S-TEC SYSTEM 55/55X

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.

1. S-TEC System 55

This system was adopted in 1999 and is installed in:

A. Saratoga II HP S/N's 3246126 thru 3246181 only.

B. Saratoga II TC S/N's 3257076 thru 3257198 only.

2. S-TEC System 55X

This system was adopted in 2001 is installed in:

A. Saratoga II HP S/N's 3246182 and up.

B. Saratoga II TC S/N's 3257199 and up.

3. Description (See Figure 1.)

The S-TEC System 55/55X is a rate based autopilot that controls the roll and pitch axis of the aircraft. The autopilot's main function is to convert pilot commands to logic signals for the roll and pitch computers. As the pilot enters the desired mode by pressing the appropriate mode selector switch, the computer acknowledges the mode, causing the appropriate annunciator to illuminate.

The Roll Computer receives select input signals from the Directional Gyro (DG) or Horizontal Situation Indicator (HSI), VHF Omnidirectional Radio (VOR), Localizer (LOC) or Global Positioning System (GPS), Deviation Indicators, and the Turn Coordinator. It then computes roll servo commands for stabilization, turns, navigation intercepts, and tracking.

The Pitch Computer receives select input signals from the Altitude Pressure Transducer, Accelerometer, Glideslope Deviation Indicator and Altitude Selector/Alerter (if installed). It then computes pitch servo commands for vertical speed, altitude hold and glideslope intercept and tracking. Sensing for trim annunciation or automatic stabilator trim is provided by the pitch servo. Drive for the stabilator trim servo is provided by the pitch computer.

A typical S-TEC System 55/55X Autopilot installation includes the following:

A. Panel Mounted:

Programmer/Computer, Turn Coordinator, Annunciator, D.G. or HSI, and Steering Horizon.

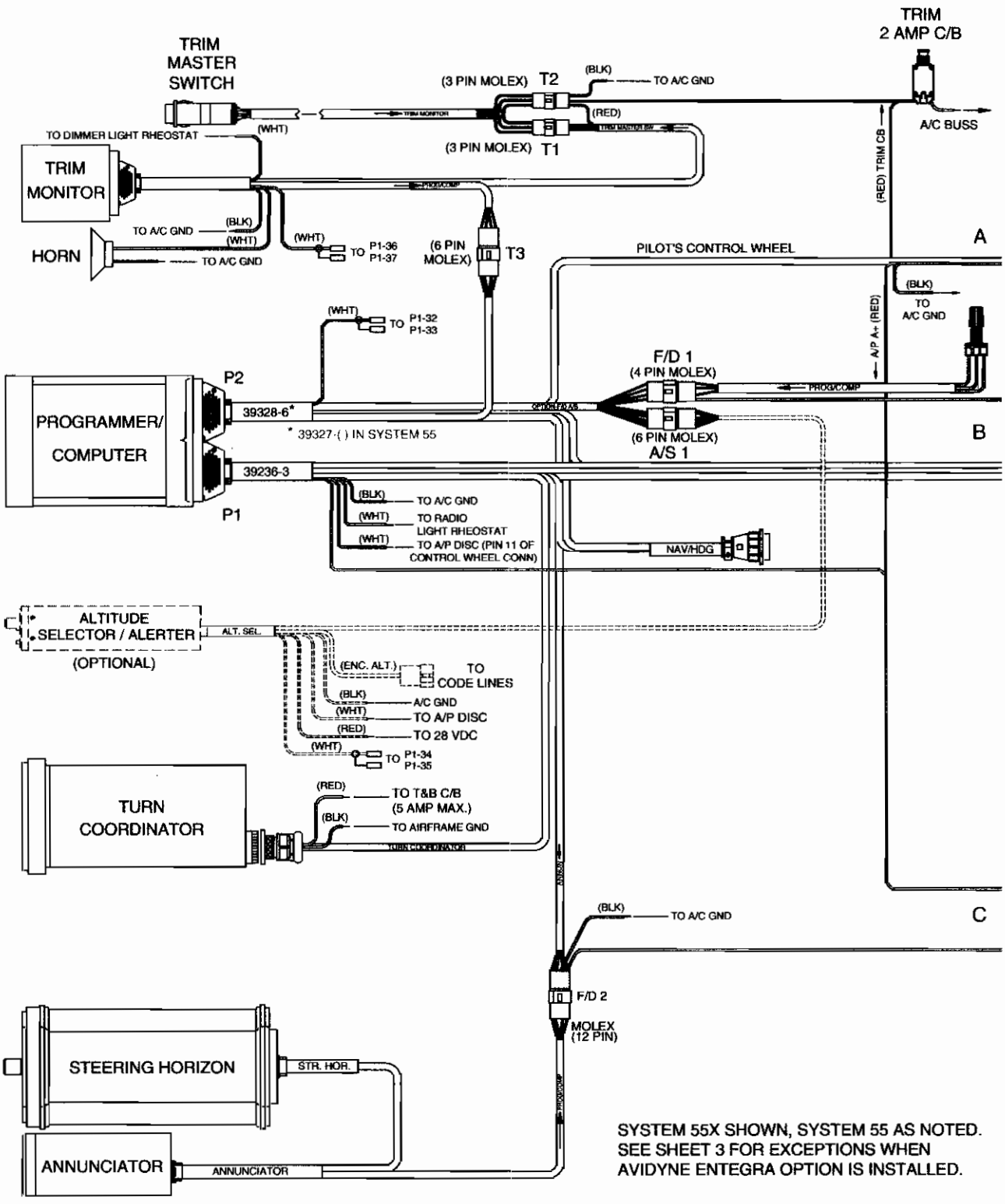
B. Remote Mounted:

Roll Servo, Pitch Servo, Trim Servo, Trim Monitor, A/P Disconnect switch, and Altitude (Pressure) Transducer.

Servo installations use aluminum brackets to secure the servos to the airframe. Attachment to the airplane's primary flight control and trim systems is accomplished with bridle cables and extension attachments.

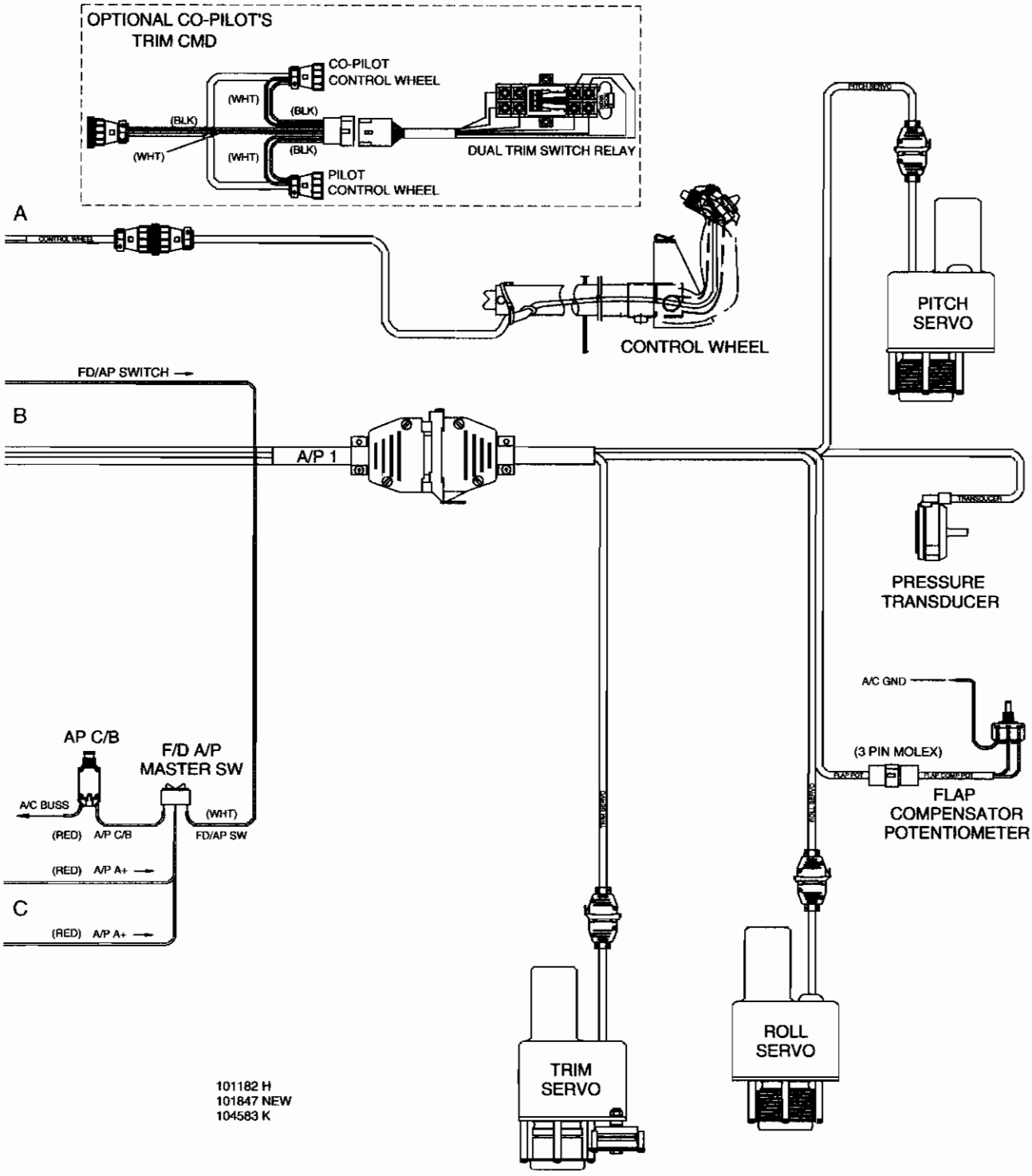
4. Troubleshooting

System functionality can be determined using functional checks descibed in the AFM Supplement and autopilot Pilot's Operating Handbook. More detailed troubleshooting should be accomplished by authorized S-TEC Dealers, holding the appropriate FAA certification, with required test equipment and service data.



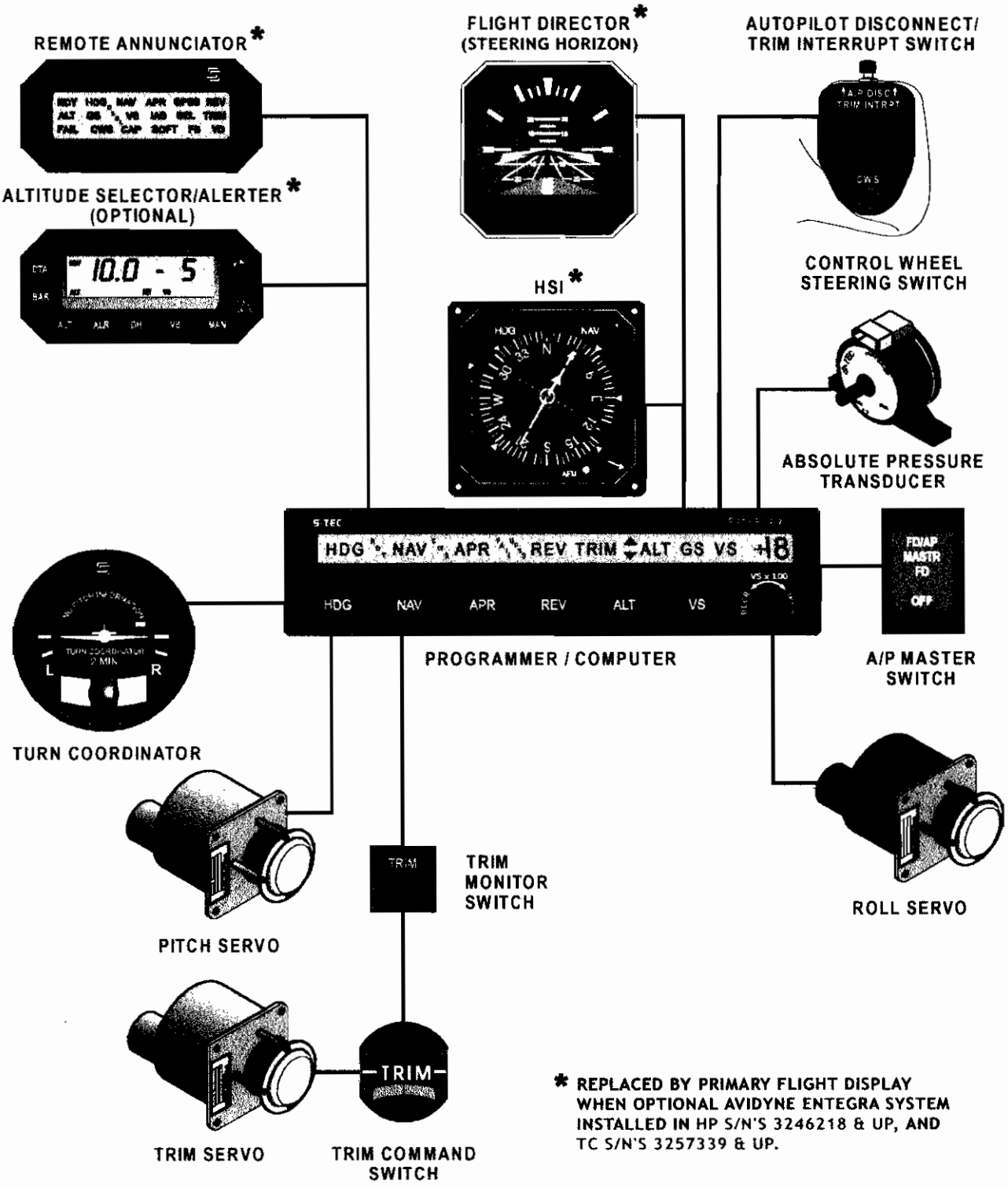
Effectivity
3246126 & up
3257076 & up

System 55/55X Autopilot Installation
Figure 1 (Sheet 1 of 3)



System 55/55X Autopilot Installation
Figure 1 (Sheet 2 of 3)

Effectivity
3246126 & up
3257076 & up



Effectivity
3246126 & up
3257076 & up

System 55/55X Autopilot Installation
Figure 1 (Sheet 3 of 3)

5. GPSS (System 55X only.)

The Global Positioning System Steering (GPSS) is a function of the 55X autopilot only. In the GPSS mode, the converter receives ground speed and bank angle digital signals that are calculated and converted to a commanded turn rate. The turn rate is then scaled and converted to a DC heading error signal that is compatible with S-TEC autopilots. The end result is an autopilot that can be directly coupled to the roll steering commands produced by the GPS Navigator, eliminating the need for the pilot to make any further adjustments to the HSI course arrow or the DG's heading bug.

6. System Operation

Operation of the autopilot and other systems is described in the FAA-approved Airplane Flight Manual Supplement (AFMS) - see airplane Pilot's Operating Handbook (POH), Section 9. Specialized controls, annunciation, operation and interpretation are covered in this supplement and in the S-TEC Autopilot POH that supplements the approved AFMS.

7. Maintenance

Except as provided in 5-20-00, servicing and/or maintenance of the autopilot system is On-Condition.

NOTE: Servicing of S-TEC System 55/55X Autopilot installations is best accomplished by approved S-TEC dealers holding the appropriate FAA-certification. Locations of and access to the components installed are described and depicted individually below. Removal and replacement of components is generally indicated by functional checks provided in the AFM Supplement, S-TEC Autopilot POH and/or below.

8. Post-Maintenance Operational Checkout (Ref. S-TEC Report No. 81191, Rev. 1.)

Complete the following checkout procedure after any maintenance to the system is performed.

NOTE: The Systems 55/55X incorporate a SELF-TEST that requires a 100% pass rate before the autopilot can be engaged.

NOTE: For airplanes equipped with the optional Avidyne Entegra Electronic Flight Display System, (see 34-20-00) references below to the remote annunciator, flight director and HSI are to those functions in the Primary Flight Display (PFD).

A. Apply aircraft power.

B. Avionics Master Switch — ON

C. Autopilot Master Switch — Set to FD / AP

NOTE: Observe that all segments of the Programmer / Computer display and annunciators illuminate for five (5) seconds during test. Satisfactory completion of the SELF-TEST is indicated when the Ready (RDY) annunciator remains on at the end of the five (5) second self-test. Should a fault be detected, the FAIL annunciator will remain on at the conclusion of the self-test and the autopilot will not operate.

D. Trim Master (ON / OFF) Switch — ON

E. HDG and VS switches — PRESS / RELEASE

Ensure that HDG and VS illuminate on the Fifty Five X annunciator.

F. VS Knob — ROTATE CW

Pitch control (i.e. - the control yoke) should move slowly out (pilot may have to assist a heavy yoke).

G. VS Knob — ROTATE CCW

Pitch control should move slowly in.

H. A/P DISC Trim Interrupt Switch (on control yoke) PRESS

Verify the autopilot disconnects.

I. HDG Mode ENGAGE

J. DG or HSI HDG bug MOVE LT / RT

Roll control should follow the HDG bug.

NOTE: If HSI equipped, center the course arrow under the lubber line and push the NAV button. Move the course arrow on the HSI left then right. Roll control should follow the course arrow. Channel a valid VOR signal and move course arrow just enough to deflect the left / right needle one (1) or two (2) dots. Roll control should follow the Course Deviation Indicator (CDI) left / right needle during the test. (This test is only valid if the left / right needle is centered with the course arrow under the lubber line.)

NOTE: If DG equipped, center the HDG bug under the lubber line. Channel a valid VOR signal. Move the OBS to cause left / right CDI needle deflection. The roll control should follow the left / right needle movement.

K. REV Mode button PUSH

Roll control should respond opposite to the course arrow and CDI left / right needle inputs.

L. Altitude Hold (ALT) button PUSH

Slowly pull out (nose up) on the pitch control (i.e. - control yoke). Autotrim should run nose down with TRIM flashing on the remote annunciator and the autopilot computer / programmer after approximately 3 seconds. Slowly move control yoke forward (nose down). After 3 seconds, autotrim should move nose up with TRIM flashing on the remote annunciator and the autopilot computer / programmer after approximately 3 seconds.

M. Trim Master (ON / OFF) Switch OFF

N. Manual Electric Trim Test:

(1) Trim Master (ON / OFF) switch ON

(a) Move each segment of the Manual Electric Trim Command Switch FWD and AFT.
Trim should not run.

(b) Move both segments of the Trim Command switch FWD.
Trim should run nose down.

(c) Move both segments of the Trim Command switch AFT.
Trim should run nose up.

(2) Re-trim aircraft for takeoff and check controls for freedom of movement. Be sure the autopilot and trim servos are dis-engaged.

O. Flight Director Test:

(1) Autopilot Master Switch SELECT FD

Note the roll, pitch and trim servos are disengaged. The steering bar should be in view on the attitude indicator.

(2) HDG Mode ENGAGE

MOVE HDG bug 45 degrees left. The roll steering bar should slowly indicate a left steering command. Repeat the same test for the right side.

(3) VS Mode — ENGAGE

SELECT 1500 FPM rate of climb. Note the pitch steering bar moves slowly up. Repeat the same test for the down direction.

(4) Autopilot Master Switch — SELECT FD / AP

The servos should re-engage.

(5) Trim Master ON / OFF Switch — ON

(6) Manual Electric Trim Command Switch — MOVE FWD or AFT

The autopilot should disconnect.

NOTE: The Manual Electric Trim Command Switch will disconnect the autopilot only if there is a Pitch Mode engaged.

9. Panel-Mounted Components

The flight director, HSI, autopilot programmer/computer, altitude selector/alerter (if installed), remote annunciator, and turn coordinator are either face-mounted or rack-mounted in the instrument panel. See 39-10-00 for removal and installation instructions.

10. Component Locator

See Figure 2.

11. Trim Monitor (See Figure 2.)

The trim monitor is mounted on the left side of the fuselage under the instrument panel.

A. Removal

(1) Disconnect autopilot harness.

(2) Remove screws (4) holding trim monitor to mounting bracket and remove trim monitor.

B. Installation

(1) Place trim monitor in position on mounting bracket and secure with screws (4).

(2) Connect autopilot harness.

(3) Perform Post-Maintenance Operational Checkout, above.

12. Pressure Transducer (See Figure 2.)

The pressure transducer is located on the forward side of the pilot's instrument panel below the control wheel shaft.

A. Removal

(1) Remove the Ty-Rap and disconnect the transducer from the static-system by removing the flexible hose.

(2) Disconnect the autopilot harness.

(3) Remove screws and washers (2 ea.) and remove transducer.

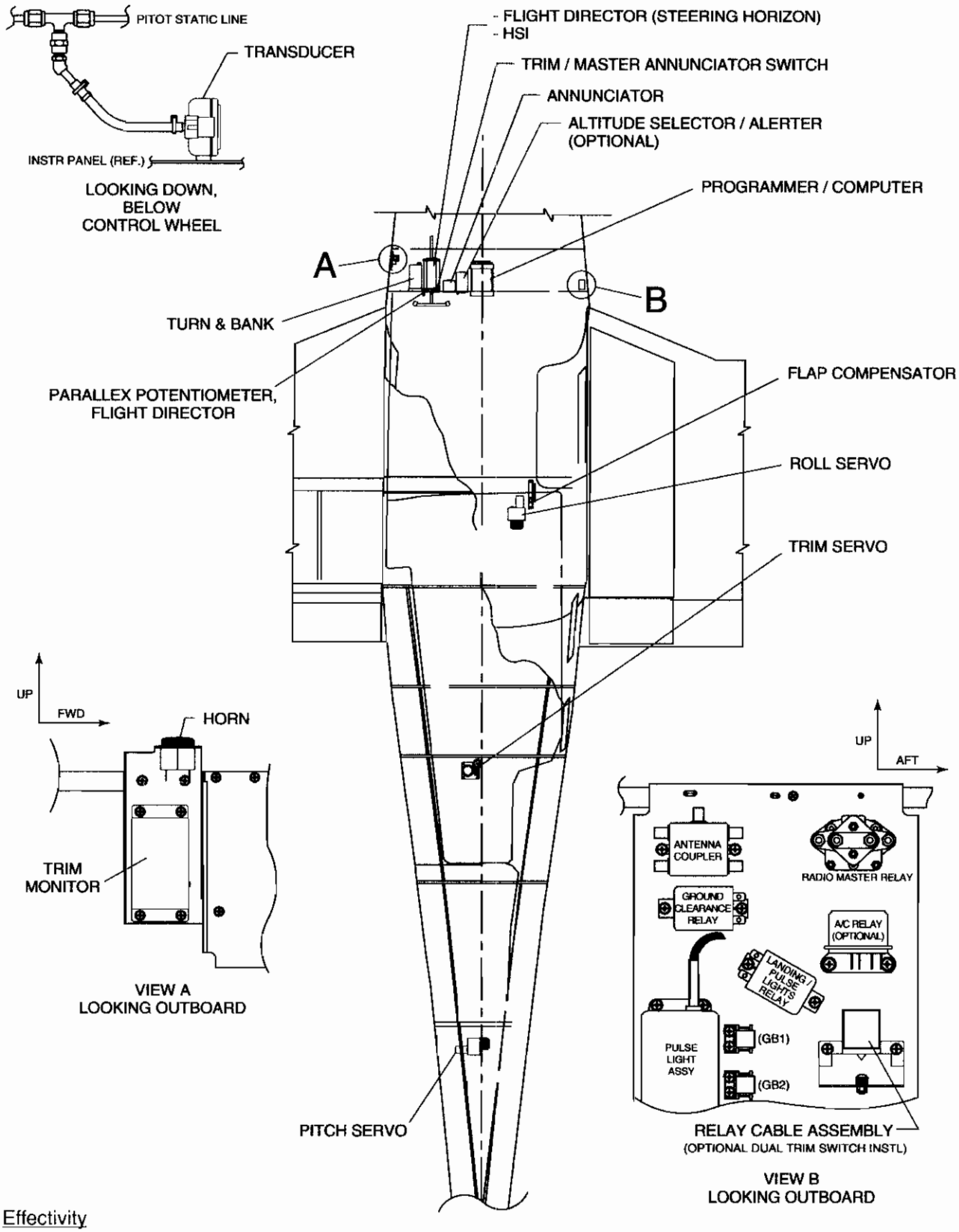
B. Installation

(1) Place transducer in position. Secure transducer to instrument panel with screws and washers (2 ea.)

(2) Connect the transducer to the static system by sliding the flexible hose over the hose barb. Then position and tighten Ty-Rap.

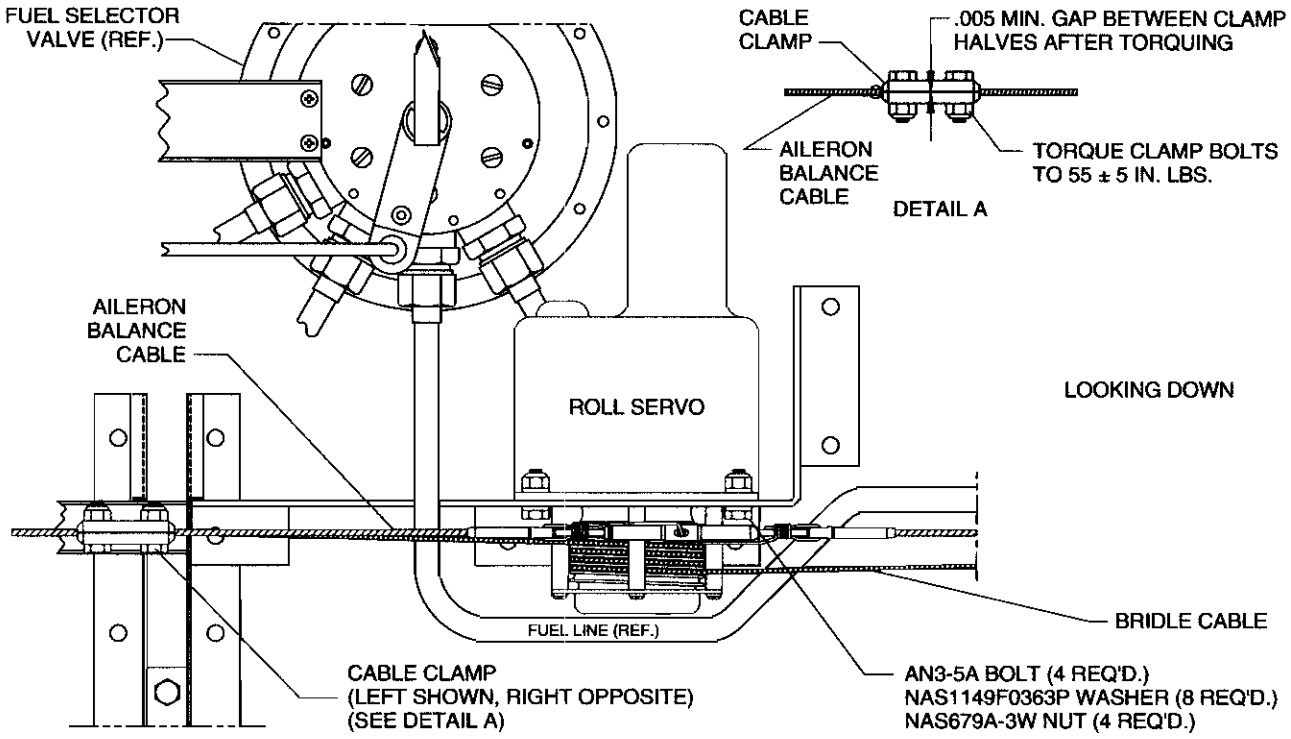
(3) Connect the autopilot harness.

(4) Perform Post-Maintenance Operational Checkout, above.



Effectivity
3246126 & up
3257076 & up

Component Locator
Figure 2



Effectivity

Roll Servo Installation
Figure 3

3246126 & up
3257076 & up

13. Roll Servo (See Figures 2 and 3.)

The roll servo is mounted underneath the right aft facing passenger seat or the entertainment cabinet, whichever is installed. A bridle cable and clamps attach the servo capstan to the aileron balance cable.

A. Removal

(1) Remove the aft facing passenger seat or entertainment cabinet, whichever is installed.

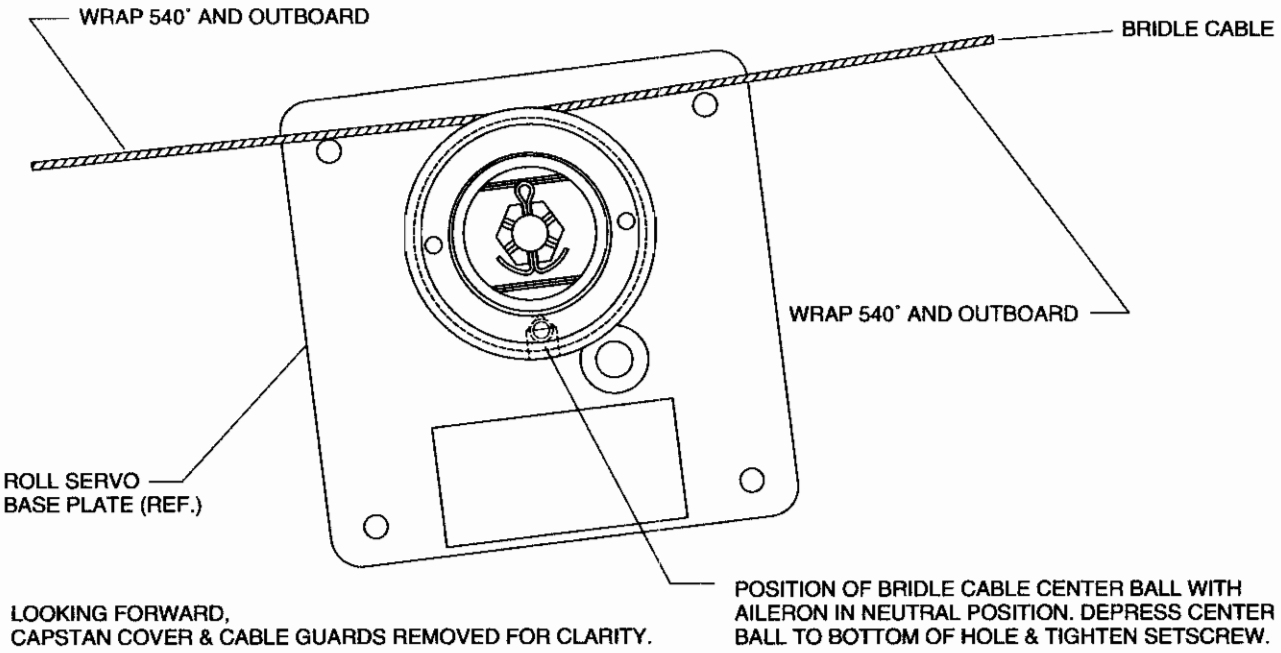
(2) Remove adjacent carpet.

(3) Remove screws securing floor panel and remove panel.

(4) Disconnect autopilot harness.

(5) Remove nuts and bolts (2 ea.) securing each cable clamp (2) and remove cable clamps from aileron balance cable and autopilot bridle cable.

(6) Remove nuts and bolts (4 ea.) and washers (8 ea.) securing roll servo to mounting bracket and remove roll servo with attached bridle cable.



Effectivity
3246126 & up
3257076 & up

Roll Servo Capstan Wrapping
Figure 4

B. Installation

(1) Rig ailerons per Aileron Control Rigging and Adjustment, 27-10-00.

(2) Place the control column tee bar in full forward position and secure by use of a suitable tool or by placing weights on the aft side of the stabilator, if stabilator cables have been previously tensioned.

(3) Lock the ailerons in neutral (i.e. - aligned with flaps) position using a suitable contour fixture at the inboard ends of the ailerons and the outboard ends of the flaps. Verify control wheels are centered and secure in that position.

(4) Remove screws (4) and remove capstan cover and cable guards from servo.

(5) Adjust roll servo clutch torque per Servo Clutch Torque Adjustment, below.

(6) Wrap autopilot bridle cable, align capstan, and and tighten center-ball setscrew as shown in Figure 4.

(7) Replace cable guards and capstan cover, secure with screws (4).

(8) Position servo as shown in Figure 3 and install and secure nuts (4 ea.) , washers (8 ea.) , and bolts (4 ea.) holding servo to mounting bracket.

(9) Position cable clamps (2) as shown in Figure 3 and tighten nuts and bolts (2 ea.). Adjust cable clamps in or out along the airleron cable to obtain a bridle cable tension of 15 + 10, -2 lbs (System 55X) or 15 ± 2 lbs (System 55). Torque cable clamp bolts to 55 ± 5 in. lbs.

(10) Remove the locking fixtures at the inboard ends of the airlerons. Aileron neutral (i.e. - aligned with flaps) position should be maintained with the control wheels in neutral. A droop of 1/8 inch is allowable.

(11) Remove the control wheel/tee bar locks. Check to insure that the left aileron up and right aileron down stops are contacted simultaneously and vice versa. Adjust stops as required.

(12) Rotate the left (pilot's) control wheel in each direction until the bellcranks contact the stops. The sprocket stops on the tee bar shall not be contacted until additional "override" movement (cushion) of the wheel occurs. A "cushion" on 0.030 to 0.040 inches is to be maintained as measured between the sprocket pin and adjustable control wheel stop bolts.

(13) Place the ailerons in the neutral (aligned with the flaps) position. For each aileron, from the neutral position, check that the "up" travel and the "down" travel are within the limits shown in Figure 27-10:

(a) Center bubble of a protractor over surface of aileron at neutral position. Note reading.

(b) Move aileron full up and down. Check degree of travel in each direction. Degree of travel on protractor is determined by taking the difference between protractor reading at neutral and up, and neutral and down. Bubble must be centered at each reading.

When measuring "down" travel from the neutral position, a light "up" pressure shall be maintained at the center of the aft edge of the aileron. When measuring "up" travel from the neutral position, a light "down" pressure shall be maintained at the center of the aft edge of the aileron (at the "up" position only), just sufficient to remove the slack between the bellcrank and the aileron. Total free play measured at the aileron trailing edges shall not exceed 0.120 inches.

(14) If steps (10) thru (13), above, reveal the aileron controls out of rig, repeat steps (1) thru (9).

(15) Connect autopilot harness.

(16) Check aileron controls for free and correct movement.

(17) Perform Post-Maintenance Operational Checkout, above.

(18) Replace floor panel and secure with screws.

(19) Replace carpeting.

(20) Replace the aft facing passenger seat or entertainment cabinet, whichever was installed.

14. Trim Servo (See Figures 2 and 5.)

The trim servo is located on the centerline just aft of the cabin rear closeout panel. The left stabilator trim cable wraps around the servo idler pulley and servo capstan.

A. Removal

(1) Remove rear seats. Remove cabin rear closeout panel. Remove baggage compartment carpet and floor.

(2) Tie a pull rope to the left trim cable exposed beneath the baggage compartment floor and tie-off the pull rope to structure aft.

(3) Tie a pull rope to the left trim cable aft of the turnbuckle in the rear fuselage aft of the trim servo and tie-off the pull rope to structure forward.

NOTE: The pull ropes apply tension to the trim cables to prevent the cables from unwrapping from the trim wheel drum or the trim barrel, and to prevent the cables from fouling at any of the pulleys.

(4) Slack-off the turnbuckle in the left trim cable segment aft of the trim servo sufficient to relieve tension on the left trim cable as it wraps around the trim servo idler pulley and capstan.

(5) Disconnect the autopilot harness.

(6) Remove the capstan cover and cable guards (4) by removing the retaining screws (4).

(7) Remove the bolt, nut, and washer securing the idler pulley to the trim servo baseplate and mounting bracket and remove the idler pulley components.

NOTE: The idler pulley breaks down into the following components upon removal of the bolt, above: mounting plate/cable guard assembly, idler pulley, and two washers.

(8) Remove the remaining bolts, nuts, and washers (3 ea.) securing the trim servo to its mounting bracket and remove the trim servo.

B. Installation

(1) Adjust trim servo clutch torque per Servo Clutch Torque Adjustment, below.

(2) With the capstan cover and cable guards removed, position the trim servo as shown in Figure 5. Secure with bolts, nuts, and washers (3 ea. - i.e. - aft two and forward left).

(3) Assemble the idler pulley cable guards (3) to the mounting plate with screws (1 ea.) and star washers (2 ea.). Place the center bolt through the mounting plate/cable guard assembly and slide a washer over the threaded end and up against the mounting plate. Set the mounting plate/cable guard/bolt assembly aside.

(4) Drape the slack left trim cable over the servo capstan.

CAUTION: IN STEPS (5) THRU (9), BELOW, USAGE OF LEFT AND RIGHT IS RELATIVE TO THE VIEW OF THE TECHNICIAN IN THE CABIN BAGGAGE AREA LOOKING AFT, EXCEPT WHERE AIRPLANE COMPONENT PARTS ARE SPECIFICALLY NAMED.

(5) Place thumb and forefinger on top of the capstan over the trim cable in its groove. Pressing the trim cable into its groove, slide thumb and forefinger down around opposite sides of the servo capstan and pull the trim cable slack towards you and to your left.

(6) Holding the trim cable in that position, install the capstan cover and cable guards as shown in Figure 5.

(7) Hold the idler pulley aft of the trim servo and to the right of the aiplane's left trim cable. Move the idler pulley left to the left trim cable and capture the trim cable in the bottom cable groove on the left of the idler pulley.

(8) Keeping the trim cable in the bottom groove, slide the idler pulley forward along the trim cable, left of the servo capstan, and bring it approximately to its installed position (See Figure 5). At this point, the aft portion of the trim cable should be routed left, around the front, and to the right of the idler pulley and to the left, around the rear, and to the right of the capstan.

(9) Holding the idler pulley in this position, reach down and pull the forward portion of the trim cable over the idler pulley and seat it in the top cable groove on the idler pulley. The left trim cable should now be routed as shown in Figure 5.

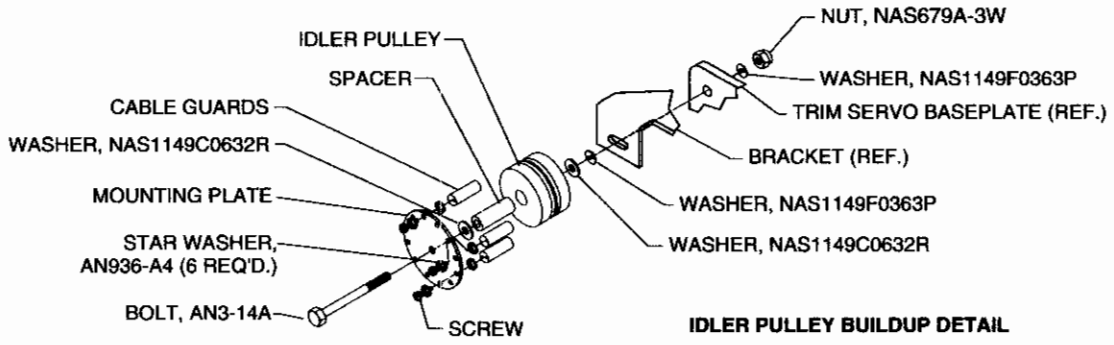
(10) Place the spacer inside the idler pulley.

(11) Position the mounting plate/cable guard/bolt assembly as shown in Figure 5 and slide the bolt through the spacer inside the idler pulley.

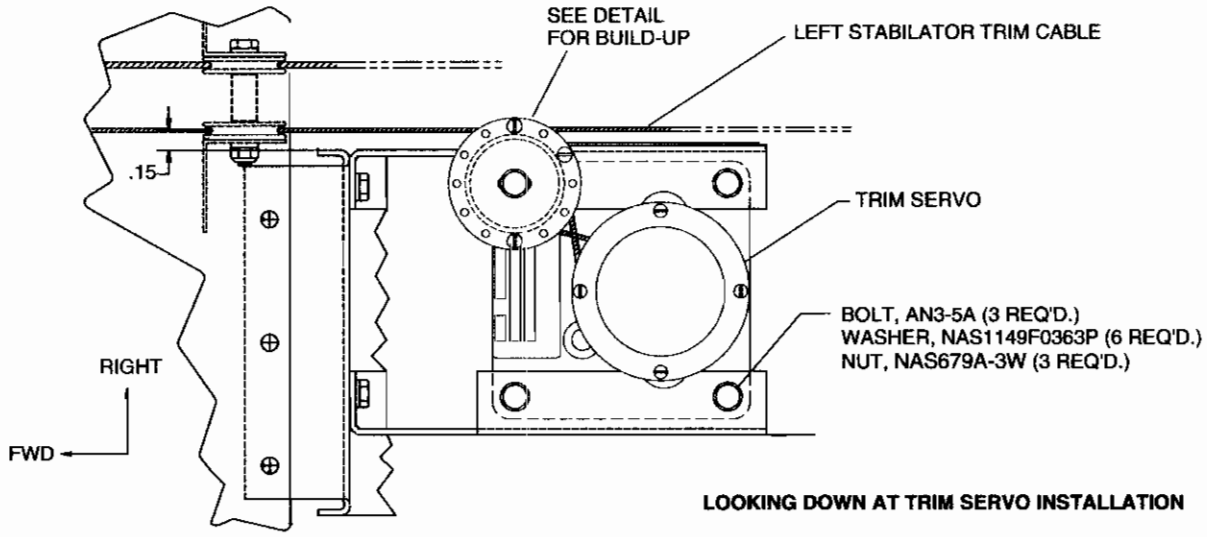
(12) Place a washer over the bolt end and put the bolt through the trim servo mounting bracket and baseplate. Secure with a nut and washer, taking care to ensure that the cable guards are positioned, and the left trim cable is routed, as shown in Figure 5.

(13) Take up the slack in the left trim cable with the turnbuckle and remove the pull ropes.

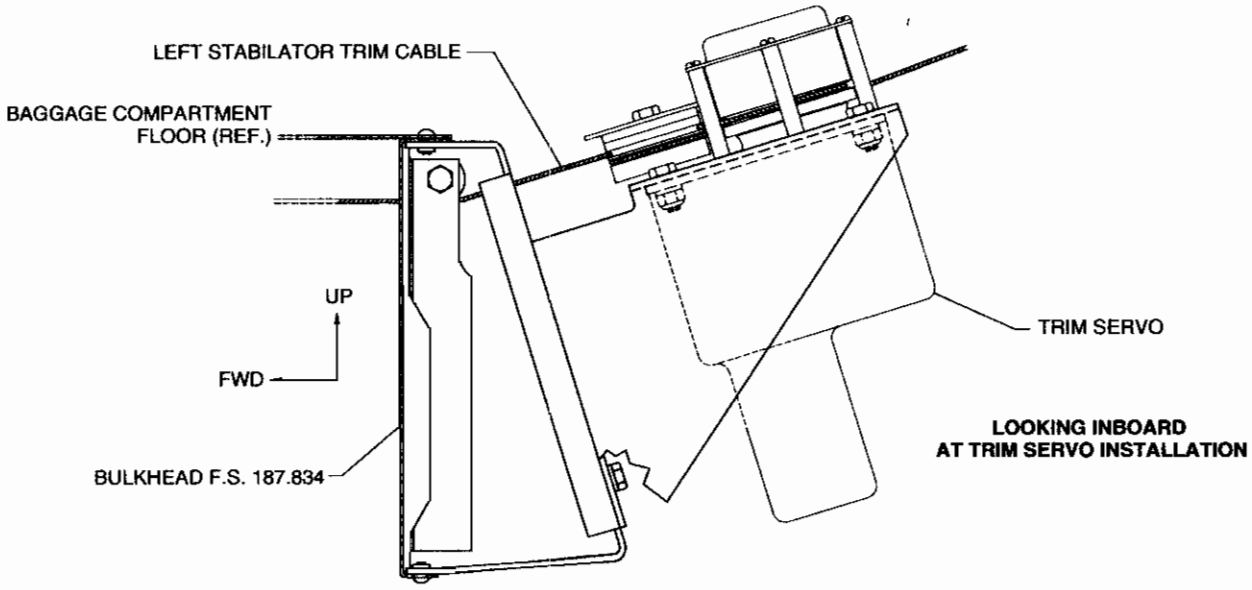
(14) Rig stabilator trim per Stabilator Trim Rigging and Adjustment, 27-30-00.



IDLER PULLEY BUILDUP DETAIL



LOOKING DOWN AT TRIM SERVO INSTALLATION



LOOKING INBOARD AT TRIM SERVO INSTALLATION

Trim Servo Installation
Figure 5

Effectivity
3246126 & up
3257076 & up

(15) Connect the autopilot harness.

(16) Perform Post-Maintenance Operational Checkout, above.

(17) Check elevator trim controls for free and correct movement.

(18) Reinstall baggage compartment floor and carpet, and cabin rear closeout panel.

(19) Reinstall rear seats.

15. Pitch Servo (See Figures 2 and 6.)

The pitch servo is located in the aft fuselage just aft of F.S. 259.00. A bridle cable and clamps attach the servo capstan to the upper and lower stabilator cables.

NOTE: The bridle cable routing, pulley buildup, and capstan wrapping and alignment differ between the System 55 / early System 55X (see Figure 6, Sheet 2) installations and current System 55X (see Figure 6, Sheet 1) installations.

A. Removal

(1) Attach a tail stand under the tail skid.

(2) Remove the cabin rear closeout panel.

(3) Crawl into the tailcone until the pitch servo is accessible.

(4) Disconnect autopilot harness.

(5) Remove nuts and bolts (2 ea.) securing each cable clamp (2) and remove cable clamps from upper and lower stabilator cables and autopilot bridle cable.

(6) Remove cotter pin from bridle cable pulley and pull upper portion of bridle cable free of the pulley.

(7) Remove nuts and bolts (4 ea.) and washers (8 ea.), securing pitch servo to mounting bracket and remove pitch servo with attached bridle cable.

B. Installation

NOTE: The bridle cable routing, pulley buildup, and capstan wrapping and alignment differ between the System 55 / early System 55X (see Figure 6, Sheet 2) installations and current System 55X (see Figure 6, Sheet 1) installations.

For enchanced accessiblity, the early System 55X installations (S/N's listed below) can be upgraded to the current System 55X configuration by replacing the following parts:

HP S/N's 3246182 thru 3246204 only; and,
TC S/N's 3257199 thru 3257296 only

	Original Factory Installed Part	Authorized Field Replacement Part
Bridle Cable	S-TEC P/N 7002-7	S-TEC P/N 7002-48
Spacer	S-TEC P/N 44234	S-TEC P/N 4407-14
Washer	N/A	NAS1149F0363P

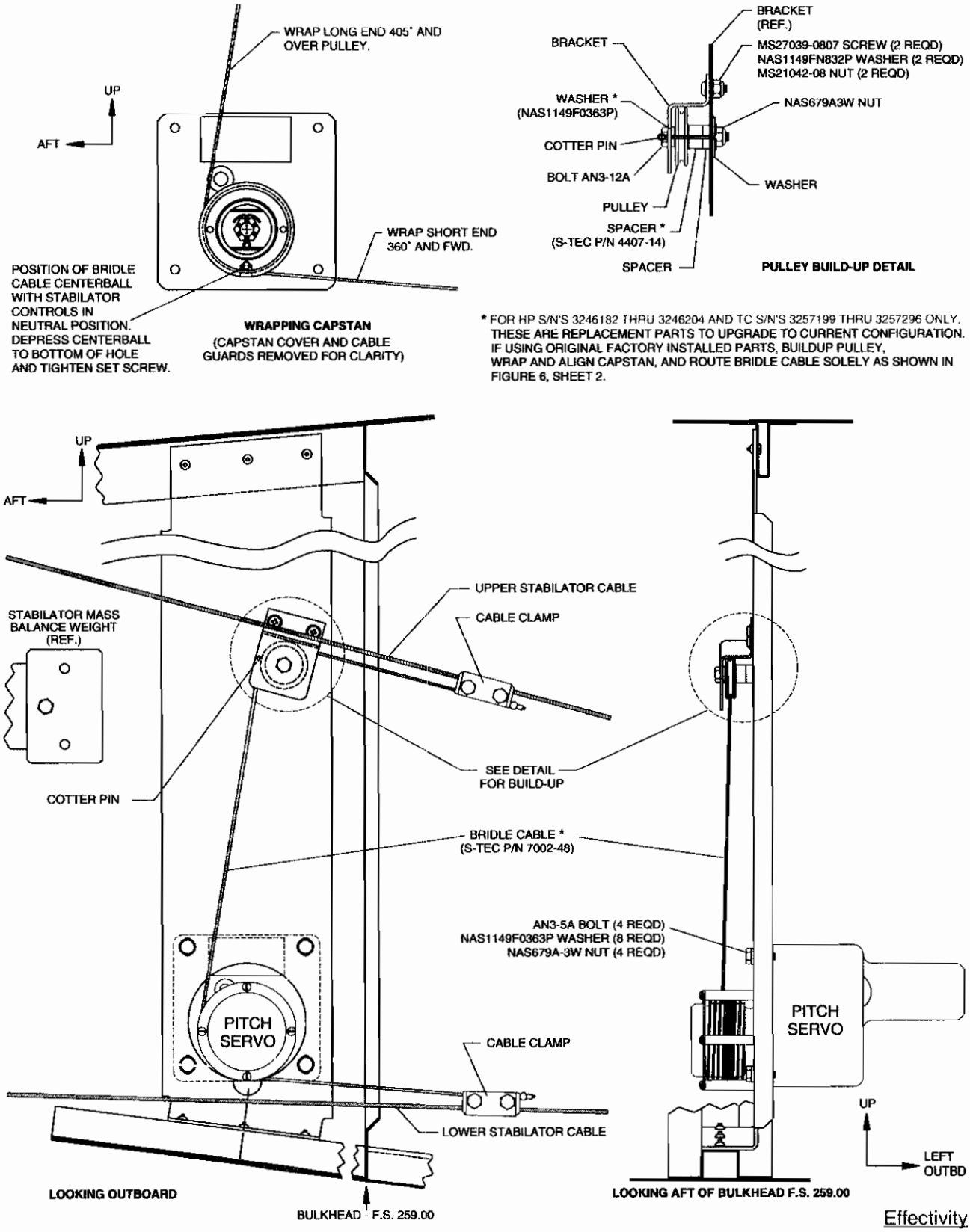
(1) Rig stabilator controls per Stabilator Controls Rigging and Adjustment, 27-30-00.

(2) Remove screws (4) and remove capstan cover and cable guards from servo.

(3) Adjust pitch servo clutch torque per Servo Clutch Torque Adjustment, below.

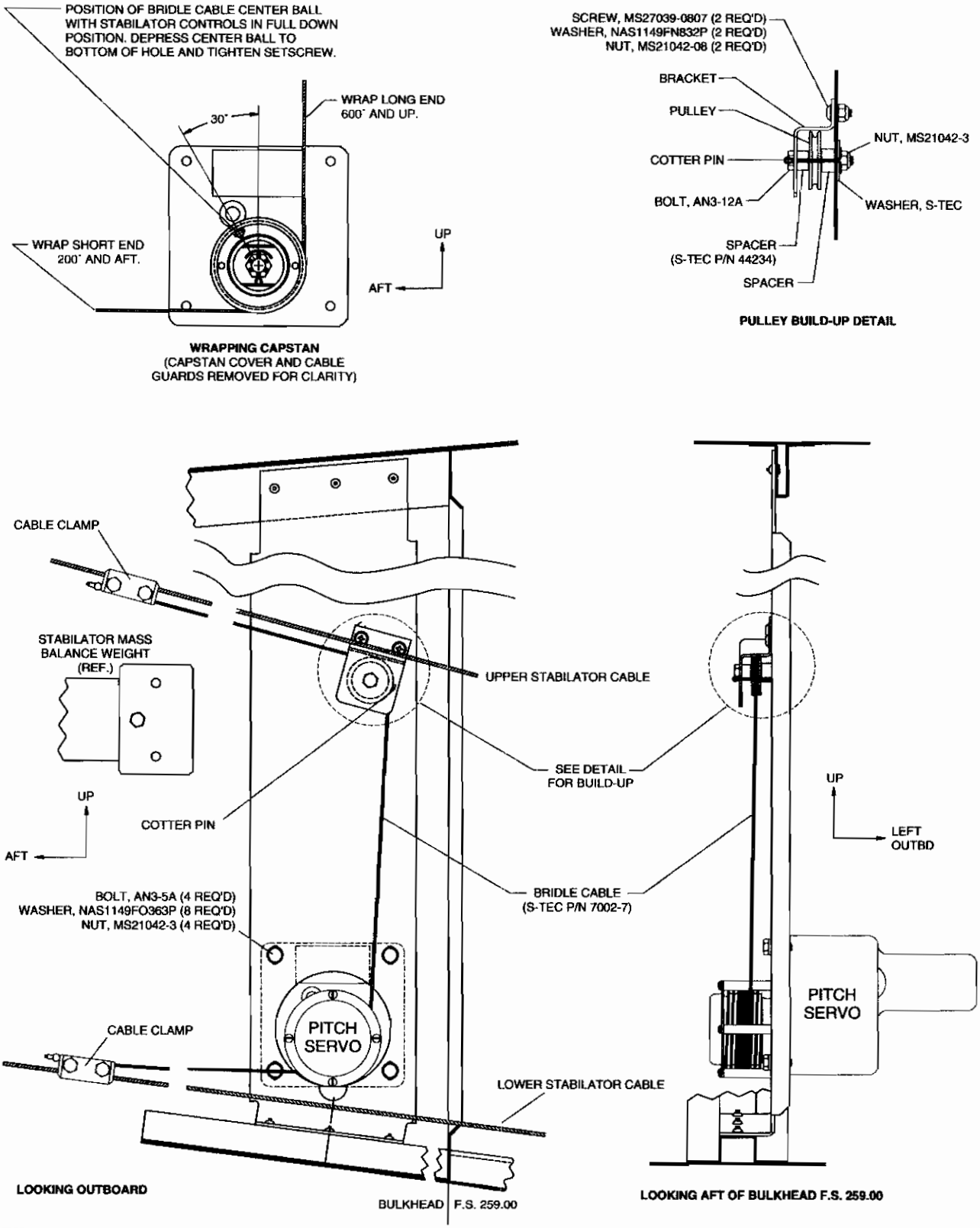
(4) Wrap autopilot bridle cable, align capstan, and tighten center-ball setscrew as shown in Figure 6.

NOTE: The capstan is wrapped and aligned differently on the System 55 (see Figure 6, Sheet 2) and System 55X (see Figure 6, Sheet 1). Verify serial number effectivity for your airplane.



Pitch Servo Installation
Figure 6 (Sheet 1 of 2)

Effectivity
3246182 & up
3257199 & up



Effectivity
3246126 thru 3246181
3257076 thru 3257198

Pitch Servo Installation
Figure 6 (Sheet 2 of 2)

(5) Replace cable guards and capstan cover, secure with screws (4).

(6) Position pitch servo as shown in Figure 6 and secure with bolts, nuts, and washers (4 ea.).

(7) Lead upper portion of bridle cable through pulley as shown in Figure 6. Reinstall cotter pin.

NOTE: The bridle cable is routed differently on the System 55 (see Figure 6, Sheet 2) and System 55X (see Figure 6, Sheet 1). Verify serial number effectivity for your airplane.

(8) Position cable clamps (2) as shown in Figure 6 and tighten nuts and bolts (2 ea.). Adjust cable clamps in or out along the stabilator cables to obtain a bridle cable tension of 15 ± 2 lbs (System 55) or 15 + 10, -2 lbs (System 55X). Torque cable clamp bolts to 55 ± 5 in. lbs.

(9) Connect autopilot harness.

(10) Perform Post-Maintenance Operational Checkout, above.

(11) Check stabilator controls for free and correct movement.

(12) Reinstall and secure the cabin rear closeout panel.

(13) Remove tail stand.

16. Servo Clutch Torque Adjustment (See Figure 7 and Chart 1.)

A. Remove servo per instructions under specific servo, above.

B. Place servo in a holding fixture (i.e. - vice) with capstan up.

C. Remove capstan cover, cable guards, and cable.

D. Check capstan torque by attaching the capstan adjusting tool (special tool - see parts catalog) to the capstan and using a currently calibrated torque wrench as shown in Figure 7.

(1) Acceptable torque is specified in Chart 1.

(2) If adjustment is required, proceed as follows.

E. Remove cotter pin from end of servo shaft and remove castle nut, shim washers, and tension washers.

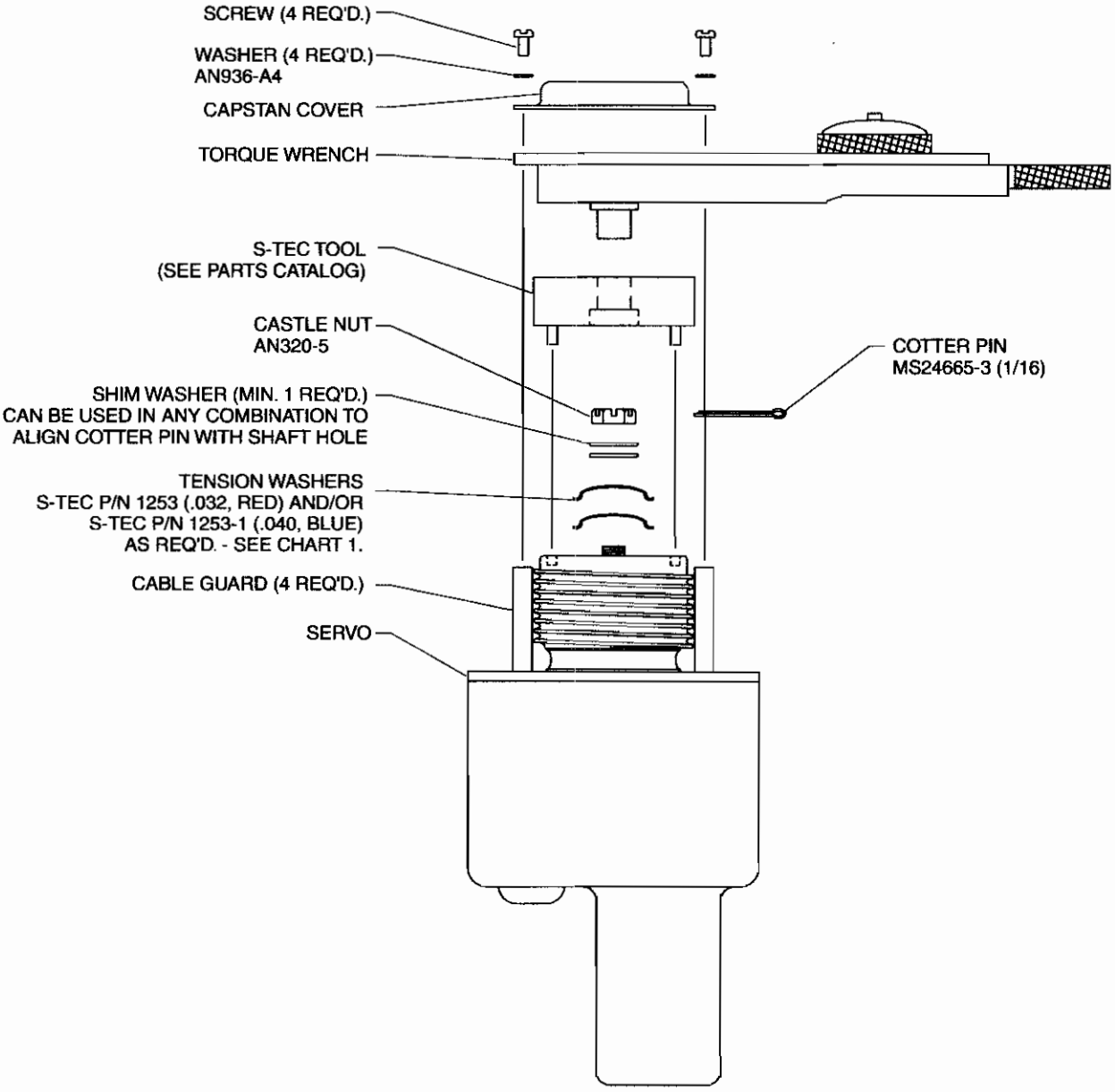
F. Replace tension washers as required (see Chart 1).

G. Replace shim washers and castle nut.

H. Tension castle nut so that capstan torque is as specified in Chart 1.

CHART 1
SERVO CLUTCH TORQUE

	TORQUE (In. Lbs.)		WASHERS REQUIRED	
SERVO	**System 55**	**System 55X**	**System 55**	**System 55X**
Roll	40 ± 2	40 ± 2	One .032; Two .040	One .032; Two .040
Pitch	44 ± 2	44 ± 2	One .032; Two .040	One .032; Two .040
Trim	20 ± 2	27 ± 2	Two .040	Three .032



Effectivity
3246126 & up
3257076 & up

Servo Clutch Torque Adjustment
Figure 7

17. Flap Compensator (See Figure 8.)

A flap compensator potentiometer is mounted underneath the right aft facing passenger seat or the entertainment cabinet, whichever is installed. The pot is mounted on a bracket just aft of the wing spar box and outboard of the fuel selector valve. The arm of the pot is linked to the flap troque tube by a cable assembly.

Adjustment

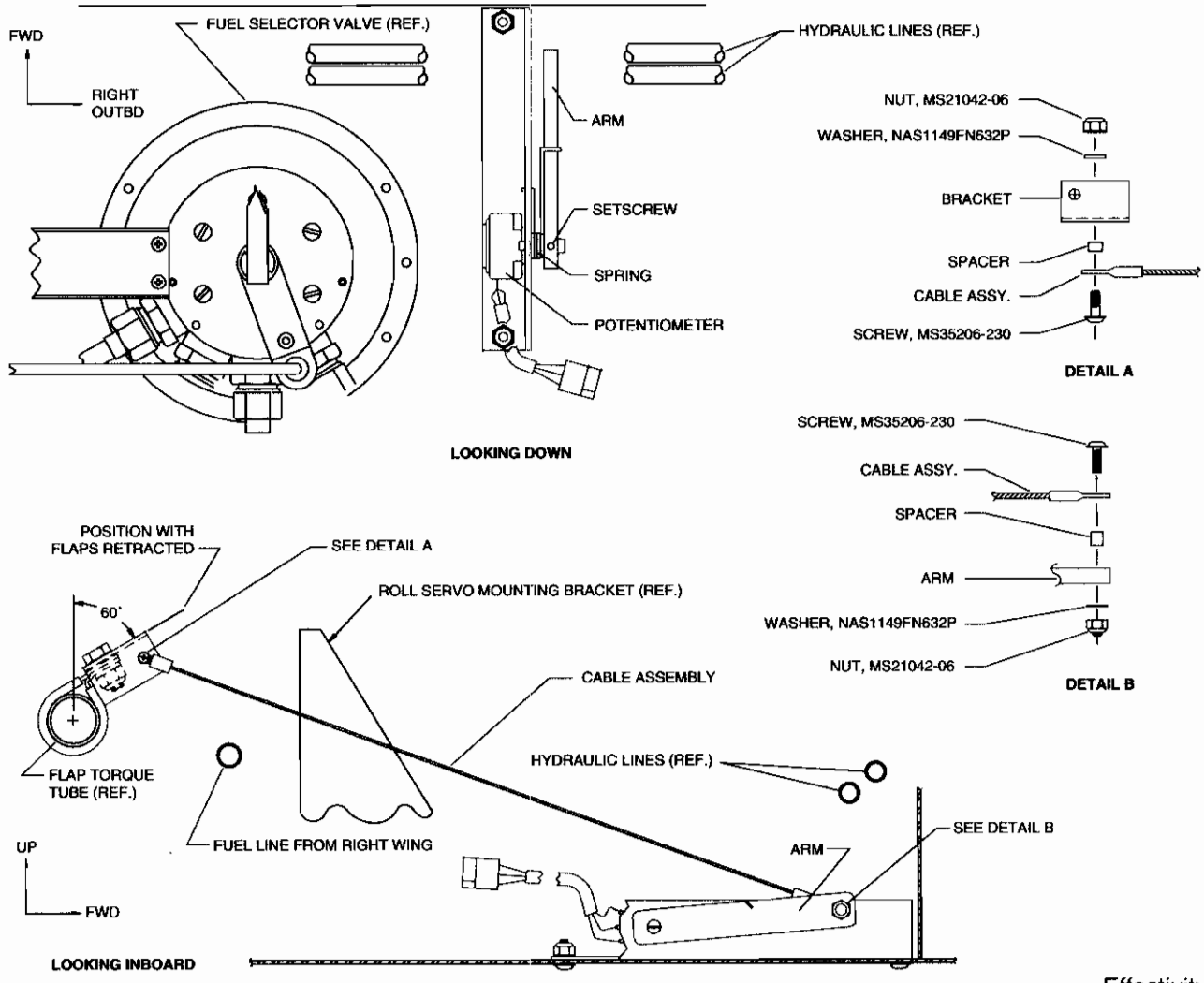
(1) With flaps in the full up position and set screw loose, turn A/P master switch ON.

(2) Connect a digital voltmeter (3 1/2 digit) between airframe ground and center terminal (wiper) of potentiometer (pot).

(3) Turn pot shaft clockwise to stop. Voltmeter should read 5.00 vdc.

(4) Turn pot shaft slowly counter-clockwise until voltage just starts to decrease from 5.00 volts.

(5) Tighten set screw and recheck wiper voltage for 4.95 to 5.00 vdc.



Flap Compensator Installation
Figure 8

Effectivity
3246126 & up
3257076 & up