

CHAPTER 4

AIRFRAME

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CHAPTER 4

AIRFRAME

4.000 Description

The R22 is a two-place, single main rotor, single engine helicopter constructed primarily of metal and equipped with skid-type landing gear.

The primary fuselage structure is welded steel tubing and riveted aluminum sheet. The tailcone is a monocoque structure in which aluminum skins carry primary loads. Fiberglass and thermoplastics are used in secondary cabin structure, engine cooling shrouds, and various other ducts and fairings.

A right-side cowl door provides access to the main gearbox and drive system. Additional access to controls and other components for maintenance is provided by removable panels and cowlings.

Stainless steel firewalls are located forward of and above the engine.

4.100 Fuselage4.110 Cabin Assembly

The cabin assembly is a non-field-replaceable assembly.

4.111 Repair

1. Vertical firewall replacement must be performed at the factory in a jig. Firewall repairs may be accomplished in accordance with U.S. FAA Advisory Circular 43.13-1B Section 4-59. Firewall material is 0.016 inch, type 301, one-quarter hard corrosion-resistant (CRES) steel.
2. Keel panel replacement must be performed at the factory in a jig. Keel panel repairs may be accomplished in accordance with U.S. FAA Advisory Circular 43.13-1B Sections 4-58 and 4-59. Keel panel material is 0.025 inch, 2024-T3 clad aluminum-alloy sheet.
3. To preserve crashworthiness, repairs to seat structure are limited to replacement of damaged components only.

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4.120 Windshield Assembly

| This section has been moved to Chapter 25 Doors and Windows.

4.130 Door Removal and Installation

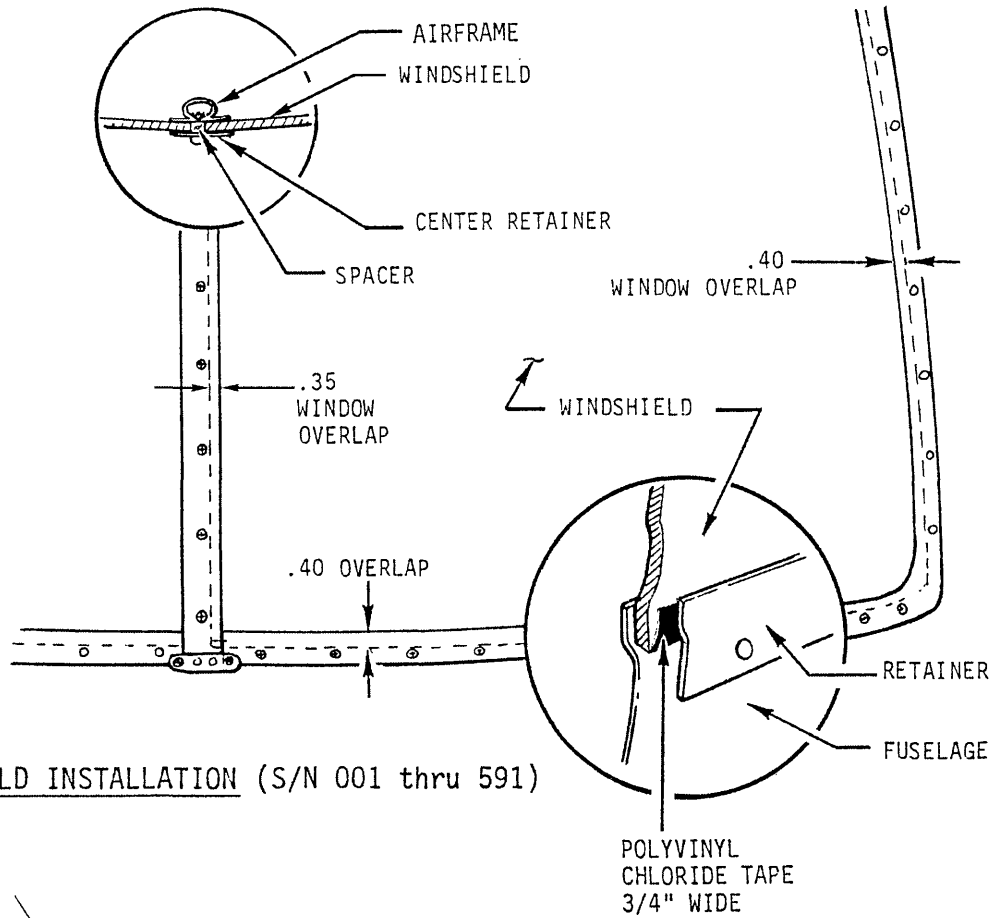
| This section has been moved to Chapter 25 Doors and Windows.

4.140 Fairing, Cowling, and Inspection Panels

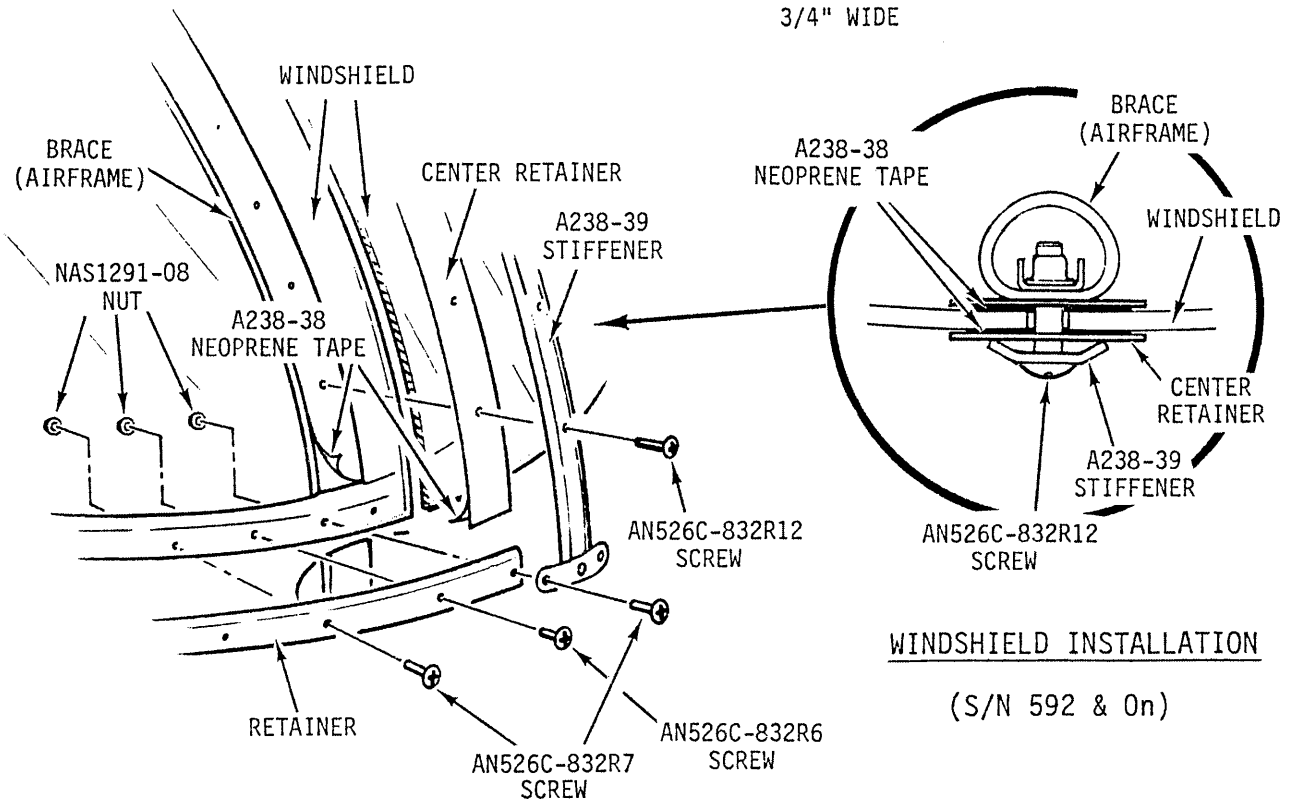
4.141 Side Skirts

CAUTION

This is a structural panel assembly and must be installed for run up and flight.



WINDSHIELD INSTALLATION (S/N 001 thru 591)



WINDSHIELD INSTALLATION

(S/N 592 & On)

4.142 Mast Fairing

CAUTION

Mast Fairing must be installed for flight.

The mast fairing upper rib is mounted to swashplate tube assembly. The lower rib is clamped to main rotor gearbox mast assembly.

The pitot tube is mounted on lower front of mast fairing.

The fuel tank vent is installed through lower rib of mast fairing. (Vent should have approximately 0.30 inch clearance from the aft cowling.)

4.143 Aft Cowling

CAUTION

Aft cowling must be installed for flight.

The aft cowling is a two-piece, sheet-aluminum structure with a removable tailcone rain guard.

4.144 Cabin Inspection Panels

CAUTION

All cabin inspection panels must be installed for flight. With the exception of side skirts, all panels may be left off for run-up.

1. Seat Backs: Left side seat back has fuel valve attached. Back cushions are installed using blind rivets.
2. Cyclic Control Inspection Panels - 4 panels:
 - a. Center belly panel
 - b. Inside center of cabin (2 each horizontal: 1 each vertical).
 - c. Instrument console (See Instruments Section 14.000).
 - d. Forward cross tube inspection panel.

4.200 WELDED STEEL TUBE FRAME ASSEMBLIES**WARNING**

All welded steel tube structures used in the rotorcraft are stress relieved. No weld repairs are permissible outside Robinson Helicopter Co.

1. Frames required on R22 Alpha & Beta Models
 - A020-2 Upper Frame Serial Number 0400 and subsequent.
 - A046-1 Lower Left Frame
 - A046-2 Lower Right Frame
 - A046-3 Right-Hand Strut

2. Frames required on R22 Standard & HP Models
 - A020-2 Upper Frame
 - A020-1 Lower Left Frame
 - A020-84 Lower Right Frame
 - A020-3 Right-Hand Strut

3. Optional frame on Mariner
 - A047-1 Upper Frame with Tie Downs

4.210 Left-Hand Frame Assembly

4.211 Removal

- a) Remove main rotor blades per Section 9.111.
- b) Remove clutch assembly per Section 7.210.
- c) Remove main rotor gearbox per Section 7.110.
- d) Remove tailcone assembly per Section 4.311.
- e) Remove power plant per Section 6.110.
- f) Remove seat backs and center panels per Section 4.144.
- g) Disconnect the three lower forward firewall and left-hand upper aft attach points on the left-hand frame.
- h) Disconnect the aft NAS1306 landing gear attach bolt from the left-hand landing gear support.
- i) Disconnect the two upper left-hand frame attach points at the vertical firewall.
- j) Remove the through bolts connecting the upper frame to the fuselage and lower left-hand frame assembly.
- k) Remove the left-hand frame.
- l) Remove the landing gear support from the left-hand frame assembly.

4.212 Left-Hand Frame Assembly Installation

- a) Install the landing gear support bearing.
- b) Position left-hand frame for installation.
- c) Install the bolt (internal wrenching) connecting the upper frame assembly to the left-hand frame assembly through the horizontal firewall. Torque bolt to 75 ft-lbs. (wet).

4.212 Left-Hand Frame Assembly (cont'd)

- d) Install the two NAS1304 bolts on upper support of the left-hand frame to the vertical firewall. Torque to 100 in-lbs. plus nut drag.
- e) Install fasteners at firewall forward attachment points. Torque the attaching screws and bolts per Fastener Torques, Section 1.300.

NOTE

Lower support at fuselage has a large-area washer AN 970-4 under bolthead next to tab of frame.

NOTE

The outboard support of the frame requires a washer between the frame and the fuselage skin.
(See Fig. 4-1 View H)

- f) Install NAS1306 landing gear attach bolt from frame support to landing gear. Torque NAS1306 bolts to 300 in.-lb plus nut drag. Install palnuts.
- g) Install upper aft support of the left-hand frame arm. Torque NAS1304 bolt to 100 in-lbs. plus nut drag. Install palnut.
- h) Install power plant per Section 6.120.
- i) Install tailcone per Section 4.312.
- j) Install main rotor gearbox per Section 7.120.
- k) Install clutch assembly per Section 7.220.
- l) Install main rotor blades per Section 9.112.
- m) Install seat backs and panels after verifying all attaching nuts and screws are secure.

4.220 Right-Hand Frame Assembly

4.221 Right-Hand Frame Removal

- a) Remove main rotor blades per Section 9.111.
- b) Remove clutch assembly per Section 7.210.
- c) Remove main rotor gearbox per Section 7.110.

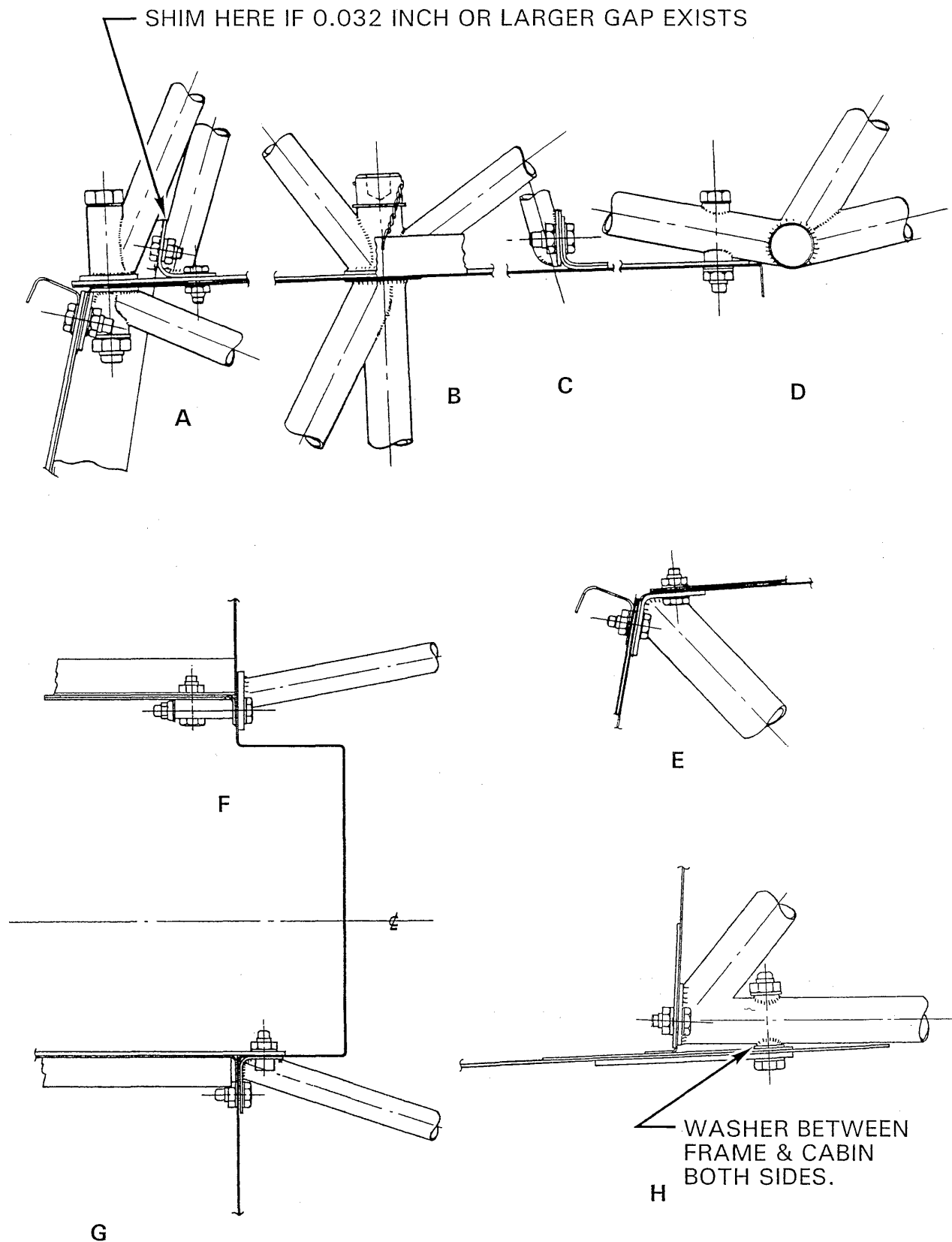


FIGURE 4-1 FRAME-TO-CABIN ATTACHMENTS

FIGURE 4-1A A960 CLAMP ASSEMBLY

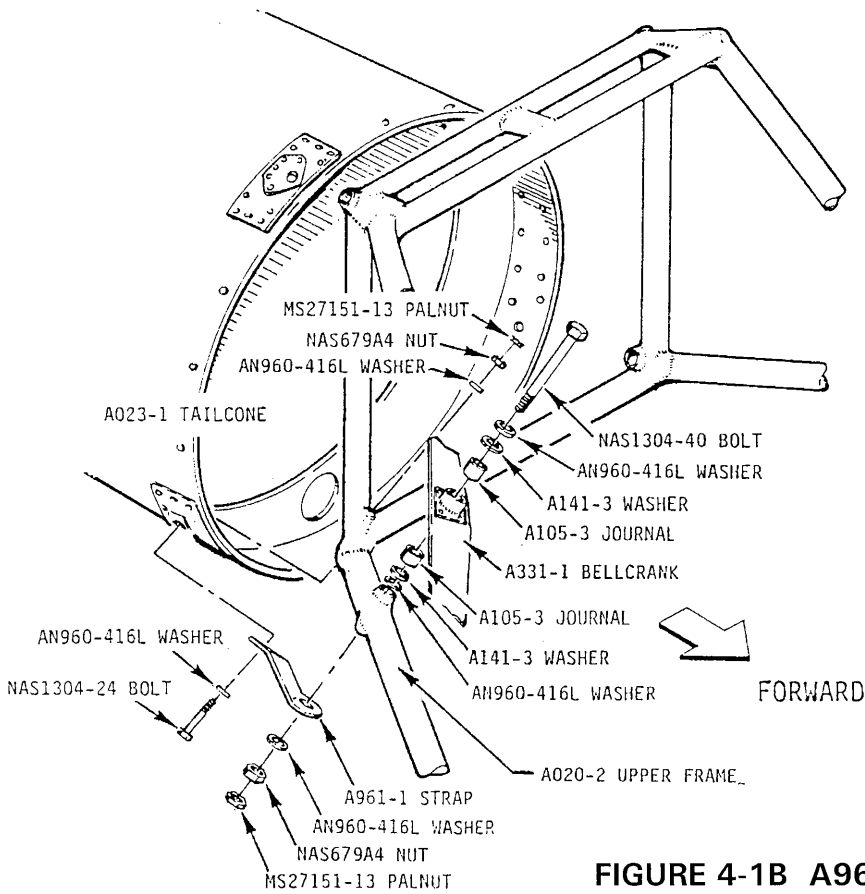
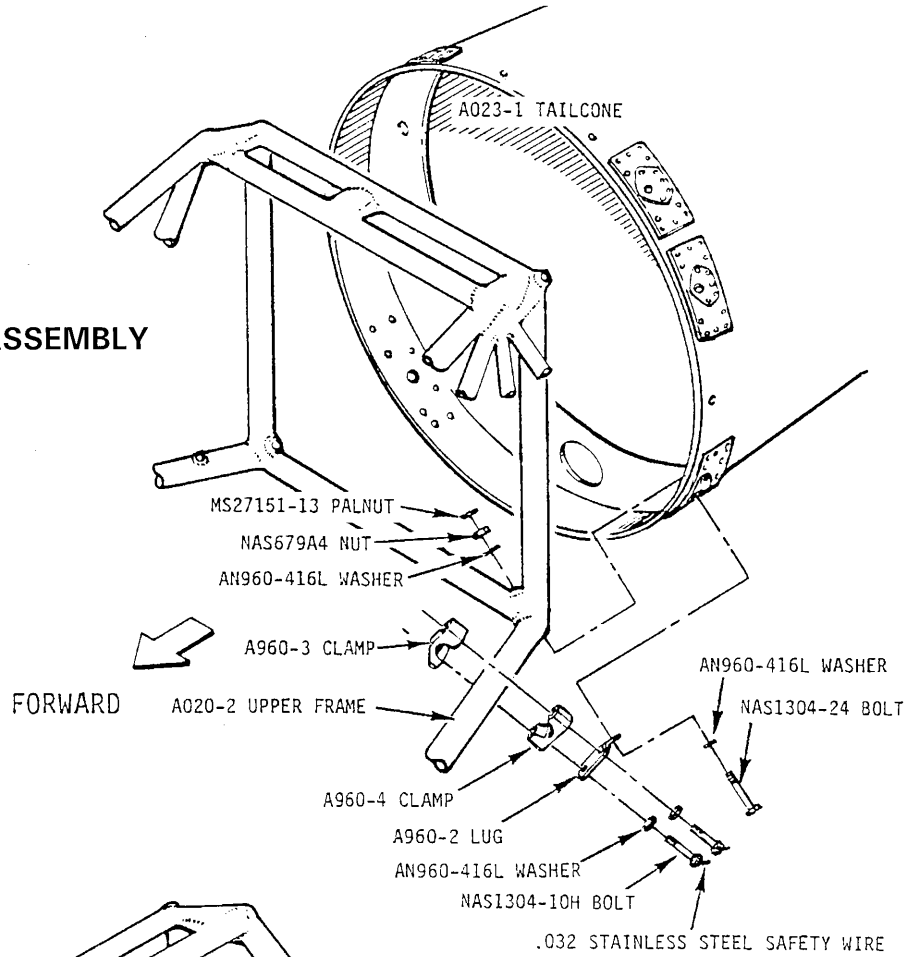


FIGURE 4-1B A961 STRAP ASSEMBLY

4.221 Right-Hand Frame Removal (cont'd)

- d) Remove tailcone assembly per Section 4.311.
- e) Remove powerplant per Section 6.110.
- f) Disconnect aft landing gear attach bolt from right-hand landing gear support.
- g) Disconnect four forward firewall attach points.
- h) Remove (2) through bolts connecting right side of upper frame to fuselage.
- i) Remove right-hand frame from helicopter.
- j) Remove landing gear support from right frame assembly.

4.222 Right-Hand Frame Installation

- a). Install landing gear support bearing.
- b) Position right-hand frame for installation.
- c) Install attaching screw (internal wrenching) connecting upper frame assembly to right hand frame assembly through horizontal firewall. Torque screw per Section 1.330.
- d) Tighten lower inboard support attaching screws to the vertical firewall.
- e) Install fasteners at the forward firewall attachment points. Torque fasteners per Section 1.300.
- f) Install landing gear attach bolt from frame support to landing gear.
- g) Install powerplant per Section 6.120.
- h) Install aft strut assembly between right-hand lower frame and upper frame assemblies. Torque bolts per Section 1.320. Install palnuts.

NOTE

Seal around inner diameter of bolt holes in strut with B270-1 sealant. Verify no sealant on bolt threads.

- i) Install tailcone per Section 4.312.
- j) Install main rotor gearbox per Section 7.120.
- k) Install clutch assembly per Section 7.220.
- l) Install main rotor system per Section 9.112.

4.222 Right-Hand Frame Installation (cont'd)

- m) Install seat backs and panels after verifying all attaching nuts and screws are secure.

4.230 Upper Frame Assembly

4.231 Upper Frame Removal

Before the upper frame is disconnected and removed, the power plant must be either removed or supported.

CAUTION

Extensive damage to the firewall and lower welded tube structures will occur if power plant is not supported or if support is dislodged.

- a) Remove main rotor blades per Section 9.111.
- b) Remove clutch assembly per Section 7.210
- c) Remove the right and left seat back and center push-pull tube panel assemblies.
- d) Remove main rotor gearbox per Section 7.110.
- e) Remove tailcone assembly per Section 4.311.
- f) Support power plant or remove per Section 6.110.
- g) Disconnect right-hand aft vertical strut assembly at upper frame and lower right-hand attach points and remove.
- h) Disconnect the forward support at the horizontal and vertical firewall.

NOTE

If same upper frame is to be re-installed, any shims found at the forward support should be re-installed in the same position.

- i) Disconnect the two forward through bolts attaching the upper frame to the two lower frames.
- j) Disconnect the two (internal wrenching) bolts attaching the upper frame to the two lower frames.

4.231 Upper Frame Removal (cont'd)

- k) Disconnect the center upper frame mount point at the horizontal firewall stiffener.
- l) Disconnect the aft portion of the upper frame.
- m) Remove upper frame.

4.232 Upper Frame Installation

- a) Clean upper frame and attach points of all old sealant, grease and oil.
- b) Position upper frame for installation.
- c) Install internal wrenching bolts with anti-seize. Do not tighten at this time.
- d) Install the two NAS1306(NAS6606) forward through bolts.
- e) Torque the four attach bolts in c & d above to:

NAS1306(NAS6606)	300 in-lb
NAS1351-8H40P	75 ft-lb (wet)
- f) Measure gap on the upper frame. Shim as required (see Fig. 4-1 View A)
- g) Install the four attaching bolts in forward support. Do not install washers under the two B238-1 bolt heads in the push-pull tube tunnel. Torque the four bolts to 40 in.-lb plus nut drag (see Fig. 4-1 View A).
- h) Install the center support bolts of the upper frame assembly. Torque the two NAS1304(NAS6604) bolts.
- i) Connect the upper frame to the aft end of the horizontal firewall.
- j) Connect the aft end of the upper frame to the lower frame assembly.
- k) Torque the NAS1304(NAS6604) attach bolts.
- l) Install the power plant, if removed.
- m) Seal firewalls at the upper and lower frame attach points to insure no seepage of fuel in the event of a fuel tank leak. Use Coast Pro-Seal 890B2.

4.232 Upper Frame Installation (cont'd)

- n) Install main rotor gearbox per Section 7.120.
- o) Install tailcone per Section 4.312.

NOTE

On A020-2 upper frames S/N 0002 thru 0399 without welded tailcone straps require A960-1 clamp assembly and A961-1 strap assembly.

- p) Install clutch assembly per Section 7.220
- q) Install seat backs and panels after verifying all attaching nuts and screws and secure.

4.240 Strut Assembly Removal and Installation

To remove strut:

- a. Remove upper and lower attaching bolts.
- b. Remove strut.

To install strut:

- a. Line up holes in strut with upper and lower frame tabs. Lower end of strut goes on aft face of lower frame tab.
- b. Install NAS6604-3 attaching bolts wet with B270-1 sealant on shanks.

CAUTION

Verify threads are clean and dry.

Torque per Section 1.330. Install palnuts, torque per Section 1.320, and torque stripe.

4.300 TAILCONE AND EMPENNAGE4.310 Tailcone

4.311 Tailcone Removal

- a) Disconnect wiring (antenna, strobe, tail light and chip detector) to tailcone.
- b) Mark tail rotor driveshaft and A947-2 flexplate for reinstallation.
- c) Disconnect tail rotor driveshaft flange from flex plate leaving flex plate connected to clutch shaft. Install attaching hardware back onto flex plate in the same position from which it was removed.

WARNING

A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, flex plate is unairworthy and cannot be repaired. Ensure A947-1 forward flex plate is Rev E or subsequent (identified by letter "E" or subsequent letter on two adjacent arms of flex plate).

- d) Disconnect aft tail rotor push-pull tube from intermediate bellcrank.
- e) Remove five NAS1304 bolts that hold tailcone to steel tube structure.
- f) Carefully remove tailcone.

4.312 Tailcone Installation

- a) Install tailcone onto attaching frame structure. Insure wires on tailcone bulkhead are not pinched between bulkhead and frame.

NOTE

All R22 helicopters with upper frame A020-2 S/N 0002 thru 0399 are required to install A960-1 clamp and A961-1 strap assemblies per RHC Service Bulletin 26.

- b) Install the five attaching bolts. Torque nuts per Section 1.320. Install palnuts.
- c) Connect the A121-17 aft push-pull tube to the intermediate bellcrank. Torque nut per Section 1.320. Install palnut.
- d) Connect tail rotor driveshaft flange to intermediate flexplate. (see Section 7.320).

4.312 Tailcone Installation (cont'd)

WARNING

Shim intermediate flex plate per Section 7.330.

WARNING

A193 flex plates, which do not have bonded washers, are obsolete and must be replaced with A947 flex plates having bonded washers. If a bonded washer separates from an A947 flex plate, then flex plate is unairworthy and cannot be repaired.

Torque NAS1304 attach bolts per Section 1.320 and install palnuts.

- e. Connect electrical connections for strobe, antenna, tail light and chip detector.
- f. Check for clearance between tailcone and upper frame assembly. Refer to Figure 4-2D.

4.313 Tailcone Replacement

The following step-by-step instruction covers set-up, drilling and installation of doublers to the A023 Tailcone Assembly.

- a. Set-up
 1. Level helicopter longitudinally and laterally per Section 1.220(c). Shim as necessary under landing gear skid tubes to level helicopter.
 2. Verify tailcone part number is correct for helicopter model. Slide forward end of tailcone over upper steel tube frame and support aft end of tailcone with an adjustable stand.
 3. Refer to Figure 4-2A. Insert two bolts into horizontal mounting holes in tail rotor gearbox mount casting at aft end of tailcone. Place a bubble level across these bolts and level tailcone horizontally by turning it on the steel tube frame.
 4. Refer to Figure 4-2B. Measure from left and right lower frame vertical strut-to-upper steel tube frame attach points to aft end of tailcone; these measurements should be equal on both sides. Center tailcone laterally as required.

4.313 Tailcone Replacement (cont'd)

5. Refer to Figure 4-2C. Fill a clear plastic tube with water to level of forward end of tailcone at lowest point. Extend plastic tube under tail rotor gearbox. Recheck water level.
 6. Refer to Figure 4-2C. From level of forward end of tailcone (at lowest point) to horizontal centerline of tail rotor gearbox (horizontal mounting bolts), the distance should be 16.21 ± 0.20 inches. Adjust height of tailcone as required. Use stand to hold tailcone in place.
 7. Refer to Figure 4-2D. Place a straight edge across the forward face of tailcone and measure gap between straight edge and forward face of the steel tube mounting structure. Measurements should be taken as close as possible to the four tailcone mounting points. Adjust tailcone as necessary to obtain a minimum dimension of 0.10 inch. Recheck and adjust vertical and lateral centering of tailcone as required.
- b) Drilling the Tailcone:
1. Refer to Figure 4-2D. Prior to drilling, verify minimum 0.345 inch edge distance from tailcone edge to hole edge.
 2. Clamp tailcone over three of the mounting points to prevent its movement. To prevent oversize holes, back drill (from inside of tailcone) four mounting holes, using a center drill with a 0.250 inch diameter shank, then use a 0.250 inch diameter twist drill. After drilling each hole, secure tailcone to frame with appropriate fasteners to prevent tailcone movement.
 3. Match drill middle left-hand side tailcone mount from outside using frame tab as drill guide. Protect steel tube structure inside tailcone from drill bit with a piece of scrap sheet metal.
 4. Deburr drilled holes in tailcone. Refer to Figure 4-2E and accompanying "CAUTION" statement. Center B288-1 or -2 doublers over each tailcone mounting hole and flush with tailcone forward edge. Mark doublers from inside tailcone for drilling 0.250 inch diameter hole.
 5. Refer to Figure 4-2E. Drill B288-1 or -2 doubler with a 0.250 inch diameter twist drill at spot marked in step 4. Deburr hole and secure doubler to tailcone with a NAS1304-3 bolt. Drill through existing pilot holes in doubler with a #30 drill bit and secure with clecos.
 6. Refer to Figure 4-2E and its accompanying "CAUTION" statement. Remove NAS1304-3 bolts. Place B288-3 doubler on top of B288-1 or -2 and flush with tailcone forward edge. Mark B288-3 doubler from inside tailcone for drilling 0.250 inch diameter hole. Drill B288-3 doubler with 0.250 inch diameter twist drill and deburr. Install B288-3 doubler atop B288-1 or -2 doubler and secure with NAS1304-3 bolt. Drill through existing pilot holes with a #30 drill bit.

4.313 Tailcone Replacement (cont'd)

7. Remove doublers and deburr. Install doublers with clecos then rivet with MS20470AD4 rivets trimmed to proper grip length.
8. Prime doubler installation with zinc chromate or epoxy primer then paint to match tailcone.
9. Install tailcone per Section 4.312.

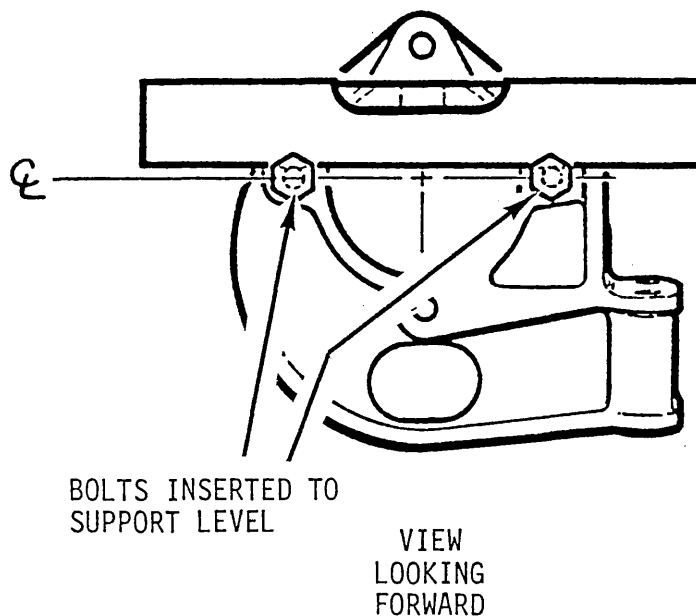


FIGURE 4-2A TAILCONE LATERAL LEVELING

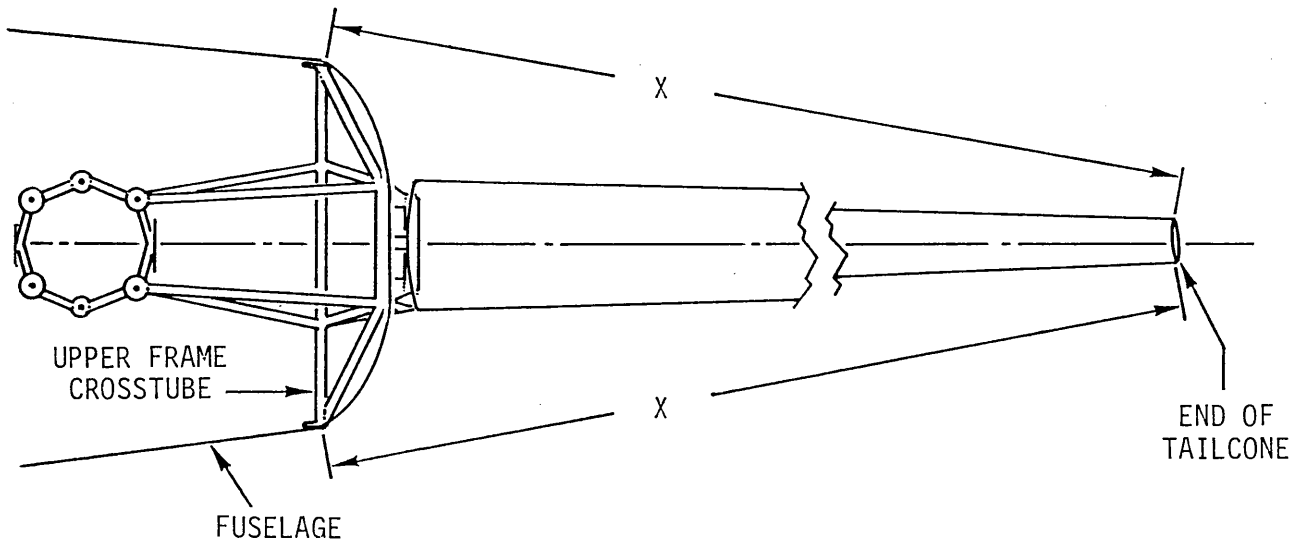


FIGURE 4-2B LATERAL TAILCONE CENTERING

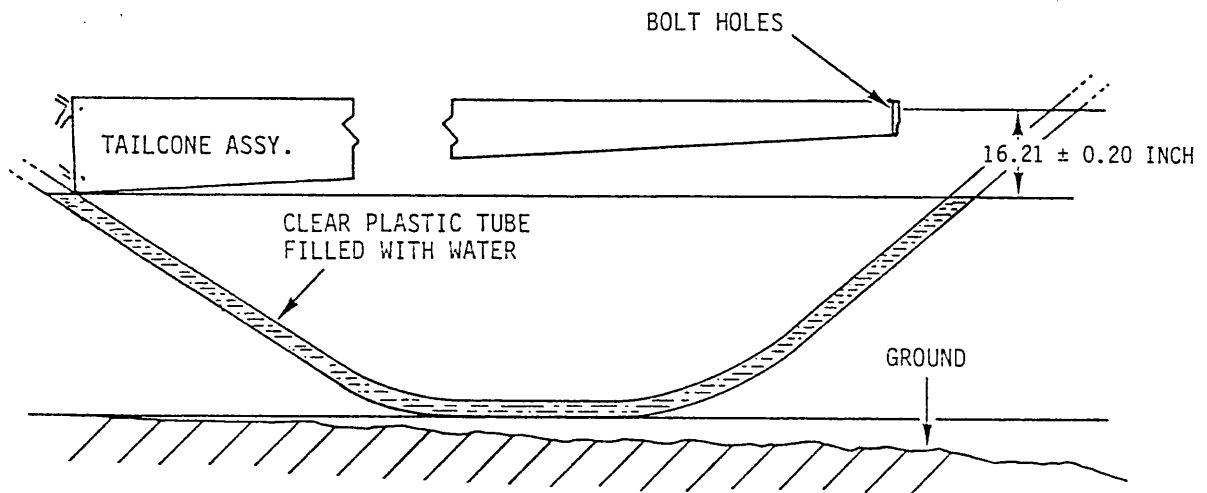


FIGURE 4-2C HORIZONTAL LEVELING

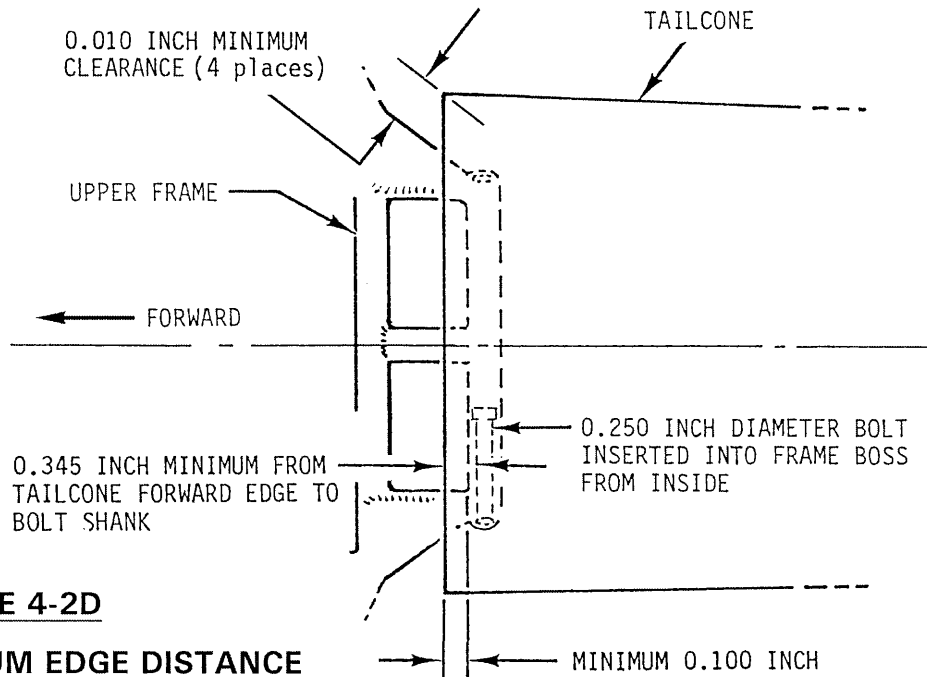
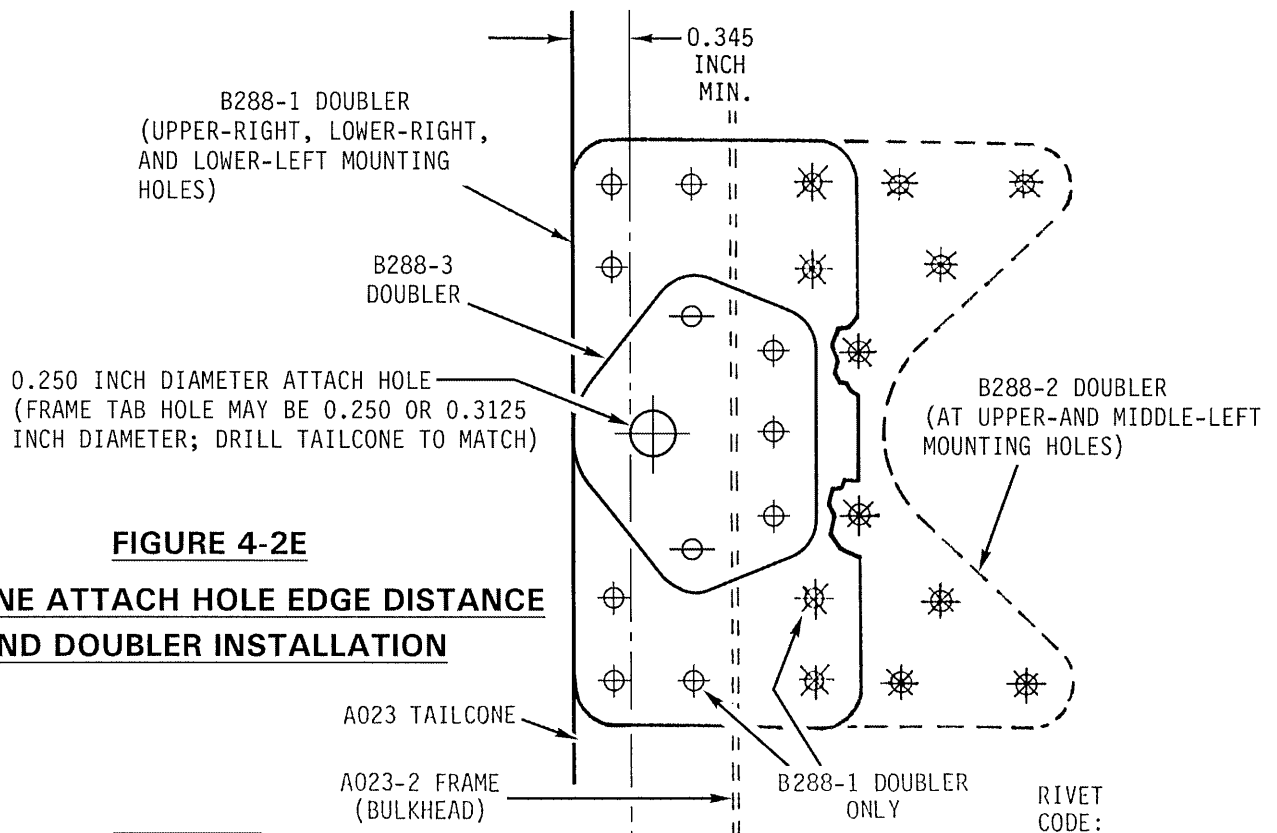


FIGURE 4-2D

VERIFYING MINIMUM EDGE DISTANCE



CAUTION

POSITION DOUBLERS TO ENSURE MINIMUM 0.345 INCH DIMENSION SHOWN. RIVET HOLES IN DOUBLERS MUST NOT PIERCE RADIUS OF A023-2 FRAME UPON DRILLING.

- ⊖ MS20470AD4-5
- ⊕ MS20470AD4-4.5
- ⊗ MS20470AD4-4

4.314 Tailcone Repair - (Permissible in Bay 5 only)

1. Dent Bay 5 only - 0.100 inch to 0.250 inch deep 0.060 inch or greater radius, not to exceed 5 inches long.

Above described dents may be repaired with 0.032 inch or 0.040 inch thick doubler of same material using rivets as follows:

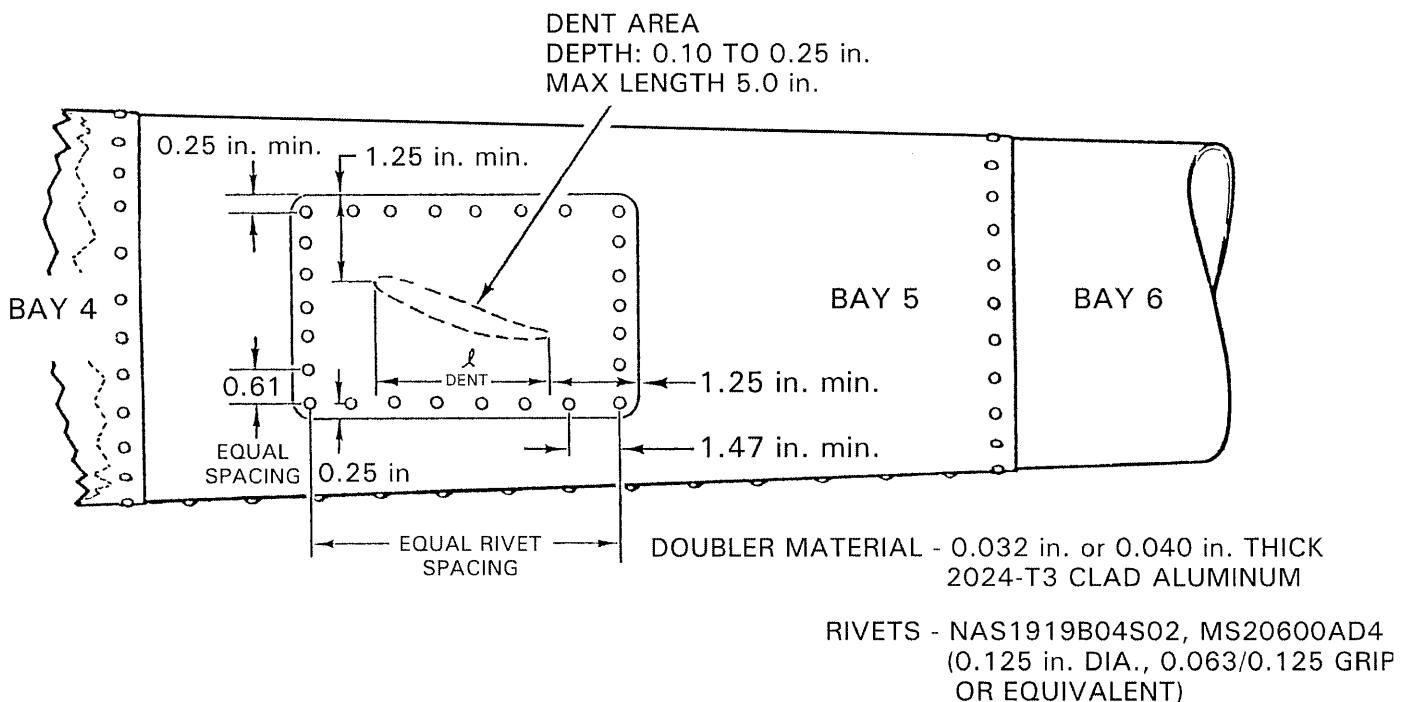


FIGURE 4-2F TAILCONE REPAIR LIMIT
(approved for Bay 5 only)

4.320 Empennage Assembly

4.321 Empennage Removal

1. Disconnect the navigation light wire at the quick disconnect.
2. Remove two attach bolts at tailcone casting and remove empennage assembly.

- 4.322 Empennage Installation
 - a) Install empennage assembly onto bulkhead fitting.
 - b) Install NAS1304 bolts and torque to 100 in-lbs. plus nut drag. Install palnuts and torque stripe.
- 4.323 Upper Stabilizer Replacement
 - a) Drill out the one rivet on the upper stabilizer attaching clip. Some ships use a #6 screw.
 - b) Remove (4) upper stabilizer attaching bolts.
 - c) Remove upper stabilizer.
 - d) Install new upper stabilizer to the horizontal stabilizer. Slight trimming of the upper stabilizer may be necessary on installation to avoid contact between stabilizer skins.

NOTE

If stabilizer is trimmed, a minimum edge distance of .140" to the 3/32 D. rivets must be maintained.

- e) Mark and drill the aft clip hole in the upper stabilizer using a #30 drill bit for rivet or #27 drill bit for #6 screw.
- f) Attach upper stabilizer to aft clip using 1/8 D. rivet or #6 screw, washer, and nut.
- g) Torque the four (4) attach bolts to 60 in-lbs. plus nut drag. Torque stripe attach bolts on stabilizer.

4.324 Lower Stabilizer Replacement

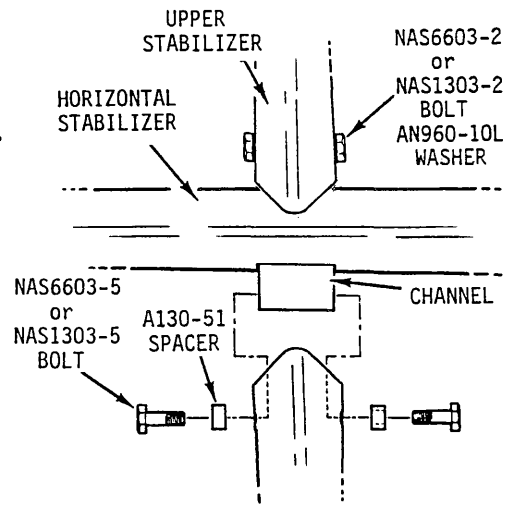
Follow procedure called out for the upper stabilizer replacement in Section 4.323.

NOTE

No contact permitted between stabilizer skins.

Torque attach bolts to 60 in-lbs.

FIGURE 4-3 STABILIZER INSTALLATION



4.325 Horizontal Stabilizer Replacement

- a) If prop protractor is used, helicopter will not have to be leveled. If just a simple level is to be used, the helicopter will need to be leveled laterally and longitudinally per Section 1.210.
- b) Install empennage assembly onto bulkhead fitting.
- c) Zero prop protractor or an accurate level on M.R. hub.
- d) Using MT068 special tool along with a prop protractor or level, check for correct angle of incidence required by NOTE below:

NOTE

R22 Standard, HP, & Mariner
Horizontal stabilizer angle of incidence
with ship leveled, to be 1.8° to 2.3° nose
up and requires A023-1 tailcone.

R22 Alpha & Beta

Horizontal stabilizer angle of incidence,
with ship leveled, to be 2.8° to 3.3° nose
down and requires A023-20 tailcone.

- e) Verify horizontal stabilizer trailing edge level within $\frac{1}{2}$ degree.
- f) Insert .250" bolt into the forward attach hole.

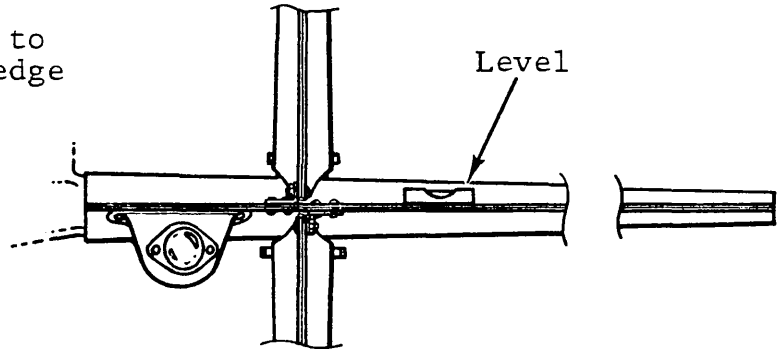
NOTE

Top holes of horizontal stabilizer attach
point are are predrilled. Bottom holes are
drilled on installation after setting angle
of incidence and stabilizer trailing edge
is level.

- g) Push forward or pull aft slightly on the tail skid to achieve the angle of incidence per note above.
- h) While holding the stabilizer at the correct angle of incidence, drill through the aft attach hole and the lower horizontal stabilizer skin using .250 ($\frac{1}{4}$) inch drill bit.
- i) Install the aft bolt and torque to 100 in-lbs. plus nut drag.
- j) Remove the forward bolt. Check the angle of incidence and trailing edge level again per step d and e. Drill the forward attach hole.
- k) Remove the stabilizer and deburr the holes. Reinstall the stabilizer, torque the bolts to 100 in-lbs. plus nut drag. install palnut.

1. Level A/C laterally and longitudinally at the M.R. hub if using simple level (See Section 1.210).

2. Horizontal stabilizer to be level at trailing edge within $\frac{1}{2}$ degree.



3. Horizontal stabilizer angle of incidence:

1.8 - 2.3 degrees nose up
(R22 Standard, HP, & Mariner)

2.8 - 3.3 degrees nose down
(R22 Alpha & Beta)

