Honeywell
Bill Gill
Air Safety Investigator
[redacted]
Olathe, Kansas [redacted]

Mr. Timothy W. Monville
Senior Air Safety Investigator
National Transportation Safety Board
45065 Riverside Parkway
Ashburn, VA 20147

August 3, 2018

Re: NTSB ID: ERA18FA167, N218BL, Beech 58 Baron; Honeywell examination

Dear Mr. Monville,

The equipment identified below from N218BL was examined at our facility in Olathe, Kansas, on July 10/11, 2018. Inspector Arno Boyle with the FAA Kansas City FSDO, hand carried the components to the Honeywell site in a sealed box. Following the examination, the components were boxed, sealed and pending NTSB direction for return shipment.

1. KC 295 Flight Computer, P/N 065-0034-00, S/N 12170, Mods 1, 2, 4, 6, 7
2. KS 270A Pitch Servo, P/N 065-0059-01, S/N 28045, Mods 1, 2, 3, 4, 5
3. KM 275 Pitch Servo Mount, P/N 065-0030-00, S/N 37290
4. KS 272A Trim Servo, P/N 065-0061-13, S/N 47091, Mods 1, 2, 3, 6
5. KM 276 Trim Servo Mount, P/N 065-0031-00, S/N 9411
6. KS 271A Roll Servo, P/N 065-0060-01, S/N 38232, Mods 1, 2
7. KM 275 Roll Servo Mount, P/N 065-0030-00, S/N 37289
8. KS 271A Yaw Servo, P/N 065-0060-04, S/N 40377, Mods 2, 3
9. KM 275 Yaw Servo Mount, P/N 065-0030-00, S/N 36810

Box as-received


Items loose -- not packaged properly

1. **KC 295 Flight Computer, P/N 065-0034-00, S/N 12170, Mods 1, 2, 4, 6, 7**

   The KC 295 Flight Computer is impact damaged and cannot be tested as a unit. The unit was disassembled to allow inspection. The following observations were noted:

   - Dried dirt/mud present on the unit.
   - Left side cover impact damaged.
   - Base and mounting tray impact damaged.
   - Connector housings are impact damaged.
   - Rear plate damaged.
   - Pitot tube cut about 3 inches from connector.
   - Crush damage to top of dust cover.
   - There is a "rattling" sound as the Flight Computer is moved from the vertical to horizontal position.

   - The unit was removed from the mounting tray to facilitate disassembly and inspection.
   - A variable resistor fell out of the unit when the cover was removed (from Lateral board).
   - One integrated circuit chip damaged (missing top) on Power Supply board – not testable.
   - Two integrated circuits chips damaged (missing tops) on Logic board – not testable.
   - End of card connector found on the top of the frame.
   - Adaptor card appears to be in good physical condition -- testable.
   - The altitude board appears to be on good physical condition -- testable.
   - Lateral card has a missing variable resistor (R106), otherwise in good condition. A replacement part was installed to allow testing of the Lateral board – now testable.
   - Pitch board has 2 chipped ceramic filter capacitors; board is bowed -- testable.
   - Connectors on rear interconnect board damaged.
   - Dried soil on bottom frame.

   The **Lateral**, **Pitch**, and **Altitude** boards were inserted into an exemplar unit for testing. After power-up, normal current draw was observed and all alignment nulls met specification. Complete acceptance testing was not practical (automated tester inoperative); however, the experienced technician manually performed numerous acceptance tests to determine proper operation/function. No out-of-tolerance conditions were detected. The "test adapter board" was then removed from the KC 295 and the accident **Adapter** Board was installed. The KC 295 Flight Computer was then installed in a KFC 200 engineering test harness for functional testing – included were all the accident servos. The KC 295 Flight Computer, KS 270A Pitch Servo, KS 271A Roll Servo, KS 272A Trim Servo, and the KS 271A Yaw Servo passes functional testing. The accident unit circuit boards were removed from the KC 295 exemplar unit and the replacement R106 was removed from the Lateral card.

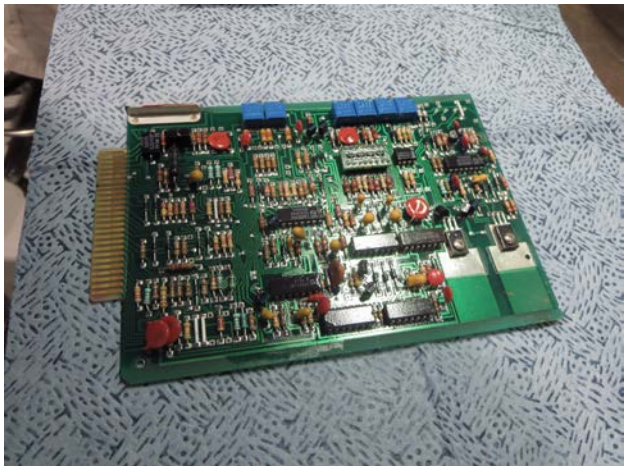
KC 295: impact damaged with dry dirt/mud on unit

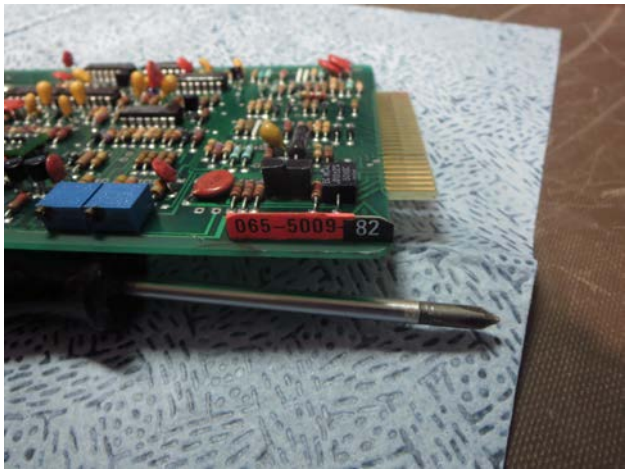
KC 295 connectors damaged

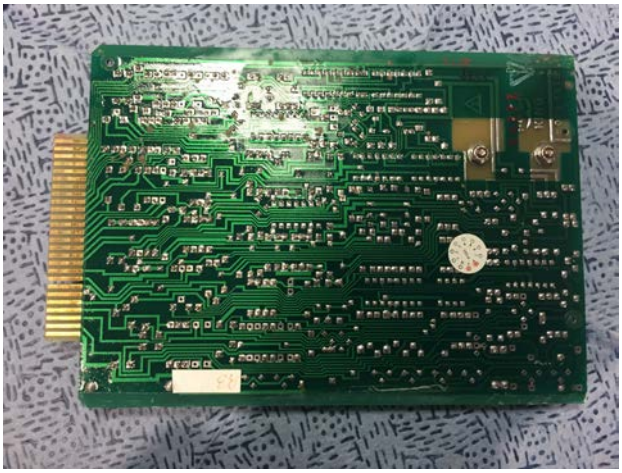
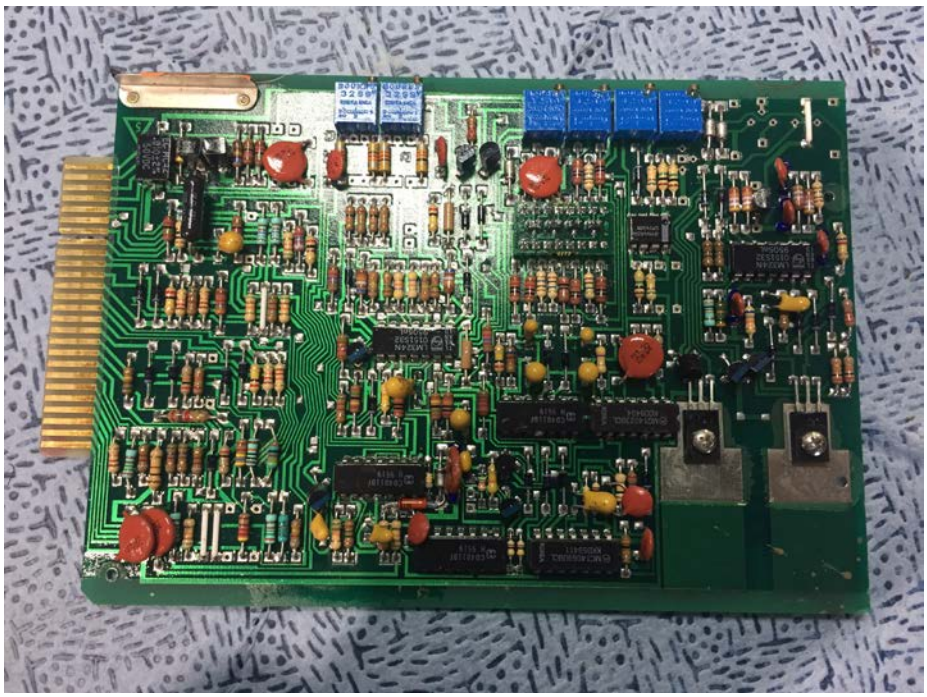
KC 295 crush damaged on left side of unit

Internal view of KC 295 with end plate containing the power supply removed. Several damaged electrical components can be observed.

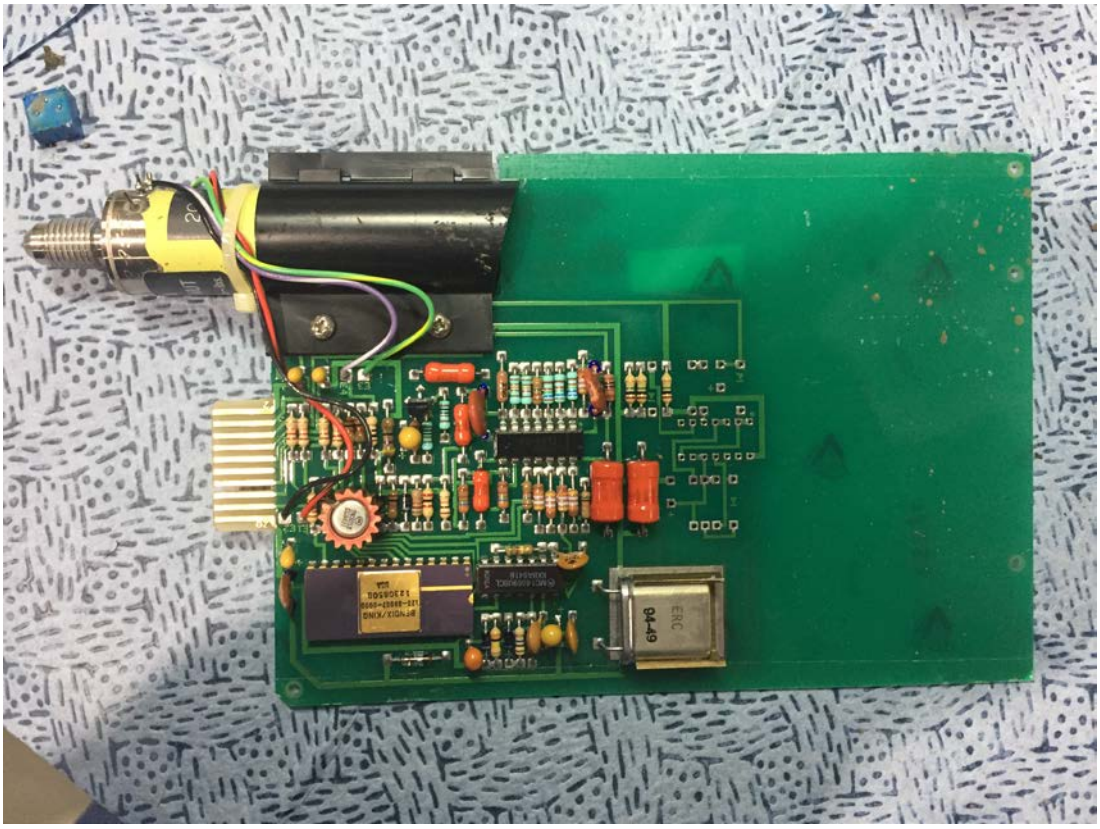
KC 295 **Power Supply** board – damaged part circled above (not testable)

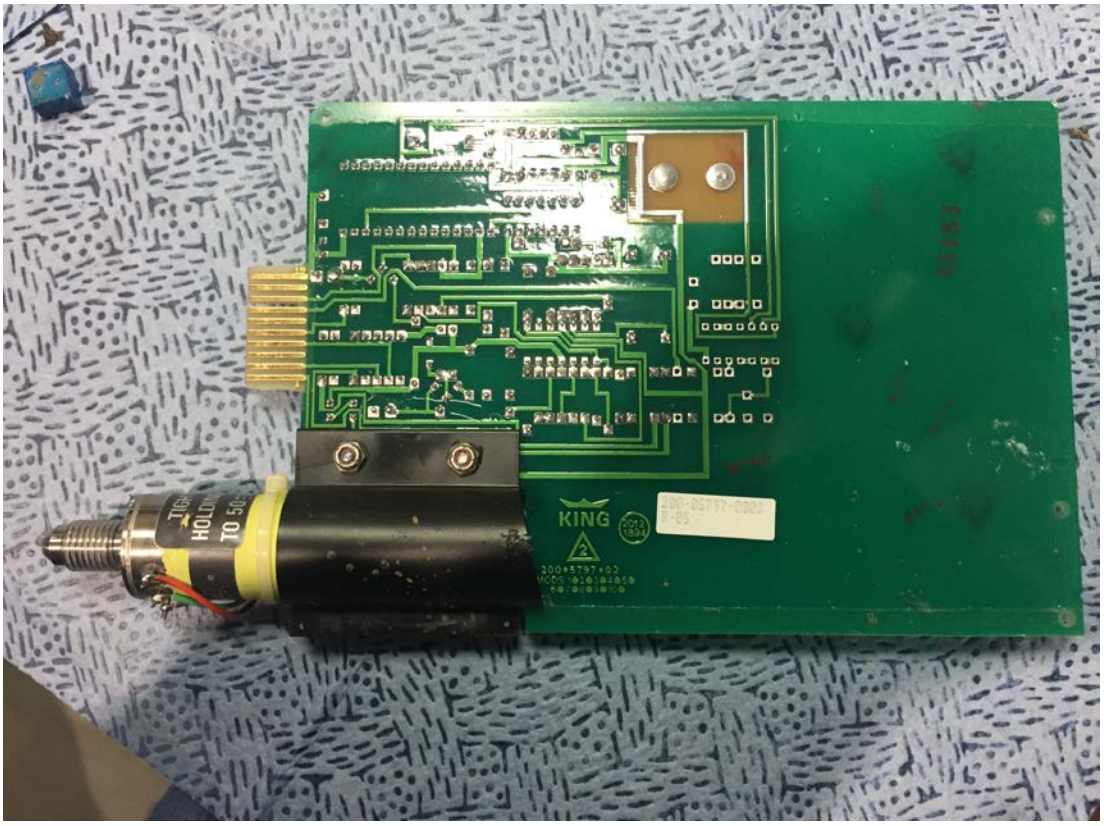


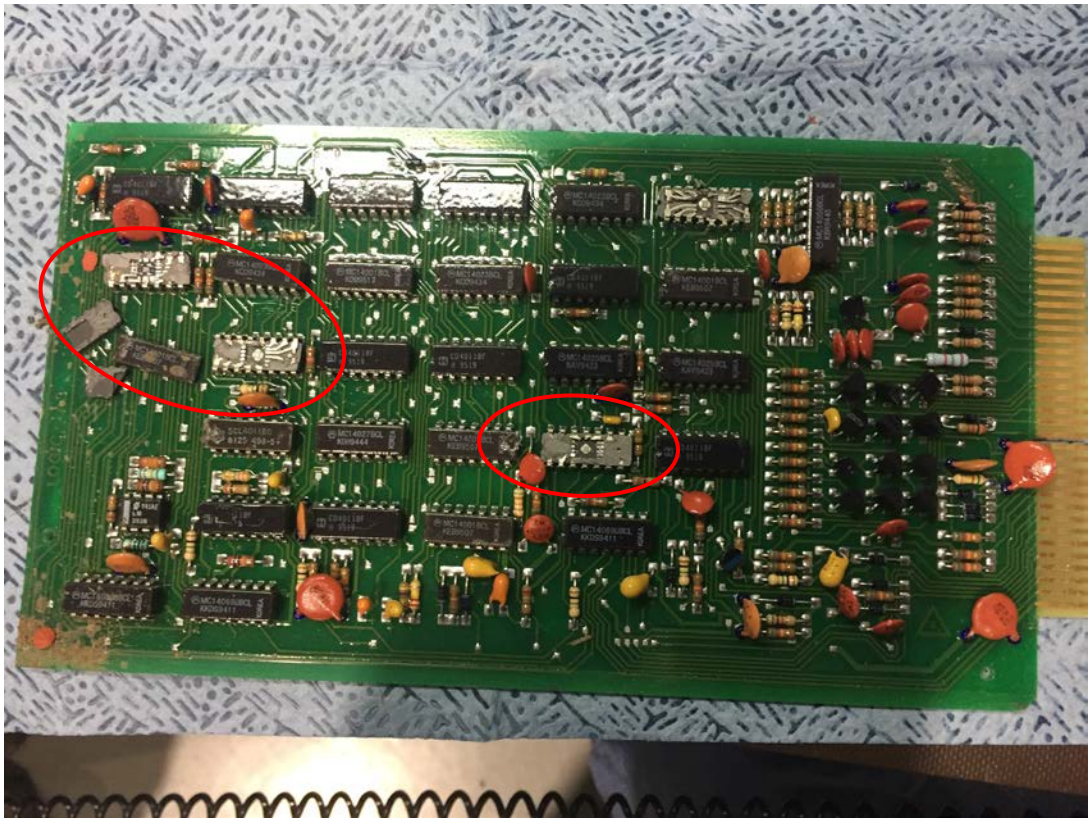



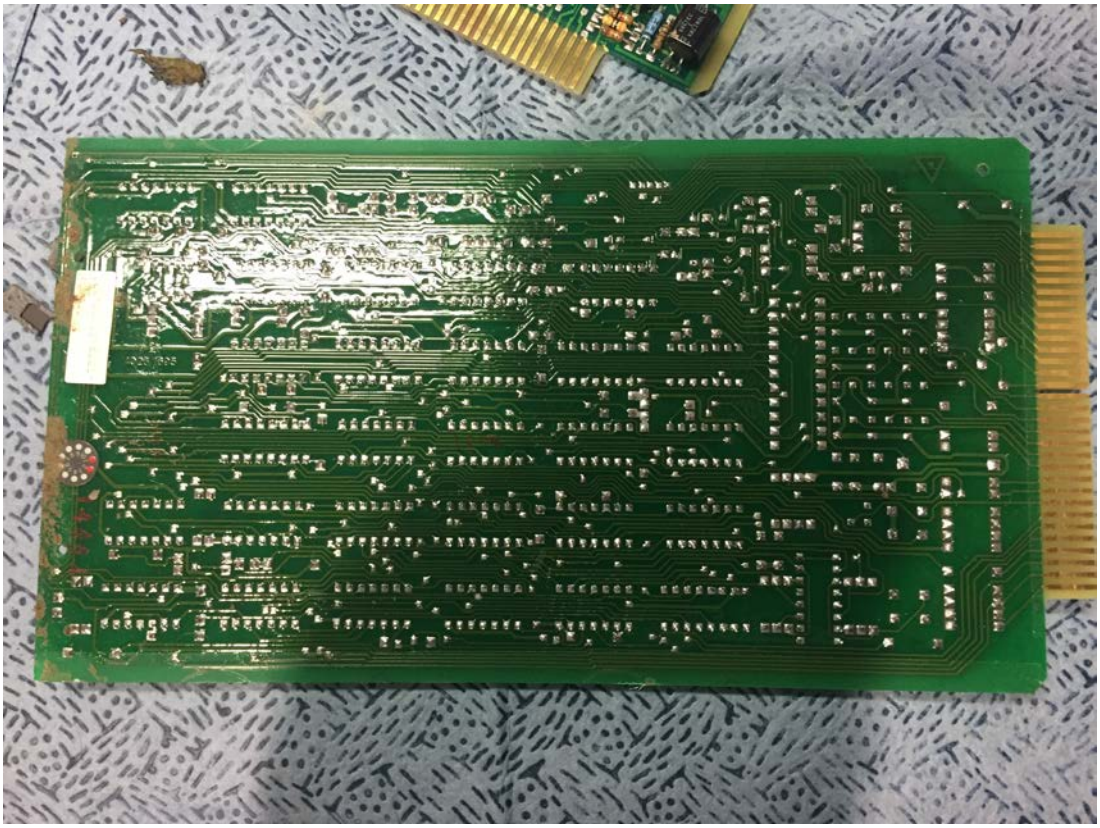
KC 295 **Adapter** board, P/N 065-5009-82, Mods 8, 9. This is the correct Adapter board for the 58 Baron.



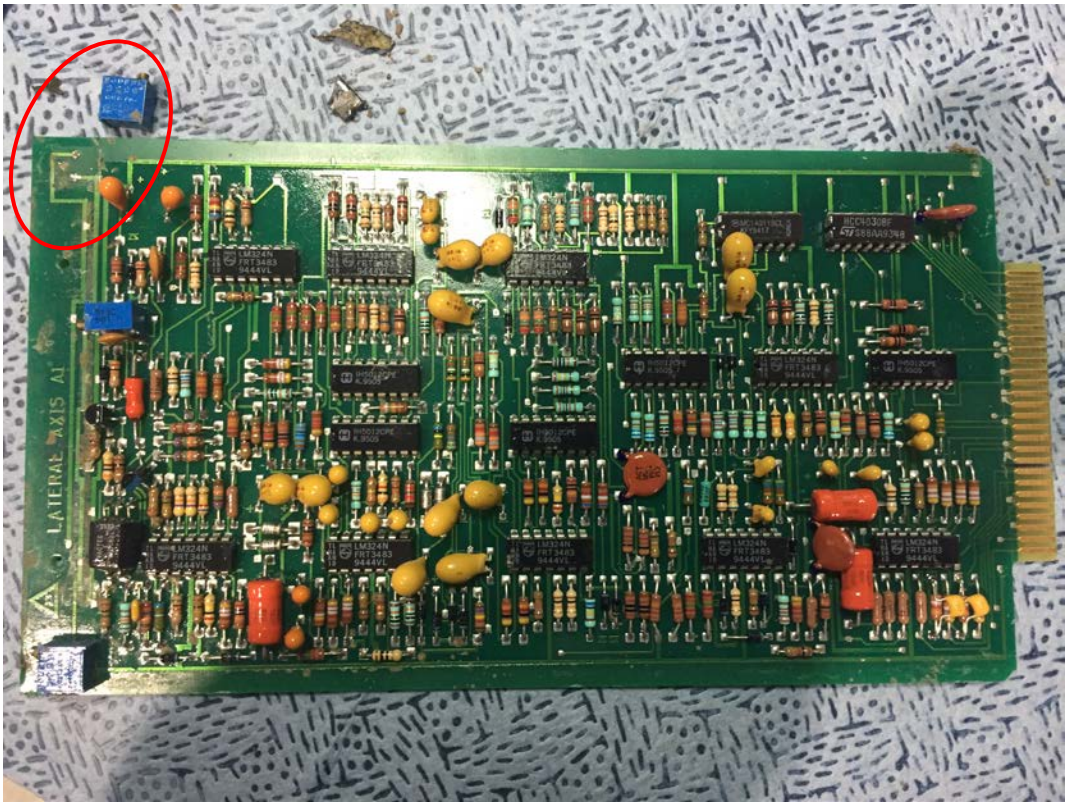


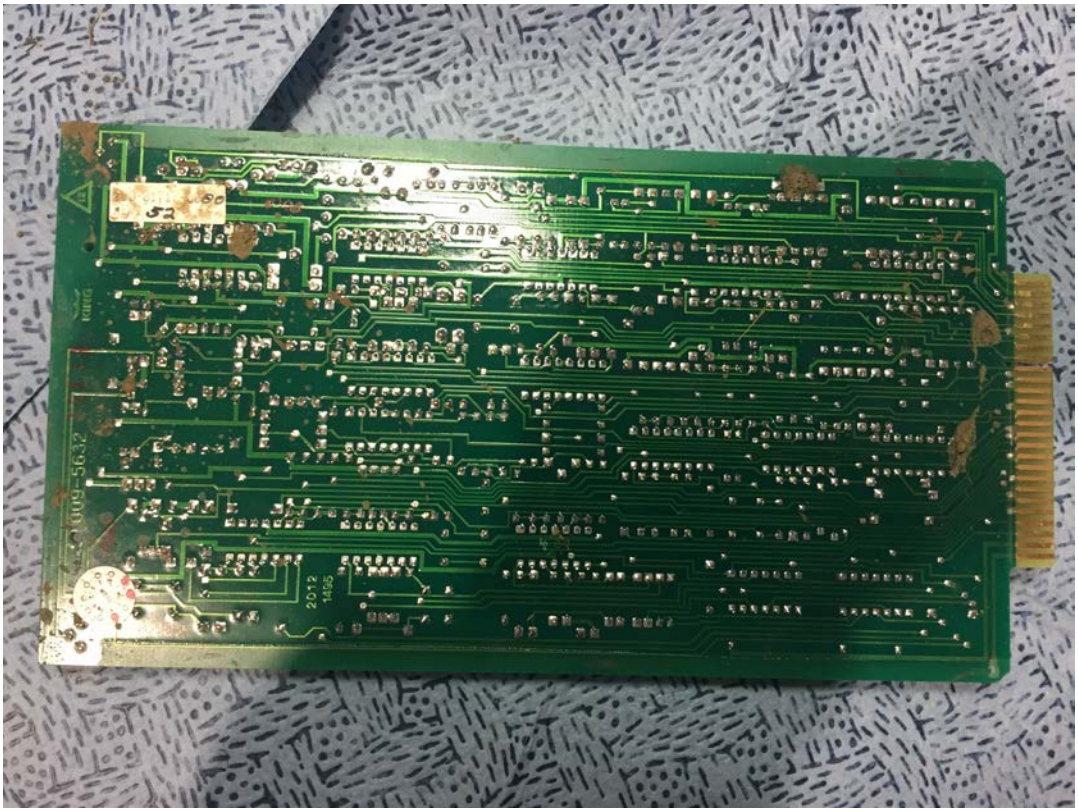
KC 295 **Altitude** board – no impact damage detected



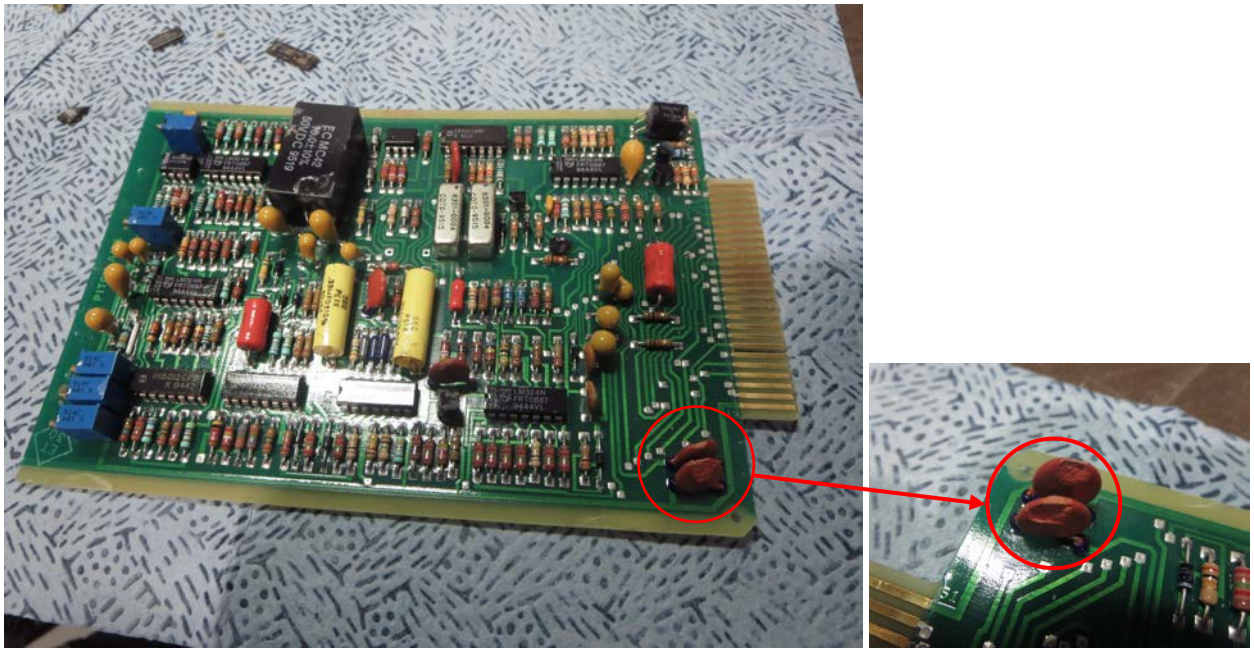


KC 295 **Logic** board contains several damaged components circled above – not testable.

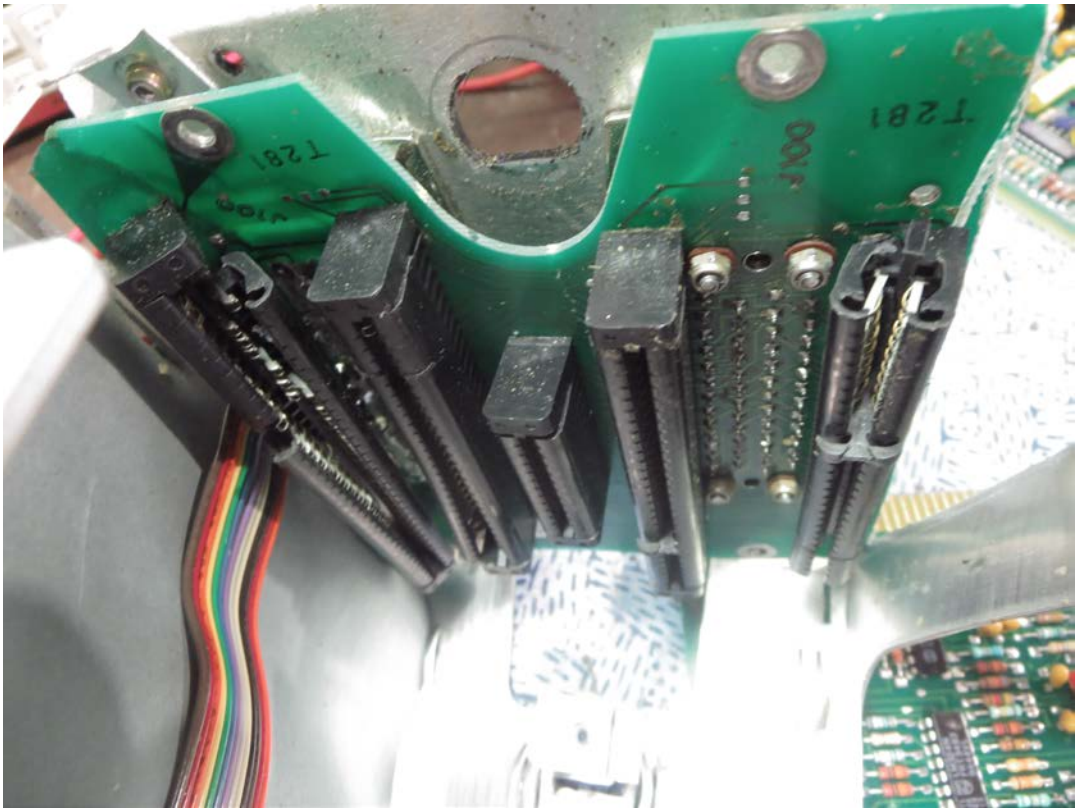


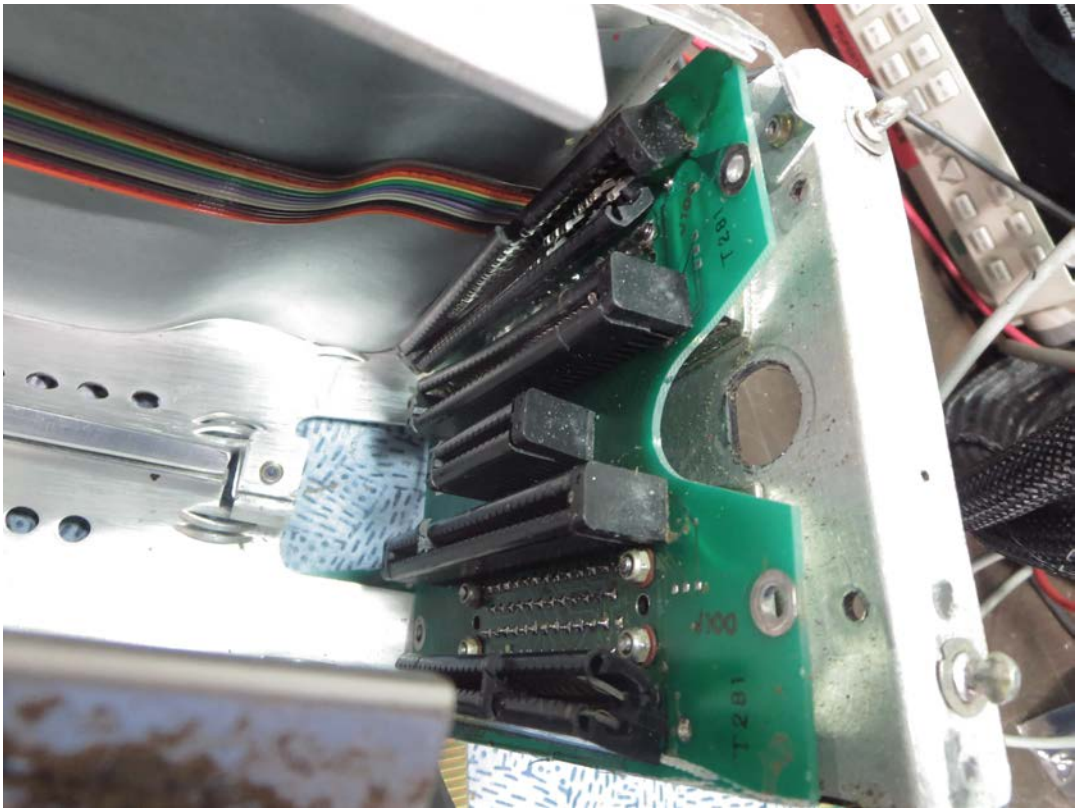


R106 broken off the **Lateral** board from impact damage as circled above. A replacement part was installed to allow testing.



KC 295 **Pitch** board: contains two chipped capacitors – no other damage noted and testable





KC 295 **Interconnect** board contains impact damaged connectors – not testable

2. KS 270A Pitch Servo, P/N 065-0059-01, S/N 28045, Mods 1, 2, 3, 4, 5

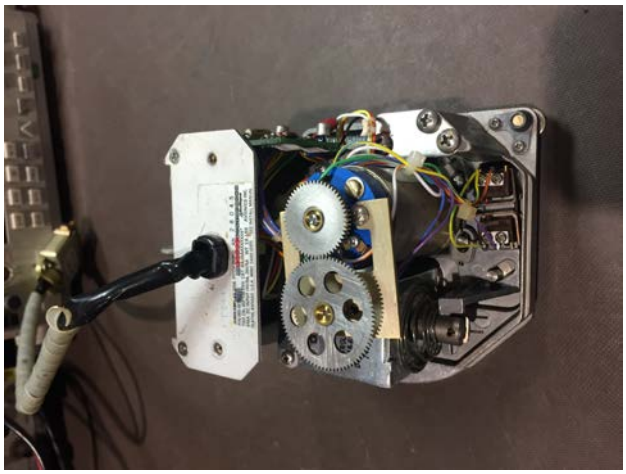
The KS 270A Pitch Servo was inspected and the following observations were noted:

- Dried dirt/mud present on the unit.
- Cover is cracked.
- Removed cover to allow internal inspection – no obvious damage noted.
- Subjected the unit to final acceptance tests and two minor out-of-tolerance conditions were detected.
    - Autotrim threshold test: measured 4 in-lbs. CCW direction and 7.5 in-lbs. CW direction -- limit is 5.5 to 7 in-lbs.
    - Torque characteristics test: Servo will not stay engaged while attempting to provide a torque of 80 in-lbs. The servo pinion and capstan gears "jump" teeth above 75 in-lbs.
- The KS 270A Pitch Servo passed all other testing. The out-of-tolerance conditions noted above would not adversely affect proper operation.

KS 270A Pitch Servo data plate


Cover cracked


KS 270A – front view


KS 270A – no internal damage detected

3. KM 275 Pitch Servo Mount, P/N 065-0030-00, S/N 37290

The KM 275 Pitch Servo Mount was inspected. The following observations were noted:

- Capstan turns freely.
- Dried dirt/mud on the unit.
- Tested the slip clutch – measured 15 in-lbs. CW direction and 20 in-lbs. CCW direction. The specified limit is 18 to 22 in-lbs. The minor out-of-tolerance condition would not adversely affect proper operation.

KM 275 data plate and torque tag

KM 275 – back view

KM 275 – front view

4. KS 272A Trim Servo, P/N 065-0061-13, S/N 47091, Mods 1, 2, 3, 6

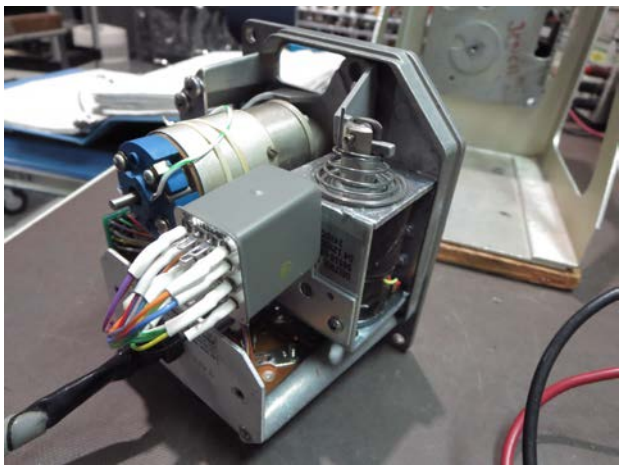
The KS 272A Trim Servo was inspected and the following observations were noted:

- The cover is cracked/broken.
- The unit was subjected to and passes all final acceptance tests.

KS 272A data plate


KS 272A – cover cracked


KS 272A – front view


KS 272A – cover removed

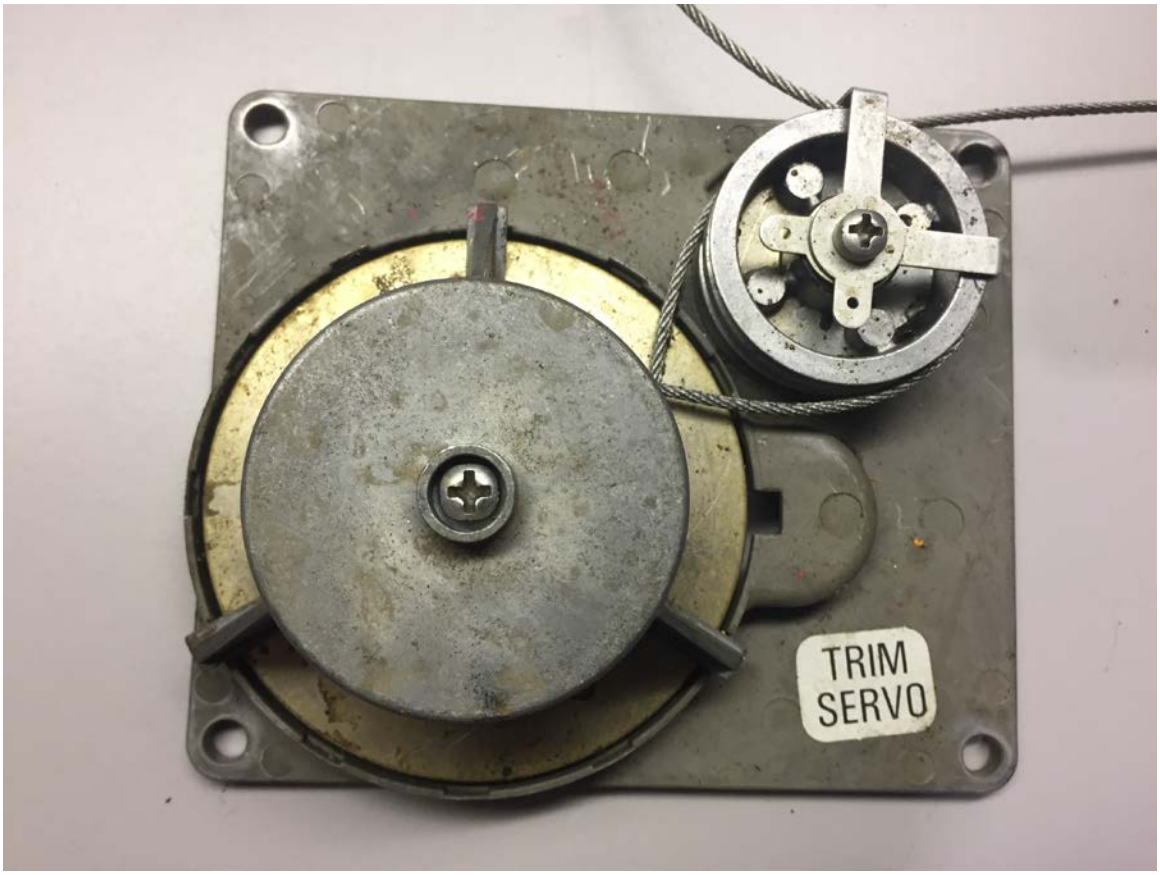
5. KM 276 Trim Servo Mount, P/N 065-0031-00, S/N 9411

The KM 276 Pitch Trim Servo Mount was inspected. The following observations were noted:

- Capstan turns freely.
- Dried dirt/mud on the unit.
- Tested the slip clutch – measured 30 in-lbs. CW direction and 30 in-lbs. CCW direction. The specified limit is 28 to 32 in-lbs.

KM 276 data plate


KM 276 – back view



KM 276 Pitch Trim Servo Mount – front view

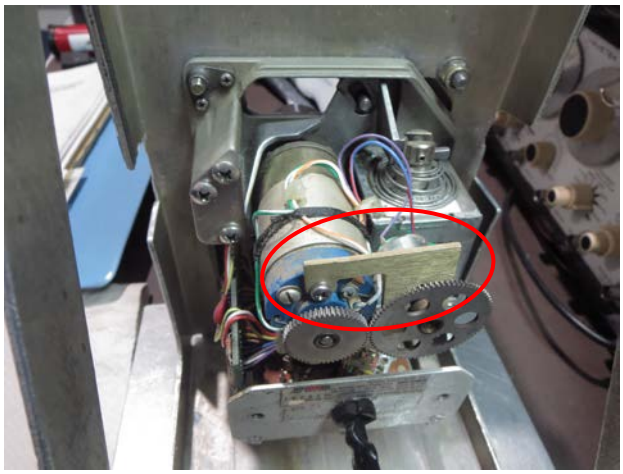
6. KS 271A Roll Servo, P/N 065-0060-01, S/N 38232, Mods 1, 2

The KS 271A Roll Servo was inspected and the following observations were noted:

- The cover is cracked/broken.
- Dried dirt/mud on unit.
- Capital Avionics seal intact.
- Tach motor bracket bent downward towards the front of the unit. The tach motor bracket was straightened to allow testing.
- Two connector pins are damaged. Straightened pins to allow testing.
- The unit was subjected to and passes all final acceptance tests.

KS 271A data plate


KS 271A – cover cracked/broken


KS 271A – Tach motor bracket


KS 271A – bent connector pins

7. KM 275 Roll Servo Mount, P/N 065-0030-00, S/N 37289

The KM 275 Roll Servo Mount was inspected. The following observations were noted:

- Cable guard and capstan are impact damaged. Removed damaged cable guard -- capstan turns freely.
- Tested the slip clutch – measured 30 in-lbs. CW direction and 30 in-lbs. CCW direction. The specified limit is 25 to 31 in-lbs.

KM 275 data plate

KM 275 – back view

KM 275 – front view


KM 275 – capstan impact damaged

8. KS 271A Yaw Servo, P/N 065-0060-04, S/N 40377, Mods 2, 3

The KS 271A Roll Servo was inspected and the following observations were noted:

- The cover is cracked/broken.
- Dried dirt/mud on unit.
- The unit was subjected to and passes all final acceptance tests.

KS 271A data plate

KS 271A – top view


KS 271A – cover cracked

KS 271A – front view

9. KM 275 Yaw Servo Mount, P/N 065-0030-00, S/N 36810

The KM 275 Yaw Servo Mount was inspected. The following observations were noted:

- Capstan turns freely.
- Dried dirt/mud on the unit.
- Tested the slip clutch – measured 50 in-lbs. CW direction and 50 in-lbs. CCW direction. The specified limit is 49 to 61 in-lbs.

KM 275 ta plate

KM 275 – back view

KM 275 – front views

The KS 271A Roll Servo, KS 271A Yaw Servo, and the KS 272A Trim Servo units passed all final acceptances tests. The KM 275 Roll Servo Mount, KM 275 Yaw Servo Mount, and the KM 276 Trim Servo Mount units meet the designed slip clutch settings.

The KS 270A Pitch Servo and the KM 275 Pitch Servo Mount were found marginally out-of-tolerance during final acceptance testing. It was not determined if the impact forces or debris contaminants caused these out-of-tolerance conditions. None of the out-of-tolerance conditions would adversely affect proper operation.

The KC 295 Flight Computer is impact damaged and could not be tested as a unit. The KC 295 was disassembled and it was determined that the Pitch board and the Altitude board could be tested as-is. The Lateral board had a device, R106, that is dislodged from the board. A replacement R106 was installed to allow testing of the Lateral board. The Adapter board is not damaged, but could only be subjected to functional testing due to lack of acceptance test capability. The Power Supply, Logic, and Interconnect boards are impact damaged and could not be tested.

> Repeated from page 2: The **Lateral**, **Pitch**, and **Altitude** boards were inserted into an exemplar unit for testing. After power-up, normal current draw was observed and all alignment nulls met specification. Complete acceptance testing was not practical (automated tester inoperative); however, the experienced technician manually performed numerous acceptance tests to determine proper operation/function. No out-of-tolerance conditions were detected. The "test adapter board" was then removed from the KC 295 and the accident **Adapter** Board was installed. The KC 295 Flight Computer was then installed in a KFC 200 engineering test harness for functional testing, which also included all the accident servos. The KC 295 Flight Computer, KS 270A Pitch Servo, KS 271A Roll Servo, KS 272A Trim Servo, and the KS 271A Yaw Servo passes functional testing. The accident unit circuit boards were removed from the KC 295 exemplar unit and the replacement R106 was removed from the Lateral card.

Test data sheets, where applicable, are contained in the appendix of this report.

Thank you for inviting Honeywell to assist with your investigation. Please contact me should you have questions/comments.

Sincerely,

[redacted]

Bill Gill, Air Safety Investigator

Appendix

KC 295
Flight Computer

Note: Only partial testing was performed to confirm proper function of the accident boards installed (Pitch board, Lateral board, Altitude board) in the exemplar KC 295 Flight Computer. The results of the tests performed are noted using blue ink.

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
9 10.3.0.0.8	VOLTMETER TO PIN 2952-BB (Pitch FD CMD Bar Drive null.)		MEASUREMENT FOR 0 ± .5
10.3.0.0.9	ELEV SERVO FEED BACK LOOP OFF ELEVATOR TACH F.B. +UP TO STIMULUS #1 ON ELEVATOR TACH F.B. +DN TO STIMULUS #1 ON VOLTMETER TO PIN 2952-j DELAY 1 SEC MEASUREMENT RECORDED (Fader off servo out T.P. null measured and recorded.)		MEASUREMENT FOR 0 ± 5
10 10.3.0.0.10	VOLTMETER TO PIN 2952-j (Differentially negativee step stimulating elevator tach voltage inputs, the servo open loop time response is measured at servo out T.P. relative to null recorded in 10.3.0.0.9.)	STIMULUS #1 TO-.25 VOLTS (Tach)	TEST @ 500 MS FOR 3.16 ± .948 VOLTS D.C. 3.4V
10.3.0.0.11			TEST @ 3000 MS FOR 5.2 ± 1.3 VOLTS D.C. 5.38V
10.3.0.0.12	SET RECORDED OFFSET TO ZERO (The absolute voltage is measured on servo out T.P. without offset subtraction and this measurement is recorded.) MEASUREMENT RECORDED		MEASUREMENT FOR 5.2 ± 2 5.38V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.3.0.0.13	VOLTMETER TO PIN 2952-R (Elev up servo drive should be diode drop from servo out T.P.)		MEASUREMENT FOR -.6 ± .2 -0.70V
10.3.0.0.14	VOLTMETER TO PIN 2952-V SET RECORDED OFFSET TO ZERO (Elev dn servo drive should be resistive divided to small negative voltage.)		MEASUREMENT FOR -.5 ± .2 -0.49V
10.3.0.0.15	VOLTMETER TO PIN 2952-j MEASUREMENT RECORDED	STIMULUS #1 TO 0 VOLTS (Tach) DELAY 6 SEC	MEASUREMENT FOR 0 ± 5 -0.006V
(19) 10.3.0.0.16	VOLTMETER TO PIN 2952-j (Differentially positive step stimulating elevator tach inputs, the servo open loop time response is measured at servo out T.P. relative to the null recorded in 10.3.0.0.15.)	STIMULUS #1 TO +.25 VOLTS (Tach)	TEST @ 500 MS FOR -3.16 ± .948 VOLTS D.C. -3.20V
10.3.0.0.17			TEST @ 3000 MS FOR -5.2 ± 1.3 VOLTS D.C. -5.25V
10.3.0.0.18	MEASUREMENT RECORDED (The absolute voltage is measured on servo out T.P. without offset subtraction and this measurement is recorded.)		MEASUREMENT FOR -5.2 ± 2 -5.25V
10.3.0.0.19	VOLTMETER TO PIN 2952-V (Check for inversion unity gain of Elev DN servo drive.)	KPN 004-0221-00/ XX Sheet 34 of 126	MEASUREMENT FOR 10 ± 1 9.11V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.3.0.0.20	VOLTMETER TO PIN 2952-R SET RECORDED OFFSET TO ZERO (Elev up servo drive should be resistive divided to small negative voltage. This completes pitch servo amplifier tests.)		MEASUREMENT FOR -.5 ± .2 -0.46V
10.4.0.0.0		STIMULUS #1 TO 0 VOLTS (Tach) DELAY 3 SEC	
10.4.0.0.1	SET ANALOG INPUTS TO SIGNAL GROUND RESET LOGIC TO FDR MODE ALT HOLD SHORTING RELAY OFF ALT HOLD -UP TO STIMULUS #4 ON (Altitude mode is toggled on with altitude switch.)	ALT SWITCH TO GROUND OFF ALT SWITCH TO +10 VOLTS ON DELAY .1 SEC ALT SWITCH TO +10 VOLTS OFF ALT SWITCH TO GROUND ON	
10.4.0.0.2	VOLTMETER TO PIN 2952-Z (Pitch fader off leakage test measured at pitch fader out T.P. with positive hardover into fader.)	STIMULUS #4 TO 10 VOLTS (Alt Error) DELAY 1 SEC	MEASUREMENT FOR 0 ± 1.5 0.002V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.4.0.0.3	VOLTMETER TO PIN 2952-E (Measurement of pitch acceleration positive limit.)		MEASUREMENTS FOR 13.25 ± 2.25 13.43 V
10.4.0.0.4	VOLTMETER TO PIN 2952-Z (Pitch fader off leakage test at pitch fader out T.P. with negative hardover into fader.)	STIMULUS #4 TO -10 VOLTS (Alt Error) DELAY 1 SEC	MEASUREMENT FOR 0 ± 1.5 -0.014 V
10.4.0.0.5	VOLTMETER TO PIN 2952-E (Measurement of pitch acceleration negative limit.)		MEASUREMENT FOR -13.25 ± 2.25 -14.20 V
10.4.0.0.6	SET ANALOG INPUTS TO SIGNAL GROUND RESET LOGIC TO NOT FDR SET RECORDED OFFSET TO ZERO VGYRO PITCH SENSOR SHORTING RELAY OFF VGYRO PITCH SENSOR TO STIMULUS #3 ON VGYRO REF TO STIMULUS #3 ON (Reset to no mode condition.)	STIMULUS #4 TO 0 VOLTS (Alt Error)	
10.4.0.0.7 (10)	VOLTMETER TO PIN 2952-E DELAY 5 SEC MEASUREMENT RECORDED (Derived rate test for high pass leakage gyro pitch negative step input,	STIMULUS #3 TO ± 500 VOLTS (Pitch Altitude) DELAY 5 SEC	MEASUREMENT FOR 0 ± 3.5 -0.089 V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.4.0.0.8 (16) (10)	(Derived rate differentiation of gyro input ramp stimulus measured at pitch acceleration T.P. at instant of input ramp reaching zero.)	RAMP STIMULUS #3 FOR TEN SECONDS -.500 TO 0 VOLTS, RAMP UP TO ONE ADDITIONAL SECOND (Pitch Attitude)	CHECK PIN 2952-E FOR 5.9 ± 1.77 WHEN RAMP JUST REACHES AT 2952-P, 0±30MV 6.5V
10.4.0.0.9 (16) (10)	(Negative polarity test of gyro pitch differentiation.)	STIMULUS #3 TO +.500 VOLTS (Pitch Attitude) DELAY 5 SEC	
(10)		RAMP STIMULUS #3 FOR TEN SECONDS FROM +.500 TO 0 VOLTS, RAMP UP TO ONE ADDITIONAL SECOND (Pitch Attitude)	CHECK PIN 2952-E FOR -5.9 ± 1.77 WHEN RAMP JUST REACHES AT 2952-P, 0±30MV MEASUREMENT FOR 0 ± 4 -6.53V
⚠ 10.4.0.0.10	DELAY 10 SEC		
	RESET LOGIC TO FDR MODE		
	SET RECORDED OFFSET TO ZERO		-0.097V
	VOLTMETER TO PIN 2952-E		
	DELAY 5 SEC		
	MEASUREMENT RECORDED		
	(FDR mode engage of pitch attitude hold at zero attitude.)		

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.4.0.0.11	(Analytic gain of 1.5 check of pitch attitude hold with negative 2/3 degree gyro pitch error resulting in a negative one degree of control signal at pitch acceleration T.P.)	STIMULUS #3 TO -.0333 VOLTS (Pitch Attitude) DELAY 2 SEC	MEASUREMENT FOR -5.9 ±1.1 -4.31 V
10.4.0.0.12	MEASUREMENT RECORDED (Gyro pitch stimulus to positive 2/3 degree resulting in positive one degree of control signal at pitch acceleration T.P. This measurement stored for reference.)	STIMULUS #3 TO +.0333 VOLTS (Pitch Attitude) DELAY 5 SEC	MEASUREMENT FOR 5.9 ±1.18 5.55V
10.4.0.0.13	DELAY 60 SEC (Pitch attitude hold, drift test; must not drift 1/10 degree in one minute from recorded measurement of 10.4.0.0.12)		DRIFT MEASUREMENT FOR 0 + .6 RELATIVE TO PREVIOUS MEASUREMENT 0.011V
10.5.0.0.0	VOLTMETER TO PIN 2952-Z OFFSET TO ZERO MEASUREMENT RECORDED The pitch fader turn on is measured by the time it takes the fader output voltage-to go from null to full command after AP engagement. Take 100 samples of the fader output starting by AP engagement. Samples to be spaced at .25 second intervals. Null value is the first aample (At AP engagemnet), the final value is the 100th sample. Subtract null value from all samples. Find time - T1, when fader output is equal to or greater than 10% of the final value. Find time-T2, when fader output is equal to or greater than 90% of final value	STIMULUS #3 TO 0 VOLTS AUTO PILOT SWITCH ON DELAY 4 SEC AUTOPILOT SWITCH OFF DELAY 1 SEC STIMULUS #3 TO +.333 VOLTS (Pitch Attitude) ENGAGE AUTOPILOT AND WAIT 25 seconds	MEASUREMENTS (T2-T1) should be greater 1.0 second and less than 5.25 seconds. 2.36sec

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.5.0.0.1		STIMULUS #3 to +.0333 VOLTS	MEASUREMENT FOR -2.25±.45 -2.16V
	(This is reference for analytic gain check through the fader.)		
10.5.0.0.2	(One degree out of the fader for 2/3 gyro pitch attitude change.)	STIMULUS #3 TO -.0333 (Pitch Attitude) DELAY 5 SEC	MEASUREMENT FOR 2.25 ± .45 2.40V
10.5.0.0.3	CONTROL WHEEL STEERING SWITCH ON		MEASUREMENT FOR 0 ± 1.2
	DELAY 2 SEC		0.142V
	CONTROL WHEEL STEERING SWITCH OFF		
	DELAY 10 SEC		
	SET RECORDED OFFSET TO ZERO		
	(Check of CWS resyncing pitch attitude hold to zero.)		
10.5.0.0.4	VOLTMETER TO PIN 2952-j		MEASUREMENT FOR 0 ± .5
	MEASUREMENT RECORDED		0.046V
	(Reference null for PAH analytic gain through servo out T.P.)		
10.5.0.0.5	(One degree at servo out T.P. for 2/3 gyro.)	STIMULUS #3 TO 0 VOLTS (Pitch Attitude) DELAY 5 SEC	MEASUREMENT FOR -1 ± .2 -0.971V
		KPN 004-0221-00/XX Sheet 39 of 126	

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.5.0.0.6	COUNTER TO PIN 2952-E SET COUNTER TO T.I. FROM -5.9 TO 5.9 VOLT POSITIVE SLOPE INPUTS COMMON (Analytic gain check of PAH trim rate of one attitude degree per second. Test times interval from -1 control degree to +1 control degree which should be 2 seconds divided by the analytic gain of 1.5. Measurement at pitch acceleration T.P. Stimulus -15 volts on vertical trim switch line.)	STIMULUS #3 TO 0 VOLTS (Pitch Attitude) DELAY 2 SEC CONTROL WHEEL STEERING SWITCH ON DELAY 2 SEC CONTROL WHEEL STEERING SWITCH OFF DELAY 5 SEC SET RECORDED OFFSET TO ZERO V TRIM SW TO +15 DELAY 3 SEC START COUNTER V TRIM SW TO -15 DELAY 8 SEC	CHECK COUNTER FOR 1.33 $\pm$ .13 SECONDS 1.34 sec

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.5.0.0.7	SET COUNTER TO T.I. FROM 5.9 TO -5.9 VOLTS NEGATIVE SLOPE INPUTS COMMON STIMULUS #2 10:1 DIVIDER OFF (Test of PAH trim rate in the other direction. Measurement at pitch acceleration T.P. stimulus +15v on vertical trim switch line.)	V TRIM SW OFF CONTROL WHEEL STEERING SWITCH ON DELAY 2. SEC CONTROL WHEEL STEERING SWITCH OFF V TRIM SW TO -15 DELAY 3 SEC START COUNTER V TRIM SW TO +15 DELAY 10 SEC	CHECK COUNTER FOR 1.33 ± .13 SECONDS (49)
10.5.0.0.8	SET RECORDED OFFSET TO ZERO STIMULUS #2 10:1 DIVIDER OFF VGYRO CAL TO GROUND ON VOLTMETER TO PIN 2952-j SET RECORDED OFFSET TO ZERO MEASUREMENT RECORDED (Test of D.C. offset of vertical gyro pitch angle through to servo out T.P. using go around mode with go around command shorted out.)	V TRIM SW OFF GA SWITCH ON DELAY .1 SEC GA SWITCH OFF DELAY 3 SEC	MEASUREMENT FOR 0 ± .5 0.013V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.5.0.0.9	(Analytic D.C. gain of 1 for vertical gyro pitch angle through to servo out T.P.in GA mode measured relative to offset of 10.5.0.0.8.)	STIMULUS #3 TO +.05 VOLTS (Pitch Attitude) DELAY 3 SEC	MEASUREMENT FOR -1 ±.2 -1.01V
10.5.0.0.10	(With a standard GA command of +5° on the "99" adapter card and +4° of vertical gyro pitch attitude the servo out T.P. should show one degree relative to offset of 10.5.0.0.8.)	VGYRO CAL TO GROUND OFF STIMULUS #3 TO +.2 VOLTS (Pitch Attitude) DELAY 3 SEC	MEASUREMENT FOR 1 ± .5 0.905V
10.6.0.0.0	SET ANALOG INPUTS TO SIGNAL GROUND RESET LOGIC TO FDR MODE	AUTOPILOT SWITCH ON	
10.6.0.0.1	G.S. SHORTING RELAY OFF G.S. +UP TO STIMULUS #1 ON G.S. +DN TO STIMULUS #1 ON G.S. VALID SHORTING RELAY OFF G.S. VALID +FLAG TO STIMULUS #2 ON G.S. VALID -FLAG TO STIMULUS #2 ON LOC FREQ SENSOR ON		
10.6.0.0.2	(Loc approach coupled mode toggled on with approach switch. Insufficient glideslope valid voltage inhibits GSC.)	APPR SW TO GROUND OFF APPR SW TO +10 ON DELAY .1 SEC APPR SW TO +10 OFF APPR SW TO GROUND ON STIMULUS #2 TO .1 VOLTS (GS Valid) DELAY 3 SEC STIMULUS #2 TO 0 VOLTS DELAY 5 SEC.	AP CLUTCH ENGAGE ON FDR LIGHT ON APPR LIGHT ON CPLD LIGHT ON AP LIGHT ON SW HOLDING COIL ON OK

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.6.0.0.3	(Glideslope valid signal engages glideslope capture mode.) 68 42	STIMULUS #2 TO .25 VOLTS (GS Valid) DELAY 3 ± 2 SEC	AP CLUTCH ENGAGE ON GSC LIGHT ON FDR LIGHT ON APPR LIGHT ON CPLD LIGHT ON AP LIGHT ON SW HOLDING COIL ON OK
10.6.0.0.4	(An off glideslope error voltage is simulated and Loc Appr is toggled off with Appr switch.)	STIMULUS #1 TO .150 VOLTS (GS RCVR) APPR SW TO GROUND OFF APPR SW TO +10 ON DELAY .1 SEC APPR SW TO +10 OFF APPR SW TO GROUND ON	AP CLUTCH ENGAGE ON FDR LIGHT ON AP LIGHT ON SW HOLDING COIL ON OK
10.6.0.0.5	(Loc Appr toggled on with Appr switch without GSC due to off beam error voltage input, then GSC occurs as error is ramped with negative slope through zero.)	APPR SW TO GROUND OFF APPR SW TO +10 ON DELAY .1 SEC APPR SW TO +10 OFF APPR SW TO GROUND ON DELAY 1 SEC	AP CLUTCH ENGAGE ON FDR LIGHT ON APPR LIGHT ON CPLD LIGHT ON AP LIGHT ON SW HOLDING COIL ON OK
10.6.0.0.6 ⚠1	(GSC time measured.)	RAMP INPUT FROM .150 TO -.150 IN 35 SEC (GS RCVR)	TEST TIME TO CAPTURE FOR 17.5 ±1.75 SEC OK

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.6.0.0.7	(Logic check for GSC)		AP CLUTCH ENGAGE ON GSC LIGHT ON FDR LIGHT ON APPR LIGHT ON CPLD LIGHT ON AP LIGHT ON SW HOLDING COIL ON
10.6.0.0.8	(Positive slope polarity ramp through zero for GSC)	APPR SW TO GROUND OFF APPR SW TO +10 ON DELAY .1 SEC APPR SW TO +10 OFF APPR SW TO GROUND ON DELAY .1 SEC APPR SW TO GROUND OFF APPR SW TO +10 ON DELAY .1 SEC APPR SW TO +10 OFF APPR SW TO GROUND ON RAMP INPUT FROM -.150 TO +.150 IN 35 SEC (GS RCVR)	AP CLUTCH ENGAGE ON FDR LIGHT ON APPR LIGHT ON CPLD LIGHT ON AP LIGHT ON SW HOLDING COIL ON TEST TIME TO CAPTURE FOR 35.5 ±1.75 SEC

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.6.0.0.9	(Logic check for GSC)		AP CLUTCH ENGAGE ON GSC LIGHT ON FDR LIGHT ON APPR LIGHT ON CPLD LIGHT ON AP LIGHT ON SW HOLDING COIL ON
10.7.0.0.0	LOC FREQ SENSOR OFF (Zero deviation glideslope error is provided.)	STIMULUS #1 TO 0 VOLTS (GS RCVR) DELAY 5 SEC	
10.7.0.0.1	VOLTMETER TO PIN 2952-j SET RECORDED OFFSET TO ZERO MEASUREMENT RECORDED (The beam center glideslope offset is measured at servo out T.P.)		MEASUREMENT FOR 0 ± .5 -0.018V
10.7.0.0.2	(Differential positive stimulus to glideslope receiver inputs the glideslope analytic gain of 20 is measured relative to the offset recorded in 10,7.0.0.1.)	STIMULUS #1 TO .0108 VOLTS (GS RCVR) DELAY 5 SEC	MEASUREMENT FOR 1 ± .2 0.999V
10.7.0.0.3	(Differential negative stimulus glideslope analytic gain test.)	STIMULUS #1 TO -.0108 VOLTS (GS RCVR) DELAY 6 SEC	MEASUREMENT FOR -1 ± .2 -1.036V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.8.0.0.0	G.S. +UP TO STIMULUS #1 OFF G.S. +DN TO STIMULUS #1 OFF G.S. SHORTING RELAY ON MIDDLE MARKER SHORTING RELAY OFF MIDDLE MARKER REF TO STIMULUS #1 ON MIDDLE MARKER RCVR TO STIMULUS #1 ON SET RECORDED OFFSET TO ZERO	STIMULUS #1 TO 0 VOLTS (GS RCVR) DELAY 5 SEC	
10.8.0.0.1	(The beam center glideslope offset is measured at servo out T.P. prior to middle marker gain.)		MEASUREMENT FOR 0 ± 1 -0.023V
10.8.0.0.2	(Middle marker stimulus simulates one pulse. Logic verification for MM gain.)	STIMULUS #1 TO 3 VOLTS (MM RCVR) DELAY 1 SEC STIMULUS #1 TO 0 VOLTS (MM RCVR)	AP CLUTCH ENGAGE ON GSC LIGHT ON FDR LIGHT ON MM GAIN CMD ON OK APPR LIGHT ON CPLD LIGHT ON AP LIGHT ON SW HOLDING COIL ON
10.8.0.0.3	MIDDLE MARKER RCVR TO STIMULUS #1 OFF MIDDLE MARKER REF TO STIMULUS #1 OFF MIDDLE MARKER SHORTING RELAY ON G.S. SHORTING RELAY OFF G.S. +DN TO STIMULUS #1 ON G.S. +UP TO STIMULUS #1 ON DELAY 5 SEC SET RECORDED OFFSET TO ZERO MEASUREMENT RECORDED (Zero deviation glideslope error provided.)		MEASUREMENT FOR 0 ± .5 -0.038 V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.10.0.0.0	ALT ERROR SHORTING SWITCH OFF RESET LOGIC TO NOT FDR		
10.10.0.0.1	SET ANALOG INPUTS TO SIGNAL GROUND RESET LOGIC TO FDR MODE		
10.10.0.0.2	VOLTMETER TO PIN 2952-j V TRIM SW TO STIMULUS #2 ON AUTOPILOT SWITCH ON ALT HOLD SHORTING RELAY OFF ALT HOLD -UP TO STIMULUS #4 ON SET RECORDED OFFSET TO ZERO MEASUREMENT RECORDED Delay 90 Sec (Servo out offset measured on altitude hold mode.)	ALT SWITCH TO GROUND OFF ALT SWITCH TO +10 VOLTS ON DELAY .1 SEC ALT SWITCH TO +10 VOLTS OFF ALT SWITCH TO GROUND ON	MEASUREMENT FOR 0 ± .6 0.004V
10.10.0.0.3	(A low impedance negative voltage stimulus effectively shorts out altitude error from the altitude hold board in order to measure altitude analytic gain of .05.)	STIMULUS #4 TO -.4 VOLTS (Altitude) DELAY 10 SEC STIMULUS #4 TO-2.4 VOLTS DELAY 10 SEC	MEASUREMENT FOR +.265±.05V 0.267V MEASUREMENT FOR +2.25 ±.6V 2.44V
10.10.0.0.4	(Positive stimulus altitude analytic gain of .05 for altitude hold mode.)	STIMULUS #4 TO+.4 VOLTS (Altitude) DELAY 10 SEC STIMULUS #4 TO +2.4 VOLTS DELAY 10 SEC	MEASUREMENT FOR -.265±.05V -0.294V MEASUREMENT FOR -2.25 ±.6V
10.10.1.0.0	(Altitude hold error fixed at zero volts input.)	STIMULUS #4 TO 0 VOLTS (Altitude) DELAY 5 SEC KPN 004-0221-00/XX Sheet 51 of 126	-2.31V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.12.0.0.0	RESET LOGIC TO NOT FDR (Start of Lateral Axis Test)		
10.12.0.0.1	SET ANALOG INPUTS TO SIGNAL GROUND SET RECORDED OFFSET TO ZERO	⚠ Servo loop open for all lateral axis testing.	
10.12.0.0.2	VOLTMETER TO PIN 2952-S G.S. SHORTING RELAY OFF G.S. +UP TO STIMULUS #1 ON G.S. +DN TO STIMULUS #1 ON DELAY 1 SEC MEASUREMENT RECORDED (No mode offset measured and recorded at roll acceleration T.P.)		MEASUREMENT FOR 0 ± 2 -0.013V
10.12.0.0.3	(No mode isolation at roll acceleration T.P. from bi-polarity signals present at G.S. receiver differential inputs.)	STIMULUS #1 TO 1 VOLTS (GS RCVR) DELAY 1 SEC	MEASUREMENT FOR 0 ±.1 -0.013V
10.12.0.0.4		STIMULUS #1 TO -1 VOLTS (GS RCVR) DELAY 1 SEC	MEASUREMENT FOR 0 ± .1 -0.013V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.12.0.0.5	G.S. +UP TO STIMULUS #1 OFF G.S. +DN TO STIMULUS #1 OFF G.S. SHORTING RELAY ON COURSE DATUM ERROR SHORTING RELAY OFF C.D. AND HDG REF TO STIMULUS #2 ON COURSE DATUM TO STIMULUS #2 ON	STIMULUS #1 TO 0 VOLTS (GS RCVR) STIMULUS #2 TO 10 VOLTS (CD) DELAY 1 SEC	MEASUREMENT FOR 0 ± .1 -0.013V
10.12.0.0.6	(No mode isolation at roll acceleration T.P. from bi-polarity signals present at course datum differential inputs.)	STIMULUS #2 TO -10 VOLTS (CD) DELAY 1 SEC	MEASUREMENT FOR 0 ± .1 -0.013V
10.12.0.0.7	COURSE DATUM TO STIMULUS #2 OFF COURSE DATUM ERROR SHORTING RELAY ON HEADING SELECT ERROR SHORTING RELAY OFF HEADING SELECT ERROR TO STIMULUS #2 ON	STIMULUS #2 TO 0 VOLTS (HS) STIMULUS #2 to 10 VOLTS (HS) DELAY 1 SEC	MEASUREMENT FOR 0 ± .1 -0.013V
10.12.0.0.8	(No mode isolation at roll acceleration T.P. from bi-polarity signals present at heading select differential inputs.)	STIMULUS #2 TO -10 VOLTS (HS) DELAY 1 SEC STIMULUS #2 TO 0 VOLTS (HS) DELAY 1 SEC	MEASUREMENT FOR 0 ± .1 -0.013V
61 10.12.0.0.9	VOLTMETER TO PIN 2952-X ROLL ADJ POT TO GROUND OFF ROLL ADJ POT TO STIMULUS #4 ON (Roll adjust external offset control measured at demod roll attitude to Yaw T.P.)	STIMULUS #4 TO 15 VOLTS (Roll Adj)	MEASUREMENT FOR -0.66±.13 -0.667V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
32 10.12.0.0.10		STIMULUS #4 TO -15 VOLTS (Roll ADJ)	MEASUREMENT FOR+0.66±.13 0.689V
10.12.0.0.11	ROLL ADJ POT TO STIMULUS #4 OFF ROLL ADJ POT TO GROUND ON	STIMULUS #4 TO 0 VOLTS (Roll Adj)	
10.13.0.0.0	SET ANALOG INPUTS TO SIGNAL GROUND RESET LOGIC TO NOT FDR		
10.13.0.0.1	SET RECORDED OFFSET TO ZERO		
10.13.0.0.2	VOLTMETER TO PIN 2952-r DELAY 1 SEC (Aileron servo out T.P. open loop no mode offset measured.)		MEASUREMENT FOR 0 ± .3 -0.0007V
10.13.0.0.3	VOLTMETER TO PIN 2952-v (Aileron servo motor drive voltage +R open loop no mode offset measured.)		MEASUREMENT FOR 0 ± .3 -0.0001V
10.13.0.0.4	VOLTMETER TO PIN 2952-e (Aileron servo motor drive voltage +L open loop no mode offset measured.)		MEASUREMENT FOR 0 ± .3 0.0005V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.13.0.0.5	VGYRO ROLL SENSOR SHORTING RELAY OFF VGYRO ROLL SENSOR TO STIMULUS #3 ON VGYRO REF TO STIMULUS #3 ON VOLTMETER TO PIN 2952-S (Negative voltage limit test of roll acceleration.)	STIMULUS #3 TO -1 VOLTS (Roll Attitude) DELAY 5 SEC	MEASUREMENT FOR -13.25 ± 2.25 -14.21V
10.13.0.0.6	VOLTMETER TO PIN 2952-a (Fader off leakage test at fader out T.P. with maximum negative voltage acceleration.)		MEASUREMENT FOR 0 ± 2 -0.023V
10.13.0.0.7	VOLTMETER TO PIN 2952-S (Positive voltage limit test of roll acceleration.)	STIMULUS #3 TO +1 VOLTS (Roll Attitude) DELAY 2 SEC	MEASUREMENT FOR +13.25 ± 2.25 13.45V
10.13.0.0.8	VOLTMETER TO PIN 2952-a (Fader off leakage test at fader out T.P. with maximum positive voltage acceleration.)		MEASUREMENT FOR 0 ± 2 0.005V
10.13.0.0.9	VOLTMETER TO PIN 2952-EE (No mode zero command bar drive to flight director test with maximum voltage acceleration.)		MEASUREMENT FOR 0 ± .2 0.0003V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.13.0.0.10	AILERON TACH +L TO GROUND OFF AILERON SERVO FEEDBACK LOOP OFF AILERON TACH +R TO STIMULUS #1 ON AILERON TACH +L TO STIMULUS #1 ON SET RECORDED OFFSET TO ZERO VOLTMETER TO PIN 2952-v (Open loop aileron servo motor drive voltage +R offset measured.)	STIMULUS #3 TO 0 VOLTS (Roll Attitude)	MEASUREMENT FOR 0 ± .5 0.0004V
10.13.0.0.11	VOLTMETER TO PIN 2952-e (Open loop aileron servo motor drive voltage +L offset measured.)		MEASUREMENT FOR 0 ± 5 0.0005V
10.13.0.0.12	VOLTMETER TO PIN 2952-r MEASUREMENT RECORDED (Open loop aileron servo out T.P. offset measure and recorded.)		MEASUREMENT FOR 0 ± 5 -0.0006V
10.13.0.0.13	VOLTMETER TO PIN 2952-r (Aileron servo tach feedback amplifier open loop response to negative step differential input measured relative to offset of 10.3.0.0.12.)	STIMULUS #1 to -.1214 VOLTS (Aileron Tach)	TEST @ 300 MS for 3.5 ±1.05 VOLTS D.C. 3.4V
10.13.0.0.14			TEST @ 1500 MS FOR 5 ± 1.25 VOLTS D.C. 5.10V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.13.0.0.15	SET RECORDED OFFSET TO ZERO MEASUREMENT RECORDED (Aileron servo out T.P. voltage relative to zero offset measured and recorded.)		MEASUREMENT FOR 5 ± 5 5.18V
10.13.0.0.16	VOLTMETER TO PIN 2952-v (Aileron servo motor drive voltage +R output relative to aileron servo out T.P. measured when it is at positive voltage.)		MEASUREMENT FOR -.6 ± .2 -0.69V
10.13.0.0.17	SET RECORDED OFFSET TO ZERO VOLTMETER TO PIN 2952-e (Aileron servo motor drive voltage +L output relative to zero offset measured when aileron servo out T.P. is at positive voltage.)		MEASUREMENT FOR -.5 ± .2 -0.48V
10.13.0.0.18	VOLTMETER TO PIN 2952-r MEASUREMENT RECORDED (Open loop aileron servo out T.P. offset measured and recorded.)	STIMULUS #1 TO 0 VOLTS (Aileron Tach) DELAY 6 SEC	MEASUREMENT FOR 0 ± 5 -0.028V
10.13.0.0.19	(Aileron servo tach feedback amplifier open loop response to positive step differential input measured relative to offset of 10.13.0.0.18.)	STIMULUS #1 TO .1214 VOLTS (Aileron Tach)	TEST @ 300 MS FOR -3.5 ±1.05VOLTS D.C.

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.14.0.0.0	SET ANALOG INPUTS TO SIGNAL GROUND		
10.14.0.0.1	SET ANALOG INPUTS TO SIGNAL GROUND RESET LOGIC TO NOT FDR RESET LOGIC TO FDR MODE SET RECORDED OFFSET TO ZERO VGYRO ROLL SENSOR SHORTING RELAY OFF VGYRO ROLL SENSOR TO STIMULUS #3 ON VGYRO REF TO STIMULUS #3 ON		
10.14.0.0.2 ⚠1	VOLTMETER TO PIN 2952-a MEASUREMENT RECORDED (The offset on FDR & AP modes is measured at roll fader out T.P. and recorded. Then AP is disengaged, one degree of differential roll attitude simulated at vertical gyro roll sensor, than as AP is engaged. The lateral fader turn on is measured by the time it takes the fader output voltage-to go from null to full command after AP engagement. Take 100 samples of the fader output starting by AP engagement. Samples to be spaced at .25 second intervals. Null value is the first sample(At AP engagement), the final value is the 100th sample. Subtract null value from all samples. Find time-T1, when fader output is equal to or greater than 10% of the final value. Find time-T2, when fader output is equal to or greater than 90% of final value.	AUTOPILOT SWITCH ON DELAY 4 SEC AUTOPILOT SWITCH OFF DELAY 1 SEC STIMULUS #3 TO -1.0 VOLTS (Roll Attitude) ENGAGE AUTOPILOT AND WAIT 25 SECONDS	MEASUREMENTS (T2-T1) should be greater than 1.0 second and less than 5.25 seconds. 2.16

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
⚠10.14.0.0.3	VOLTMETER TO PIN 2952-a (The fader full on output is measured for one degree of positive command voltage relative to the offset of 10.14.0.0.2.)	STIMULUS #3 TO -.05 ⚠Delay 10 sec.	MEASUREMENT FOR 3.14 ± .628 3.20V
10.14.0.0.4	(Fader output negative voltage of one command degree measured relative to offset of 10.14.0.0.2 when roll attitude stimulus is inverted.)	STIMULUS #3 TO +.05 VOLTS ⚠Delay 5 sec. (Roll Attitude) DELAY 1 SEC	MEASUREMENT FOR -3.14 ± .628 -3.20V
10.14.0.0.5	HEADING SELECT ERROR SHORTING RELAY OFF HEADING SELECT ERROR TO STIMULUS #2 ON C.D. AND HDG REF TO STIMULUS #2 ON VOLTMETER TO PIN 2952-S SET RECORDED OFFSET TO ZERO MEASUREMENT RECORDED (Heading Mode toggled on with Heading Switch. Roll acceleration T.P. offset on this mode is measured and recorded.)	STIMULUS #3 TO 0 VOLTS (Roll Attitude) DELAY 1 SEC HDG SW TO GROUND OFF HDG SW TO +10 ON DELAY .1 SEC HDG SW TO +10 OFF HDG SW to GROUND ON DELAY 5 SEC	MEASUREMENT FOR 0 ± 2 0.028V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
4 10.14.0.0.6	(Maximum positive differential heading select error of 27 degrees is simulated. Roll acceleration verified at limit.)	STIMULUS #2 TO 15 VOLTS (HS) DELAY 3 SEC	MEASUREMENT FOR -13.25 ± 4.25 -14.22V
44 10.14.0.0.7		STIMULUS #3 TO -2.75 VOLTS (Roll Attitude) DELAY 3 SEC	18
17 44	(The roll rate command limit of -5.5°/sec is measured by simulating +5.5°/sec of roll attitude rate and measuring roll acceleration for a resultant command of 0 degrees. This measurement at zero attitude time, as the ramp reaches zero.)	RAMP STIMULUS #3 FOR TEN SECONDS FROM -2.75 TO 0 VOLTS [illegible] SECOND (Roll Attitude)	CHECK PIN 2952-S for 0±10v WITHIN 100Msec OF PIN 2952-X REACHING 0 VOLTS.
44 10.14.0.0.8	(Differential heading select error of -27 degrees is simulated. Roll acceleration verified at limit.)	STIMULUS #2 TO -15 VOLTS (HS) DELAY 1 SEC	MEASUREMENT FOR +13.25 ± 4.25 13.91V
44 10.14.0.0.9 17 44	(The roll rate command limit of +5.5°/sec is measured by simulating -5.5°/sec of roll attitude rate and measuring roll acceleration for a resultant command of 0 degrees. This measurement at zero attitude time, as the ramp reaches zero.)	STIMULUS #3 TO +2.75 VOLTS (Roll Attitude) DELAY 1 SEC RAMP STIMULUS #3 FOR TEN SECONDS (Roll Attitude) FROM +2.75 TO 0 VOLTS 18 [illegible] (Roll Attitude)	CHECK PIN 2952-S FOR 0 ± 10 WHEN RAMP JUST REACHES AT 2952-X, 0±30 MV. 18 CHECK PIN 2952-S FOR 0 ± 10v WITHIN 100 MSEC OF PIN 2952-X REACHING 0 VOLTS.
10.14.0.0.10	SET ANALOG INPUTS TO SIGNAL GROUND		

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.16.0.0.2	SET RECORDED OFFSET TO ZERO VGYRO ROLL SENSOR SHORTING RELAY OFF VGYRO ROLL SENSOR TO STIMULUS #3 ON VGYRO REF TO STIMULUS #3 ON NAV RCVR SHORTING RELAY OFF NAV RCVR +R TO STIMULUS #1 ON NAV RCVR +L TO STIMULUS #1 ON (A nav receiver differential error of +15.1333 degrees is simulated, then AP is engaged with Nav arm mode toggled on. Logic check for this condition is made. NOTE: APPR mode is armed prior to Nav in order to fast charge initial conditions on all capacitors responding to receiver error.)	AUTOPILOT SWITCH ON STIMULUS #1 TO .227 VOLTS (Nav RCVR) DELAY 5 SEC APPR SW TO GROUND OFF APPR SW TO +10 ON DELAY .1 SEC APPR SW TO +10 OFF APPR SW TO GROUND ON DELAY 8.75 SEC NAV SW TO GROUND OFF NAV SW TO +10 ON DELAY .1 SEC NAV SW TO +10 OFF NAV SW TO GROUND ON	AP CLUTCH ENGAGE ON FDR LIGHT ON ARM LIGHT ON NAV LIGHT ON AP LIGHT ON SW HOLDING COIL ON
10.16.0.0.3	SET COUNTER TO T.I. FROM +5 TO +5 VOLTS POSITIVE TO NEGATIVE SLOPE INPUTS SEPARATE (The Nav receiver differential error is ramped to zero at -1.5133°/sec and the Nav capture time relative to the ramp start is measured.)	DELAY 20 SEC START COUNTER RAMP STIMULUS #1 FROM .227 TO 0 VOLTS FOR 10 SECONDS (Nav RCVR)	NAV CAPTURE @ 8 ± 1 SEC

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.16.0.0.4	SET COUNTER TO T.I. FROM +5 TO +5 VOLTS NEGATIVE TO POSITIVE SLOPE INPUTS SEPARATE (A Nav receiver differential error of +15.1333 degrees is simulated after transfer back to APPR mode in order to fast charge the re-initialise conditions on all capacitors responding to receiver error. Nav mode is then toggled back on and mode status is verified.)	APPR SW TO GROUND OFF APPR SW TO +10 ON DELAY .1 SEC APPR SW TO +10 OFF APPR SW TO GROUND ON STIMULUS #1 TO .227 VOLTS (Nav RCVR) DELAY 8.75 SEC NAV SW TO GROUND OFF NAV SW TO +10 ON DELAY .1 SEC NAV SW TO +10 OFF NAV SW TO GROUND ON DELAY .1 SEC	AP CLUTCH ENGAGE ON FDR LIGHT ON NAV LIGHT ON ok CPLD LIGHT ON AP LIGHT ON SW HOLDING COIL ON
10.16.0.0.5	(The gyro roll stimulus simulates a high bank roll to enable the Nav track logic and then subsequently after 10 sec a return to zero bank attitude is simulated. The Nav receiver differential error is then ramped to zero at -1.5133°/sec and the transfer to Nav track mode time relative to the ramp start is measured.)	DELAY 25 SEC STIMULUS #3 TO-1 VOLTS (Roll Attitude) DELAY 10 SEC STIMULUS #3 TO 0 VOLTS (Roll Attitude)	NAV TRACK @ 7 ± 1 SEC ok

Continued on next page

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.19.0.0.1	SET ANALOG INPUTS TO SIGNAL GROUND NAV RCVR SHORTING RELAY OFF NAV RCVR +L TO STIMULUS #1 ON NAV RCVR +R TO STIMULUS #1 ON COURSE DATUM ERROR SHORTING RELAY OFF COURSE DATUM TO STIMULUS #2 ON C.D. AND HDG REF TO STIMULUS #2 ON VGYRO ROLL SENSOR SHORTING RELAY OFF VGYRO ROLL SENSOR TO STIMULUS #3 ON VGYRO REF TO STIMULUS #3 ON	AUTOPILOT SWITCH ON	
10.19.0.0.2	VOLTMETER TO PIN 2952-S (Nav capture mode is toggled on then the offset of roll acceleration T.P. is measured to be within 2 command degrees.)	NAV SW TO GROUND OFF NAV SW TO +10 ON DELAY .1 SEC NAV SW TO +10 OFF NAV SW TO GROUND ON DELAY 25 SEC	MEASUREMENT FOR 0 ± 8.2 1.64V
10.19.0.0.3	(Roll acceleration limit with course datum negative differential stimulus is measured.)	STIMULUS #2 TO -8 VOLTS (Course Datum) DELAY 5 SEC	MEASUREMENT FOR 13.25 ± 2.25 13.39V
10.19.0.0.4	(Roll acceleration limit with course datum positive differential stimulus is measured.)	STIMULUS #2 TO 8 VOLTS (Course Datum) DELAY 5 SEC	MEASUREMENT FOR -13.25 ± 2.25 -14.2V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.19.0.0.5	(Offset of roll acceleration T.P. is remeasured 5 seconds after course datum stimulus removed.)	STIMULUS #2 TO 0 VOLTS (Course Datum) DELAY 5 SEC	MEASUREMENT FOR 0 ± 8.2 1.70V
10.19.1.0.0	VOLTMETER TO PIN 2952-r		
10.19.1.0.1	MEASUREMENT RECORDED (The offset at aileron servo out T.P. for NAVLBC mode is measured and recorded.)	NAV SW TO GROUND OFF NAV SW TO +10 ON DELAY .1 SEC NAV SW TO +10 OFF NAV SW TO GROUND ON DELAY 2.5 SEC NAV SW TO GROUND OFF NAV SW TO +10 ON DELAY .1 SEC NAV SW TO +10 OFF NAV SW TO GROUND ON DELAY 25 SEC	MEASUREMENT FOR 0 ± 2 -0.406V
10.19.1.0.2	(For a positive differential input stimulus the course datum analytic gain of 1.5 for NAVLBC mode is measured at aileron servo out T.P. relative to offset of 10.19.1.0.1.)	STIMULUS #2 TO .13333 VOLTS (Course Datum) DELAY 1 SEC	MEASUREMENT FOR 1 ± .25 0.933V

TEST STEP	PROCEDURE & (SIGNIFICANCE)	INPUTS	OUTPUTS
10.19.1.0.3	(For a negative differential input stimulus the course datum analytic gain of 1.5 for NAVLBC mode is measured at aileron servo out T.P. relative to offset of 10.9.1.0.1.)	STIMULUS #2 TO -.13333 VOLTS (Course Datum) DELAY 3 SEC	MEASUREMENT FOR -1 ± .25 -0.960V
10.19.2.0.0	VOLTMETER TO PIN 2952-r	STIMULUS #2 TO 0 VOLTS (Course Datum) DELAY 3 SEC	
10.19.2.0.1	(For a positive differential input stimulus the Nav scallop filter response and Nav channel analytic gain of 8 for NAVLBC mode is measured at aileron servo out T.P. relative to offset of 10.19.1.0.1	STIMULUS #1 TO .002 VOLTS (Nav RCVR)	TEST @ 6000 MS FOR .63 ± .252 VOLTS D.C. 0.7V
10.19.2.0.2			TEST @ 25000 MS FOR 1 ± .25 VOLTS D.C. 1.071V
10.19.2.0.3	VOLTMETER TO PIN 2952-r (For a negative differential input stimulus the Nav scallop filter response and Nav channel analytic gain of 8 for NAVLBC mode is measured at aileron servo out T.P. relative to offset of 10.19.1.0.1.)	STIMULUS #1 TO 0 VOLTS (Nav RCVR) DELAY 25 SEC STIMULUS #1 TO -.002 VOLTS (Nav RCVR)	TEST @ 6000 MS FOR -.63 ± .252 VOLTS D.C. -0.7V
10.19.2.0.4			TEST @ 25000 MS FOR -1 ± .25 VOLTS D.C. -1.09V

KS 270A
Pitch Servo

KS270A

Pitch Servo

Honeywell

Business, Regional, &
General Aviation
[redacted]
Olathe, KS [redacted]

SN28045

Service Aid

SERVICE AID: KS 270A-104
Pitch Servo for KAP 200, KFC 200, and
KFC 250 Flight Control Systems

SUBJECT: Testing KS 270A Autopilot Servos P/N 065-0059-XX with the KTS 151 Autopilot Bench Tester

The KS 270 Pitch Servo has been replaced in production by the improved KS 270A Pitch Servo. These units operate identically in aircraft installations. However, it has come to our attention that these two servos do not respond to the KTS 151 Test Set in the same manner.

Because of a different test set reference potential, the voltage required to produce the same servo RPM and tach voltage from a KS 270A will be exactly double the values that were listed in Servo Maintenance Manual P/N 006-05557-0000, page 6-13, Section 6.2.3.10.

Use the following information and procedures when testing a KS 270A.

Refer to KS 270A Servo Maintenance Manual for the remaining procedures for the KS 270A. The voltage values for all other tests remain the same. Refer to Service Aid KS 270/A-103, P/N 601-01490-003X, for the procedures for Autotrim Threshold Switch Torque. The torque values are provided here in Table 1 for information.

This information will be added to the KS 270A Servo Maintenance Manual, P/N 006-05288-0004, the next time it is revised.

Date: Sep/87
Rev. 3: Dec/04
P/N: 601-01490-0043

CCW CW | CCW CW | Tach Voltage
− + | ↓ ↓ |
4+7.5 | 59sec. 58sec ok | -6.0 5.6

KS 270A Version	Autotrim Threshold (in./lbs.)	Speed Characteristics (revs / seconds)	*Tach Voltage Equal to	*Optimum Tach Voltage CW	CCW
-01	6 +1/-.5	5 in 63 ±9	68.5 / T	-5.44	+5.44
-02	6 +1/-.5	2 in 50 +5/-6	68.5 / T	-2.91	+2.91
-03	11 ±1	5 in 63 ±9	68.5 / T	-5.44	+5.44
-04	11 ±1	2 in 50 +5/-6	68.5 / T	-2.91	+2.91
-05	3 +1/-0	5 in 63 ±9	68.5 / T	-5.44	+5.44
-06	15 ±1.5	5 in 63 ±9	68.5 / T	-5.44	+5.44
-07	6 +1/-.5	2 in 58 +5/-6	68.5 / T	-2.91	+2.91
-08	11 +1/-.5	2 in 58 +5/-6	68.5 / T	-2.91	+2.91
-18	6 +1/-.5	2 in 50 +5/-6	68.5 / T	-2.91	+2.91
-19	11 ±1	1 in 45 ±7	72.0 / T	-1.60	+1.60
-23	11 ±1	1 in 33 ±5	49.9 / T	-1.53	+1.53
-25	11 ±1	2 in 32 ±6	54.4 / T	-3.40	+3.40

*See the note below.

Table 1

NOTE

In the Tach Voltage Formula, *T* is the time in seconds for one revolution of the capstan. The tolerance for the Tach Voltage is ±15% for units without Mod 4 incorporated and ±5% for units with Mod 4. The Optimum Tach Voltage is only approximate and is given for use as a guide. The actual Tach Voltage must be calculated using the formula.

MOTOR DIRECTION AND BREAKOUT

This test checks the direction of the servo motor drive and checks the servo's ability to respond to small drive commands.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)
AP CLUTCH ENGAGE	IN

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for 0.0 ±.5Vdc. Depress the RAMP button, and monitor the input voltage as it begins to ramp

negative. Depress the HOLD button at the first indication of the output capstan beginning to turn. The output capstan should begin to rotate counterclockwise before the voltage reaches -7.30Vdc. (For the KS 270A -07 and -08 versions, the breakout voltage will be -8.60Vdc.) After measuring the voltage, depress the RAMP button again, (which causes the voltage to go to zero) and switch the HOLD button to the OUT position. — 4.04

Reverse the direction of the ramp by depressing the INVERT switch. Depress the RAMP button, and monitor the input voltage as it begins to ramp positive. Depress the HOLD button at the first indication of the output capstan beginning to turn. The output capstan should begin to rotate clockwise before the voltage reaches +7.30Vdc. (For the KS 270A -07 and -08 versions, the breakout voltage will be +8.60Vdc.) Return all buttons to the OUT position. 5.0

Due to variations in capstan RPM, the rate at which the KTS 151 ramp reaches ±7.30Vdc (or ±8.60Vdc), and the rate at which the digital voltmeter updates, several measurements might be required to determine the exact voltage required for servo motor breakout.

CAPSTAN SPEED OK

This test checks the servo's ability to drive at the proper speed.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
TACH FEEDBACK	IN
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)
AP CLUTCH ENGAGE	IN

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for -19.0 ±.5Vdc as read at the Master Selector meter jacks. (For KS 270A -07 and -08 versions, adjust STIMulus 1 to -11.5Vdc.) The capstan should be rotating counterclockwise.

Measure the time required for the specific number of capstan revolutions in Table 1. The time shall be within the tolerance specified. Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. The voltage should be positive.

Rotate the MISC SELECTOR control to the KS 270/271 Input Volts position. Depress the invert button and, if necessary, adjust the STIMulus 1 control for +19.0 ±.5Vdc as

read at the Master Selector meter jacks. (For KS 270A -07 and -08 versions, adjust STIMulus 1 to +11.5Vdc.) The capstan should be rotating clockwise.

Measure the time required for the specific number of capstan revolutions in Table 1. The time must be within the tolerance specified. Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. The voltage should be negative.

TACH FEEDBACK O/K

This test checks the polarity and value of the servo motor feedback generated in the KS 270A.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
TACH FEEDBACK	OUT
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)
INVERT	IN
AP CLUTCH ENGAGE	IN

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for +19.0 ±.5Vdc as read at the Master Selector meter jacks. (For KS 270A -07 and -08 versions, adjust STIMulus 1 to +11.5Vdc.) Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. Refer to Table 1 above. The voltage reading should be within the tolerance for the particular servo being tested, and of negative polarity.

Rotate the MISC SELECTOR control to the KS 270/271 Input Volts position.

Repeat the test for the counterclockwise tach voltage output by depressing the INVERT button and, if necessary, adjust the STIMulus 1 control for -19.0 ±.5Vdc as read at the Master Selector meter jacks. (For KS 270A -07 and -08 versions, adjust STIMulus 1 to -11.5Vdc.) Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. Refer to Table 1. The voltage reading should be within the tolerance for the particular servo being tested, and of positive polarity.

TORQUE CHARACTERISTICS

This test checks the servo motor's ability to provide at least 80 in/lbs of torque to the capstan.

CAUTION

IF THE MOUNTING PLATE BOLTS ARE NOT SECURE, DAMAGE TO THE GUIDE PIN ON THE BASE PLATE COULD OCCUR.

The bench test slip clutch should be set to 80 in/lbs. Set the torque wrench into position. Use the handle to secure the wrench to the test stand.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
TACH FEEDBACK	IN
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for -24.0 ±.5Vdc as read at the Master Selector meter jacks.

Jump out @ 75 LBS

The motor drive gear should begin to drive at this time. Remove the input signal by depressing the STIMulus ENGAGE button, and observe that the motor stops turning. Depress the AP ENG button. After the clutch has engaged, apply the input drive signal with the STIMulus 1 ENGAGE button. The capstan should begin to drive and the clutch should begin to slip. When the clutch begins to slip, quickly remove the drive signal by depressing the STIMulus 1 ENGAGE button.

Release the solenoid by depressing the AP CLUTCH ENGAGE switch. Wait one minute before proceeding.

Depress the STIMulus 1 ENGAGE button to ON.

Depress the INVERT button, and, if necessary, adjust the STIMulus 1 control for +24.0 ±.5Vdc as read at the Master Selector meter jacks.

Jump out @ 75 LBS

The motor drive gear should begin to drive at this time. Remove the input signal by depressing the STIMulus 1 ENGAGE button, and observe that the motor stops turning. Depress the AP ENG button. After the clutch has engaged, apply the input drive signal by depressing the STIMulus 1 ENGAGE button. The capstan should begin to drive and the clutch should begin to slip. When the clutch begins to slip, quickly remove the drive signal by depressing the STiMulus 1 ENGAGE button.

Return all switches to the out (OFF) position. Remove the torque wrench.

KS 271A
Roll Servo

Roll Servo

KS271A-01

SN 38232

Honeywell

Business, Regional, & General Aviation
[redacted]
Olathe, KS [redacted]

Service Aid

SERVICE AID: KS 271A-103
Primary Servo for KAP 200, KFC 200, and KFC 250 Flight Control Systems

SUBJECT: Testing KS 271A Autopilot Servos P/N 065-0060-XX with the KTS 151 Autopilot Bench Tester

The KS 271 Primary Servo has been replaced in production by the improved KS 271A Pitch Servo. These units operate identically in aircraft installations. However, it has come to our attention that these two servos do not respond to the KTS 151 Test Set in the same manner.

Because of a different test set reference potential, the voltage required to produce the same servo RPM and tach voltage from a KS 271A will be exactly double the values that were listed in Servo Maintenance Manual P/N 006-05557-0000, page 6-13, Section 6.2.3.10.

The following information and procedures should be used when testing a KS 271A.

Refer to KS 271A Servo Maintenance Manual P/N 006-05289-0002 for the remaining procedures for the KS 271A. The voltage values for all other tests remain the same.

This information will be added to KS 271A Servo Maintenance Manual P/N 006-05289-0002 the next time it is revised.

CCW CW

39 sec 36 sec.

OK

CW −1.41 CCW 1.34

KS 271A Version	Speed Characteristics (revs / seconds)	*Tach Voltage Formula	*Optimum Tach Voltage CW	CCW
-00	10 in 44 ±5	22.16/T = Tach Voltage	-5.68	+5.68
-01	3 in 37 ±7	16.7/T = Tach Voltage	-1.35	+1.35
-02	1 in 32 ±6	16.7/T = Tach Voltage	-0.52	+0.52
-03	2 in 52 ±9	68.5/T = Tach Voltage	-2.70	+2.70
-04	10 in 44 ±5	No Tach		
-05	3 in 47 ±8	16.7/T = Tach Voltage	-1.07	+1.07
-06	3 in 37 ±7	39.76/T = Tach Voltage	-3.21	+3.21
-09	3 in 47 ±8	81.33/T = Tach Voltage	-5.19	+5.19
-18	10 in 44 ±5	22.16/T = Tach Voltage	-5.68	+5.68
-19	3 in 37 ±7	16.7/T = Tach Voltage	-1.35	+1.35
-30	1 in 36 ±7	20.6/T = Tach Voltage	-0.61	+0.61
-33	2 in 32 ±6	54.4/T = Tach Voltage	-3.40	+3.40
-60	3 in 37 ±7	81.33/T = Tach Voltage	-6.59	+6.59
-61	1 in 48 ±9	81.33/T = Tach Voltage	-1.69	+1.69
-62	1 in 36 ±7	100.8/T = Tach Voltage	-2.80	+2.80
-63	2 in 37 ±7	42.18/T = Tach Voltage	-2.27	+2.27

NOTE

In the Tach Voltage Formula, *T* is the time in seconds for one revolution of the capstan. The tolerance for the Tach Voltage is ±15% for units without Mod 3 incorporated and ±5% for units with Mod 3.

The Optimum Tach Voltage is only approximate and is given for use as a guide. The actual Tach Voltage must be calculated using the formula.

MOTOR DIRECTION AND BREAKOUT OK

This test checks the direction of the servo motor drive and checks the servo's ability to respond to small drive commands.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)
AP CLUTCH ENGAGE	IN

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for 0.0 ±.5Vdc. Depress the RAMP button, and monitor the input voltage as it begins to ramp negative. Depress the HOLD button at the first indication of the output capstan beginning to turn. The output capstan should begin to rotate counterclockwise before the voltage reaches -7.30Vdc. After measuring the voltage, depress the RAMP button again, (which causes the voltage to go to zero) and switch the HOLD button to the OUT position. -4.18

Reverse the direction of the ramp by depressing the INVERT switch. Depress the RAMP button, and monitor the input voltage as it begins to ramp positive. Depress the HOLD button at the first indication of the output capstan beginning to turn. The output capstan should begin to rotate clockwise before the voltage reaches +7.30Vdc. Return all buttons to the OUT position. 3.9

CAPSTAN SPEED OK

This test checks the servo's ability to drive at the proper speed.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
TACH FEEDBACK	IN
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)
AP CLUTCH ENGAGE	IN

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for -19.0 ±.5Vdc as read at the Master Selector meter jacks. The capstan should be rotating counterclockwise.

Measure the time required for the specific number of capstan revolutions in Table 1. The time must be within the tolerance specified. Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. The voltage should be positive.

Rotate the MISC SELECTOR control to the KS 270/271 Input Volts position. Depress the invert button and, if necessary, adjust the STIMulus 1 control for +19.0 ±.5Vdc as read at the Master Selector meter jacks. The capstan should be rotating clockwise.

Measure the time required for the specific number of capstan revolutions in Table 1. The time must be within the tolerance specified. Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. The voltage should be negative.

Return all switches to the out (OFF) position.

TACH FEEDBACK ok

This test checks the polarity and value of the servo motor feedback generated in the KS 271A.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
TACH FEEDBACK	OUT
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)
INVERT	IN
AP CLUTCH ENGAGE	IN

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for +19.0 ±.5Vdc as read at the Master Selector meter jacks. (For KS 270A -07 and -08 versions, adjust STIMulus 1 to +11.5Vdc.) Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. Refer to Table 1 above. The voltage reading should be within the tolerance for the particular servo being tested, and of negative polarity.

Rotate the MISC SELECTOR control to the KS 270/271 Input Volts position.

Repeat the test for the counterclockwise tach voltage output by depressing the INVERT button and, if necessary, adjust the STIMulus 1 control for -19.0 ±.5Vdc as read at the Master Selector meter jacks. (For KS 270A -07 and -08 versions, adjust STIMulus 1 to -11.5Vdc.) Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. Refer to Table 1. The voltage reading should be within the tolerance for the particular servo being tested, and of positive polarity.

TORQUE CHARACTERISTICS ok

This test checks the servo motor's ability to provide at least 50 in/lbs of torque to the capstan.

CAUTION

DO NOT RUN THE SERVO IN THE STALLED CONDITION FOR MORE THAN FIVE SECONDS.

IF THE MOUNTING PLATE BOLTS ARE NOT SECURE, DAMAGE TO THE GUIDE PIN ON THE BASE PLATE COULD OCCUR.

The bench test slip clutch should be set to 62±5 in/lbs. for the -00 and -04 units, 75±5 in/lbs for the -01, -02, -03, -05, -09, -60, and -62 units, 50±5 in/lbs for the -33 and -63 units, or 20±2 in/lbs for the -61 unit. Set the torque wrench into position. Use the handle to secure the wrench to the test stand.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
TACH FEEDBACK	IN
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for -24.0 ±.5Vdc as read at the Master Selector meter jacks.

The motor drive gear should begin to drive at this time. Remove the input signal by depressing the STIMulus ENGAGE button, and observe that the motor stops turning. Depress the AP ENG button. After the clutch has engaged, apply the input drive signal with the STIMulus 1 ENGAGE button. The capstan should begin to drive and the clutch should begin to slip. When the clutch begins to slip, quickly remove the drive signal by depressing the STIMulus 1 ENGAGE button.

Release the solenoid by depressing the AP CLUTCH ENGAGE switch. Wait one minute before proceeding.

Depress the STIMulus 1 ENGAGE button to ON.

Depress the INVERT button, and, if necessary, adjust the STIMulus 1 control for +24.0 ±.5Vdc as read at the Master Selector meter jacks.

The motor drive gear should begin to drive at this time. Remove the input signal by depressing the STIMulus 1 ENGAGE button, and observe that the motor stops turning. Depress the AP ENG button. After the clutch has engaged, apply the input drive signal by depressing the STIMulus 1 ENGAGE button. The capstan should begin to drive and the clutch should begin to slip. When the clutch begins to slip, quickly remove the drive signal by depressing the STiMulus 1 ENGAGE button.

Return all switches to the out (OFF) position. Remove the torque wrench.

KS 271A
Yaw Servo

Yaw Servo

KS271A-04

SN 40377

Honeywell

Business, Regional, & General Aviation
[redacted]
Olathe, KS [redacted]

Service Aid

SERVICE AID: KS 271A-103
Primary Servo for KAP 200, KFC 200, and KFC 250 Flight Control Systems

SUBJECT: Testing KS 271A Autopilot Servos P/N 065-0060-XX with the KTS 151 Autopilot Bench Tester

The KS 271 Primary Servo has been replaced in production by the improved KS 271A Pitch Servo. These units operate identically in aircraft installations. However, it has come to our attention that these two servos do not respond to the KTS 151 Test Set in the same manner.

Because of a different test set reference potential, the voltage required to produce the same servo RPM and tach voltage from a KS 271A will be exactly double the values that were listed in Servo Maintenance Manual P/N 006-05557-0000, page 6-13, Section 6.2.3.10.

The following information and procedures should be used when testing a KS 271A.

Refer to KS 271A Servo Maintenance Manual P/N 006-05289-0002 for the remaining procedures for the KS 271A. The voltage values for all other tests remain the same.

This information will be added to KS 271A Servo Maintenance Manual P/N 006-05289-0002 the next time it is revised.

CCW CW

43 42

KS 271A Version	Speed Characteristics (revs / seconds)	*Tach Voltage Formula	*0ptimum Tach Voltage CW	CCW
-00	10 in 44 ±5	22.16/T = Tach Voltage	-5.68	+5.68
-01	3 in 37 ±7	16.7/T = Tach Voltage	-1.35	+1.35
-02	1 in 32 ±6	16.7/T = Tach Voltage	-0.52	+0.52
-03	2 in 52 ±9	68.5/T = Tach Voltage	-2.70	+2.70
-04	10 in 44 ±5	No Tach		
-05	3 in 47 ±8	16.7/T = Tach Voltage	-1.07	+1.07
-06	3 in 37 ±7	39.76/T = Tach Voltage	-3.21	+3.21
-09	3 in 47 ±8	81.33/T = Tach Voltage	-5.19	+5.19
-18	10 in 44 ±5	22.16/T = Tach Voltage	-5.68	+5.68
-19	3 in 37 ±7	16.7/T = Tach Voltage	-1.35	+1.35
-30	1 in 36 ±7	20.6/T = Tach Voltage	-0.61	+0.61
-33	2 in 32 ±6	54.4/T = Tach Voltage	-3.40	+3.40
-60	3 in 37 ±7	81.33/T = Tach Voltage	-6.59	+6.59
-61	1 in 48 ±9	81.33/T = Tach Voltage	-1.69	+1.69
-62	1 in 36 ±7	100.8/T = Tach Voltage	-2.80	+2.80
-63	2 in 37 ±7	42.18/T = Tach Voltage	-2.27	+2.27

NOTE

In the Tach Voltage Formula, *T* is the time in seconds for one revolution of the capstan. The tolerance for the Tach Voltage is ±15% for units without Mod 3 incorporated and ±5% for units with Mod 3.

The Optimum Tach Voltage is only approximate and is given for use as a guide. The actual Tach Voltage must be calculated using the formula.

MOTOR DIRECTION AND BREAKOUT OK

This test checks the direction of the servo motor drive and checks the servo's ability to respond to small drive commands.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)
AP CLUTCH ENGAGE	IN

TACH FEEDBACK NA

This test checks the polarity and value of the servo motor feedback generated in the KS 271A.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
TACH FEEDBACK	OUT
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)
INVERT	IN
AP CLUTCH ENGAGE	IN

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for +19.0 ±.5Vdc as read at the Master Selector meter jacks. (For KS 270A -07 and -08 versions, adjust STIMulus 1 to +11.5Vdc.) Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. Refer to Table 1 above. The voltage reading should be within the tolerance for the particular servo being tested, and of negative polarity.

Rotate the MISC SELECTOR control to the KS 270/271 Input Volts position.

Repeat the test for the counterclockwise tach voltage output by depressing the INVERT button and, if necessary, adjust the STIMulus 1 control for -19.0 ±.5Vdc as read at the Master Selector meter jacks. (For KS 270A -07 and -08 versions, adjust STIMulus 1 to -11.5Vdc.) Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. Refer to Table 1. The voltage reading should be within the tolerance for the particular servo being tested, and of positive polarity.

TORQUE CHARACTERISTICS OK

This test checks the servo motor's ability to provide at least 50 in/lbs of torque to the capstan.

CAUTION

DO NOT RUN THE SERVO IN THE STALLED CONDITION FOR MORE THAN FIVE SECONDS.

IF THE MOUNTING PLATE BOLTS ARE NOT SECURE, DAMAGE TO THE GUIDE PIN ON THE BASE PLATE COULD OCCUR.

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for 0.0 ±.5Vdc. Depress the RAMP button, and monitor the input voltage as it begins to ramp negative. Depress the HOLD button at the first indication of the output capstan beginning to turn. The output capstan should begin to rotate counterclockwise before the voltage reaches -7.30Vdc. After measuring the voltage, depress the RAMP button again, (which causes the voltage to go to zero) and switch the HOLD button to the OUT position. -4.65

Reverse the direction of the ramp by depressing the INVERT switch. Depress the RAMP button, and monitor the input voltage as it begins to ramp positive. Depress the HOLD button at the first indication of the output capstan beginning to turn. The output capstan should begin to rotate clockwise before the voltage reaches +7.30Vdc. Return all buttons to the OUT position. 4.8

CAPSTAN SPEED OK

This test checks the servo's ability to drive at the proper speed.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
TACH FEEDBACK	IN
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)
AP CLUTCH ENGAGE	IN

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for -19.0 ±.5Vdc as read at the Master Selector meter jacks. The capstan should be rotating counterclockwise.

Measure the time required for the specific number of capstan revolutions in Table 1. The time must be within the tolerance specified. Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. The voltage should be positive.

Rotate the MISC SELECTOR control to the KS 270/271 Input Volts position. Depress the invert button and, if necessary, adjust the STIMulus 1 control for +19.0 ±.5Vdc as read at the Master Selector meter jacks. The capstan should be rotating clockwise.

Measure the time required for the specific number of capstan revolutions in Table 1. The time must be within the tolerance specified. Rotate the MISC SELECTOR control to the KS 270/271 Motor Sense position. The voltage should be negative.

Return all switches to the out (OFF) position.

The bench test slip clutch should be set to 62±5 in/lbs. for the -00 and -04 units, 75±5 in/lbs for the -01, -02, -03, -05, -09, -60, and -62 units, 50±5 in/lbs for the -33 and -63 units, or 20±2 in/lbs for the -61 unit. Set the torque wrench into position. Use the handle to secure the wrench to the test stand.

Place the following controls in their corresponding positions:

EXTERNAL SUPPLY VOLTAGE	+28V
VOLTAGE SELECT SWITCH	+28V ON
TACH FEEDBACK	IN
MISC SELECTOR	KS 270/271 INPUT VOLTS
MASTER SELECTOR	MISC TP (VOLTAGE)

Depress the STIMulus 1 ENGAGE button and adjust the STIMulus 1 control for -24.0 ±.5Vdc as read at the Master Selector meter jacks.

The motor drive gear should begin to drive at this time. Remove the input signal by depressing the STIMulus ENGAGE button, and observe that the motor stops turning. Depress the AP ENG button. After the clutch has engaged, apply the input drive signal with the STIMulus 1 ENGAGE button. The capstan should begin to drive and the clutch should begin to slip. When the clutch begins to slip, quickly remove the drive signal by depressing the STIMulus 1 ENGAGE button.

Release the solenoid by depressing the AP CLUTCH ENGAGE switch. Wait one minute before proceeding.

Depress the STIMulus 1 ENGAGE button to ON.

Depress the INVERT button, and, if necessary, adjust the STIMulus 1 control for +24.0 ±.5Vdc as read at the Master Selector meter jacks.

The motor drive gear should begin to drive at this time. Remove the input signal by depressing the STIMulus 1 ENGAGE button, and observe that the motor stops turning. Depress the AP ENG button. After the clutch has engaged, apply the input drive signal by depressing the STIMulus 1 ENGAGE button. The capstan should begin to drive and the clutch should begin to slip. When the clutch begins to slip, quickly remove the drive signal by depressing the STiMulus 1 ENGAGE button.

Return all switches to the out (OFF) position. Remove the torque wrench.

KS 272A
Pitch Trim Servo

KS272A-13

SN47091

Honeywell

Business & General Aviation
One Technology Center
[redacted]
Olathe, Kansas [redacted]

Service Aid

SERVICE AID: KS 272/A-104
KS 272 and KS 272A Trim Servo

SUBJECT: Changes to the Test Parameter Table in the Maintenance Manuals

Refer to KS 272 Trim Servo Maintenance Manual, P/N 006-05282-0004, Rev. 4, May, 1991, and KS 272A Trim Servo Maintenance Manual, P/N 006-05290-0000, Rev. 0, May, 1991. The data in Table 5-1, KS 272A Test Parameters, has been revised. This table is found on Page 5-20 of the KS 272 maintenance manual, and on Page 5-29 of the KS 272A maintenance manual. The following table contains the updated information.

Unit Version	Bench Test Mating Servo Mount Type	Load (in/lbs)	Input Power (+VDC)	Voltage At Pin A (+VDC)	Manual Speed Characteristics (Revolutions / Seconds)	Max Clutch Setting, (in/lbs) Torque Test	R111
065-0061-01	200-1678-01	7.5	28	27.5 to 28.5	2 / 31 to 48	31.25	
065-0061-02	200-1678-02	12.5	14	5.6 to 8.2	5 / 51 to 66	21.80	
065-0061-03	200-1678-02	12.5	14	12 to 14	5 / 17 to 26	31.25	
065-0061-04	200-1678-01	7.5	28	14 to 17	2 / 48 to 70	31.25	
065-0061-05	200-1678-02	12.5	14	9 to 11	2 / 55 to 75	31.25	
065-0061-06	200-1678-01	6.25	28	17 to 23.1	5 / 18.9 to 25.2	31.25	
065-0061-07	200-1678-01	7.5	14	11 to 13	5 / 15 to 23	31.25	
065-0061-08	200-1678-02	7.5	14	13.5 to 14.5	10 / 10 to 18	21.80	
065-0061-09	200-1678-01	7.5	14	10.4 to 11.6	1 / 15.5 to 23.5	31.25	
065-0061-10	200-1678-01	6.25	28	12.3 to 16.8	3 / 18.5 to 23.5	31.25	
065-0061-11	200-1678-01	12.5	14	13.5 to 14.5	5 / 13 to 21	31.25	
065-0061-12	200-1678-01	12.5	14	13 to 15	3 / 32 to 44	31.25	
065-0061-13	200-1678-01	7.5	28	15.6 to 21	2 / 45 to 55	31.25 OK	
065-0061-14	200-1678-01	12.5	28	25.5 to 28.5 17.1V ccw 5/sec cw 53sec	5 / 9.5 to 17.5	31.25 ~~ok~~	
065-0061-15	200-1678-02	7.5	14	8.6 to 9.6	5 / 9 to 14	21.80	
065-0061-16	200-1678-01	12.5	28	27.5 to 28.5	2 / 19 to 27	31.25	
065-0061-17	200-1678-01	12.5	28	19 to 21	2 / 23 to 33	31.25	
065-0061-18	200-1678-01	12.5	14	9 to 11	1 / 36 to 48	31.25	
065-0061-19	200-1678-02	7.5	28	14.2 to 15.8	5 / 43 to 64	21.80	

Unit Version	Bench Test Mating Servo Mount Type	Load (in/lbs)	Input Power (+VDC)	Voltage At Pin A (+VDC)	Manual Speed Characteristics (Revolutions / Seconds)	Max Clutch Setting, (in/lbs) Torque Test	R111
065-0061-21	200-1678-01	12.5	14	9.3 to 10.7	2 / 32 to 48	31.25	
065-0061-22	200-1678-01	12.5	28	25.5 to 28.5	2 / 32 to 38	31.25	
065-0061-24	200-1678-01	7.5	28	22.7 to 25.5	5 / 24 to 34	31.25	
065-0061-25	200-1678-01	7.5	14	12 to 14	2 / 17 to 25	31.25	
065-0061-26	200-1678-02	7.5	14	9 to 14	6 / 8 to 12	21.80	
065-0061-27	200-1678-01	12.5	28	14 to 16	2 / 32 to 48	31.25	
065-0061-28	SEE NOTE 1	7.5	14	13.5 to 14.5	5 / 8 to 12	31.25	
065-0061-29	200-1678-01	12.5	28	19 to 21	2 / 23 to 33	31.25	
065-0061-30	200-1678-01	12.5	14	13.5 to 14.5	2 / 24 to 34	31.25	
065-0061-31	200-1678-01	12.5	28	27.5 to 28.5	2 / 24 to 34	31.25	
065-0061-32	200-1678-01	12.5	28	22.8 to 25.2	2 / 24 to 32	31.25	
065-0061-33	200-1678-01	12.5	28	19 to 21	2 / 37 to 49	31.25	
065-0061-34	200-1678-01	12.5	28	22.5 to 25.5	2 / 24 to 32	31.25	
065-0061-35	200-1678-01	12.5	14	13.5 to 14.5	2 / 19 to 27	31.25	
065-0061-36	200-1678-01	12.5	28	19.75 to 23.25	2 / 21 to 29	31.25	
065-0061-37	200-1678-01	12.5	28	14 to 21	4 / 27.5 to 35	31.25	
065-0061-38	200-1678-01	12.5	14	6.5 to 10.5	4 / 27.5 to 35	31.25	
065-0061-39	200-1678-01	6.5	28	17 to 19	5 / 21.2 to 25.9	31.25	
065-0061-40	200-1678-01	7.5	28	19 to 21	5 / 29 to 39	31.25	
065-0061-41	200-1678-01	6.5	28	28	3 / 15 to 25	31.25	
065-0061-42	200-1678-02	12.5	28	25.4 to 28.5	5 / 12 to 18	21.80	
065-0061-43	200-1678-01	25.0	28	25.4 to 26.5	3 / 9 to 13	31.25	
065-0061-44	200-1678-01	12.5	28	14.7 to 17.3	3 / 40 to 55	31.25	
065-0061-45	200-1678-01	12.5	28	19.7 to 22.5	3 / 20 to 25.7	31.25	
065-0061-50	200-1678-01	12.5	28	19 to 21	2 / 23 to 33	31.25	3.48K, 1%
065-0061-51	200-1678-01	12.5	28	19 to 21	2 / 27 to 37	31.25	5.49K, 1%
065-0061-52	200-1678-01	12.5	28	19 to 21	3 / 36 to 48	31.25	7.50K, 1%
065-0061-53	200-1678-01	12.5	28	19 to 21	5 / 29 to 41	31.25	11.5K, 1%
065-0061-56	200-1678-01	12.5	28	19 to 21	2 / 27 to 37	31.25	5.49K, 1%

NOTE 1: This Version uses a special load and must be returned to Honeywell for repair and testing.

Table 5-1
KS 272A TEST PARAMETERS