Section 12
Engine, Torque Link and Clutch

Procedures covered in this section:
Install upper engine mount cup; install engine; fit and install torque link; assemble and install idler arm, idler pulley and clutch tube; tension main drive belts; install pressure regulator and hydraulic hoses.

Cards used in this section:

HARDWARE CARD	E24 CARD 1	E24 CARD 3
E13 CARD 1	E24 CARD 2	E27 CARD 1

Prints used in this section:

E27-2000	E49-2001

Templates used in this section:
E13-1

Tools required for this section:

Air or electric drill	Floor jack or	Metal cutting snips	Spring scale
Allen wrench 1/4"	scissors jack	Pliers	Straight edge
Band saw	Grinder	Pop rivet gun	Tap: 5/16-24
Dial calipers	Level	Ruler	Tap handle

Drill bits of the following sizes: 1/8", 5/16", 7/16"
Ratchet with sockets of the following sizes: 1/4", 5/16", 3/8", 7/16", 1/2", 3/4", 11/16", 7/8"
Wrenches of the following sizes: 1/4", 5/16", 3/8", 7/16", 1/2", 3/4", 11/16", 7/8"

Notes:

1. ENGINE: Before beginning any work with the engine, make sure the exhaust port holes have been taped over with duct tape. If this is not done and a washer or other object is accidentally dropped into the exhaust port, you will run the risk of damaging a valve the first time the engine is started.

2. LOWER ENGINE MOUNT SHIMS: Determine if the engine should be shimmed up or down and cut out the appropriate shims. (Refer to Section 3.)

3. CLUTCH: It is important for the centerline of the clutch idler pulley shaft to be parallel to that of the secondary shaft in both the fore and aft and lateral planes. The height of the idler pulley should be adjusted so that it is centered on the secondary drive pulley.

4. TORQUE LINK: Leave enough thread in the rod end for future adjustment.

5. TAIL BOOM SUPPORT: The tail boom support brace tubes can be removed form the airframe for easier access to the engine mount area. BEFORE REMOVING THESE TUBES, BE SURE THAT THE TAIL BOOM IS REMOVED OR PROPERLY SUPPORTED, OR DAMAGE TO THE AIRFRAME WILL RESULT.

ENGINE INSTALLATION

Photo #1

Use print E13-2000 and template E13-1 when installing the R.I. 162F engine assembly.
Parts as received from RotorWay International.

Photo #2

Fit the rubber strip so it covers the machined area on the inside of the upper engine mount cup. Glue the rubber to the cup with the 3M 2 part epoxy adhesive, also called “blade glue” (found on E09 CARD 4). Rivet the rubber strip in place, using 1/8" washers on both pop rivets.

Photo #3

The cup is shown here bolted to the clevis for a better understanding of how they fit together.

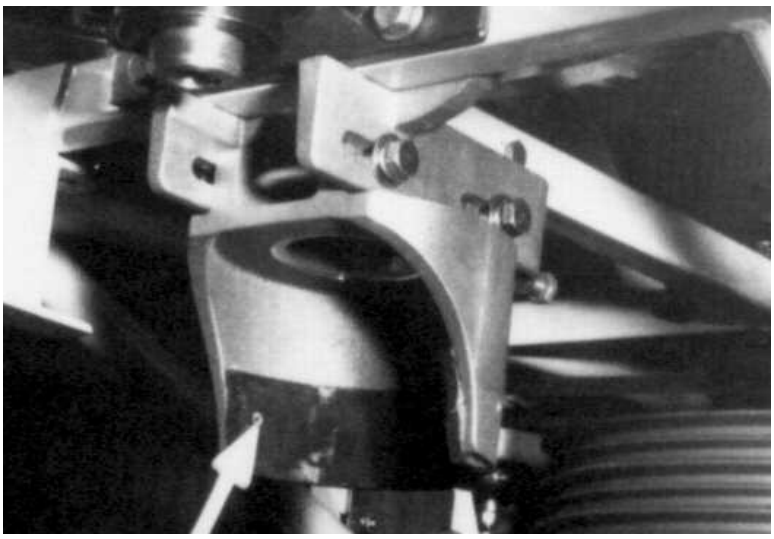


Photo #4

There should be a 1/8" gap between the rear of the upper engine mount clevis and the bottom of the square drive mount tubes. (See also Section 11 Photo 3.)

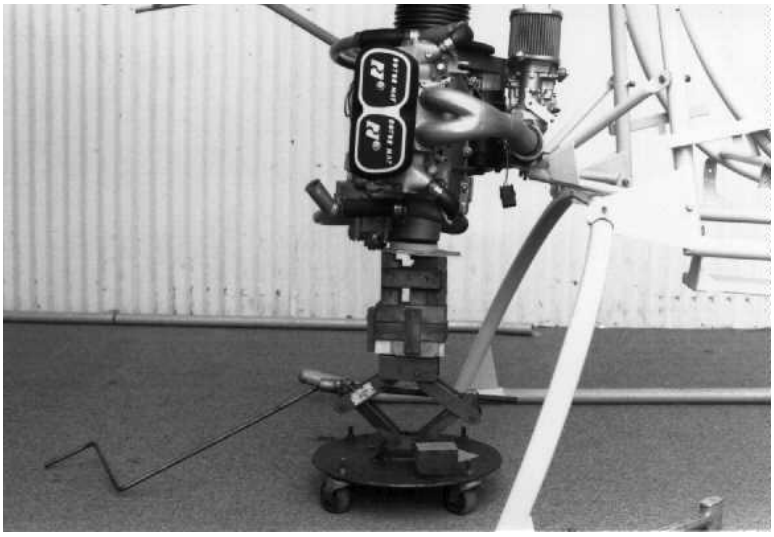


Photo #5

Place the engine mount support ring on a scissors jack and set the engine in it vertically, in a manner that will not allow it to slip off. The jack should be raised to a height of about 15". Have someone help you hold the engine; a drop to the floor from this height could cause considerable damage to the engine.
Note: Place the main drive belts over the top of the engine pulley while installing the engine.

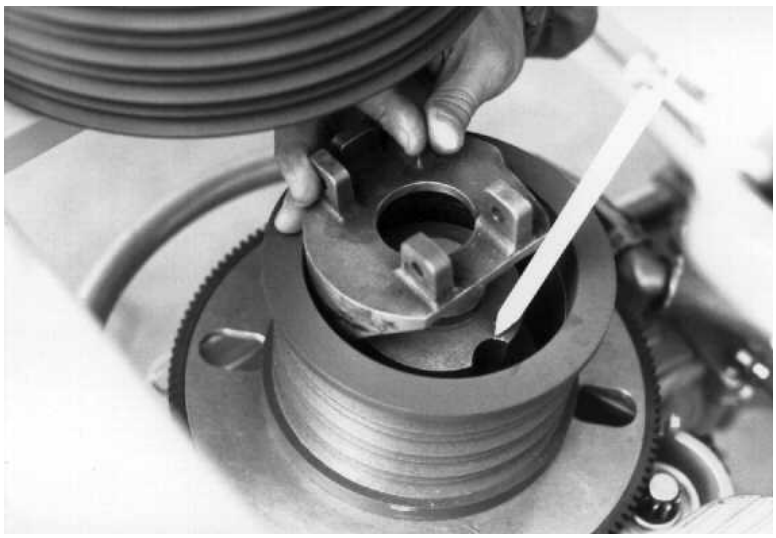


Photo #6

Place the upper engine mount cup into the main drive pulley mounted on top of the engine. Rotate the upper drive cup in the pulley so that the half moon (arrow) is toward the front of the engine.
Note: Although similar in size, the round boss on top of the drive cup is not supposed to fit inside the hole in the engine mount cup. When installed, the only point of contact between the two pieces should be the rubber lining.

Photo #7

On the engine pulley, note that the distance from the top of the uppermost groove to the top surface is .200" greater than that of the secondary pulley. If the engine was installed with the top of the engine pulley at the same height as the top of the secondary pulley, the drive belt would be .200" lower at the engine pulley. For future alignment, place a piece of masking tape on the engine pulley as shown and mark a reference line .200" below the top. Raise the engine until the upper engine mount cup fits into the clevis. Install the three 5/16" bolts that hold the engine mount support ring to the engine mount weldment.

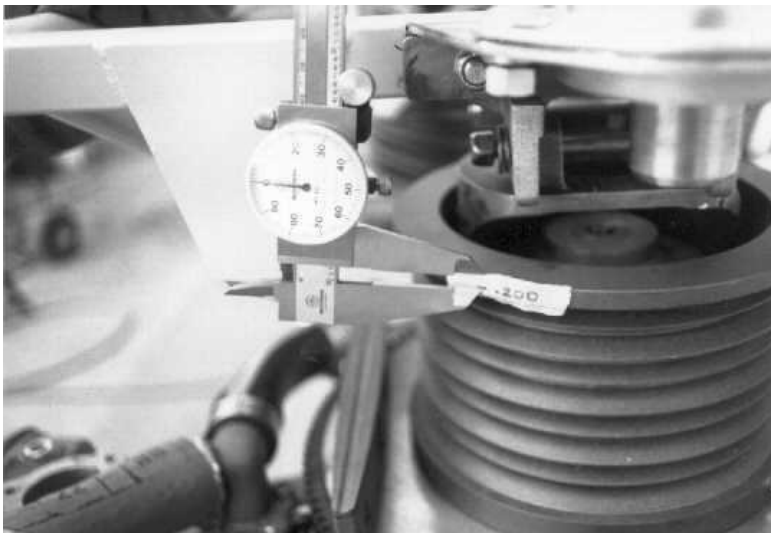


Photo #8

Place a level on the secondary pulley and shim under the skids until the level reads zero fore/aft and laterally.

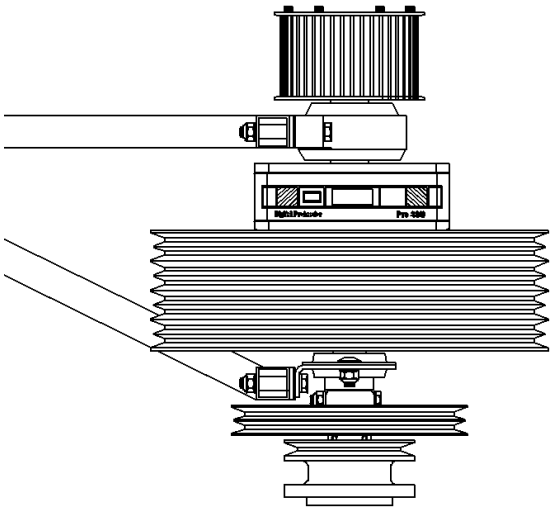


Photo #9

Place a level on the engine flywheel to check the fore and aft level. Move the top or bottom of the engine until the bubble centers.

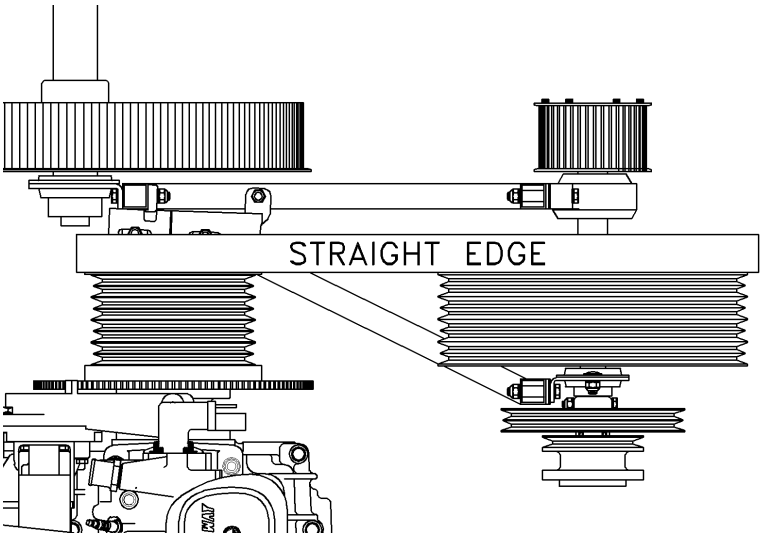


Photo #10

Check the alignment of the secondary pulley and the engine pulley. The straight edge should make contact with both sides of the secondary pulley and align with the mark on the masking tape that is .200" from the top of the engine pulley. Use shims on the lower engine mount to achieve the proper alignment, by either raising or lowering the engine.

Photo #11

Move the engine to the rear as far as the adjustment on the top and bottom mounts will allow.

Photo #12

Check on the pilot side to see that the valve cover drain does not hit the frame. The engine may be rotated by adjusting the torque link.

TORQUE LINK

Photo #13

Tap the arm of the torque link with a 5/16-24 tap and assemble it as shown on print E27-2000.

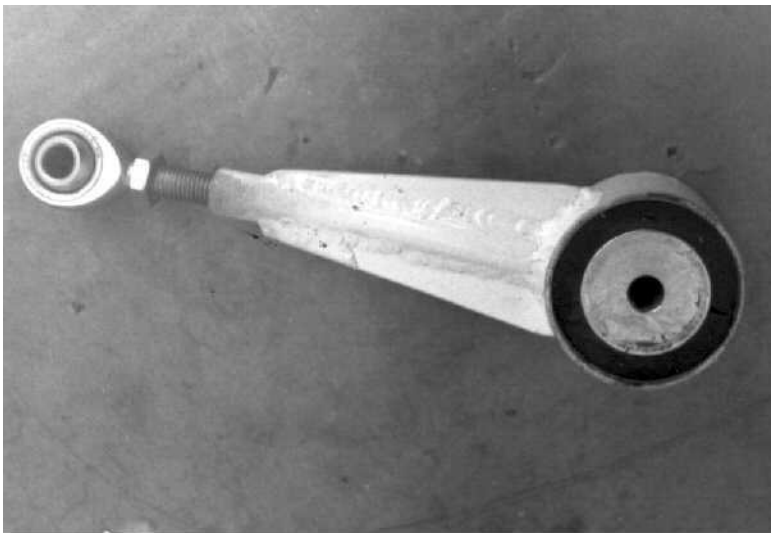
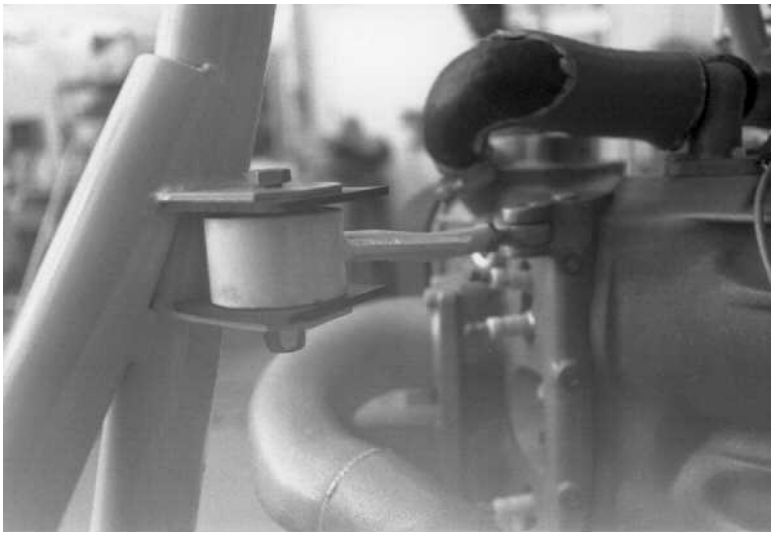


Photo #14

Fit the torque link by grinding off the top or bottom as necessary for alignment. When the engine is at the rear of the slots in the mounts, the rod end should not be screwed all the way into the torque link arm. It may be necessary to shorten the torque link as the engine is moved forward to achieve proper belt adjustment.



IDLER ARM AND CLUTCH TUBE

Photo #15

One of the 1/2" washers supplied with the idler arm is chamfered on the inside diameter to clear the radius on the idler arm spindle. Install this chamfered washer first. Additional washers may be added after this one to adjust pulley height and clearance.

Photo #16

Install the idler pulley assembly on the idler arm spindle, using another 1/2” washer under the nut. Carefully torque the nut to12 foot pounds. Do not over torque this nut or it could reduce the internal clearance of the bearings, which will cause them to run hot. On final installation, use Loctite 609 on the nut.

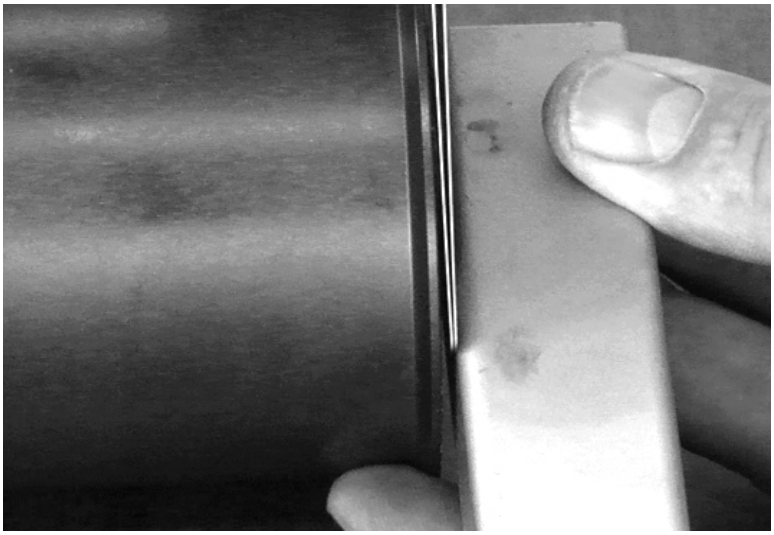


Photo #17

Ensure that there is at least .025 inch clearance between the idler arm and the rim of the pulley on top, and the same clearance on bottom between the pulley and the 7/16” brace tube. Clearance and height of pulley can be adjusted by adding washers on the spindle.

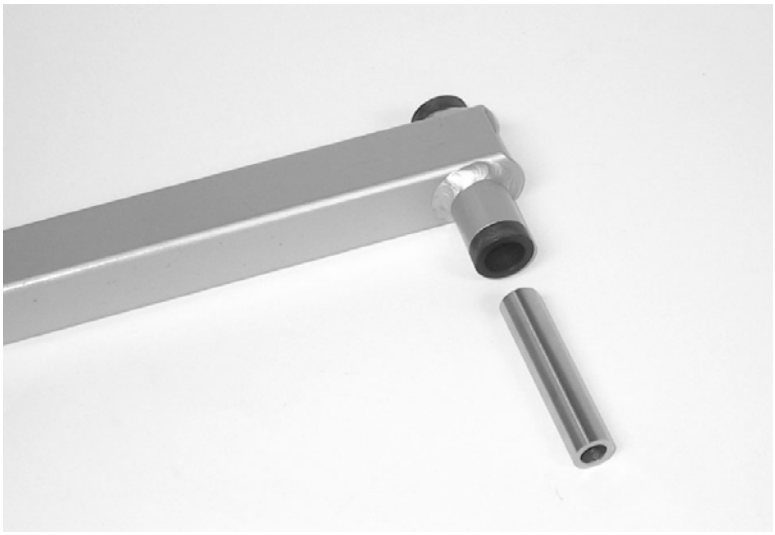


Photo #18

Install the Nylatron (plastic) bushings and the steel pivot spacer in the idler arm.

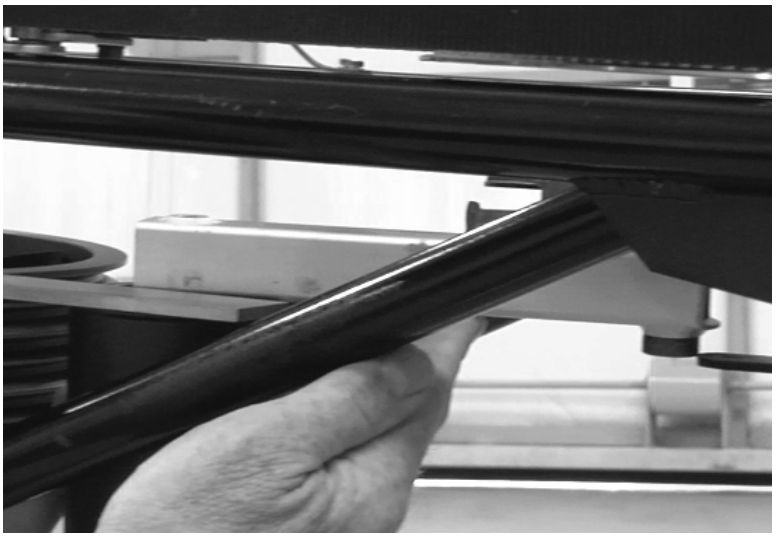


Photo #19

To determine pulley height, lightly clamp a straight edge to the secondary pulley. At the correct height, the idler pulley will be centered on the secondary pulley.

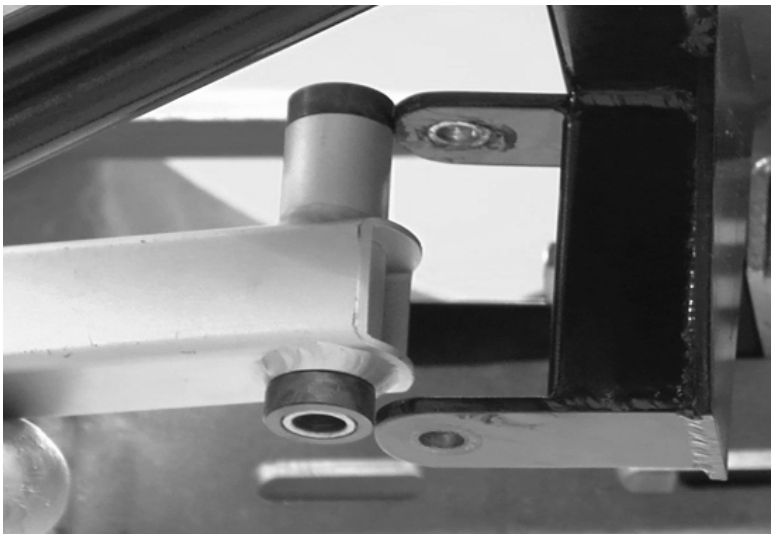


Photo #20

To adjust the pulley up or down, grind off the top or bottom of the bushings and pivot spacer as needed. The ends must be ground squarely (90 degrees) to the hole. After grinding, the bushings must fit snug in the airframe bracket without any end play. Caution: The inner pivot spacer is a precision fit. Be careful not to mar the surface or distort this spacer.

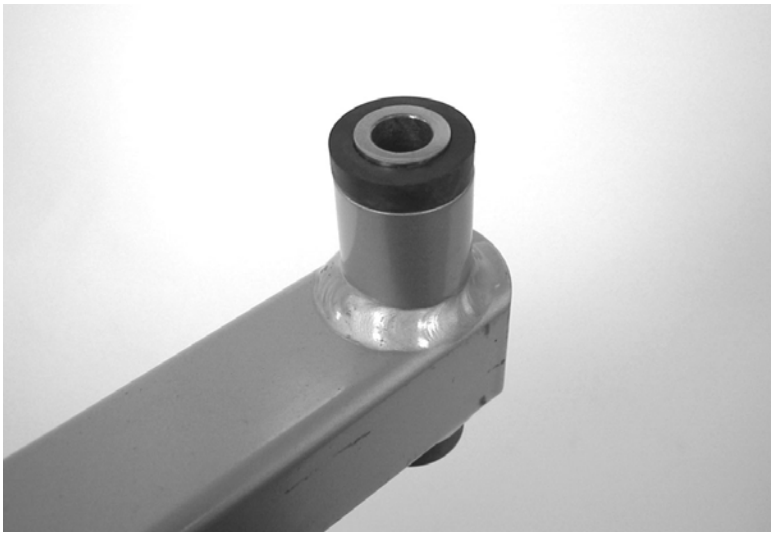


Photo #21

When the correct fit is achieved, trim the Nylatron bushings so that the total length is about .005 inch less than the length of the inner steel pivot spacer.

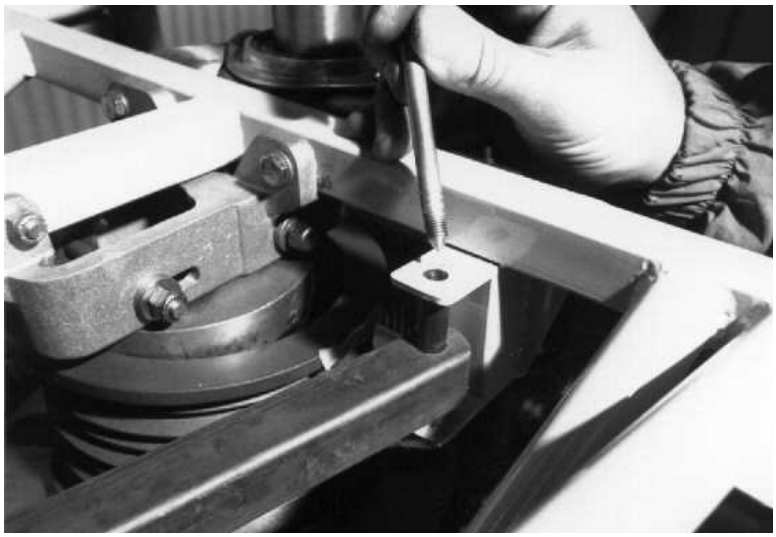


Photo #22

Grind a 5/16” bolt to a point. Drill a 5/16” hole through the top ear of the bracket only. Align the idler pulley, and use the pointed bolt as a punch to locate the hole to be drilled in the bottom ear. Drill a smaller hole then open it to 5/16”.

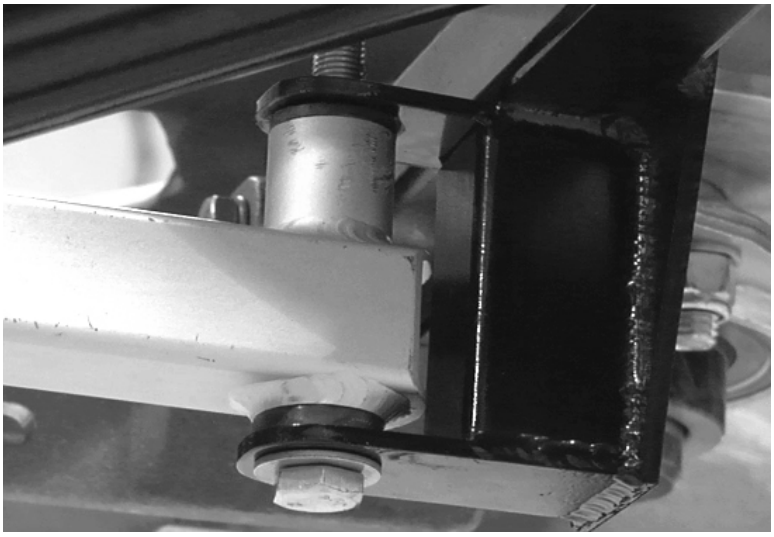


Photo #23

Clean and grease the Nylatron bushings and the steel pivot spacer. Install the pivot bolt from the bottom and the nut on top. On final installation, torque the bolt to 12 ft. lbs. The idler pulley should be centered on the secondary pulley, and parallel with it both fore/aft and laterally. The arm should pivot freely with no breakout pressure or up and down movement.

Photo #24

Exploded view of the clutch tube assembly.

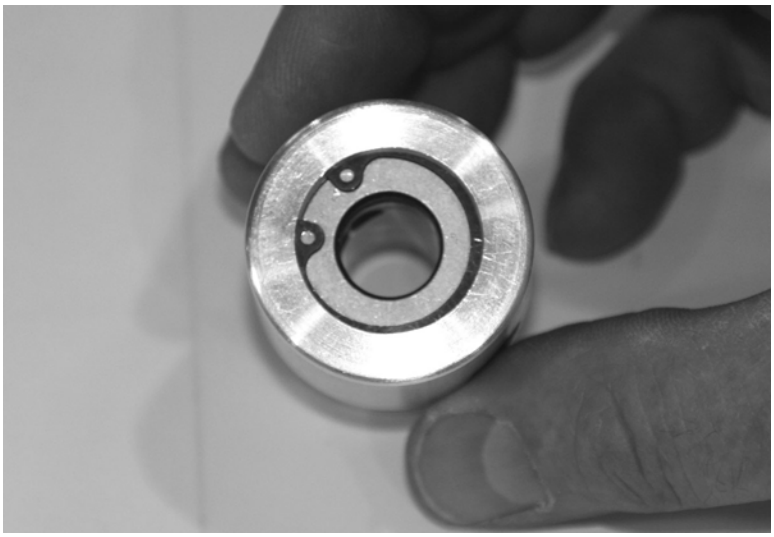


Photo #25

Install the seal into the cylinder end plug, followed by the aluminum flat washer and snap ring.

Photo #26

Install the clutch tube piston on the piston rod. Assemble with a 1/4 x 5/8 bolt, part number E00-2400, and washer E00-4401, using Loctite 242 on the threads of the bolt.

Photo #27

Install O-rings on piston, cylinder end plug and piston rod. Insert the piston rod into the end plug. Engine oil can be used as an assembly lubricant. Clean and oil the inside of the clutch tube weldment so that the clutch tube piston will slide freely.
Note: The red silicone O-ring is a travel indicator; it will move on the shaft during operation.

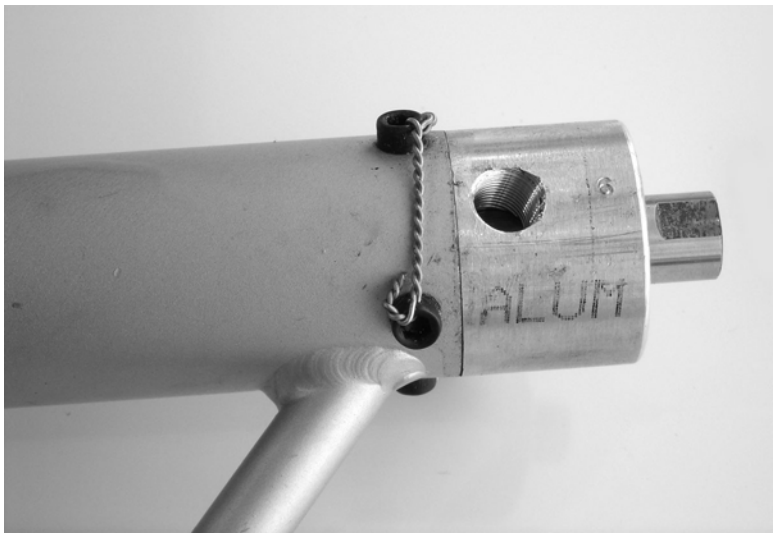


Photo #28

Install the parts into the clutch tube weldment. The cylinder end plug has two threaded holes for hose fittings. The angled hole should be towards the front of the ship when the assembly is installed.
Install the four 8-32 socket head cap screws using Loctite 242 on the threads. Then safety wire the screws as shown.

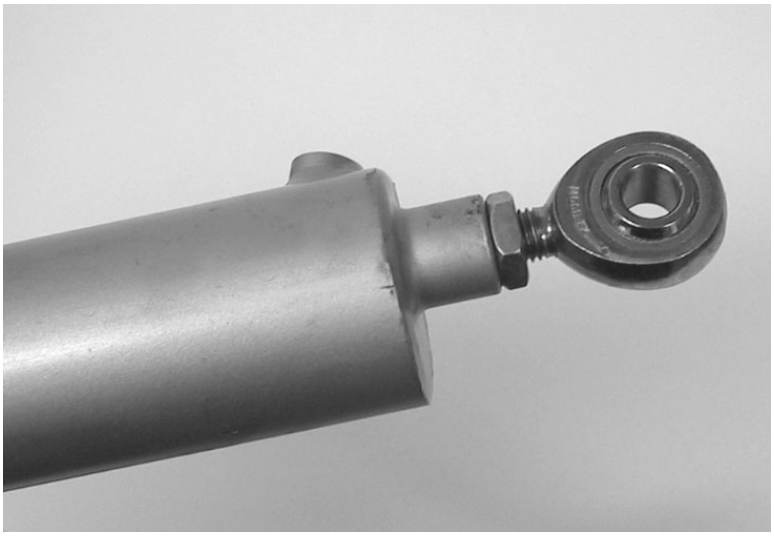


Photo #29

The top rod end on the passenger's side must be turned in until about two threads show past the lock nut. The threaded part of the rod end must not limit the cylinder from completely closing, and should not contact the internal piston. If necessary, it may be shortened to one inch of threaded shank. Coat the threads with a sealant such as Loctite PST.
Note: On some cylinders this is a blind hole. In that case, it cannot contact the inner piston, and sealant is not necessary.
The lower rod end should also be screwed in until about two threads show past the jam nut. The threaded shank may be shortened to about one inch if necessary.

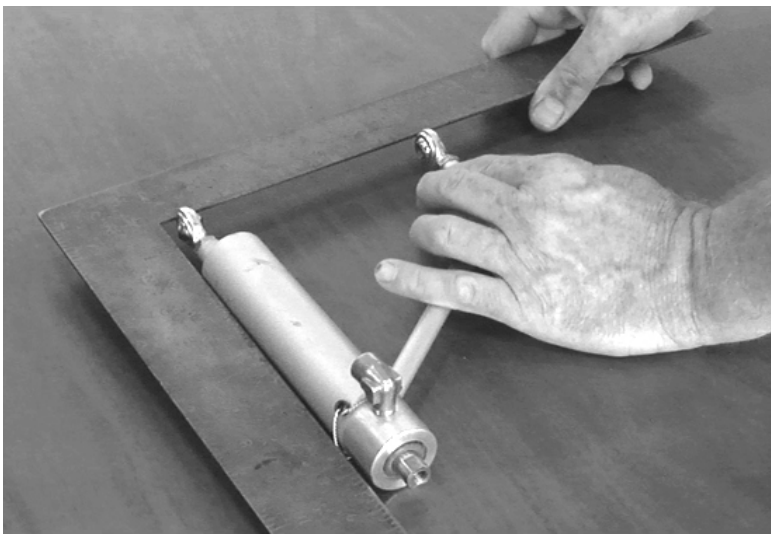


Photo #30

Using a square against the top of the cylinder, check that both rod ends are positioned to form a 90 degree angle. Turn the top rod end in or out until a 90 degree angle is achieved. Note: This angle should remain the same on final installation.

Photo #31

Install the clutch tube assembly on the idler arm. (For clarity, the parts are shown here removed from the airframe.)

Photo #32

Check the clearance between the bottom of the square tube and the cylinder. Rod ends on the pulley side can be adjusted to change clearance.

Photo #33

Space the rod end with washers. There should not be any upward or downward pressure on the rod end.

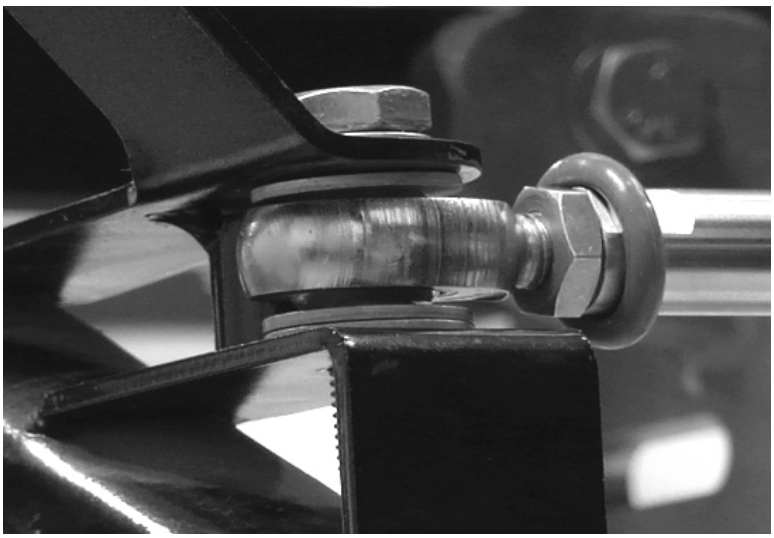


Photo #34

With the hydraulic cylinder fully extended, there should be a minimum 1/8 inch pulley to frame clearance on the passenger side. This can be adjusted by the rod end on the pilot's side of the cylinder.
Note: Start up belt tension can be tightened by turning this rod end inward.

Photo #35

Using a spring scale, pull seven pounds on one main drive belt. The belt should move 5/8 to 3/4 inch. To change the tension of the main drive belts, move the engine. The top and bottom engine mounts are slotted for this reason. The secondary pulley and the engine flywheel must remain parallel and the same height.

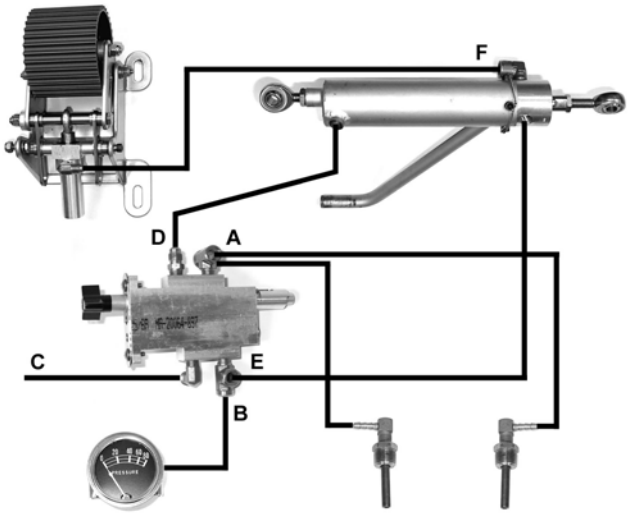


Photo #36

Overview of oil hose routing for the clutch system:

A. E28-8300 oil drains from the pressure regulator to the cylinder heads on the engine.
B. E28-8310 from the regulator to the oil pressure gauge.
C. E28-8320 from the "T" on the oil filter mount to the pressure regulator.
D. E28-8330 from the regulator to clutch tube.
E. E28-8340 from the clutch tube to the regulator.
F. E28-8350 from the clutch tube to the cog belt tensioner.

Use sealant or Teflon tape on all threaded connections, except swivel connections.

Photo #37

Mount the pressure regulator assembly on the seat back between the pilot and passenger. Measure 8 inches from the top of the center collective tube (with collective tube down). This is the point for the bottom 8/32” screw hole. Use the trim plate as a guide for locating the holes. If fiberglass in this area is thin, reinforce it by fabricating a 2” wide by 3” high .050” thick backing plate. This can be installed between the regulator and the seat back.

Photo #38

Route the two 3/16" hoses, part number E28-8300, from the brass “T” on top of the pressure regulator to the top of each cylinder head. Remove the 3/8" aluminum plugs above the valve covers. Install the 3/8" reducers (A24-4420) and oil return fittings (A24-4400). Use Teflon tape on the threads, and direct the hose barbs towards front of ship, angled slightly outward. Make sure hoses are routed away from exhaust. Trim hoses to length as needed.

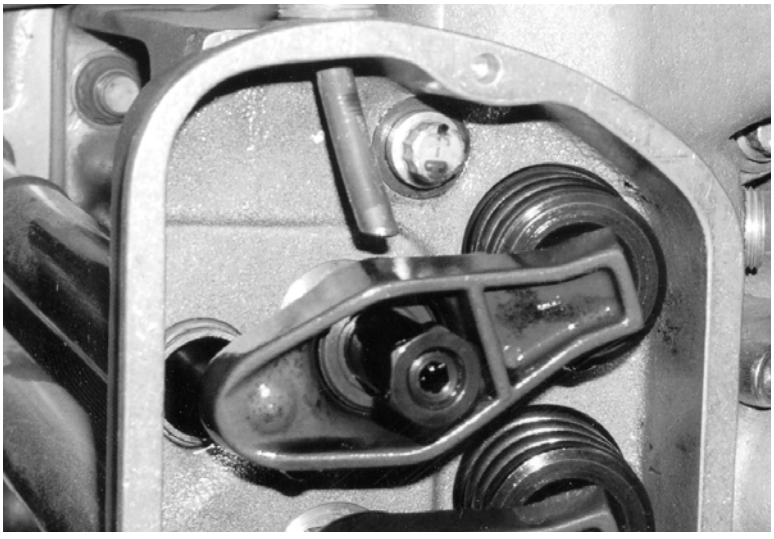


Photo #39

Bend copper pipes to direct oil flow at the pivot point of rockers. A minimum of 1/8" clearance is required.

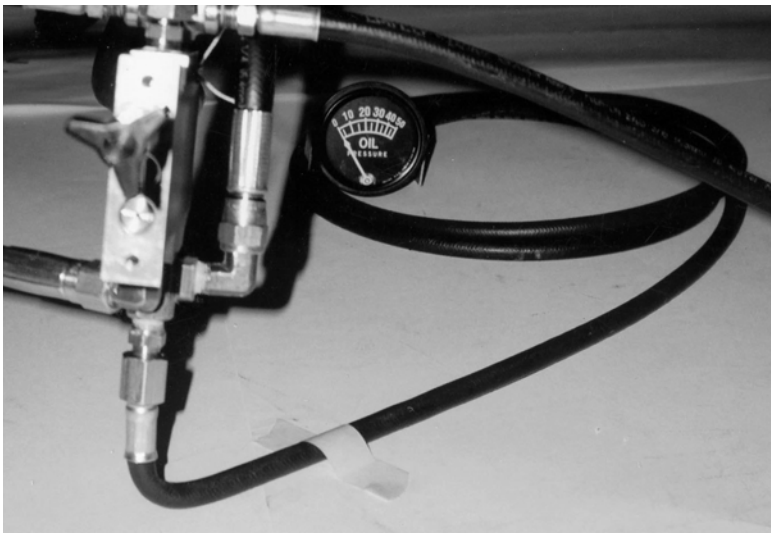


Photo #40

Install the hose, part number E28-8310, from the bottom aft fitting of the regulator to the oil pressure gauge. The gauge can be permanently mounted in the ship or used for set up then removed. A plug is supplied in the kit for gauge and hose removal.

Photo #41

Install the brass “T” fitting into the hose fitting on the oil filter mount. Route the hose, part number E28-8320, to the front fitting on the bottom side of the pressure regulator assembly.
Note: The oil pressure sensor will be installed later, see Section 21.

Photo #42

Route the 1/4" hose, part number E28-8330, from the passenger’s side of the clutch tube cylinder to the forward fitting on top of the pressure regulator. Tie the line to the square tube close to the main shaft lower bearing flange. Note: This line must be installed loose enough to follow the cylinder through its full travel.

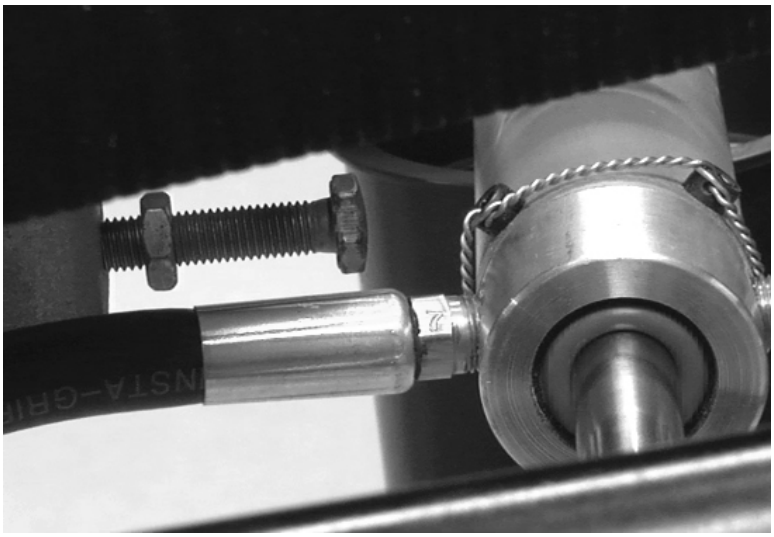


Photo #43

Route the 1/4" hose, part number E28-8340, from the pilot's side of the clutch tube cylinder (the forward hole) to the lower rear "T" fitting on the pressure regulator. Tie the hose to the square tube on the left side of the main shaft. Both cylinder hoses must not bind or pull tight throughout the full travel of the cylinder.

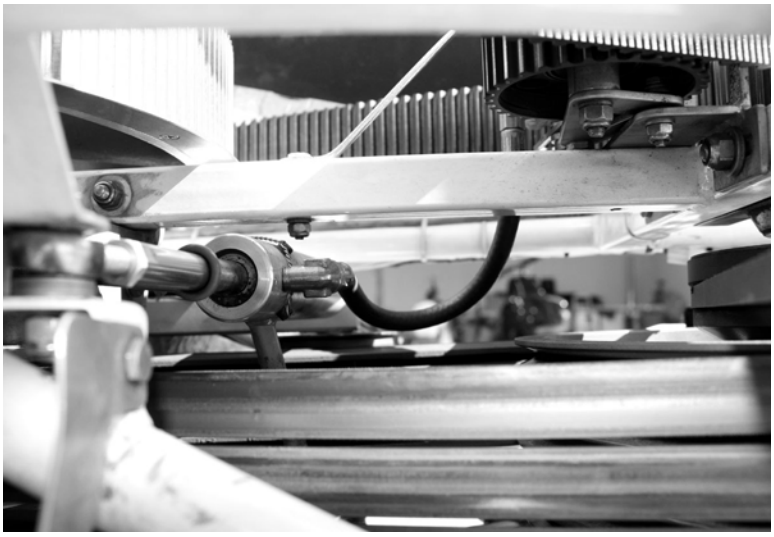


Photo #44

Install the hose, part number E28-8350, from the elbow on the pilot's side of the clutch tube cylinder to the cog belt tensioner. This connection will be used to bleed the air out of the system at start up. Note: The cog belt tensioner will be installed later, see Section 15.

FINAL CHECKLIST

1. Idler pulley should be parallel to secondary, both fore/aft and laterally. Idler pulley should be centered up/down on the secondary pulley. Belts should track in the center of the idler.

2. With the clutch tube cylinder fully extended, idler pulley to frame clearance should be 1/8" on the passenger side.

3. Check routing of all oil lines. All hose connections should be tight with no kink or twists. Use thread sealant or Teflon tape on all hose connections except swivel connections.

4. Oil lines attached to the clutch tube cylinder must be able to move with the cylinder without binding or restricting movement. Check full travel of arm.

5. The bolt head on the bottom of the idler pulley should not contact the 1" water manifold on the engine. The water manifold and hoses can be adjusted forward on the engine for clearance if necessary.