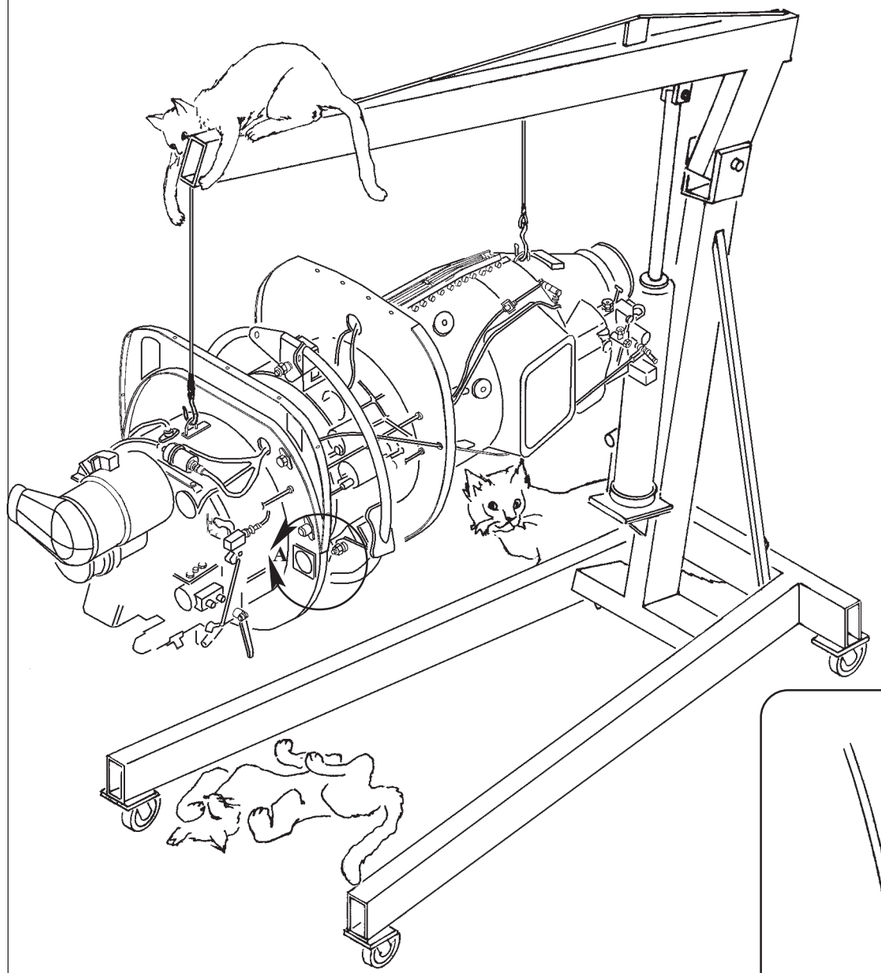
After the placement of the Aft Engine Baffle Extension (5004) is correct, begin drilling and fastening with clecos at the lower two corners of the flange. It may be necessary to use a ruler to locate the correct positions of these holes. Please see Fig. J:2 for the exact locations of these holes. Refer to this drawing for the drilling locations on the top flange of the Aft Engine Baffle Extension. These holes will be used for the installation of the Top Engine Cover P/N 5008-01.



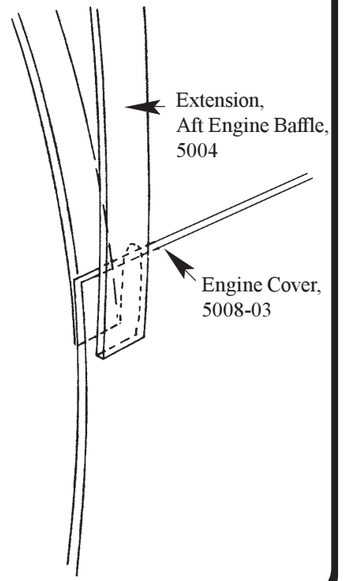
Drilling Locations For Aft Engine Baffle Extension
Rear Bulkhead View
Prop / Aft



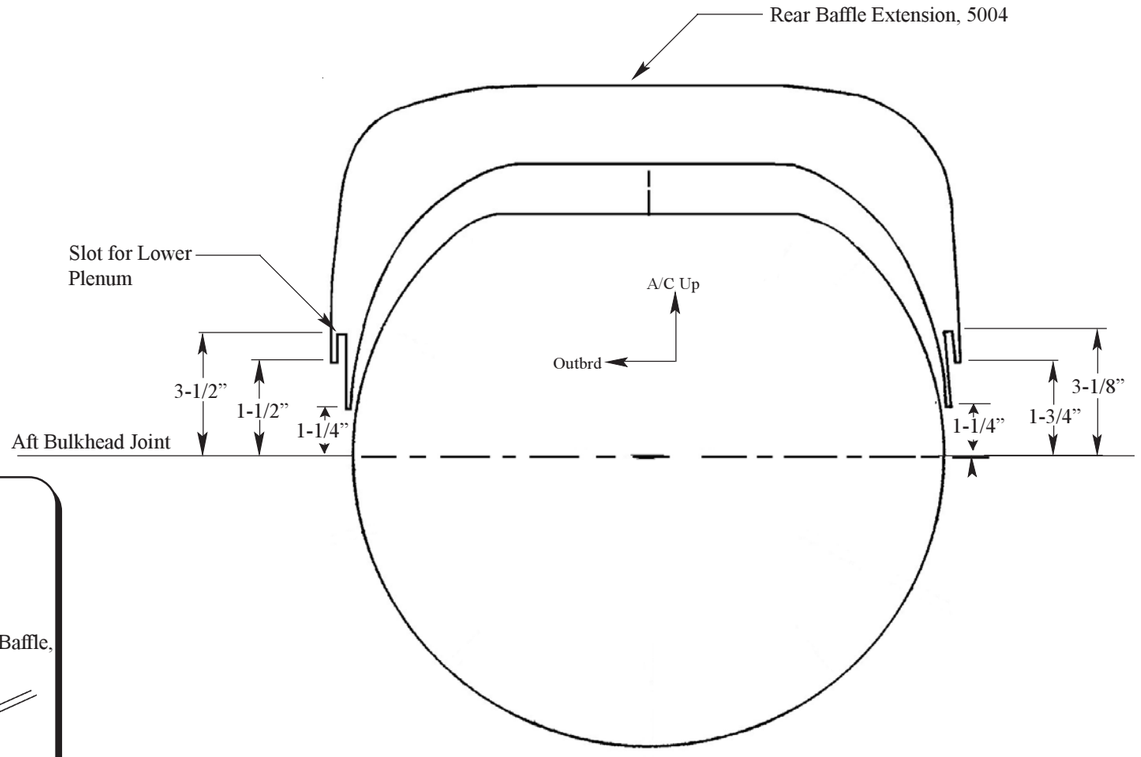
Creating a Notch in the Aft Engine Baffle Extension
Fig. J:9



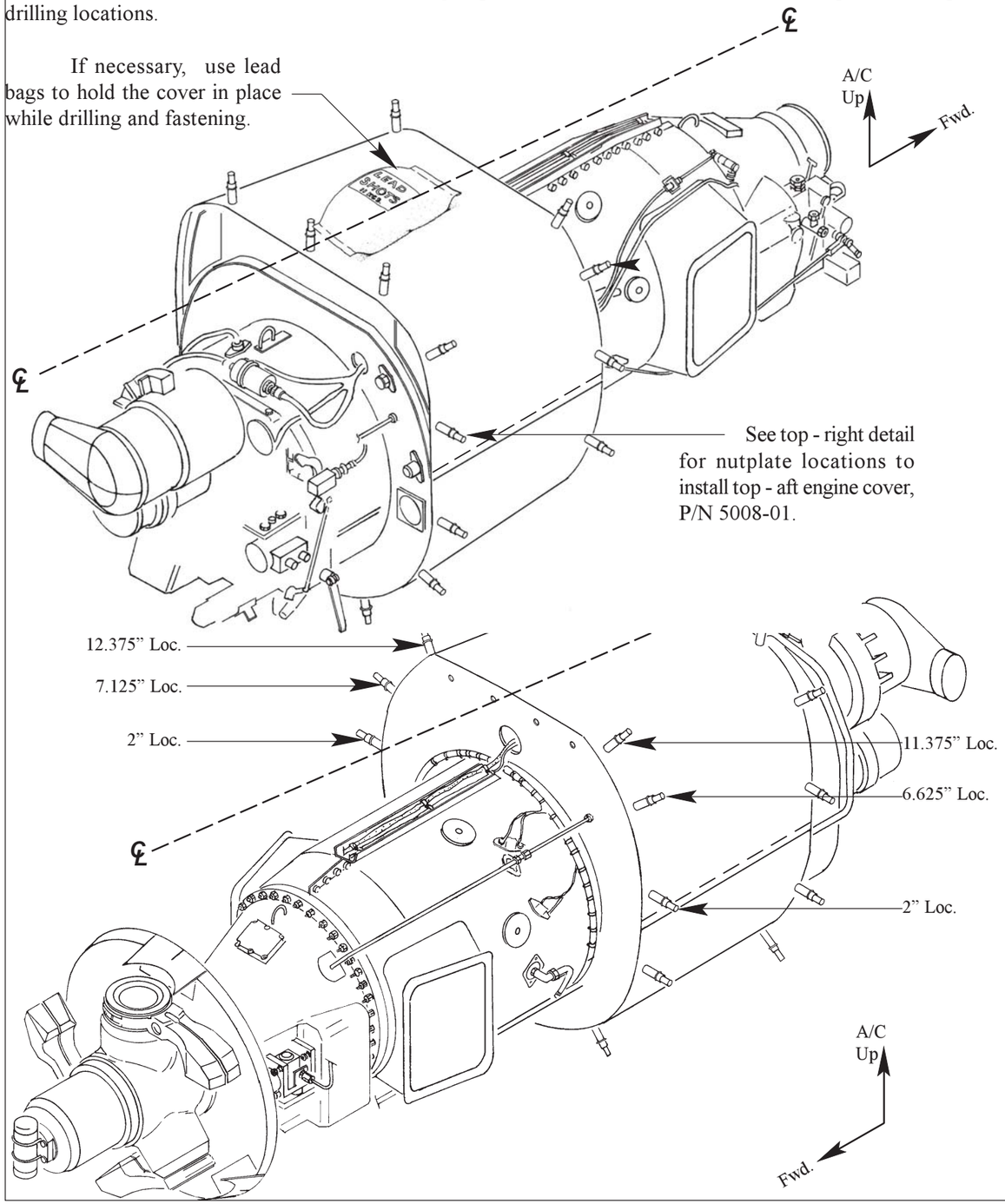
DETAIL A



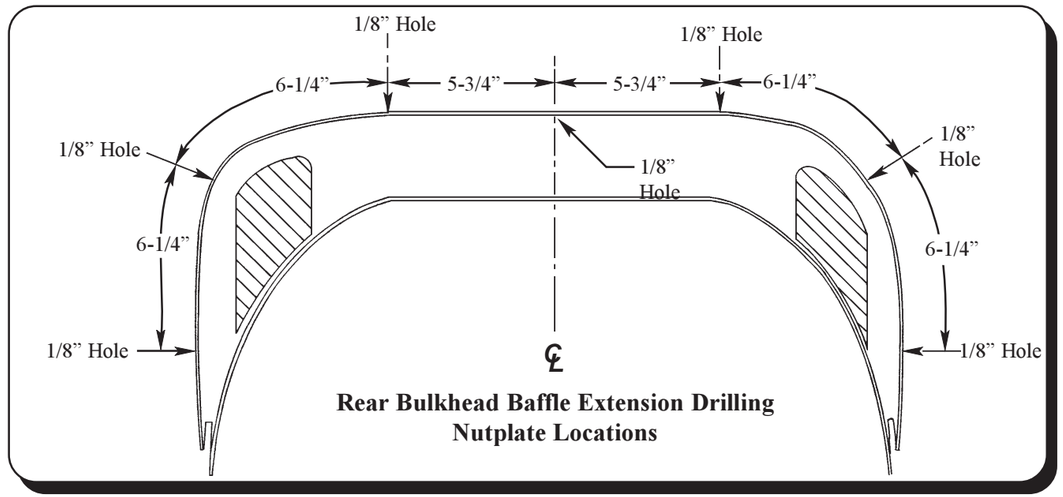
Rear Bulkhead View
Prop / Aft

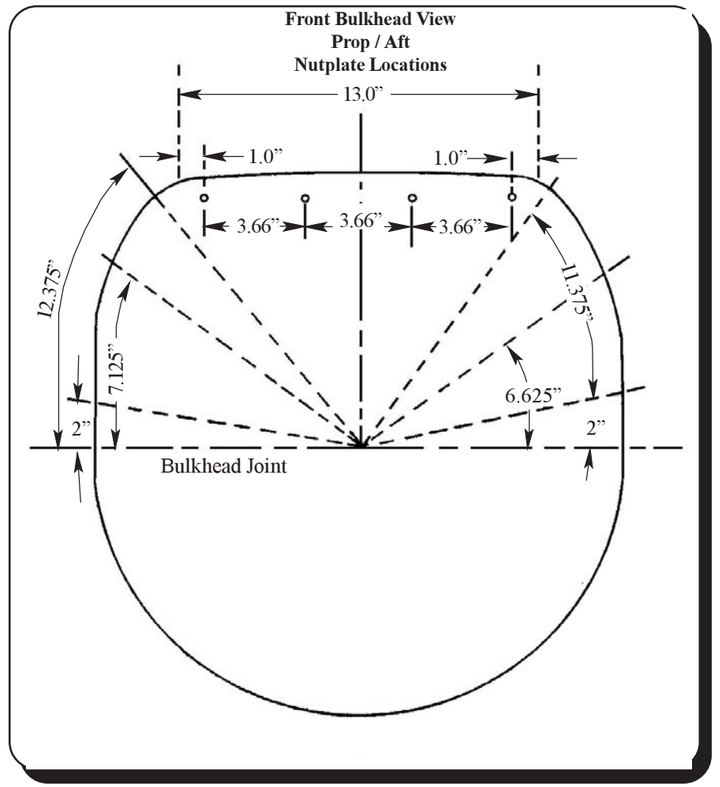


If you have not yet drilled the 1/8” holes on the flange of P/N 5004, you should do so now. These holes will be needed at the indicated locations to install the top engine cover P/N 5008-01. Please see the figure to the right for drilling locations.



Drilling Upper Engine Cover
Fig. J:10

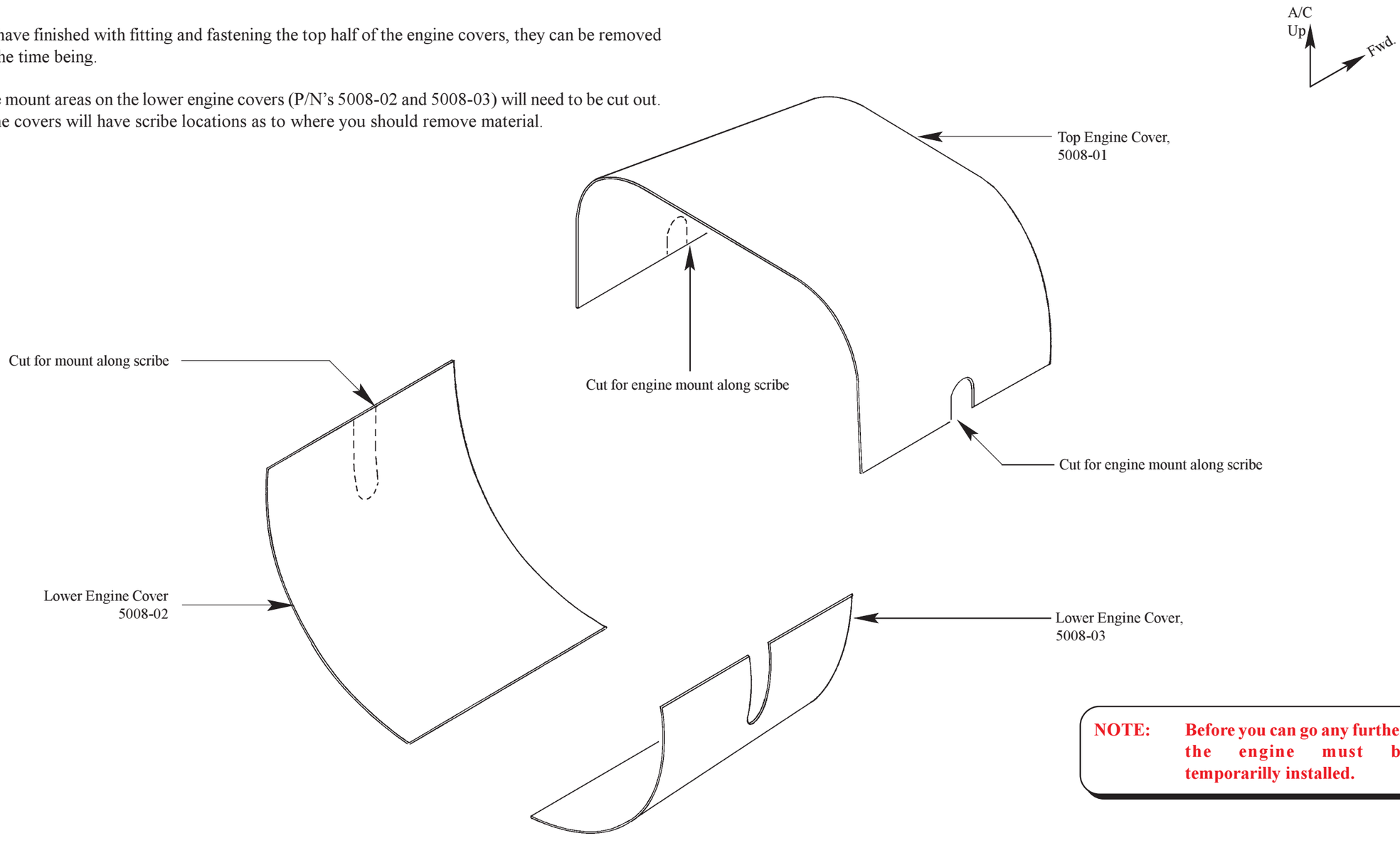




Cutting Lower Engine Covers Along Scribe
Fig. J:11

Once you have finished with fitting and fastening the top half of the engine covers, they can be removed and set aside for the time being.

The engine mount areas on the lower engine covers (P/N's 5008-02 and 5008-03) will need to be cut out. These lower engine covers will have scribe locations as to where you should remove material.

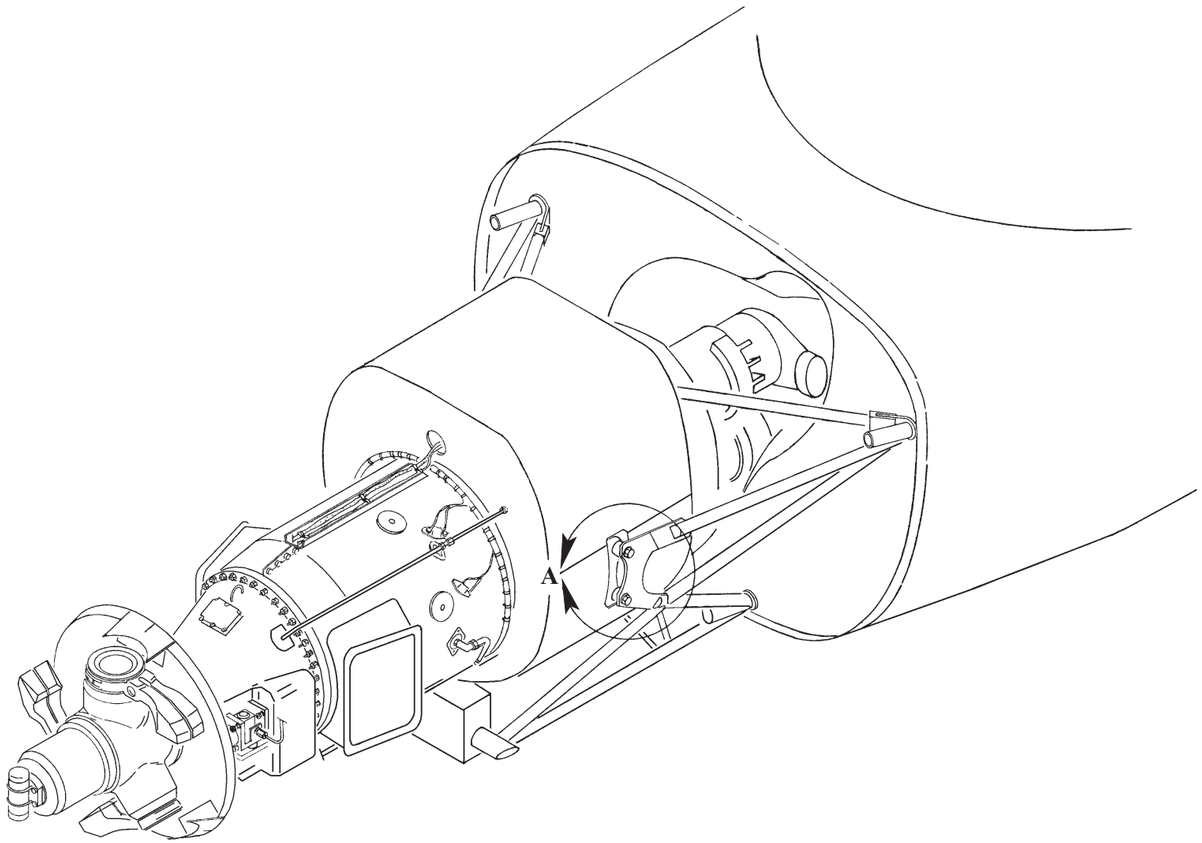


NOTE: Before you can go any further, the engine must be temporarily installed.

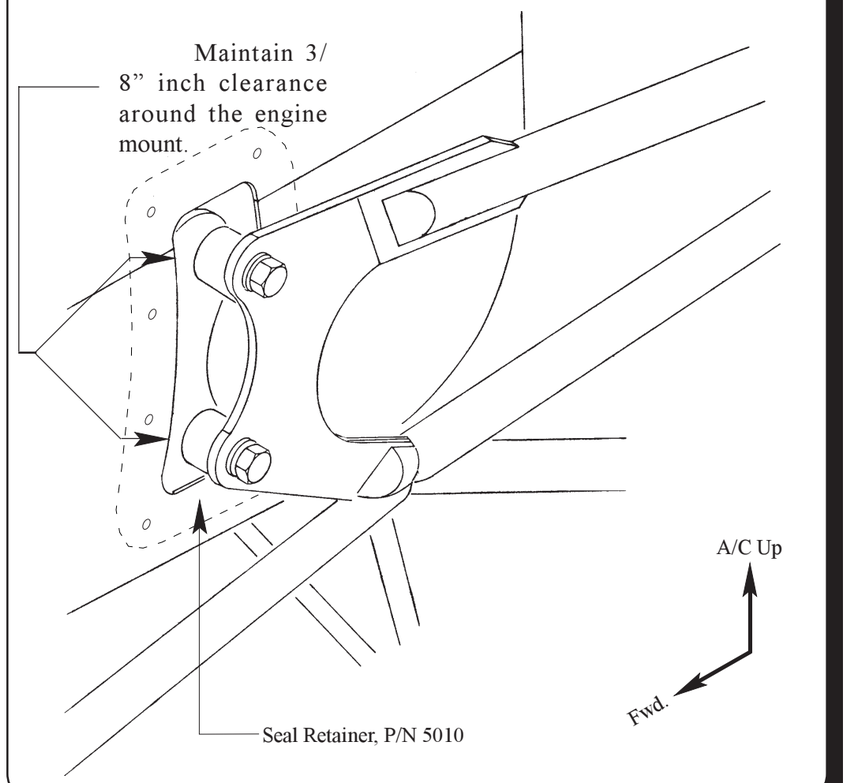
Fitting Upper and Lower Engine Covers to Engine Mount
Fig. J:12

With the engine installed, replace the lower engine cowlings onto the engine and check for proper clearance around the mounts. Try to maintain a 3/8" inch clearance around the mount. Remove part of the blue ring. Install hardware where cleco's are. Locate and install seal retainers p/n 5010.

- Remove part of Blue Ring.
- Install hardware where clecoes are.
- Locate and install seal retainers, 5010.



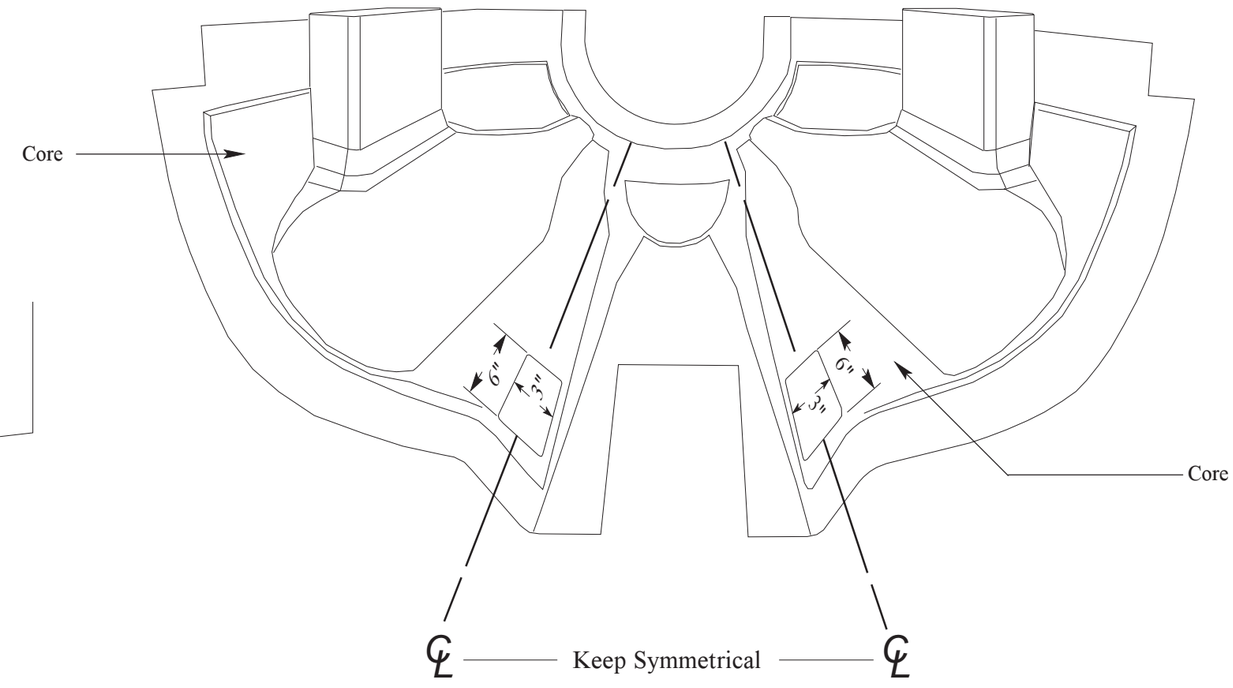
DETAIL A



Decoring Area Where Louvers are Bonded to Cowl
Fig. J:13

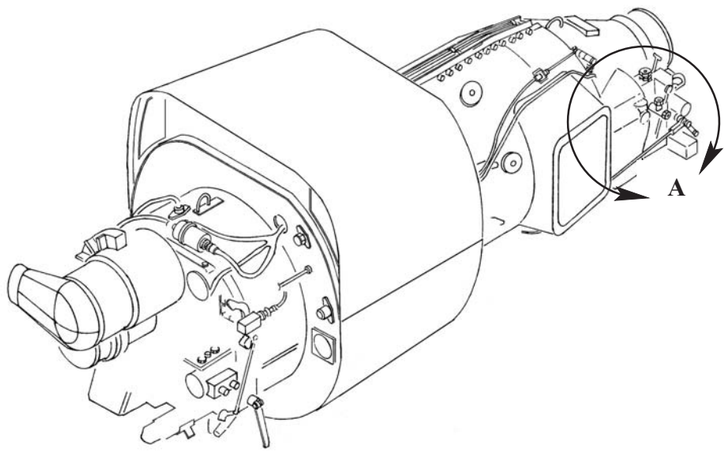
1. De-core the area where the louvers are to be bonded to the cowl and bevel the edges of this de-cored area.
2. Cleco into position and check clearance to the engine mount.
3. Fit the outlets and mark to cutout cowling (see fig. J:13).
4. Cut out 3” x 6” on cowling.

VIEW LOOKING FORWARD

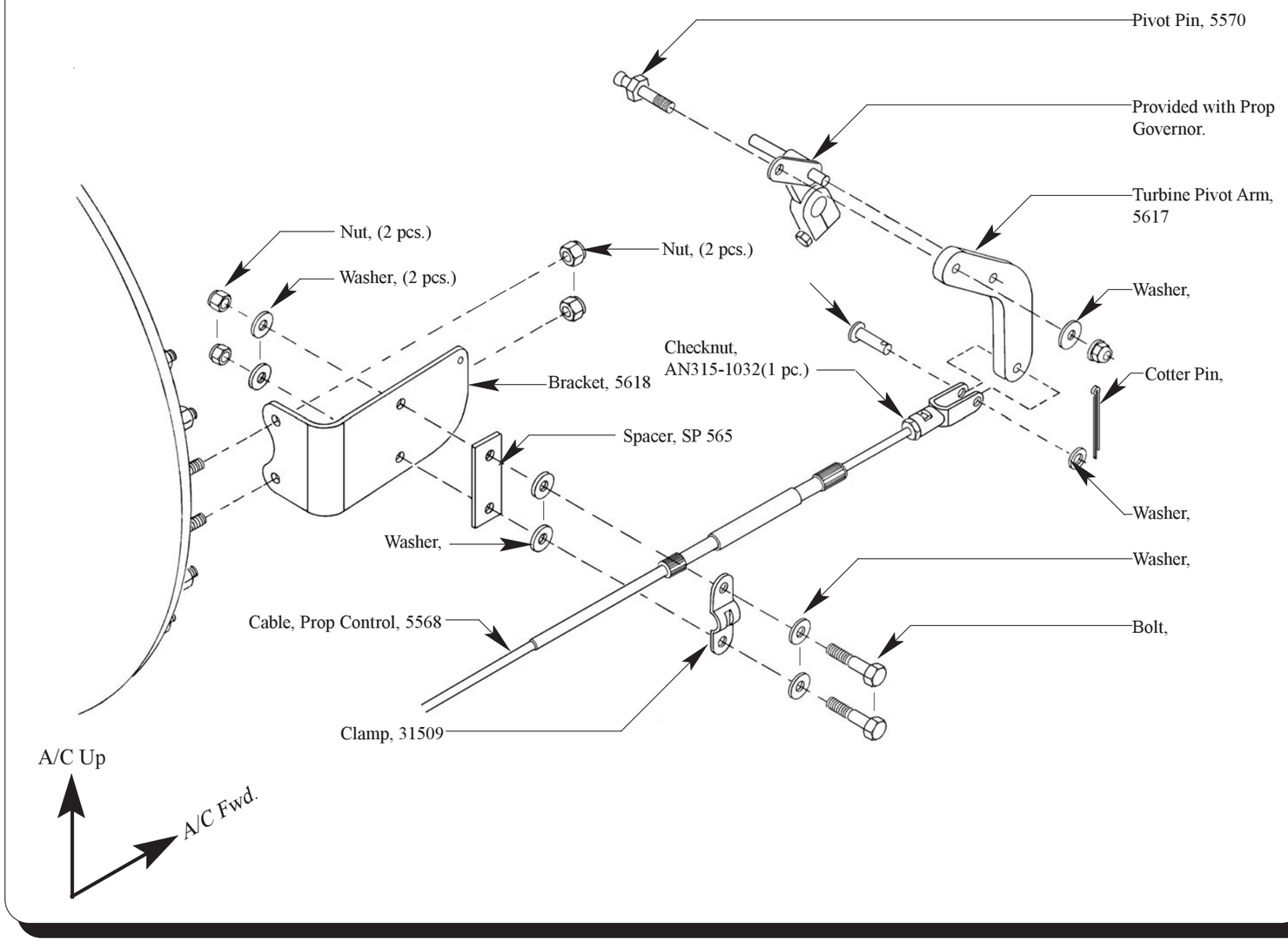


K. ENGINE CONTROLS - THROTTLE QUADRANT - INSTRUMENT PANELS

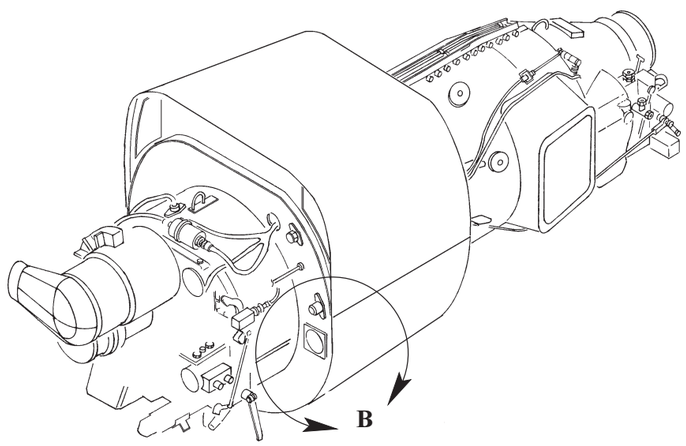
Engine Controls - Propeller Assembly Forward - Exploded View
Fig. K:1



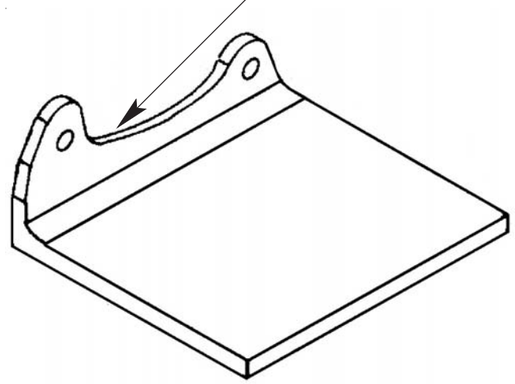
DETAIL A



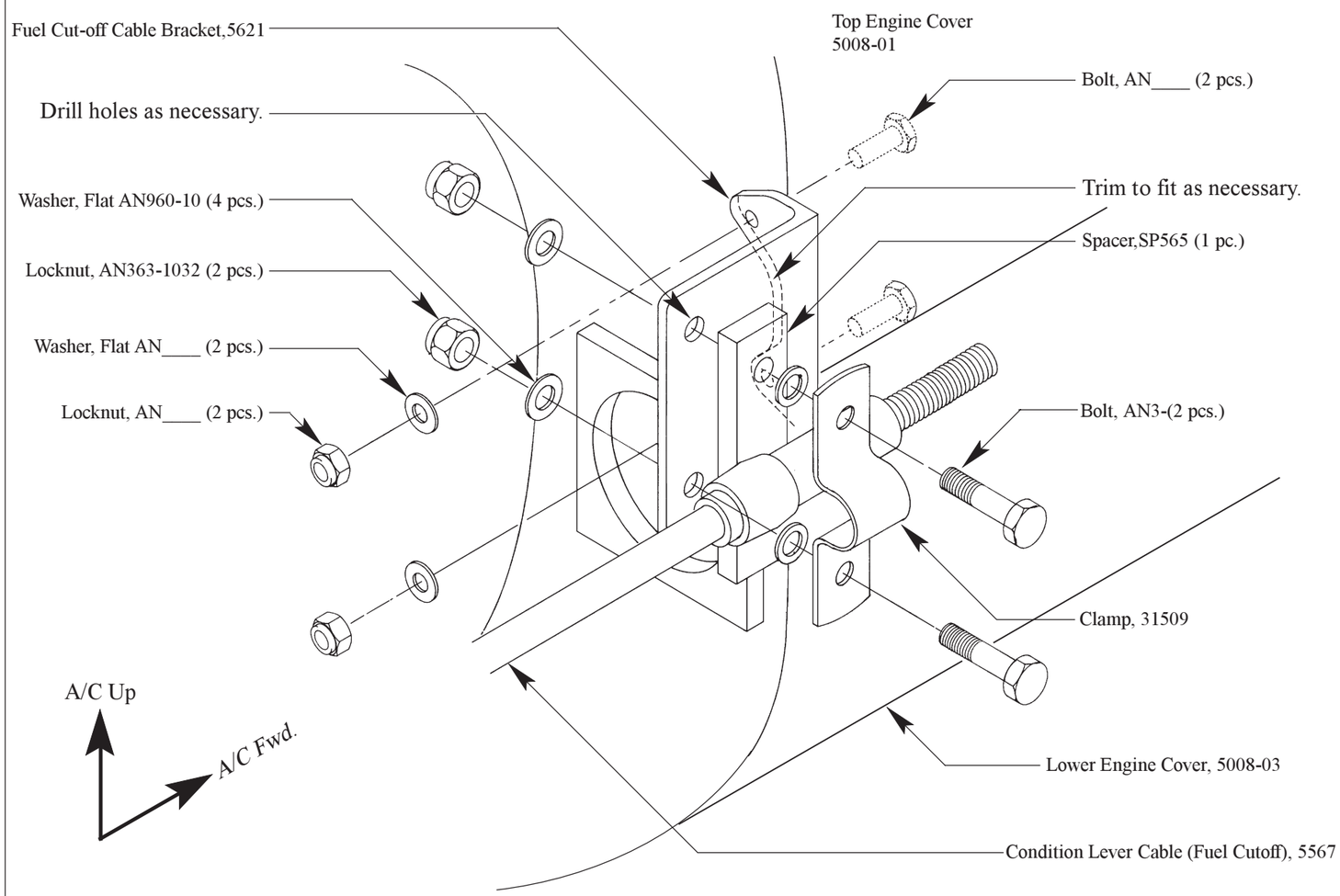
Engine Controls - Condition Lever Assembly Aft Bulkhead Exploded View
Fig. K:2



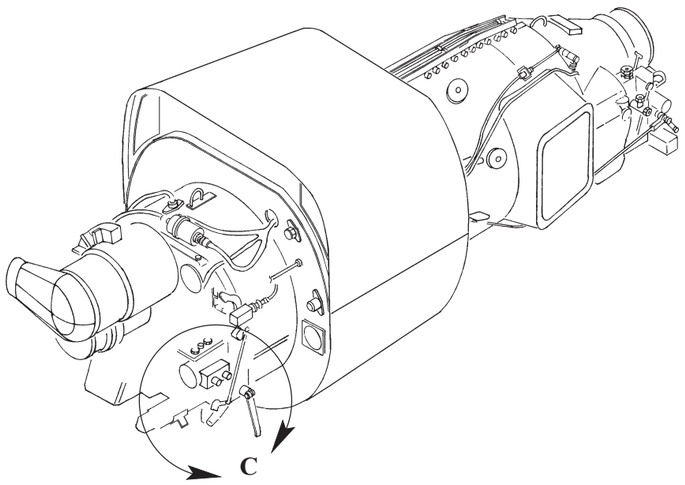
Trim this area to fit engine.



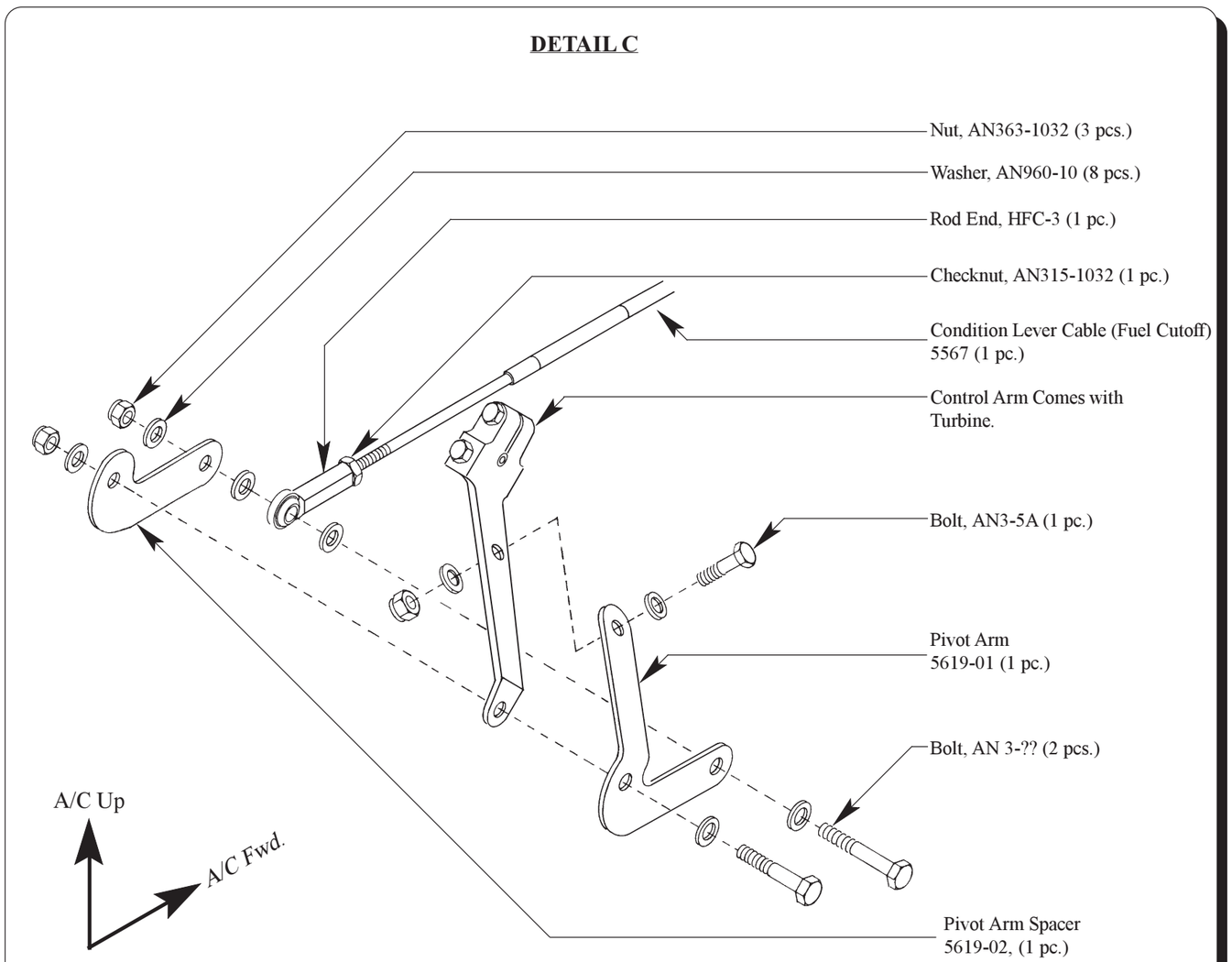
DETAIL B



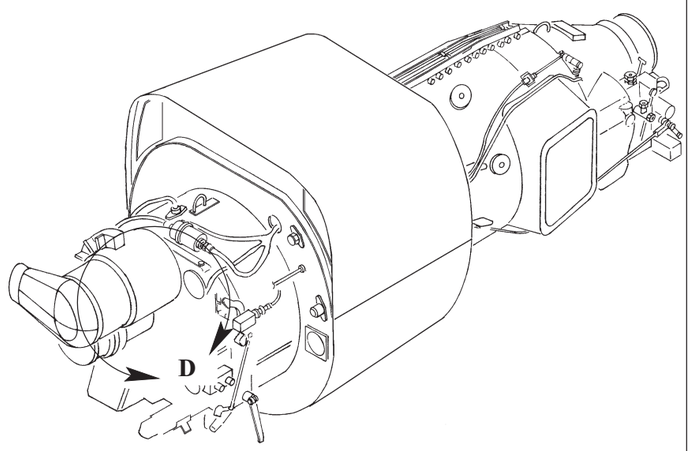
Engine Controls - Condition Lever Assembly Aft - Exploded View
Fig. K:3



DETAIL C



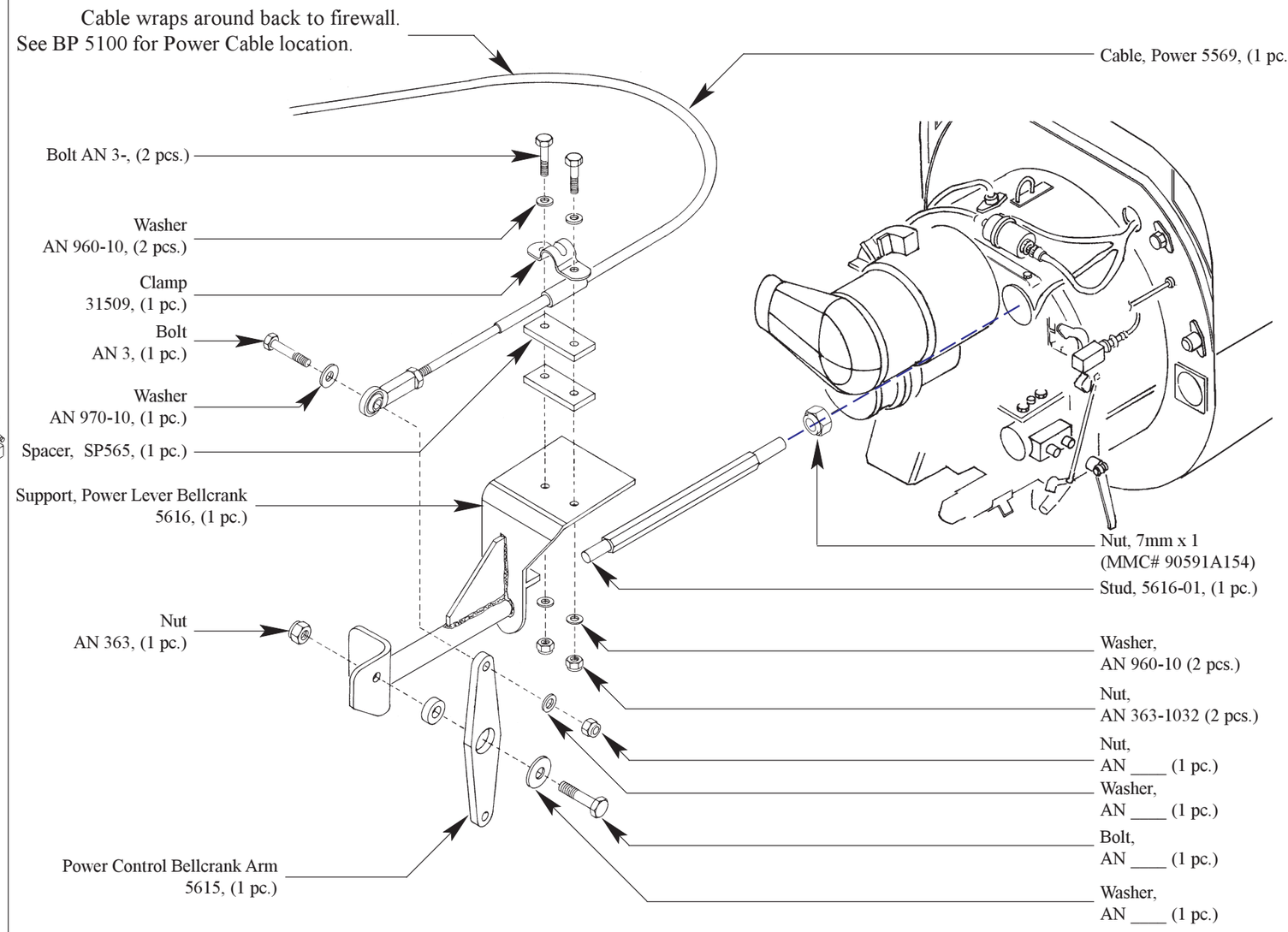
Engine Controls - Power Lever Assembly - Exploded View
Fig. K:4



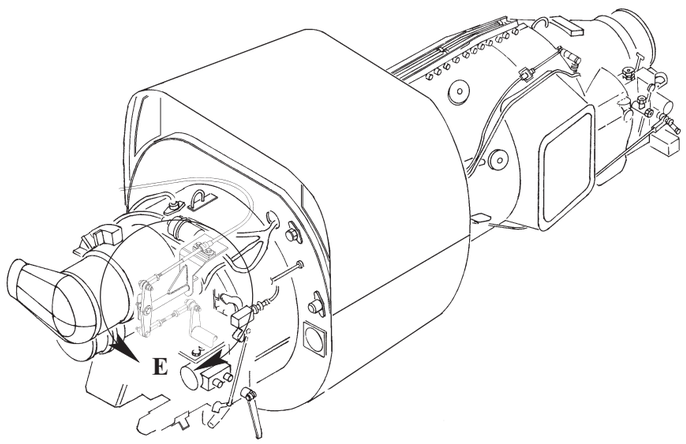
A/C Up

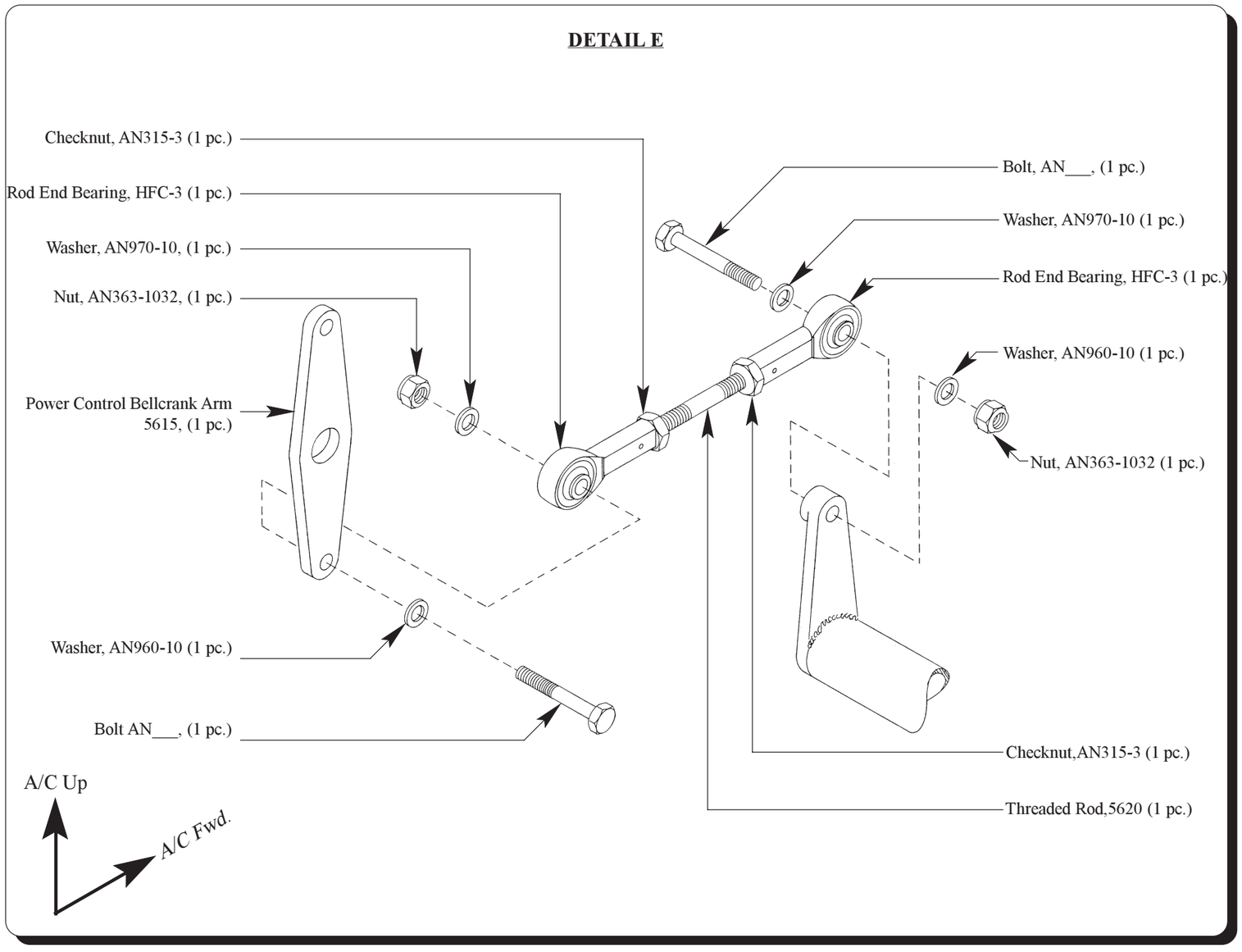
A/C Fwd.

DETAIL D



Engine Controls - Power Return Line - Exploded View
Fig. K:5





K. THROTTLE QUADRANT

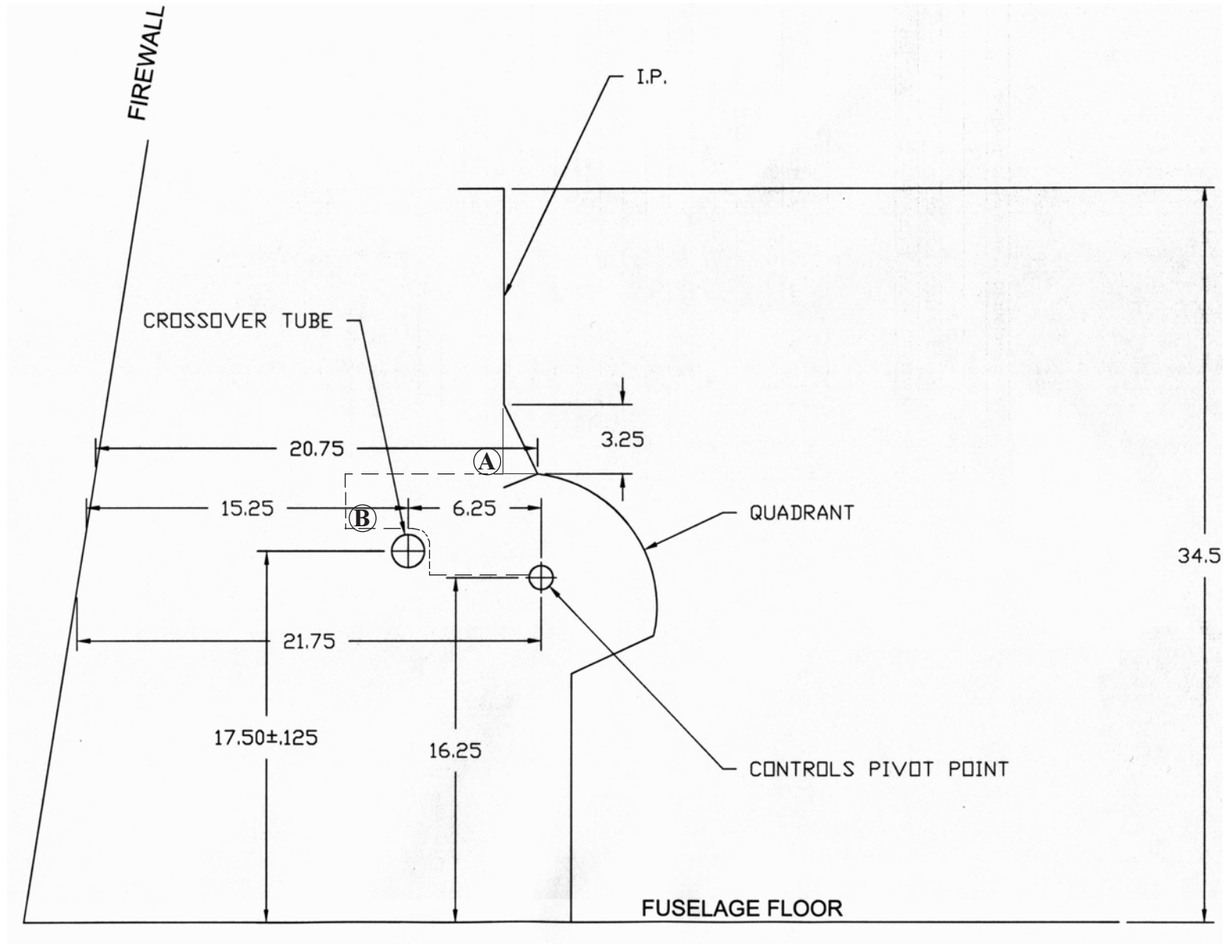
Throttle Quadrant Location
Fig. K:6

-Top of quadrant is fit into the instrument panel under the radio stack.

-Face of instrument panel is 14.5 inches from blister in firewall-measured at the firewall shelf.

-Crossbar Ⓐ on quadrant is flush with back surface of instrument panel.

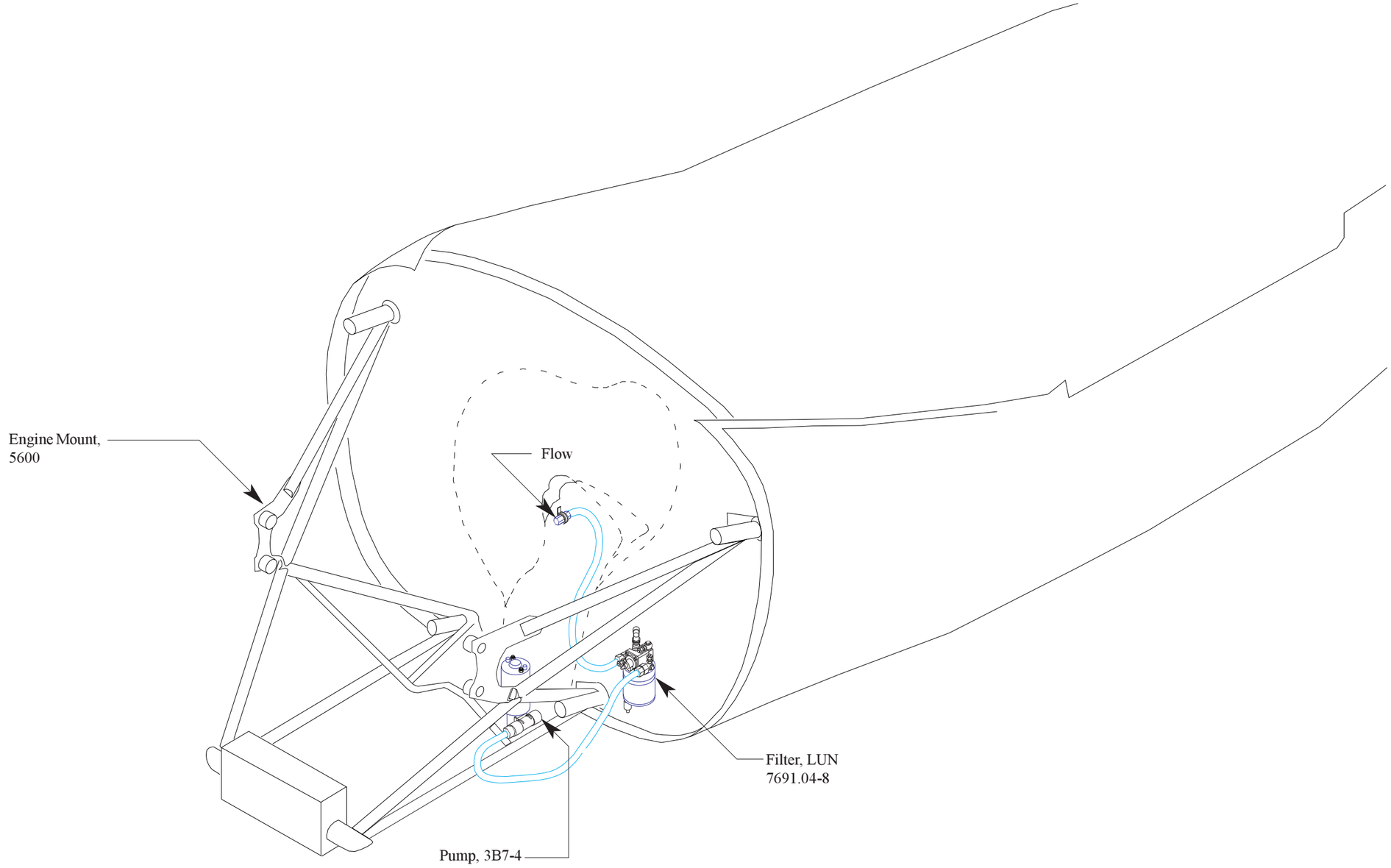
-Cable attach bar Ⓑ on quadrant must have clearance to crossover tube.



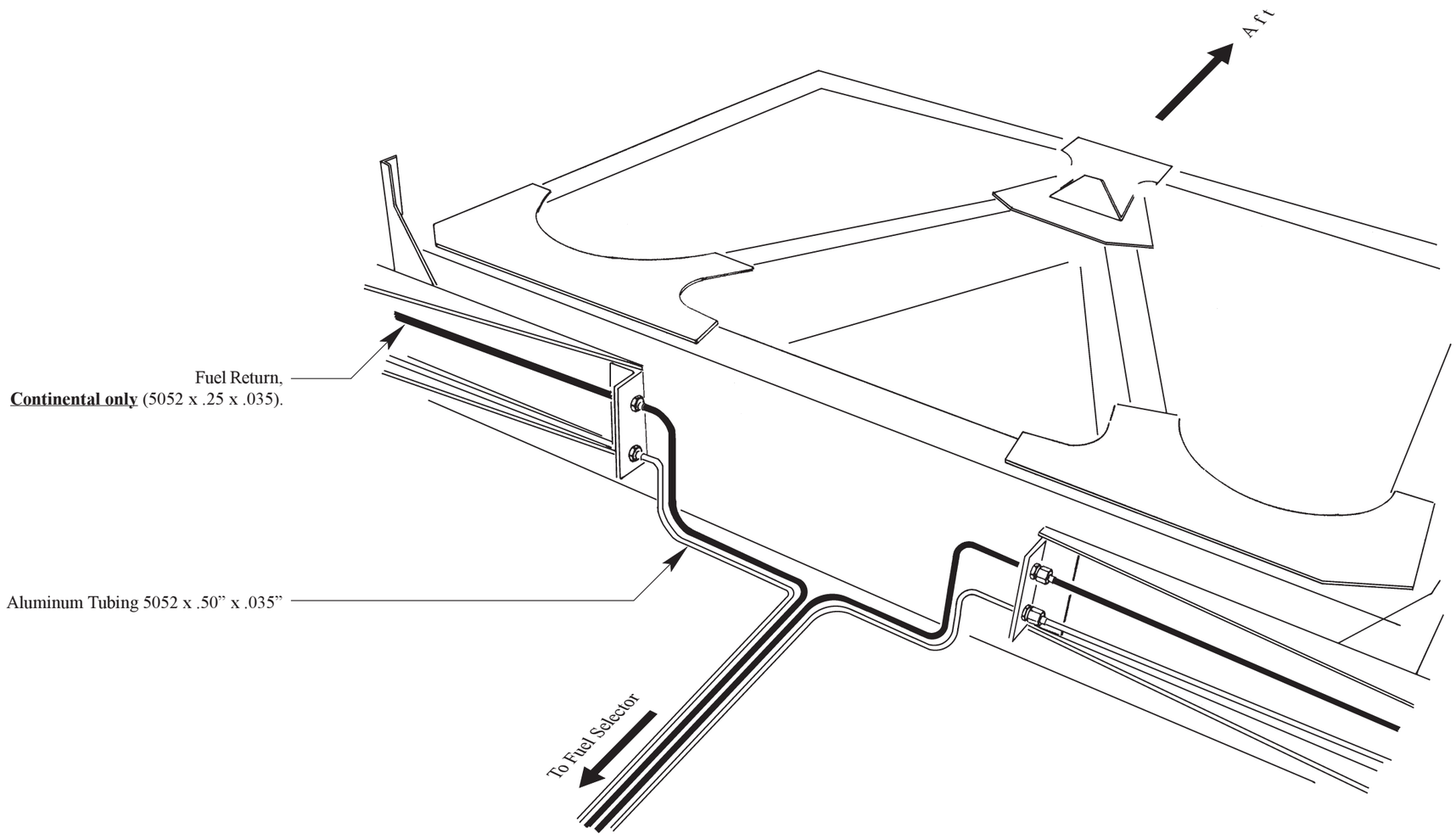
K. INSTRUMENT PANELS

L. FUEL SYSTEMS

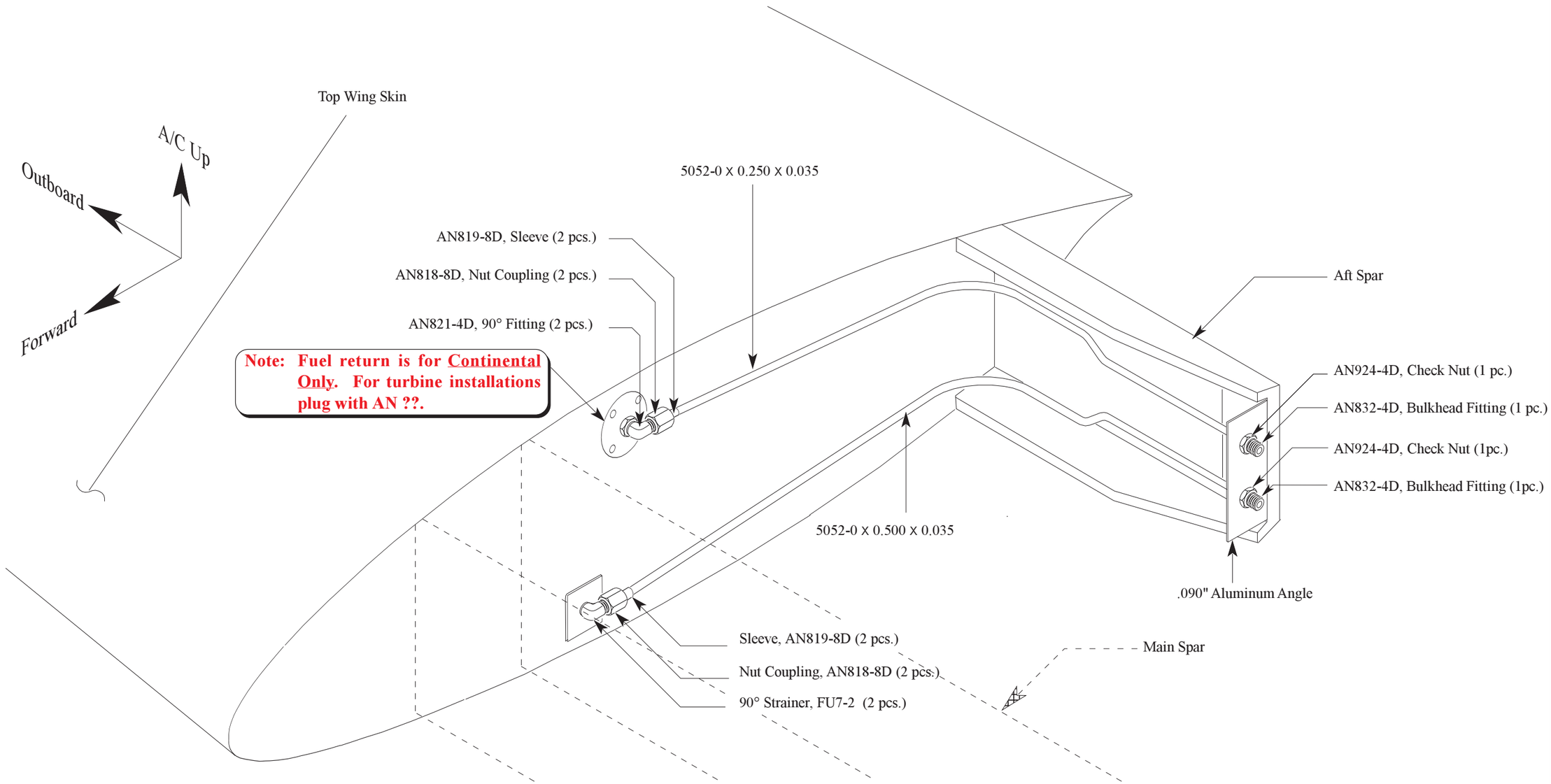
Propjet fuel system
Fig. L:1



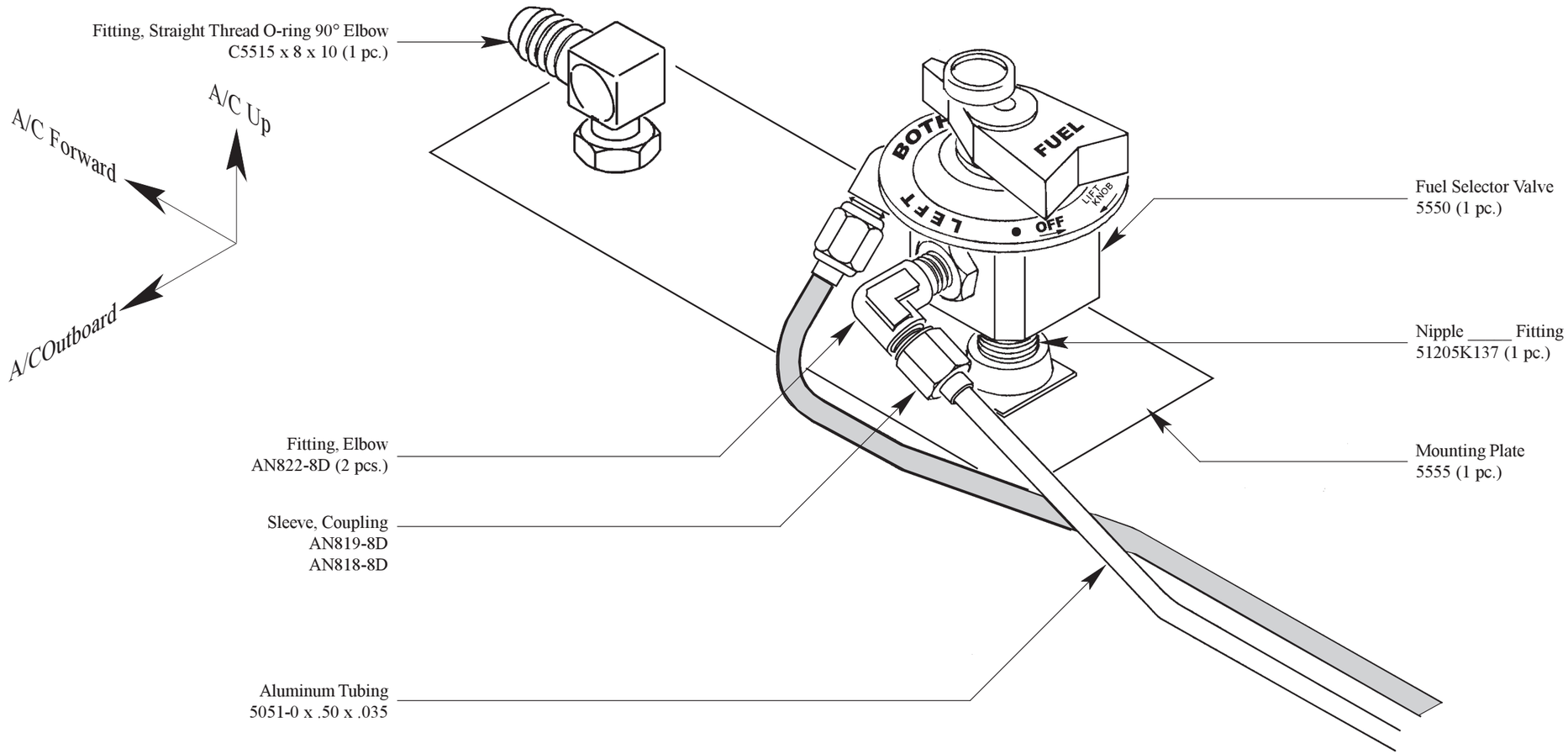
Fuel Line Installation
Fig. L:2



Fuel Lines Installation
Fig L:3



Fuel Lines Installation
Fig L:4

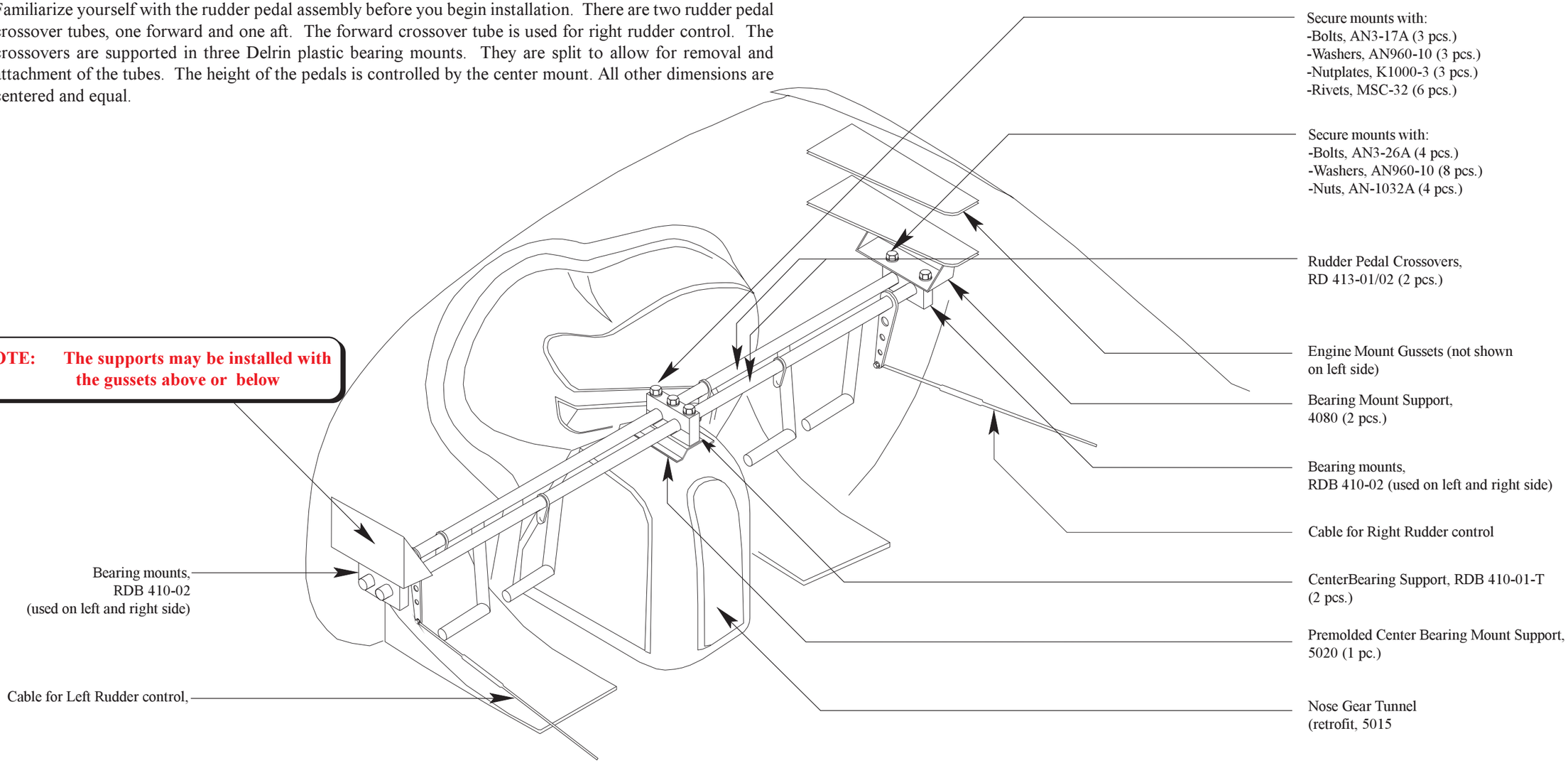


M. RUDDER CONTROLS

The Lancair Propjet has dual rudder pedals so either the pilot or co-pilot can actuate the rudder. The rudder pedal assembly is mounted using the nose gear tunnel and engine mount reinforcements as supports. Familiarize yourself with the rudder pedal assembly before you begin installation. There are two rudder pedal crossover tubes, one forward and one aft. The forward crossover tube is used for right rudder control. The crossovers are supported in three Delrin plastic bearing mounts. They are split to allow for removal and attachment of the tubes. The height of the pedals is controlled by the center mount. All other dimensions are centered and equal.

NOTE: The supports may be installed with the gussets above or below

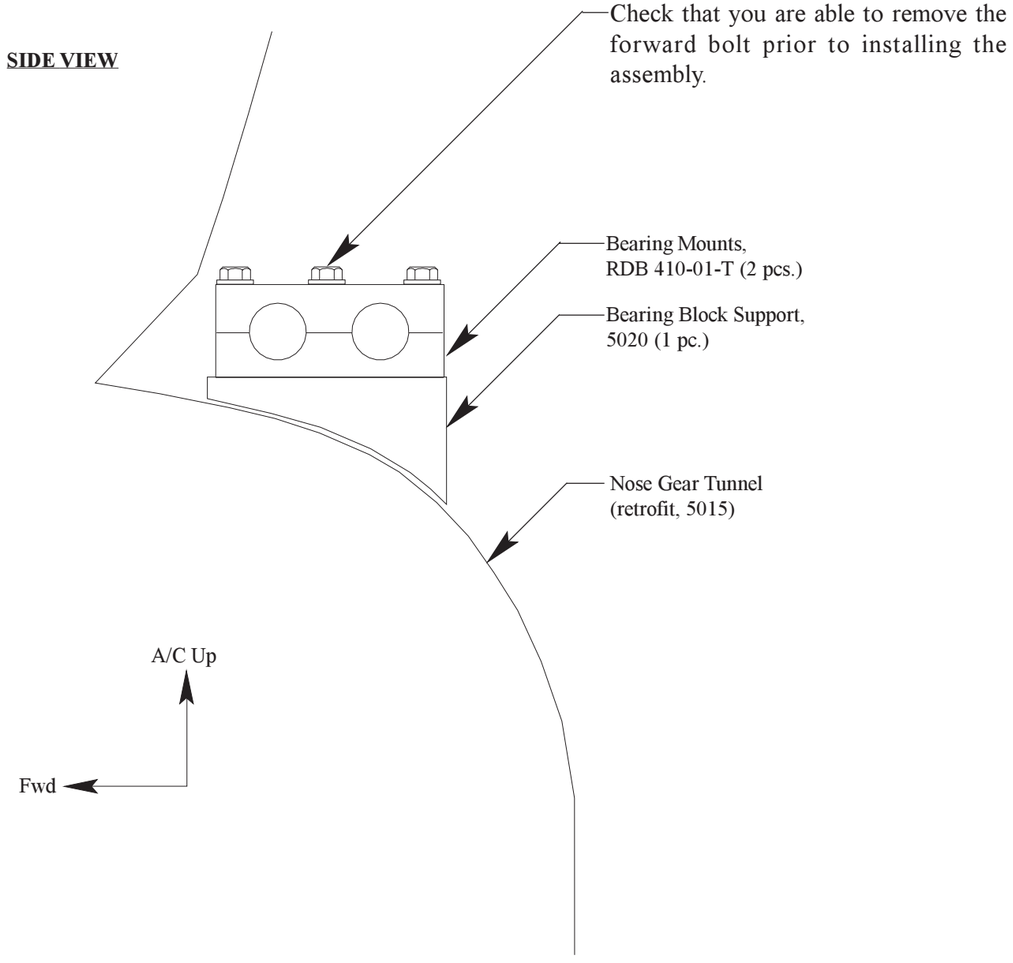
Rudder Pedal Installation
Fig. M:1

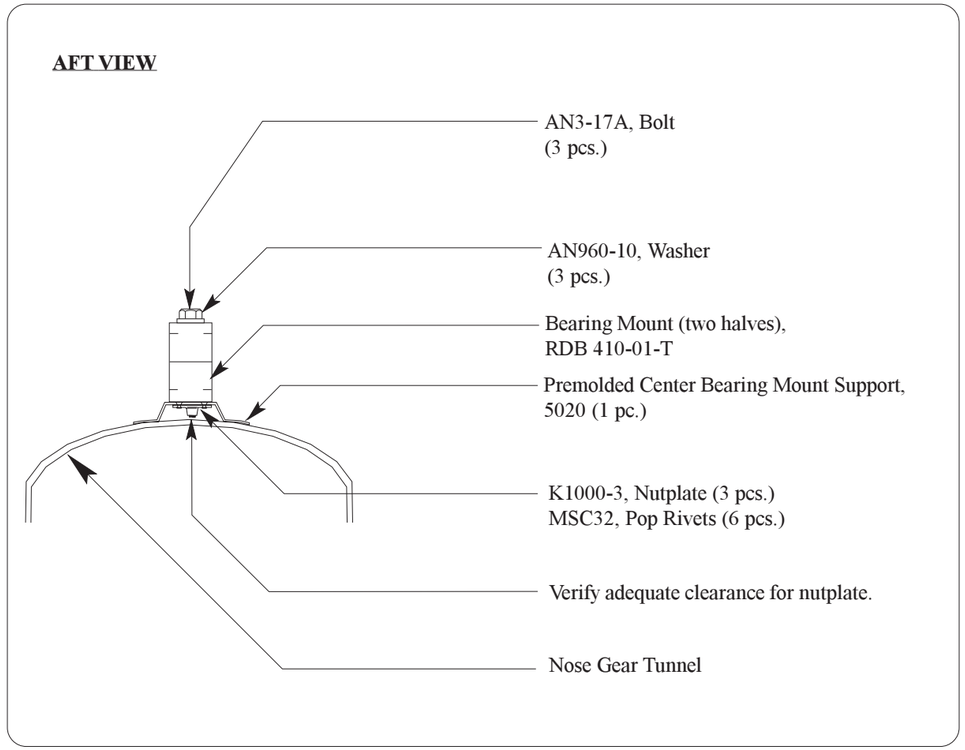


Rudder Pedal Installation
Fig. M:2

M 1. Fit and install the center bearing block mount. the center piece is installed first. It mounts to a premolded flange. The objective is to install the bearing block as far forward as possible for leg room. It is acceptable to remove some material off the from corner of the bearing block. Also keep in mind you must be able to remove the bolts. With this in mind, fit the bearing block. Mount the bearing mount to the bearing block support.

Once satisfied with the fit of the bearing mount and the bearing mount supports, bond the support in place using approved bonding procedures.



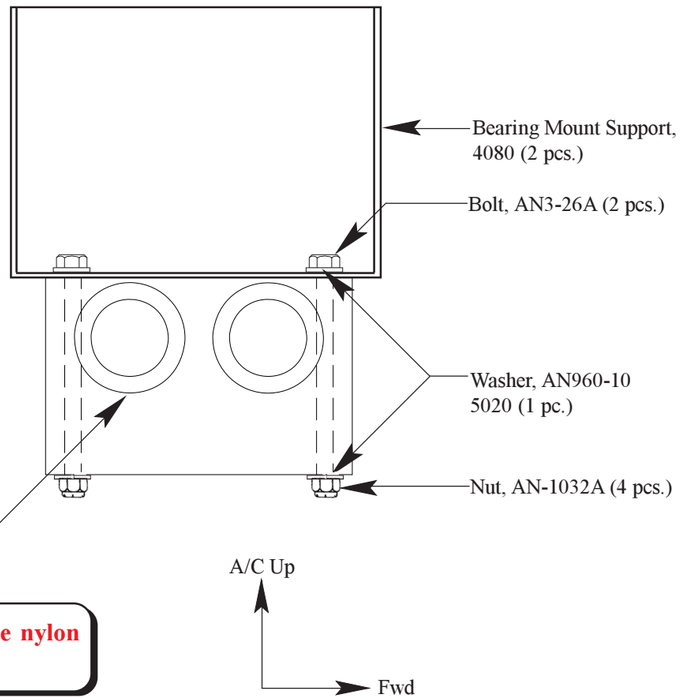


Rudder Pedal Installation
Fig. M:3

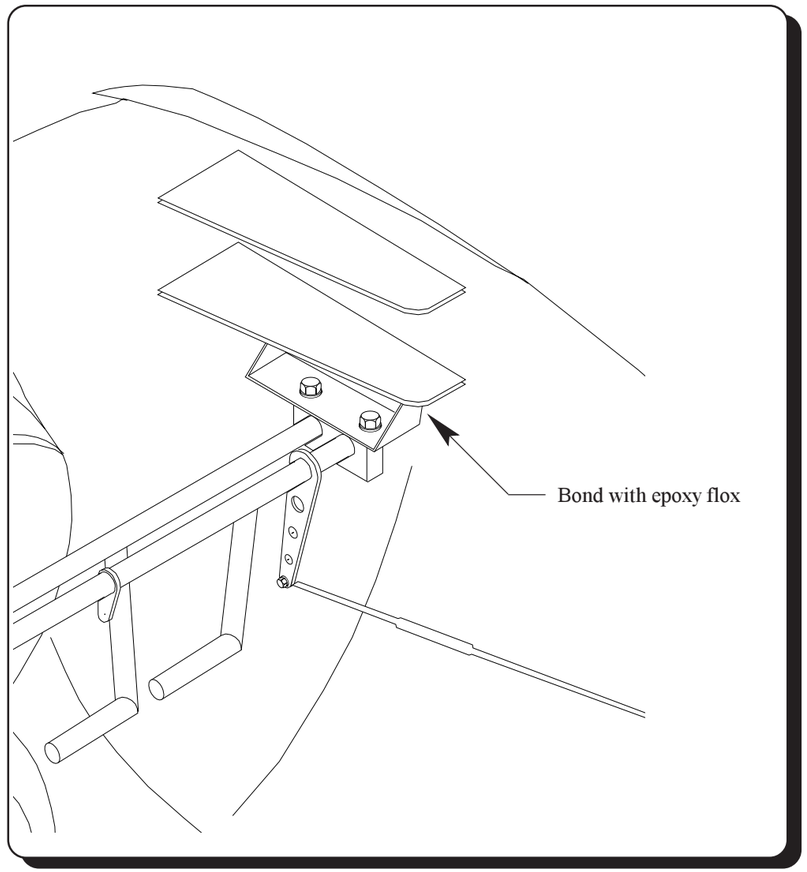
M 2. Use clecos to hold the 4080 supports to the side of the fuselage. Install at a height that keeps the crossover tubes level.

M 3. Center the crossover tubes by measuring equal distances from the end of the table to the side of the fuselage. Mark the location of the mounting holes by installing the RDB 410-02 blocks onto the crossover tubes and holding them in place. Drill one side and install the bolts before drilling the other.

M 4. Install the 4080 supports using standard bonding procedures. This is a good time to practice with a "dry run" before the final installation.



NOTE: The chamfered edge of the nylon block faces inboard.

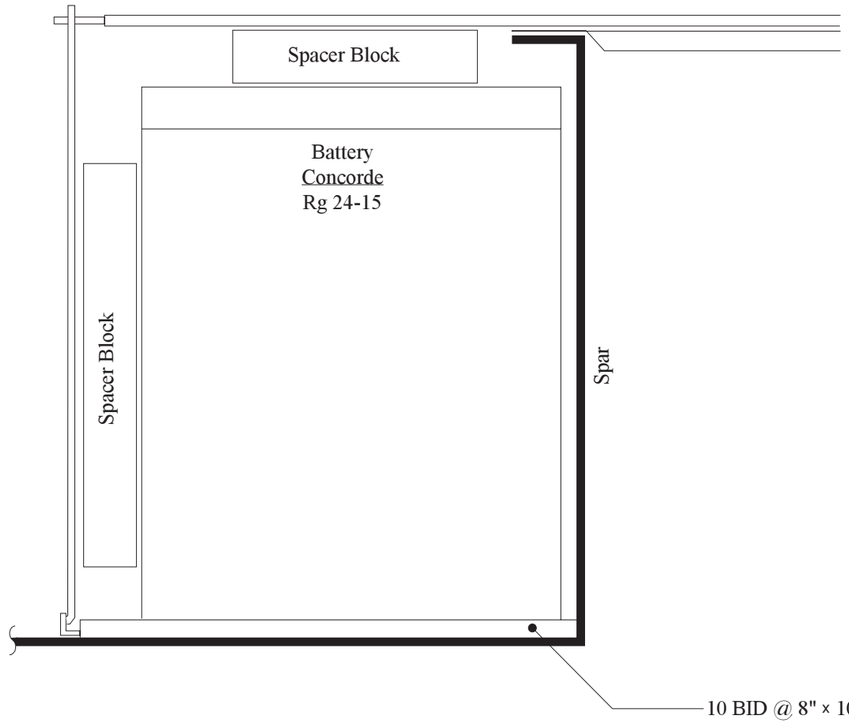


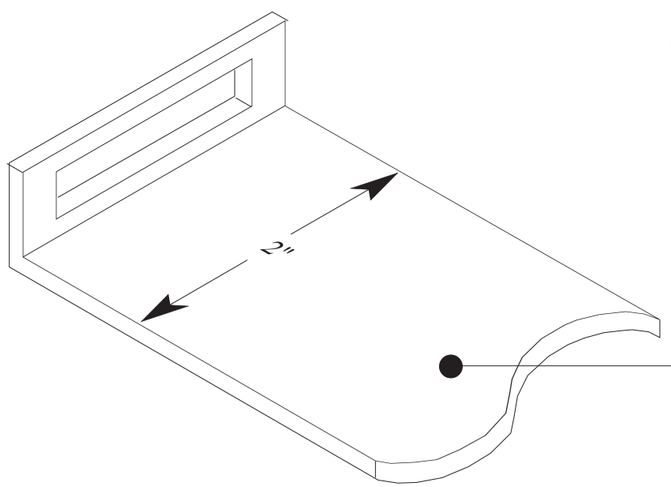
NOTE: Make sure the crossover tubes are parallel to the firewall and level.

N. BATTERY INSTALLATION

Battery Installation
Fig. N:1

- Steel strap hooks over aft spar shear web.

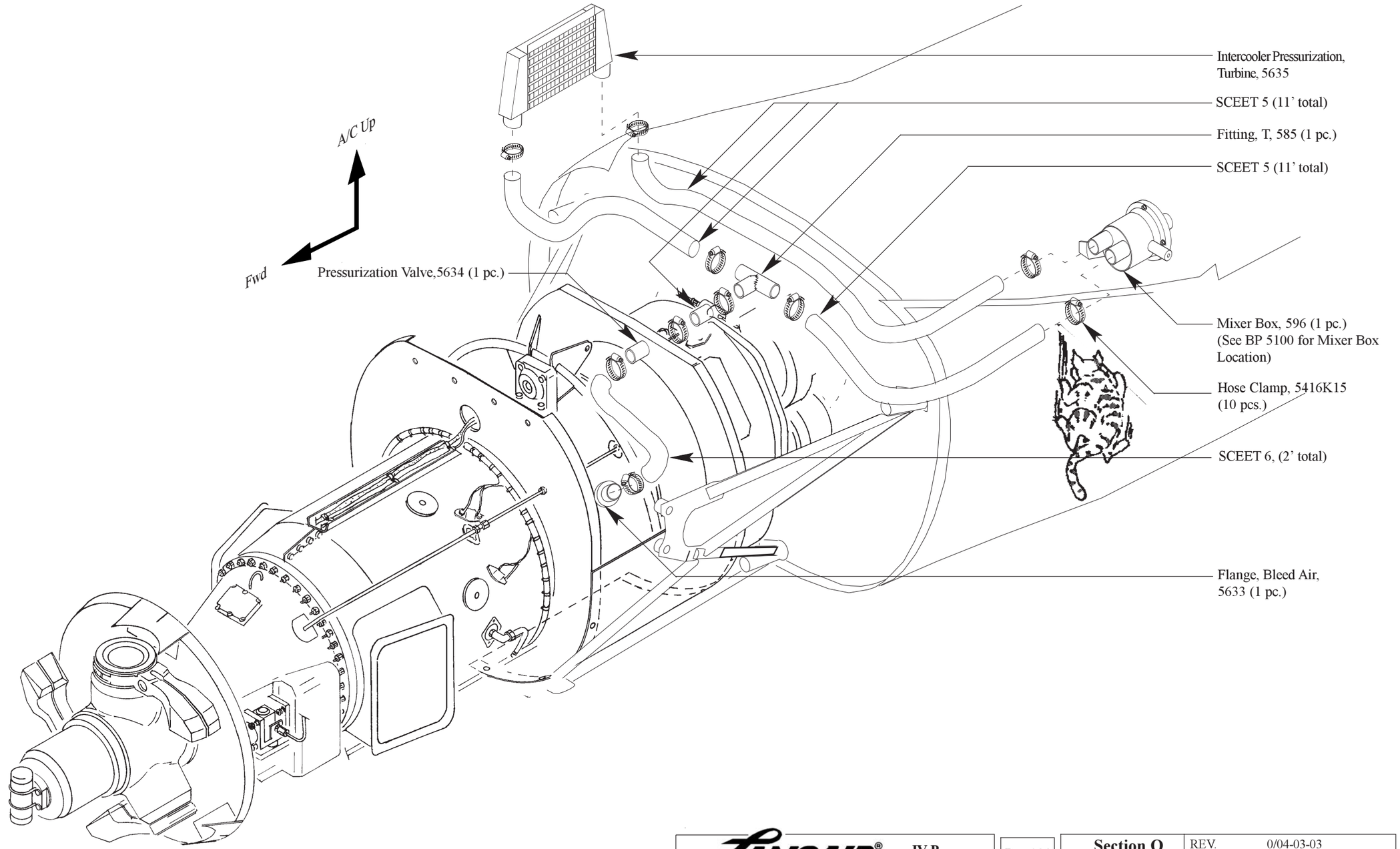




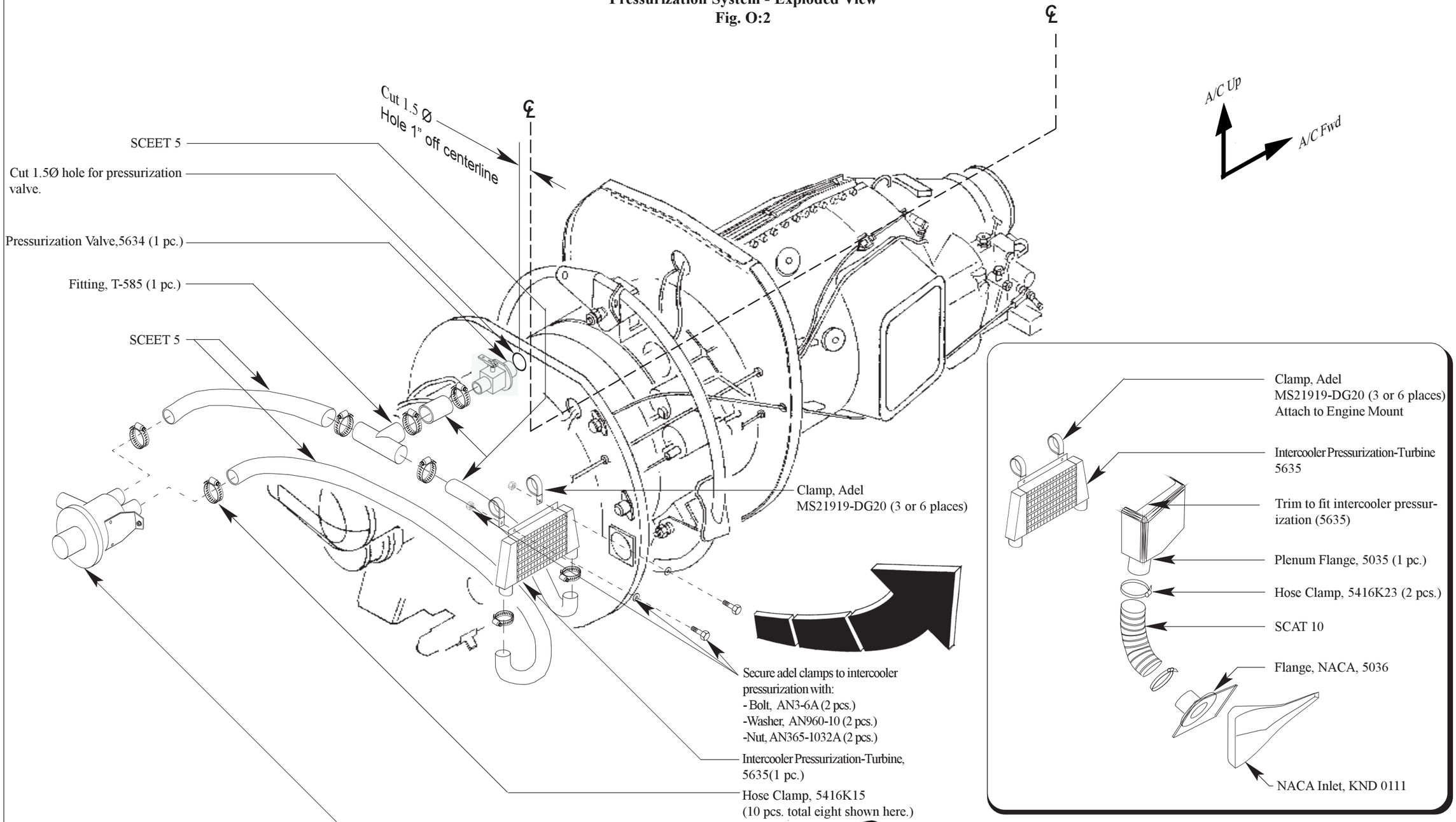
- 2" steel strap under the 10 BID
- Strap has slot at forward edge to receive vertical member.

O. PRESSURIZATION SYSTEM

Pressurization System - Exploded View
Fig. O:1



Pressurization System - Exploded View
Fig. O:2



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