

Starter adapter CCI-90-L-1

Lycoming aircraft engines.

The complete document set consists of the following:

Six pages of "A" size blueprints

Four pages of instruction.

One page: Bill of materials

MATERIALS suppliers are listed in order of prices and performance. Their inclusion on this list is not necessarily an endorsement although some suppliers, like Dillsburg, have developed a large following because of their demonstrated willingness to provide prompt, personalized service. If a local vendor has prices that are equal to or better than those merchants listed, for the same grade and type of material, by all means use them.

FABRICATION: of the starter bracket is straight forward. All drawings are full scale except for sheet 6 which shows the gear-tooth relationships. Sheets 2 and 4 of the plans-set were plotted so as to eliminate the need for doing precision layouts on the raw steel plate. Sheets 1,3,5 & 6 are data sheets only. Use a spray adhesive to attach the templates to the raw material. Then, center-punch, drill and cut per the template. It is suggested that when cutting and shaping the two primary metal parts that all edges be "broken" with a file and contoured so as to not present any sharp edges. Remember that it is likely that you may want to work around the engine at some point in the future and it doesn't make any sense to leave sharp edges on any fabricated part that will cause injuries. Part alignment is important. The few problems encountered with the installation, have all been attributed to mis-alignment of the two parts during welding. The welding should be done by a professional. The two pieces must be perpendicular to one another after the welding and heat treatment are completed.

INSTALLING THE BRACKET: While one individual claimed that he was able to install the assembly without pulling the propeller and ring gear, we found that trying to work around them made things needlessly difficult and time consuming. In order to install the starter and bracket, it is suggested that the prop be taken off. With the propeller removed, the ring-gear can be easily slipped from the nose of the crankshaft after the two flat head screws are removed. Before positioning the starter bracket, clean and sand the aluminum pad on the crankcase where the bracket will sit. Bolt the bracket to the pad with the same starter fasteners provided by Lycoming for that purpose. If a belt driven accessory is being powered off the ring-gear, check to see if will slip under the starter weldment and onto the ring gear without difficulty. If the interference is only slight, file away a small portion of the nose plate at that corner which interferes. DO NOT grind away any of the base plate!

PAGE TWO

CAUTION: the new bracket is thinner than the base of the original starter. Take care that the bolts are not so long that they bottom. Either cut the bolts to size or purchase new bolts. Use new split washers to insure that the bracket is properly grounded electrically to the crankcase of the engine. Safety wire the four fasteners which secure the bracket to the engine.

INSTALLING THE STARTER: Position the starter within the bracket and secure using the two 10 mm bolts specified in the bill of materials. Be sure to use star washers under the head of the both bolts. Snug the bolts up finger tight only.

Using channel lock pliers, or their equivalent, grip the nose of the pinion gear and carefully pull the pinion gear out of the starter it's full travel. The return spring is not a light one so you'll have to assert yourself. While holding the gear in the full extended position with the pliers, use your other hand to slip a single-edge razor blade or thin feeler gauge behind the gear. This will keep the spring from snatching the gear back into the starter housing. The pinion gear is now in a position that will facilitate clearance checking and adjustment.

Now position the Lycoming ring gear on the nose of the crankshaft, checking for interference with the starter pinion. Do not force anything. Rotate both the ring gear and starter pinion so as to obtain the tooth orientation depicted on diagram six of the enclosed plans. Using a 1/16 inch drill bit as a feeler gauge, test the tooth clearance as shown. Note that you are checking from the square top of a ring gear tooth to the square root of a pinion tooth.

If the clearance is not sufficient, remove the ring-gear and starter and slightly elongate the "B" hole in the direction of travel needed until the drill bit slips freely between the teeth. The large pinion access hole is oversize to accommodate the small amount of travel needed and should not require enlargement for this process. Once proper tooth clearance has been established, torque the two ten mm bolts to 30 foot pounds and safety wire both to each other using appropriate safety wire and accepted methods. Carefully remove the razor or feeler gauge from behind the pinion. Watch your fingers when the pinion is snapped back! Now reinstall the ring-gear and propeller.

ELECTRICAL CONNECTIONS: Attach the existing heavy starter cable. Keep the cable length as short as possible and secure it to the engine using appropriate straps. This starter has a built in solenoid so no external solenoid is needed. If your aircraft is equipped with a starter solenoid which is activated by a grounding circuit, you should remove the solenoid completely and replace the two heavy cables that were on either side to one unit. Convert the grounding circuit to a simple switched circuit. If there is no such circuit and no existing wires, you must run a hot wire from the electrical buss, through a starter button or switch on your panel and from there to the solenoid contact on the starter. The wire gauge for that circuit should minimally be 18. 16 gauge is better but the most important factor in determining the wire gauge is the length of the cable run. The solenoid draws little current in activating the starter, so don't over do it.

PAGE THREE

RING-GEARS: Lycoming engines use ring gears either with 122 or 149 teeth with the 122 being the most popular. This installation is optimized for the 122 tooth ring gear which is the gear that Lycoming chooses to use on all the O-235's and the larger O-540's and O-720's. The mid range power plants (O-320's and 360's) are equipped with 149 tooth ring gears and while the starter can be made to work with that ring-gear, we don't recommend it. The tooth contact pattern is not optimized and we believe that a detrimental wear pattern could eventually occur. We have been assured by mechanics in the field that all Lycoming ring gears are mutually interchangeable across the entire Lycoming piston engine line. If you have a 149 tooth ring gear, we suggest you consider swapping for the 122 tooth unit.

PROPER GROUNDING: Check the existing ground strap (if there is one). If there is any doubt regarding it's capacity or ability to support the current drawn by the starter, replace the strap with one of a larger size. Remember that starters are the single highest electrical consumers on the aircraft and will only perform properly when the current can be fed through adequate circuitry.

If there is no ground strap, you must provide one from the engine to the airframe or, if a composite or wooden aircraft, you must provide a return ground all the way back to the battery. Woven belt type ground straps are relatively inexpensive, are designed to withstand engine vibrations without failure and can be purchased locally at auto-parts stores. The test aircraft, Long-Ez N-67EB, uses soft copper plumbing pipe as the ground buss with a good grade of multistrand welding cable running through its center as the other current carrying leg.

The ground strap can be attached almost anywhere on the engine but the closer to the starter, the better. You can attach a belt type ground strap, using a star washer, to the newly fabricated starter bracket with one of the four bolts that secures the bracket to the engine pad. Conventional, round battery cables are usually too thick to be used in the narrow space between the starter motor and the bracket.

CAUTION: Do not attempt to fasten a grounding strap with one of the two ten mm bolts! Aside from the fact that this compromises the physical integrity of the starter/bracket installation, there is very little clearance between the moving ring gear and the starter. You run the risk of entangling the strap in the ring gear when the engine is running!

SOME PRECAUTIONS REGARDING FASTENERS: The aero-space industry has been plagued with bogus bolts whose makers portray them as aircraft grade when they are, in fact, considerably lower in tensile strength. The two 10 mm x 1.25 pitch bolts specified on the bill of materials were carefully chosen to satisfy the demands of this application. Do not substitute common automotive grade bolts such as supplied by auto-parts stores!

PAGE FOUR

None of the bolt suppliers we contacted were able to supply metric fasteners with heads pre-drilled for safety wire, at least not at prices we considered reasonable. Unless you have access to a supplier of metric fasteners who can provide pre-drilled bolts, we suggest you simply drill the bolt-heads yourself. You can easily prepare the heads for safety wire in a drill press with a 1/16" drill. Be certain to chamfer both the entry and exit sides of each hole with a countersink so as not to chafe the safety wire.

We considered drilling out the metric threads on the starter housing and retapping the bosses to the next American size. We even considered installing Heli-coil inserts. While this would have facilitated the selection of US standard aircraft fasteners, it would also reduced the amount of material actually supporting the starter and the modification would have ruined the core value. It would also complicate future replacement and make matters far more expensive.

One of the advantages of using a stock unit is that a replacement can be found on the shelf of practically any auto-parts store in the Country and installed "as-is". If the older unit has been modified, not only is it likely to be rejected by a vendor as an exchange unit but you will now be faced with having to drill and tap the replacement starter before it can be installed. We believe that the starter unit should be used "as-is" without modifications.

IMPORTANT

ALL MATERIALS ARE SUBJECT TO FAILURE FROM FATIGUE. NONE ARE EXCEPTED FROM THIS FUNDAMENTAL LAW OF PHYSICS. WE BELIEVE IT PRUDENT AND IN THE INTERESTS OF SAFETY TO PERIODICALLY REMOVE WELDED DEVICES FROM THE A/C AND TO MAGNAFLUX OR X-RAY THEM BEFORE RETURNING THEM TO SERVICE.

THIS SHOULD BE PERFORMED AT LEAST ONCE A YEAR, PREFERABLY DURING THE "ANNUAL" FOR NON-AEROBATIC AIRCRAFT AND MORE FREQUENTLY FOR MACHINES USED TO PERFORM AEROBATIC MANEUVERS.

PAGE FIVE

BILL OF MATERIALS

ITEM: 3/16" 4130 Chrome-Moly Steel plate
QUANTITY: 4" x 10" (minimum for one complete bracket)

SUPPLIERS:

Dillsburg Airplane Works, (deals exclusivly in metals)
RD #3, Dillsburg, PA 17019 (717) 432-4589

Wicks Aircraft Supply, (limited & not as specialized)
410 Pine Street, Highland, IL 62249 (800) 221-9425

ITEM: 10 mm Metric Fasteners
QUANTITY: two 10mm x 1.25 bolts 23 mm long (grade 10.9)
two M10 flat washers

SUPPLIERS:

Auto-Metrics Incorporated	Metric Screw & Tool Company
24893 Hathaway	9 Lake Street
Farmington, Michigan 48018	Wakefield, Mass 01880
(313) 477-8001	(800) 638-7421 (617) 245-4950

ITEM: Starter 12 Volt DC, 1.9 hp geared unit; Lester Number 16760
QUANTITY: One
SUPPLIERS: Check local automotive parts jobbers

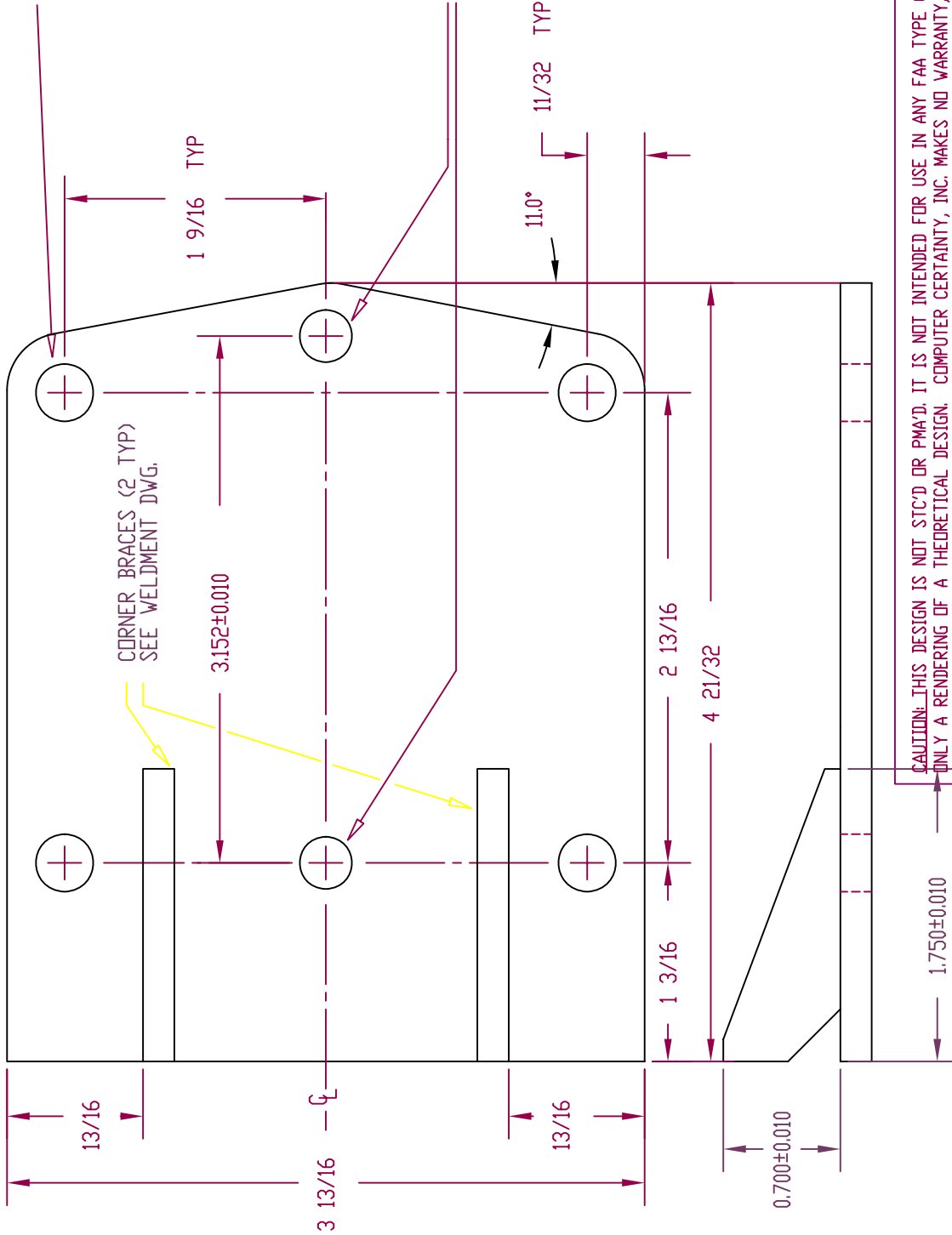
Note: "Lester Numbers" are the automotive equivalent of wattage in light bulbs and AN values in fasteners. A Lester Number is of more value to you than what year or car the unit was in, simply because different starter manufacturers will often supply one starter style to many car manufactures. Use the Lester number when asking for starter units and be sure the unit is really re-manufactured, not just cleaned and spray painted as some will do.

Computer Certainty, Inc,
Post Office Box 494
Milford, New Jersey
08848 - 0494

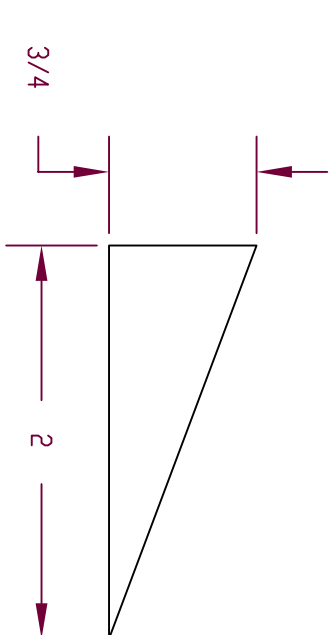
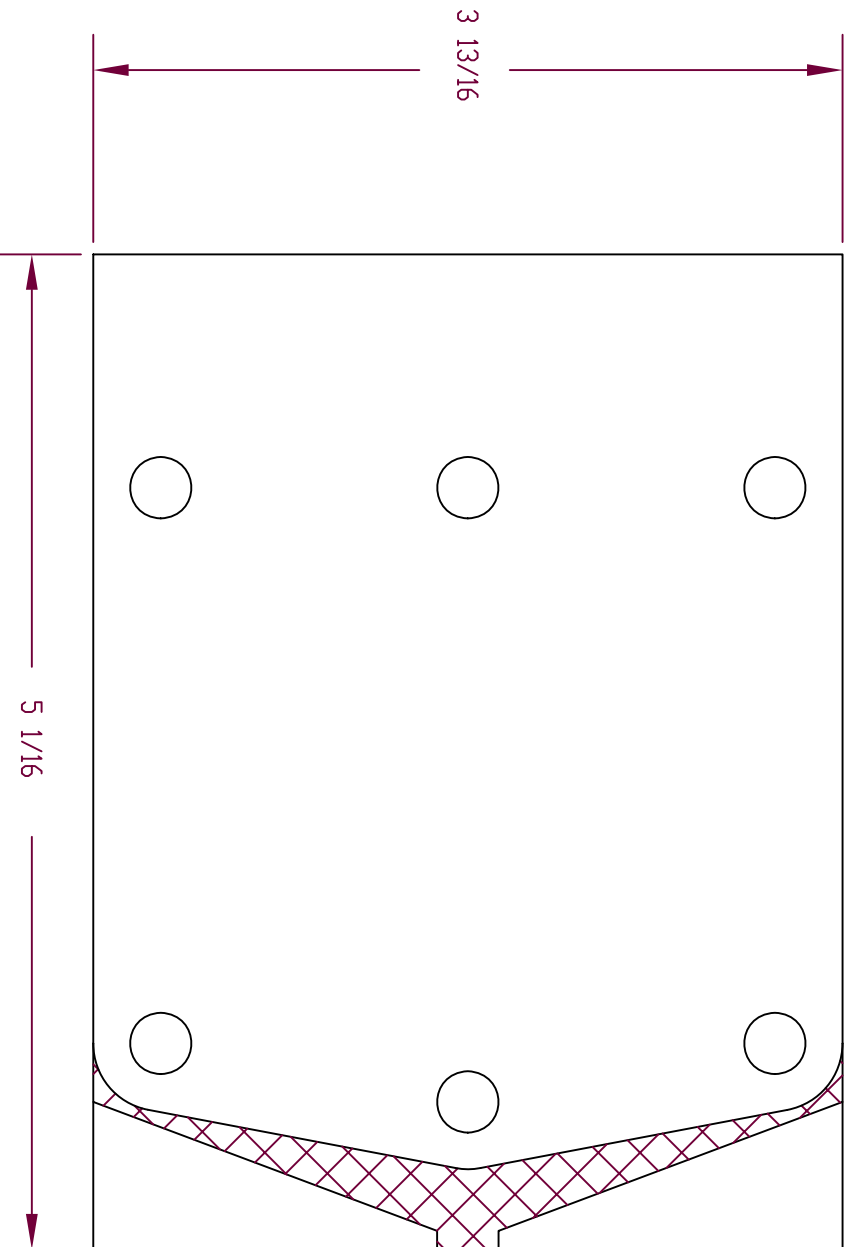
E-mail: CCIVORTEX @ BLAST.NET

11/32" DRILL, FOUR PLACES
FOR 5/16 X 18 MOUNTING BOLTS
ROUND CORNER WITH 11/32" RADIUS

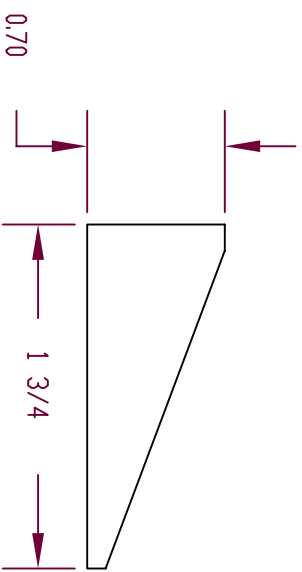
DRILL UNDERSIZE (9/32")
REAM FOR PRESS FIT FOR
TWO 5/16 DIA X 1/2"
HARDENED DOWEL PINS



TOLERANCES, UNLESS OTHERWISE SPECIFIED DECIMAL: ?030 FRACTIONAL: ? 1/32		DATE: FEB 21, 1990	COMPUTER CERTAINTY, INC. P.O.BOX494, MILFORD, N.J. USA, 08848-0494 EMAIL: CCIVORTEX @ JUNICOM
MATERIAL 3/16" 4130 CHROME MOLLY STEEL		REVISION: FEB 16, 1993	
HEAT TREATMENT STRESS RELIEVE AFTER WELDING		TITLE BASE PLATE (LYCOMING STARTER)	
LEVEL	REVISIONS	DATE	SCALE
B	EXTENDED WELD ABUTMENT 3/16" IN DIRECTION OF THE RING GEAR TO INCREASE TOOTH CONTACT AREA.	02-15-93	FULL
LEVEL	REVISIONS	DATE	SHEET
A	CORRECT POSITION ERROR, DOWEL-PIN CENTER LINE, ENLARGE BOLT HOLES, WELD ABUTMENT DIM. TO FRACTIONAL	01-26-93	1 of 6
			COMPUTER FILE NAME: BASE.DWG



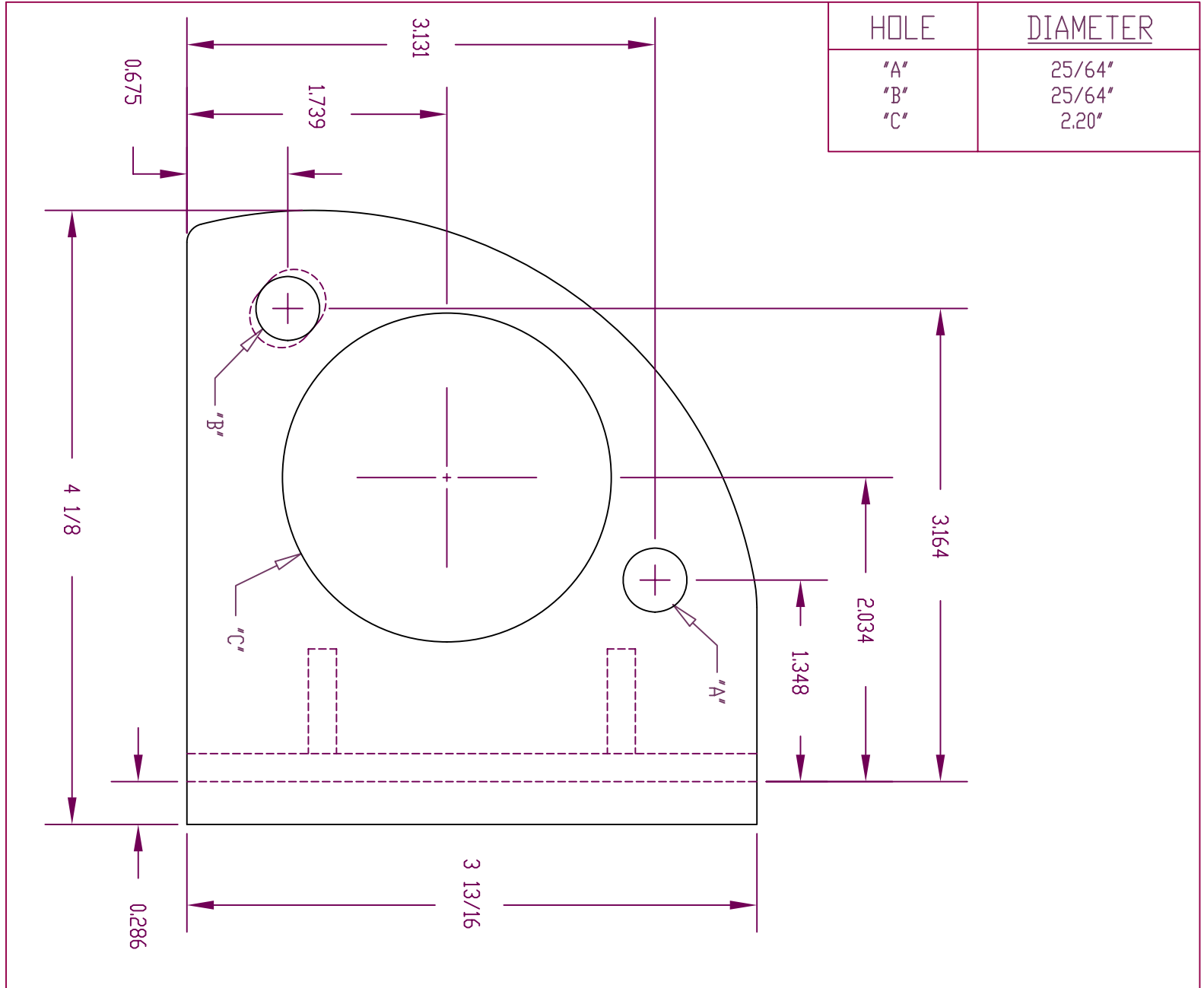
USE THE SCRAPS FROM THE END OF THE BASE PLATE FOR FABRICATING TWO BUTRESS REINFORCEMENTS AS SHOWN ABOVE. CUT AND DRESS THE SCRAPS TO 2" BY .75", THEN TRIM THE VERTICAL HEIGHT TO .70" AND THE LENGTH TO 1.75"



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DECIMAL: ?030	FRACTIONAL: ? 1/32	FEB 21, 1990	COMPUTER CERTAINTY, INC. P.O.BOX 494, MILFORD, NJ, USA 08848-0494 E-MAIL: CCIVDRTEX @ JUND.COM
MATERIAL 3/16" 4130 CHROME MOLLY STEEL	REVISION: FEB 16, 1993		
HEAT TREATMENT STRESS RELIEVE AFTER WELDING		TITLE BASE TEMPLATE (LYCDMING STARTER)	
SURFACE TREATMENT DEGREASE & PAINT W RUST INHIBITOR		SCALE FULL	SHEET 2 OF 6
PROPRIETARY TO COMPUTER CERTAINTY, INC. THIS DOCUMENT NOT TO BE REPRODUCED FOR ANY PURPOSE EXCEPT ON COMPUTER CERTAINTY, INC. WRITTEN ORDER OR CONSENT. THE ABSENCE OF A CORPORATE SEAL MARKS THIS DOCUMENT AN UNAUTHORIZED DUPLICATE		COMPUTER FILE NAME: BASE-CUT . DWG	

LEVEL	REVISIONS	DATE
A	LENGTHEN CUT LINES TO 5-1/16" TO ALLOW ENOUGH SCRAP TO CREATE BRACES TO REINFORCE WELDS	02-16-93



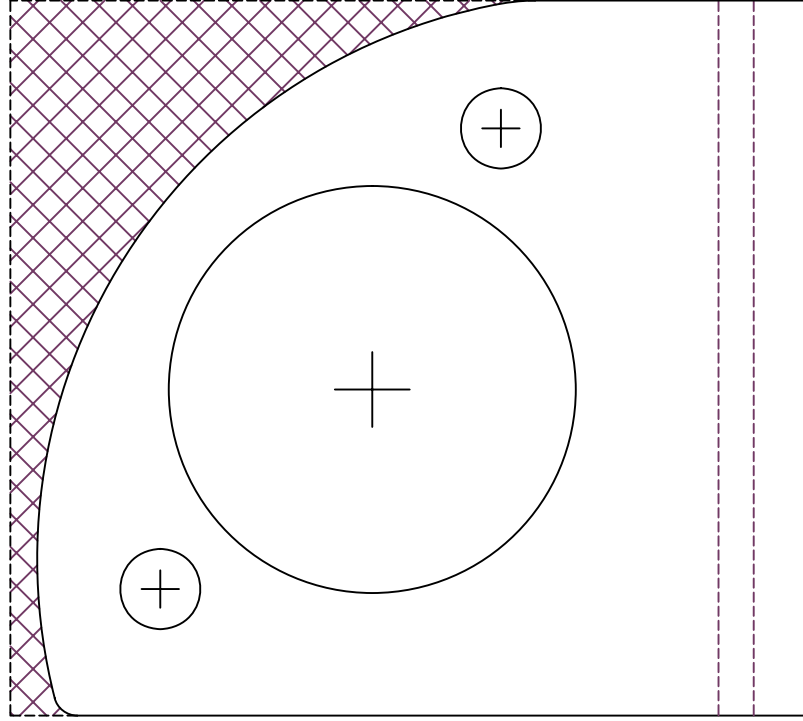
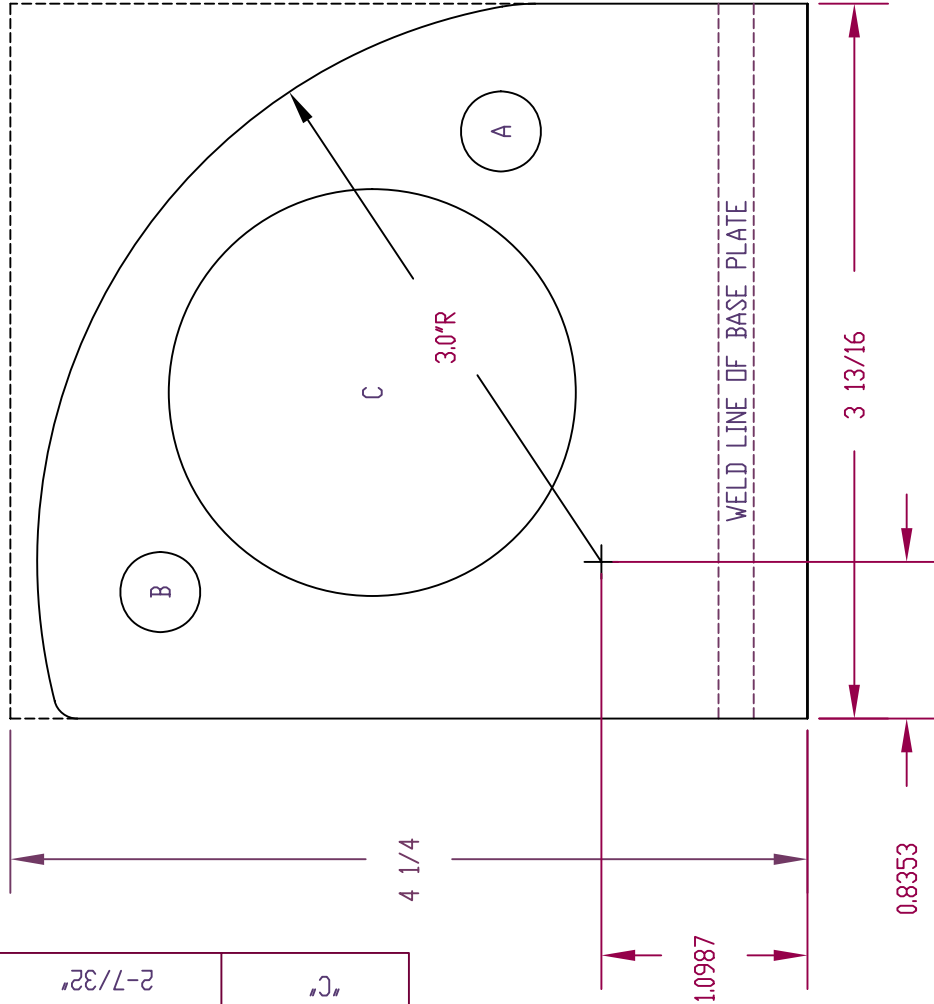
HOLE	DIAMETER
"A"	25/64"
"B"	25/64"
"C"	2.20"

LEVEL	REVISIONS	DATE
B	ENLARGED HOLE "C" TO 2.2" ADDED 3/16" GUSSETS	02-16-93
LEVEL	REVISIONS	DATE
A	CHANGED RADIUS OF HOLE "C" FROM 2-5/32" TO 2-7/32" TO SUPPORT PINION GEAR CLEARANCE ADJUST	01-21-93

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TOLERANCES, UNLESS OTHERWISE SPECIFIED FRACTIONAL: ? 1/64	FORM-FIT-FUNCTION			
MATERIAL 3/16" 4130 CHROME MOLLY	STD'S.& RECORDS			
HEAT TREATMENT STRESS RELIEVE AFTER WELDING	DSGN.		TITLE NOSE PLATE FOR LYCOMING STARTER	
SURFACE TREATMENT DEGREASE & PAINT, RUST INHIBITOR.	APPROVAL			
PROPRIETARY TO COMPUTER CERTAINTY, INC. NOT TO BE REPRODUCED OR USED FOR MANUFACTURING PURPOSES EXCEPT ON COMPUTER CERTAINTY, INC. ORDER OR PRIOR WRITTEN CONSENT.	DWG. SIZE A	SCALE FULL	SHEET 3 OF 6	DOS FILE: FRONT.DWG

DIAMETER	25/64"	A' & B'
	2-7/32"	



TEMPLATE #4

SEE SHEET #2, BASE-CUT, FOR INSTRUCTIONS ON USE OF THIS TEMPLATE.

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TOLERANCES, UNLESS OTHERWISE SPECIFIED
 DECIMAL: ?030 FRACTIONAL: ? 1/32
 MATERIAL 3/16" 4130 CHROME MOLLY STEEL
 HEAT TREATMENT
 STRESS RELIEVE AFTER WELDING
 SURFACE TREATMENT
 DEGREASE & PAINT W RUST INHIBITOR

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TITLE FRONT TEMPLATE
 (LYCOMING STARTER)

SCALE FULL
 SHEET 4 OF 6
 COMPUTER FILE NAME: FRONT CUT . DWG

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CAREFULLY JIG BOTH PIECES TO INSURE THAT BASE PLATE IS PERPENDICULAR TO THE FRONT PLATE AND THAT ALIGNMENT IS MAINTAINED THROUGHOUT THE WELDING PROCESS.

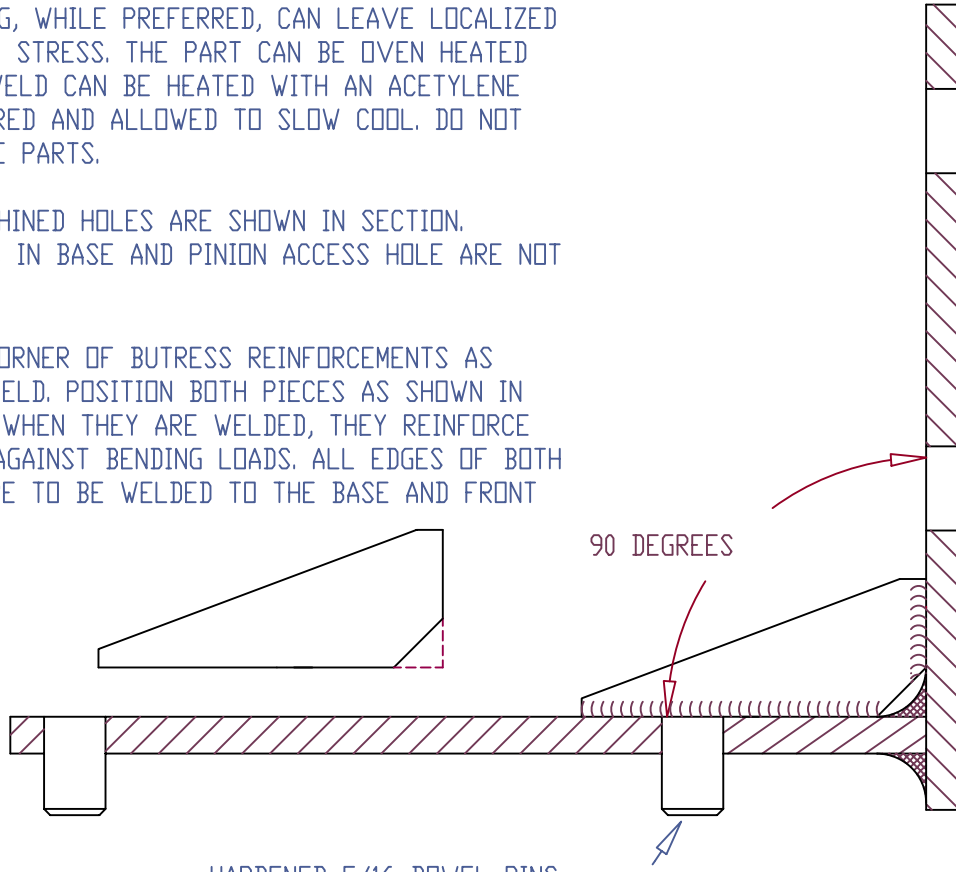
HEAVY FILLETS MUST BE BUILT UP ON BOTH SIDES OF THE BASE PLATE AS SHOWN. USE AS MANY PASSES AS ARE NECESSARY TO INSURE ADEQUATE BUILDUP OF THE WELD AS WELL AS MAXIMUM PENETRATION.

AN AIRCRAFT GRADE WELD IS CRUCIAL AND IT IS STRONGLY SUGGESTED THAT THIS BE DONE BY A PROFESSIONAL WELDER WITH APPROPRIATE EXPERIENCE AND SUITABLE EQUIPMENT TO STRESS RELIEVE THE PARTS AFTER THE WELDING IS COMPLETED.

TIG OR MIG WELDING, WHILE PREFERRED, CAN LEAVE LOCALIZED CONCENTRATIONS OF STRESS. THE PART CAN BE OVEN HEATED PER MIL-SPC. OR, WELD CAN BE HEATED WITH AN ACETYLENE TORCH TO A DULL RED AND ALLOWED TO SLOW COOL. DO NOT QUENCH COOL THESE PARTS.

NOTE: NOT ALL MACHINED HOLES ARE SHOWN IN SECTION VIEWS. BOLT HOLES IN BASE AND PINION ACCESS HOLE ARE NOT REPRESENTED.

NOTCH REMAINING CORNER OF BUTRESS REINFORCEMENTS AS SHOWN TO CLEAR WELD. POSITION BOTH PIECES AS SHOWN IN BASE.DWG SO THAT WHEN THEY ARE WELDED, THEY REINFORCE THE FRONT PLATE AGAINST BENDING LOADS. ALL EDGES OF BOTH REINFORCEMENTS ARE TO BE WELDED TO THE BASE AND FRONT PLATES.



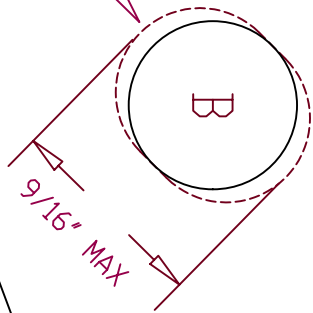
HARDENED 5/16 DOWEL PINS

LEVEL	REVISIONS	DATE
A	INSERTED TEXT AND DIAGRAMS REGARDING THE INSTALLATION OF THE CORNER BRACES.	02-17-93

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TOLERANCES, UNLESS OTHERWISE SPECIFIED FRACTIONAL: ? 1/64	FORM-FIT-FUNCTION				
MATERIAL 3/16" 4130 CHROME MOLLY	STD'S & RECORDS				
HEAT TREATMENT STRESS RELIEVE AFTER WELDING	DSGN.		TITLE STARTER WELDMENT (LYCOMING STARTER)		
SURFACE TREATMENT DEGREASE/PAINT: ZINK CHROMATE	APPROVAL				
	DWG. SIZE A	SCALE FULL	SHEET 5 OF 6	DOS FILE: WELDMENT . DWG	

ADJUST CLEARANCE SO THAT A 1/16" DRILL BIT
 SLIPS FREELY BETWEEN THE ROOT OF THE PINION
 GEAR AND THE LYCOMING RING GEAR. IF NECESSARY,
 ELONGATE HOLE "B" AS NECESSARY TO ALLOW THE
 STARTER TO BE ROTATED ABOUT BOLT "A". DO
 NOT EXCEED 9/16" ELONGATION TO ACHIEVE CLEARANCE.



TOLERANCES, UNLESS OTHERWISE SPECIFIED
 DECIMAL: .030

TOLERANCES, UNLESS OTHERWISE SPECIFIED
 FRACTIONAL: 1/32

MATERIAL
 3/16" 4130 CHROME MOLLY

HEAT TREATMENT
 STRESS RELIEVE AFTER WELDING

SURFACE TREATMENT
 DEGREASE & PAINT, RUST INHIBITOR.

DRAWN
 ART B. DATE
 1/4/92

FORM-FIT-FUNCTION

STD'S & RECORDS

DSGN.

APPROVAL

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 E-MAIL: CCIVORTEX@JUNO.COM

TITLE
 GEAR CLEARANCE
 LYCOMING STARTER

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 OR USED FOR MANUFACTURING PURPOSES EXCEPT ON
 COMPUTER CERTAINTY, INC. ORDER OR PRIOR WRITTEN CONSENT.

DWG.
 SIZE
 A

SCALE
 2 : 1

SHEET
 6 OF 6

DWG FILE:
 GEARS . DWG