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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

POWERPLANTS GROUP CHAIRMAN'S FACTUAL REPORT
HONEYWELL COMPONENT MAINTENANCE MANUAL LG80E
ENGINE PRESSURE RATIO COMPUTER TASK 77-13-01

American Airlines flight 1420
Little Rock, Arkansas
June 1, 1999

DCA99MA060

MANUAL NAME HONEYWELL-ENGINE PRESSURE RATIO COMPUTER (TRANSMITTER)							PAGE 1 OF 1	
NEW ISSUE	COMPONENT PART NBR. LG80E1			S/N		AIRCRAFT/ENGINE		
REVISION	CHAPTER NBR. 77-13-01		DATE 3/3/86		MD80			
AFFECTS:	<input type="checkbox"/> ENGLAB	<input checked="" type="checkbox"/> TEST EQ	<input checked="" type="checkbox"/> TOOLING	<input checked="" type="checkbox"/> PARTS	SHELF LIFE	<input checked="" type="checkbox"/>	MONTHS	<input checked="" type="checkbox"/> NO LIMIT
MINOR	<input checked="" type="checkbox"/> REPAIR	<input type="checkbox"/> MTC PROCEDURES	<input checked="" type="checkbox"/> PERMANENT	<input type="checkbox"/> FAR 145	ACTION COPY TO SHOP(S)			
MAJOR	<input type="checkbox"/> ALTERATION	<input type="checkbox"/> MAJOR APPROVAL	<input type="checkbox"/> INTERIM	<input type="checkbox"/> FAR 121	REPAIR VENDOR			
SFAR 36 APPROVAL				SFAR FILE NO.		PAGE OF		

This page replaces same page dated 10/18/96

1.0 Inspection and Production Requirements:

1.1 Check and Repair

1.1.1 Visually check the component for physical damage.

1.1.2 Pre-test the component in the condition received, if possible, to answer complaint.

1.1.3 Accomplish functional test per Paragraph 3.0 of this specification.

1.1.3.1 If functional test and visual check is passed and no other work is required by this specification sheet, the component may be returned to service.

1.1.3.2 If functional test and/or visual check is not passed, repair the component as determined by the functional test and visual check. Use the applicable manual specification/procedures to make the necessary repairs. Accomplish functional test per paragraph 3.0 of this specification and return to service.

1.2 Zero Time - Minimum requirements:

1.2.1 Compliance with 1.1. and 1.3.

1.3 Additional Requirements

1.3.1 Clean and lubricate all defective ball bearings and gears (gear teeth) if unit's time since last shop visit exceeds 36 months.

ENGINEERING	ENGINEER N.B. MARSALA	DATE 12/11/96	SECTION MANAGER/DESIGNEE W.E. WALTON	DATE 12/11/96
<input type="checkbox"/> ADVANCE ACTION	MDR PLANNER	SHOP	PRODUCTION	DATE
EFFECTIVE DATE			SHOP	QA
R.O.	MDR PLANNER			

**American Airlines
ENGINEERING SPECIFICATION**

TULE FORM 1739-6P2 24-7/AC1

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SPEC. NBR.
ES080668

MANUAL NAME

HONEYWELL - ENGINE PRESSURE RATIO COMPUTER TRANSMITTER

CHART NBR
77-13-01

ENGINEER

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MANAGER/DESIGNER

[Signature]

DATE

3-3-86

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2602 OVA

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2.0 Limits and Tolerances:

2.1 AS SPECIFIED IN THE ASSEMBLY SECTION AND TESTING AND TROUBLESHOOTING SECTION

3.0 Functional Test Requirements:

3.1 AS SPECIFIED IN THE TESTING AND TROUBLESHOOTING SECTION

4.0 Field Station Shop Requirements:

4.1 NOT APPLICABLE

5.0 Shelf Life:

NONE

ADVANCE ACTION

EXPIRATION DATE 120 DAYS FROM SHOP SIGNATURE DATE.

SIGNATURE DATE SHOP

PRODUCTION *[Signature]* 3-3-86 2602

QA *[Signature]* 3/4/86 2140

DATE SENT TO *[Signature]*

DATE RECEIVED *[Signature]*

REVISIONS FOR THIS PAGE: 0

EXPIRATION DATE

MANUAL NAME
 Honeywell - EPR Computer

CHAPTER NBR. & DATE
 77-13-01

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SFAR 36 File No.

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This supersedes and replaces previous page 100(a)

ALTERNATE TEST EQUIPMENT SPECIFICATION

Test Equipment Engineering has authorized the use of alternate equipment and/or procedures to be used in Tulsa Shop 2602 to test this component in accordance with the TESTING section of this CMM.

Refer to GSER # GN6327F

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ENGINEERING ENGINEER	DATE	SECTION MANAGER/DESIGNEE	DATE
[Redacted]	3/3/99	[Redacted]	3/9/99
ADVANCE ACTION EFFECTIVE DATE	MDR PLANNER	SHOP	PRODUCTION
R.O.	MDR PLANNER		

APPENDIX 5

TEMPORARY REVISION NO. 2

FILING INSTRUCTIONS: Insert facing page 101 of ATA number 77-13-01, Honeywell publication number 95-9823-3, revision number 3, dated 15 October 1989.

Paragraph 2A should read as follows:

- A. Test the EPR computer using test equipment shown in figure 101. Equivalent test equipment may be used.

Paragraph 2A.1 should follow paragraph 2A and should read as follows:

- A.1 Make connections to EPR computer as shown in figure 101.

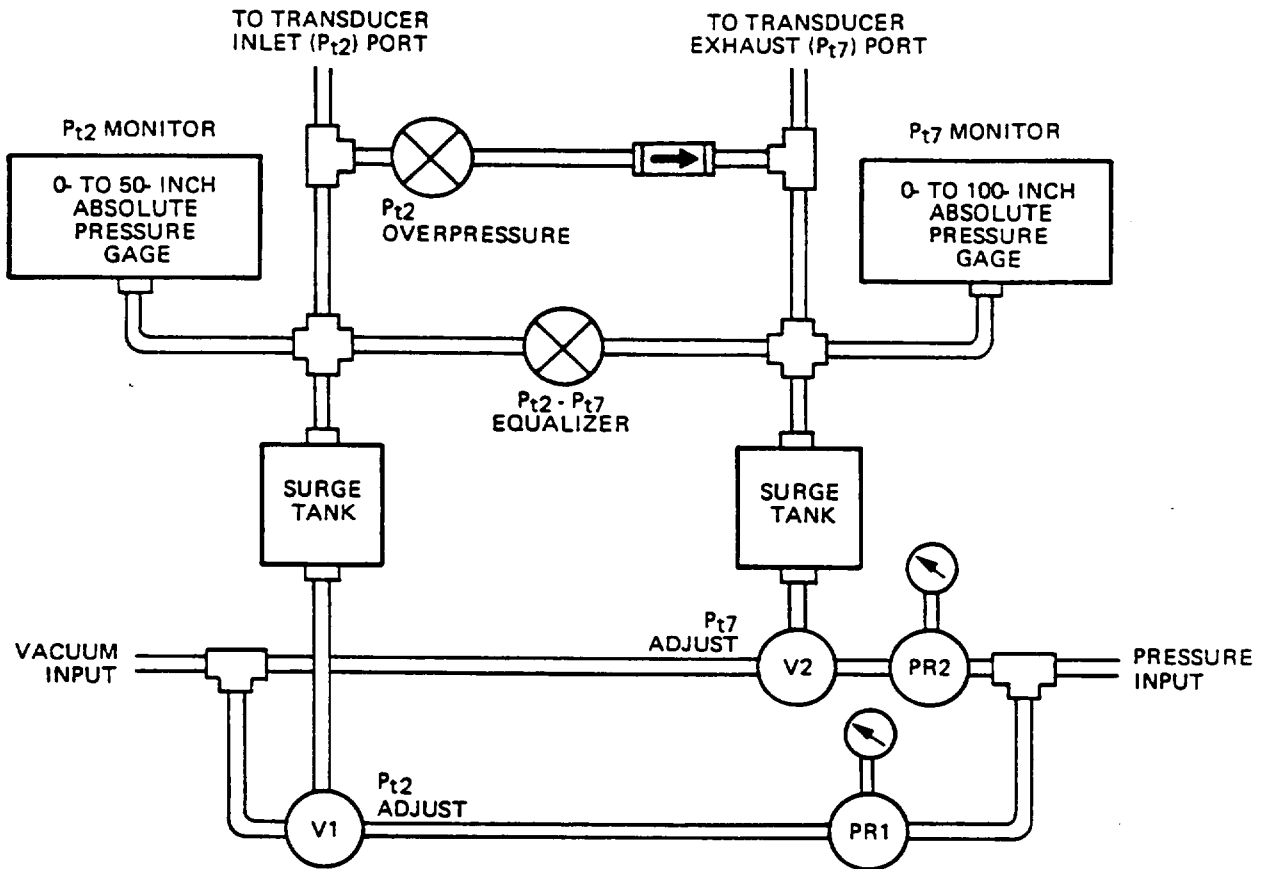
TESTING AND TROUBLESHOOTING. Paragraphs 1 to 3A.

1. General. This section describes the procedures necessary to test the EPR Computer from the device level to the component level. Troubleshooting procedures for fault isolation assistance and corrective action recommendations are also provided when applicable. Refer to SPECIAL TOOLS, FIXTURES, AND EQUIPMENT; CLEANING; DISASSEMBLY; ASSEMBLY; and REPAIR procedures found in other sections of this manual during testing and troubleshooting, when necessary.
2. Set Up Test Equipment.
 - A. Make connections to EPR computer as shown in figure 101.
 - B. Connect power cable of LG80F2101 Test Panel to a variable auto-transformer. Connect auto-transformer to a 115V 400-Hz power source.
 - C. Adjust output of variable auto-transformer to $115 \pm 2V$.
 - D. Set the pressure control panel power switch to ON. Check auto-transformer output voltage to ensure proper tolerances, and adjust if necessary. Maintain this voltage throughout all tests unless otherwise stated.
 - E. Initial setting of the LG80-E4 Adapter Junction Box switch is not critical. Settings will be specified throughout procedures, as needed.
 - F. Pneumatic Test System. Figure 102 is a schematic diagram of the pneumatic test system contained in the LG80F2100 Valve Panel. All pneumatic testing inputs for the EPR computer shall be supplied and controlled by this system, except as otherwise stated within the text. Particular attention should be paid to the use of surge tanks, as the related test will indicate whether they are in or out of the system.





NOTE: The total leakage rate for the pneumatic test system shall not exceed 0.001 inch Hg absolute per minute (exclusive of surge tanks) throughout the entire pressure testing range.

CAUTION: DEVICE SHALL ALWAYS BE ENERGIZED WHEN P_{t2} AND P_{t7} APPLIED PRESSURES ARE NOT EQUAL, EXCEPT AS EXPRESSLY STATED FOR SPECIFIC TESTS.
 - G. Electrical Test System. Figure 103 is a schematic diagram of the cabling for the electrical test system contained in the LG80F2101 Test Panel. All electrical testing of the EPR computer shall be done using this system, except as otherwise stated within the text. Position of the selector switch on the LG80-E4 Adapter Junction Box shall be as indicated within the specific testing steps.
3. Test Procedures. Several testing procedures and conditions are called out within the EPR computer tests. To ensure uniformity, they are defined as follows:
 - A. Ambient Pressure. Ambient pressure, throughout this manual, will be defined as the actual barometer reading as taken within the last one-hour time frame. Because atmospheric pressure can change very rapidly, taking a reading immediately prior to making an adjustment is recommended.

TESTING AND TROUBLESHOOTING.



NOTES:

1. CHECK VALVE  IS NUPRO, INC, NO. 4C-L/3PS1.
2. TOGGLE VALVE  IS WHITEY RESEARCH TOOL CO, NO. 1GS4.
3. SURGE TANKS (APPROXIMATELY 30 CUBIC IN.) ARE HONEYWELL INC., AVIONICS DIVISION, NO. HG180-F32.
4. VALVES  AND  ARE IDEAL-AEROSMITH, INC, NO. 219385-5.
5. PRESSURE REGULATOR PR1, WITH GAGE, IS FAIRCHILD HILLER CORP, KENDALL NO. 30132-N-G.
6. PRESSURE REGULATOR PR2, WITH GAGE, IS FAIRCHILD HILLER CORP, KENDALL NO. 30142-N-G.
7. Pt2 OVERPRESSURE VALVE SHALL BE OPEN EXCEPT WHEN TESTING EPR VALUES LESS THAN 1.0.

95-9823/110

Pneumatic Test System Diagram
Figure 102

APPENDIX 5

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ENGINEER <i>[Signature]</i> 4/5/88	MANAGER/DESIGNEE <i>[Signature]</i>	DATE 4/5/88
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THE FOLLOWING HONEYWELL MANUAL TEMPORARY REVISION No 1
 REVISES THE LEAK SPEC. IN STEPS 4A(3)(C) AND 4A(4)(C)
 FROM 0.05 INCH Hg. TO 0.25 INCH Hg.

Honeywell COMPONENT MAINTENANCE MANUAL
 LG80E ENGINE PRESSURE RATIO COMPUTER

TEMPORARY REVISION NO. 1

FILING INSTRUCTIONS: Insert facing page 105, dated 1 November 1979, of ATA 77-13-01, Revision Number 2.

Paragraph 4A(3)(c) should read as follows:

(c) Wait five minutes and read the pressure gauge. Value shall not have decreased more than 0.25 inch Hg.

Paragraph 4A(4)(c) should read as follows:

(c) Wait five minutes and read the pressure gauge. Value shall not have decreased more than 0.25 inch Hg.

ADVANCE ACTION

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QA	<i>[Signature]</i>	4-7-88	
LINE MTC. PC	<i>[Signature]</i>	4/7/88	
MCR PLANNER	<i>[Signature]</i>		
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Revision Number 95-9823-TR1

TESTING AND TROUBLESHOOTING. Paragraphs 4A to 4B(1).

- A. **Pressure Leakage Tests.** The tests which follow check the engine inlet pressure (P_{12}) and engine exhaust pressure (P_{17}) pneumatic portion of the EPR computer. Ensure that each step is followed as stated and in the order given, as failure to do so may result in extensive damage to the pneumatic sensing components of the EPR computer.

CAUTION: DO NOT APPLY POWER TO THE UNIT DURING THESE TESTS.

- (1) Turn off power to the EPR computer.
- (2) Remove the surge tanks from the pneumatic circuit. At no time will the surge tanks be included in the system while performing the following tests.
- (3) **Engine Inlet Pressure (P_{12}) Testing.**
 - (a) Vent the engine exhaust pressure (P_{17}) bulkhead fitting (235, IPL fig. 4) to room ambient pressure.
NOTE: When venting to room pressure, it is recommended that a nonrestrictive dust filter be installed to protect the system from foreign material.
 - (b) Apply 42 inches Hg absolute pressure to the P_{12} input line. Allow sufficient time for the pressure to stabilize, and then close off the source pressure. (The pressure gauge must remain actively connected to the P_{12} line.) Read and record the gauge indication.
 - (c) Wait five minutes; then read the pressure gauge. Value shall not have decreased more than 0.25 inch Hg.
 - (d) Bleed off the remaining P_{12} pressure until the P_{12} lines are at room ambient pressure.
- (4) **Engine Exhaust Pressure (P_{17}) Testing.**
 - (a) Apply 35 inches Hg absolute of pressure to the P_{12} input line. Ensure that this line is stable at this pressure and maintains this reading throughout this test.
 - (b) Apply 96 inches Hg absolute pressure to the P_{17} input line. Allow sufficient time for the pressure to stabilize; then close off the source pressure. (The pressure gauge must remain actively connected to the P_{17} line.) Read and record the pressure gauge indication.
 - (c) Wait five minutes; then read the pressure gauge. Value shall not have decreased more than 0.25 inch Hg.
 - (d) Bleed the P_{17} pressure until it equals the P_{12} pressure; then bleed both pressures to room ambient pressure.

B. **Scale Error Checks.**

- (1) Set the power switch of the LG80F2101 Test Panel to ON position.

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TEMPORARY REVISION NO. 2

FILING INSTRUCTIONS: Insert facing page 106 of ATA number 77-13-01, Honeywell publication number 95-9823-3, revision number 3, dated 15 October 1989.

Paragraph (6) should read as follows:

- (6) Repeat steps (2) through (5) for input pressures for TEST SETs 2 through 21 of table 101.

The note following paragraph (6) should be deleted.

The data in table 101 should read as follows:

Table 101. Transmitter Test Pressures

TEST SET	PRESSURE (INCHES HG ABSOLUTE)		ANGLE POSITION INDICATOR READING (DEGREES)**	PRESSURE RATIO
	INLET (P ₁₂)	EXHAUST (P ₁₇)		
1	7.000	10.500	331.50 ± 3.80	1.50 ± 0.020
2	7.000	11.900	9.50 ± 1.90	1.70 ± 0.010
3	7.000	13.300	47.50 ± 1.90	1.90 ± 0.010
4	7.000	16.100	123.50 ± 1.90	2.30 ± 0.010
5	7.000	17.500	161.50 ± 1.90	2.50 ± 0.010
6	11.000	18.700	9.50 ± 1.90	1.70 ± 0.010
7	11.000	23.100	85.50 ± 1.90	2.10 ± 0.010
8	11.000	25.300	123.50 ± 1.90	2.30 ± 0.010
9	15.000	28.500	47.50 ± 1.90	1.90 ± 0.010
10	15.000*	37.500	161.50 ± 1.90	2.50 ± 0.010
11	20.000	34.000	9.50 ± 0.95	1.70 ± 0.005
12	20.000	46.000	123.50 ± 0.95	2.30 ± 0.005
13	25.000	25.000	236.50 ± 4.75	1.00 ± 0.025
14	25.000	37.500	331.50 ± 3.80	1.50 ± 0.020
15	25.000	47.500	47.50 ± 0.95	1.90 ± 0.005
16	28.000	23.800	208.00 ± 4.75	0.85 ± 0.025

TEMPORARY REVISION NO. 2

FILING INSTRUCTIONS: Insert facing page 107 of ATA number 77-13-01, Honeywell publication number 95-9823-3, revision number 3, dated 15 October 1989.

The data in table 101 should read as follows:

Table 101. Transmitter Test Pressures (Cont)

TEST SET	PRESSURE (INCHES HG ABSOLUTE)		ANGLE POSITION INDICATOR READING (DEGREES)**	PRESSURE RATIO
	INLET (P ₂)	EXHAUST (P ₁₇)		
17	28.000*	36.400	293.50 ± 3.80	1.30 ± 0.020
18	28.000	47.600	9.50 ± 0.95	1.70 ± 0.005
19	28.000*	64.400	123.50 ± 0.95	2.30 ± 0.005
20	35.000	42.000	274.50 ± 4.75	1.20 ± 0.025
21	35.000	80.500	123.50 ± 1.90	2.30 ± 0.010

* Position error check points.

** Tolerances are for transmitter synchro B1. angle position readings for synchros B2 and B3 shall match synchro B1 readings to within ±0.38 degree and ±0.002 EPR value.

The remaining part of the note which follows table 101 should be deleted.

Paragraph (4) should read as follows:

- (4) Repeat the above steps for TEST SETs 2 through 21 of table 101 in chronological order.

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honeywell Logo Engine Pressure Ratio Computer

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Add the following note to B (5):

Note: When testing the 85 EPR position ensure that the synchro angle smoothly decreases as the pressure is applied (decreasing EPR). Ensure the synchro angle does not decrease when the pressure is reduced (increasing EPR). A decrease in synchro angle when the pressure is reduced may indicate that the roller track is kinked, has a flat spot, or the anchor and low end set screws are lower than set screw #3.

If a decrease or hesitant operation is observed at the low end adjust the 2001 reading by performing the Follower Roller Track Calibration (Paragraph K Sections (7) and (8) on page 770).

ENGINEERING	ENGINEER # Branch		DATE 1-25-90	SECTION MANAGER/DESIGNEE 	DATE 1/27/91	
ADVANCE ACTION EFFECTIVE DATE	MOR PLANNER	SHOP	PRODUCTION	DATE	SHOP QA	DATE
R.O.	MOR PLANNER					

APPENDIX 5

TESTING AND TROUBLESHOOTING. Paragraphs 4C to 4C(4).

Table 101. Transmitter Test Pressures (Cont)

TEST SET	PRESSURE (INCHES HG ABSOLUTE)		ANGLE POSITION INDICATOR	PRESSURE RATIO
	INLET (P _{t2})	EXHAUST (P _{t7})	READING (DEGREES)***	
17	11.000	18.700	9.50 ± 1.90	1.70 ± 0.010
18	11.000	23.100	85.50 ± 1.90	2.10 ± 0.010
19	11.000	25.300	123.50 ± 1.90	2.30 ± 0.010
20	15.000	28.500	47.50 ± 1.90	1.90 ± 0.010
21	15.000*	37.500	161.50 ± 1.90	2.50 ± 0.010
22	20.000	34.000	9.50 ± 0.95	1.70 ± 0.005
23	20.000	46.000	123.50 ± 0.95	2.30 ± 0.005
24	25.000	37.500	331.50 ± 3.80	1.50 ± 0.020
25	25.000	47.500	47.50 ± 0.95	1.90 ± 0.005
26	28.000	23.800	208.00 ± 4.75	0.85 ± 0.025
27	28.000*	36.400	293.50 ± 3.80	1.30 ± 0.020
28	28.000	47.600	9.50 ± 0.95	1.70 ± 0.005
29	28.000*	64.400	123.50 ± 0.95	2.30 ± 0.005
30	35.000	42.000	274.50 ± 4.75	1.20 ± 0.025
31	35.000	80.500	123.50 ± 1.90	2.30 ± 0.025

A unit may be considered operational if it meets the requirements of check points 1 through 14. Check points 15 through 31 are provided in case it is desirable to check a unit at other operating points.

*Position error check points.

**High temperature scale error check points.

***Tolerances are for transmitter synchro B1. Angle position readings for synchros B2 and B3 shall match synchro B1 readings to within ±0.38 degree and ±0.002 EPR value.

C. Friction Error Testing. All output values for the tests which follow shall be measured on transmitter synchro B1 only. Friction error tests check for mechanical binding.

(1) Apply P_{t2} and P_{t7} pressure inputs as specified in table 101 for TEST SET 1; read and record transmitter synchro B1 output on the angle position indicator.

(2) Vibrate the unit. Read and record the transmitter synchro B1 output on the angle position indicator.

(3) Compare the two readings. Values shall not differ by more than ±0.95 degree (±0.005 EPR) at room temperature (do not perform test at temperature extremes).

(4) Repeat the above steps for TEST STEPs 1 through 14 of table 101 in chronological order.

APPENDIX 5

TEMPORARY REVISION NO. 2

FILING INSTRUCTIONS: Insert facing page 108 of ATA number 77-13-01, Honeywell publication number 95-9823-3, revision number 3, dated 15 October 1989.

Paragraphs 4C(5) through 4D(14) should be deleted.

TESTING AND TROUBLESHOOTING. Paragraphs 4E to 4E(9).

- E. Position Error Testing. The steps which follow check operation of the EPR computer at non-level operating positions to ensure that assembly counterbalancing is correct.

NOTE: Avoid jerky movements and sudden stops of the equipment while performing these tests.

NOTE: The horizontal axis herein mentioned is the axis parallel to a line drawn between the centers of the bulkhead union fittings (225, 235, IPL fig. 4) when the unit is in the normal operating position, resting on the working surface, with the unions (165, 220, IPL fig. 2) and electrical connector J1 (110, IPL fig. 2) pointing downward.

- (1) Place the unit in normal operating position.
- (2) Apply P_{12} and P_{17} pressure inputs for one set of position error check point TEST SET values specified in table 101, and vibrate the unit. Read and record transmitter synchro B1 output on angle position indicator.
- (3) Maintain P_{12} and P_{17} pressure inputs as specified above, and carefully rotate the unit clockwise approximately 45° about the horizontal axis. Vibrate the unit. Read and record transmitter synchro B1 output on the angle position indicator.
- (4) Maintain P_{12} and P_{17} pressure inputs as specified above, and carefully return unit to horizontal position; vibrate the unit. Read and record the transmitter synchro B1 output on the angle position indicator.
- (5) Maintain P_{12} and P_{17} pressure inputs as specified above, and carefully rotate the unit counterclockwise approximately 45° about the horizontal axis. Vibrate the unit. Read and record transmitter synchro B1 output on the angle position indicator.
- (6) Maintain P_{12} and P_{17} pressure inputs as specified above, and carefully return unit to horizontal position; vibrate the unit. Read and record the transmitter synchro B1 output on the angle position indicator.
- (7) Calculate position error as follows:
 - (a) Determine reading differences between steps (2) and (4) and between steps (4) and (6). If either of these differences exceeds 0.950 degree (0.005 EPR), repeat steps (1) through (7) for a maximum of three times. If the unit does not pass by the third trial, mechanical rebalancing of items 5, 65, 160, 448, or 545 of IPL figure 5 is probably required.
 - (b) If the unit has passed step (a) above, determine the reading differences between steps (2) and (3) for clockwise position error and between steps (4) and (5) for counterclockwise error. Position error tolerance must not exceed 0.950 degree (0.005 EPR) in either direction.
- (8) Repeat steps (1) through (7) for the remaining two position error testing TEST SET values indicated in table 101.
- (9) Slowly bleed P_{12} and P_{17} input pressures to ambient level.

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SUPERSEDES PAGE 110(a) DATED 2/19/91.

REVISE PARAGRAPHS 4.F. AND 4.G. AS FOLLOWS:

- F. Mechanical Stop Testing. A mechanical stop (Item 75, IPL Fig. 6) is installed in the pressure ratio transmitter subassembly. The following steps ensure the proper operation of this stop:
- (1) Simultaneously apply a Pt2 and Pt7 input pressure of 28.000 inch Hg absolute.
 - (2) Read the transmitter synchro B1 output on the angle position indicator. Value shall be 236.50 +/- 4.75 degrees (1.00 +/- 0.025 EPR).
 - (3) While monitoring transmitter B1 output on the angle position indicator, slowly reduce Pt7 pressure to 19.600 inch Hg absolute. Output value shall be between 198.4 and 201.9 degrees (0.800 to 0.820 EPR). Note that the transmitter synchro B1 output will stop decreasing when Pt7 reaches approximately 23.0 to 22.4 inch Hg absolute pressure.
 - (4) Slowly bleed the Pt2 and Pt7 inputs to ambient room pressure.
 - (5) Simultaneously apply a Pt2 and Pt7 input pressure of 28.000 inch Hg absolute.
 - (6) Read the transmitter synchro B1 output on the angle position indicator. Value shall be 236.50 +/- 4.75 degrees (1.00 +/- 0.025 EPR).
 - (7) While monitoring transmitter B1 output on the angle position indicator, slowly increase Pt7 pressure to 73.900 inch Hg absolute. Output value shall be between 167.2 and 182.4 degrees (2.530 to 2.610 EPR). Note that the transmitter synchro B1 output value will stop increasing when Pt7 is slightly over 70.8 but still under 73.1 inch Hg absolute pressure.
 - (8) Slowly bleed the Pt2 and Pt7 inputs to ambient room pressure.

Note: If the output specifications of (3) and (7) are not met readjust the mechanical stop (Item 75, IPL Fig. 6) to set the value within the low end values and recheck the high end values.

G. Deleted.

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ENGINEERING	ENGINEER H. BRANCH	<i>J. Branch</i>	DATE	12-10-94	SECTION MANAGER/DESIGNEE	<i>[Signature]</i>	DATE	12/10/94
X	ADVANCE ACTION	MGR PLANNER	SHOP	260-2	PRODUCTION	<i>[Signature]</i>	DATE	12/10/94
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R.O.		MGR PLANNER						

APPENDIX 5