Landing Gear RG
Contents

7.0 - Chapter Preface ........................................................................................................ 7-4
  7.0.1 - Parts List ............................................................................................................ 7-4
  7.0.2 - Tools List .......................................................................................................... 7-5
  7.0.3 - Supplies List ..................................................................................................... 7-6
  7.0.4 - Glass List .......................................................................................................... 7-6
  7.0.5 - Process Overview ............................................................................................. 7-6

7.1 - Nose Gear Door Installation ................................................................. 7-8
  7.1.1 - Nose Gear Door Cutout ..................................................................................... 7-8

7.2 - Nose Gear Installation ..................................................................................... 7-12
  7.2.1 - Nose Gear Bushings ......................................................................................... 7-12
  7.2.2 - Overcenter Linkage ......................................................................................... 7-14
  7.2.3 - Sequence Valve ................................................................................................ 7-14
  7.2.4 - Gas Spring ......................................................................................................... 7-15
  7.2.5 - Nose Gear Guides ............................................................................................ 7-16

7.3 - Main Gear Preparation ..................................................................................... 7-19
  7.3.1 - Gear Leg Preparation ......................................................................................... 7-19
  7.3.2 - Gear Leg Torsional Reinforcement .................................................................. 7-19

7.4 - Fuselage Preparation ......................................................................................... 7-20
  7.4.1 - Gear leg cut out ................................................................................................. 7-20
  7.4.2 - Drilling Holes for Main Gear Bushings ............................................................... 7-20
  7.4.3 Transverse Bulkhead Install .............................................................................. 7-21

7.5 - Installation of Main Gear Bushings ................................................................. 7-23

7.6 - Main Gear Pulley Installation ........................................................................... 7-25
  7.6.1 - Pulley Assembly ............................................................................................... 7-25
  7.6.2 - Main Gear Overcenter Linkage and Sockets .................................................... 7-26
  7.6.3 - Hydraulic Cylinder .......................................................................................... 7-29
  7.6.4 - Cables ................................................................................................................ 7-29

7.7 - Installing the Main Gear ..................................................................................... 7-30
  7.7.1 - Gear Legs .......................................................................................................... 7-30
  7.7.2 - Brake Lines ....................................................................................................... 7-30
  7.7.3 - Main Gear Doors ............................................................................................. 7-30

7.8 - Hydraulic System ............................................................................................... 7-34
  7.8.1 - Hydraulic Power Pack and Nose Gear Door Cylinder .................................... 7-34
  7.8.2 - Plumbing ........................................................................................................... 7-35
  7.8.3 - Pressure switch adjustment .............................................................................. 7-35
  7.8.4 - Electrical .......................................................................................................... 7-38
  7.8.5 - Final System Adjustments ................................................................................ 7-39

7.9 - Emergency Extension ......................................................................................... 7-41
  7.9.1 - Basics ............................................................................................................... 7-41
  7.9.2 - Nose Gear Safety Stick .................................................................................... 7-41
### 7.0 - Chapter Preface

#### 7.0.1 - Parts List

<table>
<thead>
<tr>
<th>Part Number</th>
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### 7.0.2 - Tools List

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7.0.3 - Supplies List

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7.0.5 - Process Overview

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<td>Remove Foam From Doors</td>
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<td>Glass Over Doors</td>
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<td>Cut Out Doors</td>
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<td>Make Lip Around Doors</td>
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<td>Cut 4 Swing Arms</td>
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<td>Mount Swing Arms</td>
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<td>Cut 8 Swing Arm Tabs</td>
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<td>Mount Swing Arm Tabs</td>
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<td>Install Nose Gear Pivot Hardpoints</td>
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<td>Install Overcenter Aluminum Plates</td>
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<td>Install Keel</td>
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<td>Attach Captivator Plate</td>
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7.1 - Nose Gear Door Installation

7.1.1 - Nose Gear Door Cutout

The fuselage comes to you with the cutout location for the nose gear door flange already recessed into the fuselage.

Measurements are taken along curvature of fuselage

![Diagram of nose gear door cutout location]

Cut out the recessed area for the nose gear doors leaving 1/4” to 3/8” of lip around the hole to serve as the door flange.

![Diagram of nose gear door foam contour]

Your kit comes with a premolded nose gear door, p/n VMNGD-01, and also with the flange for the gear doors already molded into the fuselage.

Trim the doors to fit in the hole.

Trim premolded nose gear doors to trim line on part. Sand edges to get final fit in nose gear cutout.

![Diagram of nose gear door cutout trimming]
Cut four swing arms from the 3/8" fiberglass laminate using template at the end of this chapter. The laminate is supplied in the kit (VFPSA-01).

Cut two 3/8” grooves at the rear of the gear door through the inside skin and two 3/8” grooves in the front as shown in Figure 7-5, for the aft swing arm installation.

Reinstall gear door and Bondo securely in place from the outside. Place the swing arms in place on the gear doors and check for contact with the bottom skin. File swing arms until a good seat is achieved.

Assemble two 26” long 1/4” threaded rods, along with the swing arms, in such a way that the swing arms seat themselves in the previously made 3/8” grooves in the gear door. The bottom of the forward arms should fit against the inside glass surface of the door. The threaded rod can be purchased at a hardware store.

Trial fit and adjust as necessary. Once satisfied with the fit, Micro-Glass the 3/8” grooves and work the swing arms down into these grooves, forcing excess Micro-Glass out. On the forward swing arms, spread Micro-Glass under and around the contact area. You can hold them in position by placing one of the elevator counterweights between the swing arms. After curing, sand and lay-up 2 BID over the top of the swing arms to reinforce the attachment.
Using templates at the end of this chapter as a guide, make eight fiberglass tabs. These tabs are used to hold the swing arms to the fuselage and can be made from two layers of cured TRIAX, 5 plies BID or trimmings from any lay-up that is between 1/16” and 1/8” thick.

Trim the tabs until they will fit in all eight positions and attach the tabs to the respective swing arms with AN bolts, washers and nuts. See Figure 7-7.

The tabs should have a slight amount of clearance between the tab and fuselage to prevent binding. Use 5 Minute Epoxy to attach the tabs to the fuselage and allow to cure for at least 30 minutes before moving.

Measure gear door both front and aft and find the center. Draw a line connecting these two point and cut on this line.

Remove bolts and washers and hacksaw the gear door into two halves using the one inch cuts you have made in the nosegear doors.

After completing cut, break loose from Bondo and remove the gear doors.

Glass the tabs onto the fuselage using two plies BID on each side.

After cure, drill out 1/4” holes in the tabs.

It will be necessary to do some filing to keep the gear doors from catching on the fuselage.
Figure 7-10. Bevel nose gear door edges to prevent interference.

The final assembly will look as shown in Figure 7-11.

![Diagram showing modified nose gear door edges]

Figure 7-11. Nose gear door hinge detail.
7.2 - Nose Gear Installation

7.2.1 - Nose Gear Bushings

Figure 7-12 is an overview of the nose gear installation. Plywood inserts are installed in the keel as described in Chapter 6. Before continuing you should prepare the keel as described in that chapter. Trial fit the nose gear, shock, and linkage to make sure everything aligns properly.

Figure 7-12. Nose gear actuator assembly.
Slide a 1/4" drill (long snake bit) through the holes that you had the waxed pins in for keel preparation. Check alignment and if off, ream the hole slightly to align.

This step is done after the TRIAX reinforcements are done. Section 6.3.8

Using a 1" hole saw, cut through the keel hardpoints creating a 1" hole in each side of the keel. Slide the plate with the bushing attached into the holes from inside the keel as shown in fig. 7-13. You may have to file the holes slightly to get them in.

Insert the nose gear and slide the bolt through. Rotate the gear up through the hole to make sure the top of the gear lines up in the center of the keel and that the end of the nose gear comes up through the center of the hole. If it is off, you can file the holes a little to line it up. If your alignment is off your plane will not taxi straight without correction.

Once satisfied with the alignment, install the bushings with a mixture of structural adhesive and Flox using the gear as spacer. Put enough Adhesive under both the inside and the out side plate to allow some of the adhesive to squeeze out. Using the holes drilled in the outside plate as a template drill one 3/16” hole through the keel. Install one of the AN3-11A bolts through both the outside and inside plates. Drill the remaining holes and bolt the assembly together. Put a non-locking nut on the bolt and snug it up lightly since you do not want it jammed in there.
The other predrilled holes in the keel need to be opened back up since the hardpoints that were installed would have covered them.

Note: Do this step after installing the keel and reinforcing lay-ups inside. See section 6.3.8. With the upper part of the gear parallel to the canard bulkhead and the overcenter linkage overcenter 1/2". Bond the captivator into position. Once cured, remove the gear assembly and bolt the captivator in place.

Note: the linkage is overcenter by 1/2" for this step which will allow a slight push on it when the gear is down and locked. The final overcenter position is 1/8" to 1/4" overcenter. See Figures 7-12 and 7-14.

7.2.2 - Overcenter Linkage

Install the nose gear, shock and linkage temporarily. See Figure7-12. Check alignment so that the top of the gear leg is parallel to the canard bulkhead and front plane of the keel when the linkage is overcenter 1/8" to 1/4". Adjust its position by adjusting the mounting hole on the upper side of the keel.

Install the aluminum plates as shown in Figure 7-15.
### 7.2.3 - Sequence Valve

The sequence valve is installed so that the gusset that is installed on the nosegear to strengthen the pivot tube will slowly push on the sequence valve plunger as the gear comes up. This location works well because it allows fluid to slowly enter the nose gear door cylinder and it slowly closes.

With the nosegear in place rotate the nosegear up and cut out the canard bulkhead to allow the gear to come up into the wheel well and allow the tire to clear the nosegear doors. Measure one inch from the inside of the keel on the copilots side towards the center of the canard bulkhead. Relieve the hole you cut out for the gear leg back to this line. Bend your sequence valve mounting bracket 90 degrees so that one of the sides is 2 1/2” long. The 2-1/2” side will run along the front of the canard bulkhead and the other side will extend down in the keel. Install the sequence valve with the adjustment screw set in the middle of its travel so that the plunger is actuated as the main gear passes through the nose gear door opening. Bolt the sequence valve to the bracket using 2 AN3-11A bolts and 2 MS21083N3 nuts. Use two AN3-5A bolts and two MS21083N3 nuts to attach the bracket to the canard bulkhead just in side the keel.

Note: The sequence valve will be right next to the gear when it is in it's proper position. Make sure the sequence valve and the gear do not rub. Make sure that the sequence valve does not hinder the gear from reaching its full up position.

![Diagram of sequence valve installation](image)
7.2.4 - Gas Spring

The gas spring is mounted to the plywood insert in the side panel directly below the pivot, and extends up to the arm off the overcenter linkage. See Figure 7-12, and 7-17. It is adjusted to be almost fully extended when the linkage is slightly overcenter.

**VNGGS-01 Assembly: Nose Gear Gas Spring**

![Diagram of Nose Gear Gas Spring]

7.2.5 - Nose Gear Guides

The purpose of these guides is to keep the nose fork straight as it goes into the wheel well.

First lay up 7 plies of BID or equivalent (about 1/8” thick) on a piece of plastic on a flat surface and let cure.

Each guide consists of two pieces, one rectangular and one triangular. Refer to figure 7-19, mark and cut two of each piece.

Position the rectangular guide flush with the edge of the opening and trim the bottom of the triangular support as necessary to fit the bottom of the fuselage. You can let it span across the joggle near the edge of the door opening.

Hot glue or Bondo the pieces in place so that they are centered at the axle location when the gear is retracted and glass them in with two BID all the way around. No glass is needed on the face that is at the edge of the opening.

![Figure 7-17. Nose Gear Gas Spring]

**Figure 7-18. Layout pattern for gear door swing arms. (VFPSA-01)**
Figure 7-19. Nose gear guides.

Figure 7-20. Nose gear cylinder attachment and swing arm tab templates. Photocopy to use.

Note: Not done to scale

Figure 7-21A Bracket for Sequence Valve
Nose Gear Slot Template for Cutting Canard Bulkhead
Template - Photocopy to use - Don't use original

Figure 7-21B. Nose gear locator channel.

Figure 7-22. Swing arm template. Photocopy to use.
7.3 - Main Gear Preparation

7.3.1 - Gear Leg Preparation

The main gear comes to you with a 5/8” hole where the bushing will go. This hole should have been reamed for a good fit here at the factory so you should not have to do any fitting.

7.3.2 - Gear Leg Torsional Reinforcement

- Completely sand the legs with 36 - 40 grit sandpaper in preparation for the torsional lay-ups.
- Jig the gear legs, leading edge down with the tips on the table, and lightly Bondo them so they can not move around. Try to avoid getting any Bondo on the other surfaces of the gear leg.
- Cut several 10” wide strips of UNI at a 45 degree angle in preparation for these lay-ups.
- You will be installing an 1-1/4” tall steel collar on top of the gear leg so lay your torsional wraps up to this point. If you lay them further you may have to grind them back off to allow the collar to fit. Lay-up six UNI at a 45 degree bias over the gear’s trailing edge, down both sides of the gear. Each layer should be applied at opposite angles so you end up having three one way and three the other (crisscrossed). Lay them up as follows:

  The first two crossed layers go the full length of the gear. The second crossed pair goes from the tip and extends 3” past the bushing location. The last two crossed layers begin 21” from the bottom tip of the leg and extend up to the bushing location. If you need to splice pieces together, do not overlap them, just butt them together.

  After this six-ply UNI lay-up has cured, break them loose from the table, turn them over, and trim the rough edge. Taper it so there will be a fairly smooth transition for the last set of six plies of UNI. Completely sand the gear legs and bond them to the table again, this time trailing edge down.

  Lay-up the last six UNI plies exactly like the first six. When cured, trim and sand smooth without damaging the lay-up. Reopen the bushing holes using a drill and a round file.

At this time you can locate your axle position, on the right gear leg only, by measuring up from the bottom of the gear leg tip (from the mold line if there is one) 3”. This mark should be on the outside surface and 1/4” aft of center of the leg. You’ll mark the other one later when the gears are installed so you get them level.
7.4 - Fuselage Preparation

7.4.1 - Gear leg cut out

On the fuselage you have a premarked location for your main gear cutout. You have also been provided a template. The template should line up approximately 3" in front of the cowling cut out line. If your spar is further away from your firewall on one side you will have to adjust your cutout to accommodate this. When satisfied with the location of your template remark the fuselage if need and cut. At this point you can undersize your cut and once the gear leg is installed you will then trim this hole to allow clearance for the gear leg.

7.4.2 - Drilling Holes for Main Gear Bushings

The firewall, gear bulkhead and gear pockets will need to be already installed as per chapter 5. We are now going to drill out the 1/4" holes in the firewall and gear bulkhead to accept our bushings. First we need to check to make sure our 1/4" are lined up with each other in all directions. You will need the fuselage level in both directions for this. Take and insert two long 1/4" drill bits in both sides through the gear bulkhead and the firewall. If you do not have two long drill bits use 1/4" Allthread but make sure it is straight. Look in the side of the fuselage through the gear cutout and see if the drill bits line up across ways. You can also put a long level across them and make sure they are level with the top of the gear pockets. For now just note if they are not level we will do something about it after the next step.

Next we want to measure the distance between the drill bits from left to right both in front of the gear bulkhead and behind the firewall. If measurements are the same we should be parallel. You also will need to put a square on the drill bits at the firewall to make sure they are perpendicular with it. If any of the last three steps shows that your holes do not line up with each other we will have to fine tune them until they do. Using a round file you can adjust one of the hole on the firewall until they both match. You only want to adjust the holes on the firewall not the gear bulkhead and you should only have to work with one.

Now that we have our holes lining up we will open the hole size to accommodate our bushings. Take a long 1/4" drill bit and insert it through your gear bulkhead. After it is through the bulkhead put a 1 1/4" hole saw onto it. Line up the drill on you 1/4" hole you just adjusted on the firewall and cut halfway through the firewall.

Note: Make sure you do not go all the way through the firewall. If you do you will not have a 1/4" hole to line up your cut in the gear bulkhead.
Take the hole saw off and now Insert the drill bit through the firewall and put the holesaw on. Cut a hole halfway through the gear bulkhead. Go back and forth cutting the hole deeper in both the firewall and gear bulkhead until you are through. Repeat with the other side.

Figure 7-25. Drilling for main gear bushings.

### 7.4.3 Transverse Bulkhead Install

First you will need to temporarily put the 1 1/4” knurled bushings in the holes you drilled in the firewall and gear bulkhead. You will also need to install the long steel gear leg bushing in the main gear legs centered so there is about 3/4” sticking out both in front of and behind the gear leg. Insert the gear legs through the gear hole you cut out earlier in this chapter. Raise the gear leg up and trim the opening as you go. It is best to have approximately 1/8” clearance around the gear leg. Take a straightedge off the bottom of the spar and trim the hole up until the top axle bolt holes are above the straight edge. You will need to trim the top horizontal part of the gear pockets in order to allow the gear to come all the way up. You will want at least 3/32” clearance from the horizontal bulkhead (horizontal part of gear pocket.)

Figure 7-26. Checking Gear full up position

At this stage you should check your long steel bushings and make sure they are positioned properly in your gear. Raise your gear all the way up and make sure you are not rubbing the spar especially on the copilots side where there is a dimple on the top of the gear leg. You can move the gear on the bushing now if there is a problem. Another thing to check is how the two gear leg tops line up inside the airplane with the gear up. They should be in line with each other. When satisfied with your placement mark the long steel bushing on both sides of the gear.

There is a template provided for the transverse bulkhead. You want to check the fit of your transverse before you cut out the foam bulkhead. This bulkhead joins the firewall and gear bulkhead above the bolt from the bend up to the horizontal bulkhead (top of pre-made gear pocket.) See figure 7-27. With this piece in place, recheck with the gear up to make sure you have the clearance. When the gear is all the way up, that bump on the gear should touch the bottom of the transverse bulkhead, so keep the bottom out as far as you can. If you don’t the engine mount bolts may interfere with the transverse.
When you are satisfied with your fit and you have marked this position, use Bondo to attach the bulkhead on the top ledge first. This allows you a final check of with the gear up to get the bottom of the bulkhead where you want it. Bondo the bottom of the template.

Figure 7-27. Transverse bulkhead position

Be careful when you remove the gear not to upset the bulkhead. Get your lay-up templates and lay them in position to check for fit and modify if necessary. When satisfied, cut four plies of TRIAX, two for each outside off one template, and four plies, two for each inside off the other template.

Pre-wet the TRIAX on plastic. Let these layups sit 1 to 2 hours until they are tacky. This is so they will stick to a vertical service without draining epoxy. Micro-Slurry the foam, radius corners, and apply across the transverse bulkhead, lapping onto the firewall, gear bulkhead, across the bolt holes in both directions, up to the horizontal bulkhead on the outside, and up onto that bulkhead on the inside. Once in place, remove the plastic and squeegee. Make sure the lay-up stays in the corners. You may use a hair dryer to heat up your layup to ensure a good bond.
7.5 - Installation of Main Gear Bushings

Now that the transverse bulkhead is installed we can permanently install our main gear bushings. After the glass has cured for our transverse bulkhead go back and reopen your bushing holes with your 1 1/4” holesaw. Remove the long steel bushing from the gear leg and scuff it up between the marks you made in the last section. Using VelociPoxy and Flox or structural adhesive bond the long steel bushing inside the gear leg. Insert the gear leg back into the airplane and also bond in the knurled bushings, one in the firewall and one in the gear bulkhead. The steel insert inside the knurled bushing is flush on one side and recessed on the other. Make sure the flush side is facing the gear on all bushings. Vaseline the bolts and washers before you insert and lightly tighten them. Rotate the gear up and verify that the gear clears the spar in the up position making sure the gear tops are lined up see figure 7-31. Support the gear and let the whole assembly cure in this position. If you have a fastbuild install your Over Center linkage to keep the gear legs lined up.

Carefully remove the gear up through the fuselage. You may have to twist the gear after it is part way out to remove it. Sand the outside surfaces, micro-glass around bushings for a smooth transition, and apply two layers of 4” x 4” TRIAX over the bushings on the gear bulkhead and two layers of 4” x 7” TRIAX on the firewall. (The 7” dimension is horizontal). Put a fillet around any bushing material that is not flush with the bulkheads.

Note: These layups do not go between the bulkheads.

During your final assembly and checks, make four bushings or spacers that fit over your 5/8” bushings against the front and back sides of the gear. Measure the amount of bushing sticking out and make them slightly small so that when in place, the gear will fit between the aluminum bushings without being tight.
*Make sure your bushings are flush or slightly protruding towards the gear leg.

Figure 7-30. Installing Main Gear Bushings VMGBBA-01

Figure 7-31. Main gear strut alignment.
7.6 - Main Gear Pulley Installation

7.6.1 - Pulley Assembly

The hardpoints for the hydraulic cylinders have been installed at the factory.

Center the templates between the bolts at the bottom of the gear bulkhead. Make sure your template is on the floor of the fuselage. You want to keep the bottom of the pulleys in line with the cylinder shaft. Mark the holes and cut them out. Drill a good sized hole first, then use a jigsaw to do the work. See Figure 7-33.

Cut out your stiffeners and Bondo in place 6” apart and glass in place as shown below. Basically you have 1 ply TRIAX from stiffener to stiffener across the floor and 1 ply TRIAX from stiffener to stiffener across the bulkhead and holes. Use two plies of BID on the outside of the stiffeners. Cover the stiffeners with two plies of the BID from the floor up and then two plies of BID from the bulkhead on to the stiffener. See Figure 7-33.

The pulley system consists of various aluminum parts, pulleys, and hardware. Bolt the system in place as shown in figure 7-34 and enlarge the holes so the pulleys work freely through their motions.

The aluminum angle is the last thing to be installed. Slide it up in place in front of the pulley holders to find the hole position. Drill the holes and slide in place verifying the fit.

With the aluminum angle against the pulley holders and with the bolts slid in place, drill a couple of 1/8” holes down through the aluminum angle and skin. After sanding the surfaces, VelociPoxy Micro-Glass (Structural Adhesive) and rivet the angle into position (FloxC may also be used.)

Clean off any excess Micro-Glass and slide and bolt the pulley holders in place. Do not tighten it up to ensure they move freely after the installation is complete.
Note: Check assembly for unobstructed movement and clearance around the RG cables. You may need to relieve the aluminum parts with a file to assure there is no binding. If the pulley holders are installed too high a side load will be placed on the main gear cylinder and will cause it to wear prematurely.

7.6.2 - Main Gear Overcenter Linkage and Sockets

While your gears are in the fuselage, mark them where they touch the bottom of the horizontal bulkhead (Top of gear pocket) and then remove them.

Verify that the distance from the center of the 5/8” pivot bushing to the top of both gear legs is 17”.

Clean the ends and install the steel collars flush with the top of the legs with VelociPoxy Micro-Glass (Structural Adhesive).

Duct tape the whole area down past the mark you made. Pre-wet three plies of TRIAX, axis the long way, wide enough to reach at least 1/3 the way around, and long enough to go past your mark at the bottom. Lay the TRIAX on your gear legs and let cure. After cured, remove the sockets, and remove the duct tape. This piece becomes the Gear Socket into which the gear leg will fit when extended.

Find the center of those collars on the forward side (facing the nose), and drill 3/8” holes just through the steel collar on both gears.

Make a jig by taking a nice piece of straight lumber, 2” x 2” x 28”, and drill two holes 26” apart, parallel to each other and level. It’s easiest to do this on a drill press. The 26” dimension does not match the overcenter linkage, it is for ease of drilling.

Slide two bolts through the holes and check their alignment. Put your drilling jig up in place against those collars. Make sure the gear legs are an even distance out from the firewall. If one gear is further back than the other, you will have to position your jig out away a little so your holes will go through straight and parallel to the center-line of the fuselage. Have someone help you.

Level the board as you drill the hole a little at a time. Drill half way through, slide a bolt in the hole, drill half way through the other side. Repeat until all the way through.
Slide your sockets back onto the legs and, using your overcenter linkage (slightly bent so it is longer) as a gauge, start notching out the horizontal and slanted bulkheads to lower the gears down to their proper positions.

Check the gear cambers as you do this so you can get both sides the same. Refer to figure 7-38.

Check your bottom cuts in the fuselage outside the ducts to make sure you have clearance.

We find it easiest to use a saw for the initial cuts, then a coarse file to finish them.

When the linkage goes easily through its motion, trim the sockets down in size so they are flush with the top of the slanted bulkhead, flush with the bottom of the horizontal bulkhead, and wrapped around the gear within about 1/4" of the hole.

Do not install these sockets yet as they make it difficult to do your tape glassing when you put your strakes on. Make sure the airplane sits level on the ground before permanently installing the sockets. The sockets can be adjusted left to right to make the airplane sit level. Refer to figure 7-38.
Figure 7-39. Main gear cylinder installation.
7.6.3 - Hydraulic Cylinder

___ Locate the three wood hardpoints in the floor as described in Figure 7-40.

___ Mount the front cylinder mounting brackets with a total of (4) four MS24694S-109 screws and bolt in place using (2) two MS24694S-109 screws as shown in Figures 7-39 and Figure 7-40.

___ The cylinders do not have to be exactly in the middle of the hardpoints. If the cylinder is closer than 29-1/2” from the bulkhead check to make sure that the end of the cylinder shaft is far enough away from the pulleys to allow the rod ends to fit.

7-40. Main Gear Cylinder Mounting

7.6.4 - Cables

___ With the gear down and centered, and the overcenter link straight you can install the cables. You may want to wait until your gear sockets have been permanently mounted before doing this but as long as the legs are in the right position, you can proceed.

___ Adjust all of your rod ends (3) to about the middle of their travel. Assemble them in the method prescribed in the blowup views in fig. 7-39. Extend the clean end through the pulleys and up to the overcenter linkage tabs. Route the cables around the AN111 thimbles with the bolt in place to simulate the proper length and mark the cables. Make sure the rod ends are all lined up since they will angle when pulled one at a time.

With the cylinder fully extended and the gear down and locked the cables should be a little snug. Too tight and the OC link can be prematurely actuated. If the cables are really loose a cable can come off a pulley.
7.7 - Installing the Main Gear

7.7.1 - Gear Legs

Install both gears in the fuselage, with the overcenter linkage in place and centered, and the fuselage leveled laterally and the cambers the same on both sides.

![Diagram of Main Gear Legs](image)

From the previous axle position mark that you put on one leg, pull a string from that mark to the other leg. Use duct tape to hold the string on. Level that string with a 4 foot carpenter’s level, and mark the other gear.

Remember that the axle position on the right gear leg was 1/4” aft of center. Locate this axle 1/4” aft as well.

Move the gear up and down with the linkage installed. Ensure that there is clearance between the top of the gear leg and the linkage and grind the top of the leg and steel collar as necessary.

7.7.2 - Brake Lines

Cut two pieces of Nylaflow, one for each side, that will reach from the calipers up about 1 foot inside the fuselage. You will trim and hook the lines up later. Some builders have elected to mount a slightly larger Nylaflow conduit or drinking straws, which will contain the smaller Nylaflow brake line so that the line may be replaced in the future.

First **5 Minute Epoxy** the line in place along the bottom leading edge of the gear leg. Once installed, **Micro-Glass** the sides of the Nylaflow and glass with one ply of BID from 10” from the end of the leg to within 1/2” of the fuselage.

7.7.3 - Main Gear Doors

**Note:** Before installing the main gear doors, the fuel strakes must be completely installed. Go to Chapter 9 for instructions on the fuel system.

The last step of fuel strake installation is glassing the spar to strake junction. To do that, you will need to invert the fuselage.
Keep the fuselage upside down to do this section. The gear doors come to you premolded, but without stiffening foam. This allows some flexibility while fitting.

Once satisfied with the fit, hot glue or Bondo some wood stiffeners on the flat outside section of the door. Remove the door and add the foam stiffener. 5 minute works fine to attach this foam. Transition foam down to the glass, allowing 1/2” of glass to glass. Add two plies BID over the whole gear door inner surface, covering the foam. See Figure 7-44.

Put the gear up inside the wheel well within 1/8” of the top skin with the use of a spacer under the tire. Set the gear door over the hole, and mark the strake all around the gear door and also put marks outward from the gear door every 3” or so. Transfer the marks onto the gear doors. Remove and measure the amount to trim off all around the gear door and trim. Make sure you do not cut too much away as you will use sandpaper in the slot later to get the fit just right:

Keep trimming the glass tab back until the gear door is flush with the hole. These doors don’t overlap the strake. Make sure the gear door is flush everywhere else.

Put a little Bondo on the glass tab and set the gear door in place, flush with the strake. When the Bondo has cured, carefully remove the gear door, sand the Bondo and mating areas, and glass on with two plies BID on both sides with at least 1/2” overlap.
At the tire or tip of the gear you will need to make an aluminum plate with the 1/8" aluminum and template provided at the end of this chapter.

Drill the holes and install. Bend the tabs out and then flat to mate with the gear door.

When in place with all tabs touching, shine a light from underneath, and drill the four holes for attachment. Use #8 anchor nuts and attach to the aluminum fingers. As in the rest of the gear doors, you should countersink the holes and use countersink washers to mount them:

With the gear door mounted, it must be trimmed so that it doesn’t hit the fuselage when the gear is down. Allow at least 1/16” to 1/8” clearance.
With the gear up, use some sandpaper with the sandy side facing the door, to sand a 1/8" gap all around the door for clearance.

Once the fuselage is turned back over, you can go ahead and install those sockets you fit a long time ago. **Make sure you have already checked your tank for leaks because after the sockets are installed it is hard to get at the back portion of the tank.** Slide the sockets onto the gear legs and install the overcenter linkage. Put some **Micro-Glass** into the slots where the sockets will go. Lower the gear into the down and locked position.

After cured, sand and round rough areas, add a **Micro-Glass** radius where it contact the gear bulkheads, and glass the sockets into place with two **BID** at each junction. Make sure you do not get any glass on the inside surface of the socket where it comes in contact with the gear.

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7.8 - Hydraulic System

7.8.1 - Hydraulic Power Pack and Nose Gear Door Cylinder

The power pack is a self contained unit comprising motor, gear driven pump, and reservoir. The unit can actually be in any one of several locations. The recommended location is on the forward side of the canard bulkhead on the copilot side.

Position the power pack for minimum interference and accessibility. Mark hole location and drill through the bulkhead and mount with appropriate bolts.

Figure 7-51. Nose gear door cylinder.

Drill #21 holes in the nose gear swing arms 2-3/16" from the mounting hole and tap for 10-32 ball joint studs.

Assemble the actuating linkage to the cylinder (if not already installed) and attach to the swing arms. Attach the aluminum angles (VAANGD-01) to the upper end of the cylinder with (1) AN3-13A bolt. With the gear doors closed and the cylinder completely retracted, attach the angles to the bulkhead with AN3-8A bolts.

Position the slide guides (VAASG-01) as shown. Extend the cylinder fully and place the slide guides so you are at the bottom of the grooves. Attach with (4) #10 sheet metal screws. See figure above.

Extend the cylinder to check the movement of the gear doors. Make sure the slide guides do not interfere. If the slide guides prevent the gear door from closing fully the slots in the guides can be opened up to allow the travel needed.

If the slide guides do not limit the free play in the gear doors when the cylinder is extended, you may add shims between the lower fuselage and the swing arms.

Recheck the movements of the system and adjust the linkage if necessary.

Attach the springs with a slight tension on them. **Caution: Too much tension will stretch the springs when the cylinder is retracted.**
Once all is adjusted properly, hand check the up and down positions of the nose gear doors to insure proper action. **Loctite** all in place except the upper ball joint to pushrod joint. This can later be trimmed if needed for adjustment. **Note:** The ball joints are made to snap out of the mating part, making disassembly and reassembly easier.

Proceed to complete assembly of all cylinders and sequence valve if you have not yet done so.

**7.8.2 - Plumbing**

The plumbing of the hydraulic system includes proper AN fittings, high and low pressure switches, aluminum tubing, flex hose, and associated hardware. Aluminum tubing must be bent using spring bending tools or better.

It is also important to buy or borrow a proper 1/4” tube flaring tool. Remember, we are using AN fittings and proper flare is important. That means a flare of 37 degrees. **A standard automotive flare (hardware store variety) is different and using it with these fittings will cause a system failure!**

Mount the AN804-4D firewall unions through the bulkhead in the positions as shown in Figure 7-52.

Mount the high and low pressure switches to the pump using AN834-4D T’s.

Route aluminum tubing and connect per Figure 7-52.

Route aluminum tubing to sequence valve and dump valve per Figure 7-54.

The dump valve mounts on the copilot side of the keel in the premarked position just in front of the instrument panel. It can be located elsewhere.

Assemble the hose fittings to the hydraulic hose and attach to the cylinder as shown in Figure 7-52.

To assemble the hose ends first take a 3” long piece of 2”x2” wood and drill a 3/8” hole down through the center of it. Cut your block in two running right down the center of the hole you just drill lengthwise. This will be used to clamp the hose. Insert a 3/16” drill bit into the end of your hose. Insert the hose in your block with about 1-1/4” sticking above the block and clamp it in a vise. Use oil as lubrication while assembling. Take the outer sleeve portion of your end fitting and screw it onto the end of your hose counter-clockwise. You will be able to see the end of the hose bottom out inside the fitting. Remove the block from the vise and using pliers remove the 3/16” drill bit. Clamp hose end in the vise. Insert an 1/8” drill bit into the insert portion of your end fitting. This will help guide the insert as it is started into the hose. Using a 9/16” wrench, screw the insert in clockwise until it bottoms out. Try not to stop while screwing the insert in. As you screw in the insert the friction heats up the hose and makes it easier to screw it in. If you stop and start while screwing the fitting in you will have a harder time. **Do not try and make it too tight.** You will wind up snapping the head off of the insert. Remove the 1/8” drill bit.

**7.8.3 - Pressure switch adjustment.**

Both pressure switches may need to be adjusted. To do this will require a 0-2000 psi gauge. Some people have install permanent gauges in their airplanes but it really is not necessary.

Plumb the gauge into the retract side first, and once you have cycled the gear a few times to remove air from the system, remove the rubber cap from the pressure switch. This will expose one screw adjuster.

Increase pressure by turning clockwise (tightening) equally so the gear will complete its full cycle without the pump cycling and pressure will show about 1000 psi when everything shuts off.
Repeat for the extension side. However you will need to reduce pressure by turning the screw counterclockwise until the pump shuts off when reading approximately 500 psi on the gauge. You will, of course, need to plum the gauge into the gear down side of the system.

If, when flying the airplane, the pump cycles rapidly while the gear is retracting, you should adjust the gear up pressure switch to a higher pressure. This can be done without a gauge, by making quarter turn adjustments to the screws and trying again until the gear cycles without the pump turning off prematurely.

With the exception of bleeding the air from the system, this should complete the plumbing.

Figure 7-52. Hydraulic plumbing schematic.
Figure 7-53. Forward face of canard bulkhead.

Figure 7-54. Hydraulic line routing.
7.8.4 - Electrical

The gear motor will pull about 30 amps, thus, it should be operated via relays so that the switch can be standard size and rating. Two relays are required since the motor must run in both directions.

___ Install the two relays on the canard bulkhead just above or beside the pump motor and wire per Figure 7-55.

___ Install the gear warning horn in a location to insure proper audio level. The glare shield is an ideal location

___ Install the gear warning micro switch to the throttle linkage in such a way that the last 1” of throttle movement toward idle will activate the switch. This can be done at the fuel servo.

Install the nose gear overcenter safety strap and microswitch as shown in Figure 7-56.
See Figure 7-55 for complete landing gear electrical detail.

![Diagram of overcenter stop and microswitch bracket detail - top view]

**Figure 7-56. Overcenter microswitch detail.**

Mount the microswitch on the forward, right side of the linkage so that it is activated by the safety control arm. Position it so the switch is closed when the main gear is down and locked. The overcenter stop that this microswitch mounts on is installed in section 7.8.5.

The main gear down microswitch is located on the main gear OC link. The lock arm on the OC link actuates the micro switch when it locks in place.

Install the gear switch and lights on the instrument panel in easy view of the pilot. The gear switch has extra terminals to use as a Hobbs meter switch if desired, i.e.: wheels up activates Hobbs.

### 7.8.5 - Final System Adjustments

The gear down position must be determined first.

For the nose gear, you must adjust the linkage and shock to go overcenter about 1 to 2 degrees (1/4”). The reason for this is in case of hydraulic failure, when loaded, the linkage will be pulling on the cylinder, not pushing which would cause a collapse. Use a level finder on both the shock and linkage as you adjust the rod end to allow this. After you have adjusted this right, screw the rod end all the way in and count the number of turns it takes. The reason for this is that you will have to remove this a few times until you get the gear up position done. This way you won’t have to keep adjusting it every time you put it on.

When your cables are installed you set their tension for the down gear position. After the initial retract, you’ll need to readjust them because of cable stretch. For the main gear, the rod ends must be adjusted so the cables are snug but not tight to allow the overcenter linkage to go straight. The gear up position can now be adjusted.
The gear-up adjustment for the nose and main gears is accomplished using spacers on each cylinder shaft. (nose p/n: VASNGC-01, main p/m: VASMGC-01). You will probably need to trim these spacers to create a physical stop between the large area washer on the rod end and the main gear cylinder when the gear is fully retracted. An easy way to do this is to retract the gear up using the hydraulics. Be careful not to go to far and stretch your main gear cables. Stop the gear when your tires touch the top of the wheel well. Check both gear legs because the arrangement can tetter allowing one but not both wheels to touch. When you are satisfied with your up position measure the distance from the cylinder body to the stop washer. Cut your spacer to this dimension. If your spacer is not long enough, add washers as shims between the spacer and stop nut.

Note: The main gear cylinder already has one wide area washer sandwiched at the end as a bearing surface for the aluminum spacer.

It is important to have cylinders properly adjusted. The requirement is to have the cylinders bottom out against the spacer on the cylinder shafts. With the gears in the retracted position, the hydraulic pressure must not be putting a load onto the gear overcenter linkage but rather be carried by the spacer.

Warning: Do not add washers between the spacer and cylinder body as this could interfere with the downward travel and prevent the gear from locking in the down position.

___ With the gear all the way retracted the spacer should have pressure on it. If you are able to rotate it with relative ease, then it is not doing its job and will require a washer as a shim.

___ With the main gears up where you want them, gear doors flush, fashion some rubber spacers to fit at the junction of the horizontal and transverse bulkheads so the gears don’t move side to side.

___ Adjust the sequence valve screw and nut so that it activates just as the gear is up in the hole. This might take a little while to get right. Make sure it is not adjusted out so far that it starts bending the attach bracket.

___ Test the main gear overcenter linkage locking arm for proper operation. Make sure no binding occurs that could cause it to jam. Follow this procedure:

With the aircraft on jacks, put the gear switch in the “UP” position. As soon as the nose gear starts up, pull the breaker to stop the pump. This will load the cables while the main linkage is still locked. By hand, move the locking arm up and down to check for smooth operation. Some filing of the slot on the arm may be necessary to achieve smoothness. After doing this, do a full retraction test to be sure everything works properly.
7.9 - Emergency Extension

7.9.1 - Basics

When the landing gear is retracted in a Velocity it is held up in place by hydraulic pressure. There is a dump valve that is located between the high pressure side (up) and the low pressure side (down) in the Velocity gear system. In the event you have an electrical failure you can lower the gear by opening the dump valve. The main gear will positively lock in to their down position by gravity alone. The nose gear doors have springs installed on the cylinder to help open the doors during an emergency extension. The nose gear has a 90 lb. gas spring installed on the overcenter linkage to help it lock into its overcenter position during an emergency extension. Once the nose gear clears the doors as it is dropping it will also have wind loads to help push it into position.

7.9.2 - Nose Gear Safety Stick

The velocity nose gear uses a gas spring to hold the nose gear overcenter against the overcenter stop. There is a possibility that after years of use the gas spring can loose its pressure and not work properly. Since there is that possibility that your gas spring may not have enough force to push your gear into the overcenter position there is a way to check to make sure the nose gear is in the overcenter position before landing in an emergency situation.

You will need to get an 8 inch long 1 inch diameter wood dowel. Using a 1-1/8" diameter hole saw you will drill two holes in the keel that are positioned just under the pivot point of the overcenter linkage and shock as shown in figure 7-57.

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Figure 7-57 Nose Gear Safety Stick Hole

In the event that you need to do an emergency extension. After the gear is fully extended close the dump valve then insert the safety stick about half way in the hole in the keel on the pilots side. Push the stick down and pivot it on the keel so the other end of the stick will push up on the pivot point between the shock and the overcenter linkage. What you are doing is verifying that the linkage is up against the overcenter stop. The stick is long enough that you can then insert it in to the keel and partially out the copilots side and leave it there during your landing. This is just a little extra insurance to make sure the gear stays overcenter during your landing.

Another use of your safety stick is as a strake dip stick. When you calibrate the quantities of your fuel strakes you can mark your safety stick at the same time. Once it is marked if you are worried about the wood absorbing fuel you can paint a coating of epoxy on top of it to seal it.
Figure 7-58. Gear door holder and backing plate template. Photocopy to use.
Figure 7-59, Transverse bulkhead template. Photocopy to use.

Transverse Bulkhead

Make 2

I/4" Foam

1/4" Foam

Bend in bulkhead

173 Cut line - 5-3/8" high

Standard wing cutline - 6-7/8" high
No More than an 1/8" off the Floor

Pulley cut-out in gear bulkhead

Centered

Figure 7-60. Pulley cutout template. Photocopy to use.

Figure 7-61. Main gear pulley support template. Photocopy to use.