

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

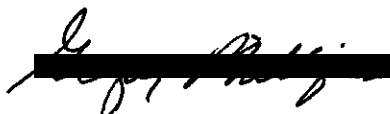
October 30, 1995

Parker Contamination Report-LeBleu
Accident: DCA-94-MA-76

The attached data sheets were provided by Parker to the Systems group following the September 1994 examination of the main rudder power control unit s/n 1596A.

These data sheets detail the results of Millipore membrane filter examinations of hydraulic fluid samples removed from the s/n 1596A PCU. Testing was performed by Norman LeBleu of Parker Hannifin at the request of the Systems group.

These tests were conducted for particle identification only. Particle count testing was performed on fluid samples at a later date as a separate investigative activity.

A handwritten signature in dark ink, appearing to read "Gregory Phillips", is written over a solid black rectangular redaction mark.

Gregory Phillips
National Resource Specialist-Airworthiness Engr.

Contamination Report
By: Norman LeBleu
November 4, 1994

Fluid submitted to the Lab was leftover contaminates that was to be run through Millipore Membrane filters for particle identification only. A particle count was not requested due to the small amount of fluid that was supplied.

The Lab did not witness the actual taking of these samples, but I am certain that the best effort was made to obtain samples in such a manner as to prevent extraneous contamination from entering them.

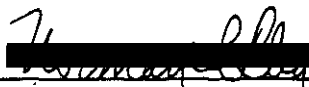
The Lab supplied pre-cleaned 1000 ML glass beakers covered with plastic wrap.

This request was made by Gary West, Manufacturing Engineer, Customer Support Operations.

No other samples were received by the Lab. Particle count was obtained by using BMF5129 and ARP598B.

See attached reports per P/N 65-44861-9, S/N 1596A:

1. System "A" Main Filter
2. System "A" Main Link
3. System "B" Yaw Damper
4. System "B" Main Filter
5. Particle Identification for all systems



Norman LeBleu

enclosures



CONTAMINATION CONTROL DEPARTMENT
LABORATORY REPORT

SAMPLE NO. 4 DATE REC'D 9-23-74 DATE TESTED 9-23-74
SAMPLE OF U.S. AIR SYSTEM U.S. AIR STAND NO. 1596 A
PART NO. 65-44861-9 SERIAL NO. 1596 A
SAMPLE TAKEN BY TIME AM
PARTICLE COUNT PER ml SAMPLE METHOD BME S129
cu. ft.

W/O 7047188-100

MICRON SIZE RANGE	PARTICLE COUNT	MAX. ALLOWABLE	TYPE
5-10 5-15			
10-25 15-25			
25-50			
50-100			
OVER 100			
FIBERS			

INSPECTED BY 7-11-11-11

REMARKS:

- Sys. "A" LINK — contaminated with fines, teflon, rubber, aluminum, plastic fibers and what appears to be anodized aluminum and corrosion products. Unable to identify 3 other particles.
- Sys. "A" MAIN FILTER — Contaminated with rubber, plastic fibers, fines, teflon, fiber metal chips, turcon, teflon and what appears to be corrosion products. Unable to identify 7 other particles.
- Sys. "B" YAW DAMPER — Contaminated with teflon fibers, teflon, rubber, turcon, metal chips and what appears to be crushed glass. Unable to identify 2 other particles.
- Sys. "B" MAIN FILTER — Contaminated with fines, rubber, teflon fibers, aluminum, teflon, turcon, clump of fines and what appears to be corrosion products. Unable to identify 1 other particle.

ACCEPTED BY 7-11-11-11

Source Inspection

SUBMITTED BY 7-11-11-11

Contamination Control Dept.



CONTAMINATION CONTROL DEPARTMENT
LABORATORY REPORT

SAMPLE NO. 1 DATE REC'D 9-23-74 DATE TESTED 9-23-74
SAMPLE OF _____ SYSTEM U.S. AIR STAND NO. _____
PART NO. 65-44861-9 SERIAL NO. 1596A
SAMPLE TAKEN BY _____ TIME ^{AM} _____
PARTICLE COUNT PER _____ ml SAMPLE METHOD BMF 5129
_____ cu. ft.

Sys. "B" MAIN FILTER

RSI 097

W/O 7047188-100

MICRON SIZE RANGE	PARTICLE COUNT	MAX. ALLOWABLE	TYPE
<u>(5-10)</u> 5-15	<u>22,630</u>	<u>128,000</u>	
<u>(10-25)</u> 15-25	<u>4,216</u>	<u>42,000</u>	
25-50/100	<u>5,704</u>	<u>7,500</u>	
50-100			
OVER 100	<u>640</u>	<u>92</u>	
FIBERS	<u>40</u>	<u>15</u>	

INSPECTED BY ~~Norman S. Bell~~

REMARKS:

ACCEPTED BY _____

Source Inspection

SUBMITTED BY ~~Norman S. Bell~~

Contamination Control Dept.



CONTAMINATION CONTROL DEPARTMENT
LABORATORY REPORT

SAMPLE NO. 1 DATE REC'D 9-23-94 DATE TESTED 9-23-94
SAMPLE OF _____ SYSTEM U.S. AIR STAND NO. _____
PART NO. 65-44861-9 SERIAL NO. 1596A
SAMPLE TAKEN BY _____ TIME ^{AM} _____
PARTICLE COUNT PER _____ ml SAMPLE METHOD BME 5129

_____ cu. ft.
Sys. "A" MAIN FILTER

RSI 097

W/O 7047188-100

MICRON SIZE RANGE	PARTICLE COUNT	MAX. ALLOWABLE	TYPE
<u>(5-10)</u> 5-15	<u>18,972</u>	<u>128,000</u>	
<u>(10-25)</u> 15-25	<u>5,766</u>	<u>42,000</u>	
25-50 <u>100</u>	<u>12,260</u>	<u>7,500</u>	
50-100			
OVER 100	<u>520</u>	<u>92</u>	
FIBERS	<u>50</u>	<u>15</u>	

INSPECTED BY [Signature]

REMARKS:

ACCEPTED BY _____

Source Inspection

SUBMITTED BY [Signature]

Contamination Control Dept.

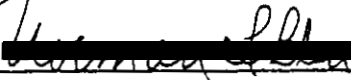


CONTAMINATION CONTROL DEPARTMENT
LABORATORY REPORT

SAMPLE NO. 1 DATE REC'D 9-23-94 DATE TESTED 9-23-94
SAMPLE OF U.S. AIR SYSTEM U.S. AIR STAND NO.
PART NO. 65-44861-9 SERIAL NO. 1596A
SAMPLE TAKEN BY TIME AM
PARTICLE COUNT PER ml SAMPLE METHOD BMF 5129
 cu. ft.

Sys. "A" MAIN LINK RSI 097 W/O 7047188-100

MICRON SIZE RANGE	PARTICLE COUNT	MAX. ALLOWABLE	TYPE
<u>5-10</u> 5-15	<u>41,416</u>	<u>128,000</u>	
<u>10-25</u> 15-25	<u>13,392</u>	<u>42,000</u>	
25-50 <u>100</u>	<u>1,510</u>	<u>7,500</u>	
<u>50-100</u>	<u> </u>	<u> </u>	
OVER 100	<u>81</u>	<u>92</u>	
FIBERS	<u>9</u>	<u>15</u>	

INSPECTED BY 

REMARKS:

ACCEPTED BY Source Inspection

SUBMITTED BY  Contamination Control Dept.

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

October 30, 1995

Main Rudder Power Control Unit S/N 1596A Test Data
Feb 11, 1987 and Sep 21, 29, 30 1992
Accident: DCA-94-MA-76

The attached data sheets were provided by Parker to the Systems group during the September 1994 examination of the main rudder power control unit s/n 1596A.

The 1596A unit was originally tested at manufacture on February 11, 1987. Results of that testing are attached (10 pages).

The 1596A unit was removed from service and tested by Parker on September 21, 29, 30, 1992. Information and data related to that event are attached (14 pages).



Gregory Phillips
National Resource Specialist-Airworthiness Engr.

MAINTENANCE AGREEMENT

☒ YES ☐ NO

3 DAY

ADVANCE NOTIFICATION

☒ YES ☐ NO

REPAIR ORDER # 7049591-100		CUSTOMER NAME USAIR		CUSTOMER CODE 008010		DATE 9, 21, 92		AIRCRAFT 737	
QTY. 1	P/N REC'D PARKER P/N 65-44861-9	CHG. LTR. VNR	SERIAL # 1596A	PART NAME RUDDER		CARD INITIATED BY AL 			
		ASSY QTR. 1087	☐ TSO ☐ TSR ☒ TSN ☐ TT	WARRANTY CLAIM ☐ YES ☒ NO		REP/OHL ESTIMATE REQ'D ☐ YES ☒ NO			
QTY. 1	P/N REC'D PARKER P/N 65-44861-9	CHG. LTR.	SERIAL # 1596A	FINAL INSPECTION REQ'D ☐ GSI ☐ FAA ☐ CUST		DUE DATE 9, 24, 92			
REASON FOR RETURN (REJECTION CODE 9600) ☒ REPAIR ☐ OVERHAUL ☐ TEST/CERT. ☐ OTHER LEAKS. RRP AS NRC IAW MFG SPC IF NOT PRIOR DONE. ACCOMP. BOR S/B 737-22- 1069, 737-27-1127, 1145. RETD AS 65-44861-9 JOHN LINEBACK					INITIAL ACTION REQUIRED ☐ FLUID SAMPLE REQUIRED ☒ SEE M.D.R. ☒ FUNCTIONAL TEST/INSPECT TO CONFIRM REASON FOR RETURN ☐ INVESTIGATION ☐ OTHER TO BE WITNESSED BY ☐ QC ☐ ENG ☐ DCAS ☒ CUSTOMER				
CONDITION AS RECEIVED (INCLUDING LRU'S) OCT 01 1992 ☐ DAMAGED OR BROKEN HARDWARE. REPORTED TO ENGINEERING DIRTY, PORTS WERE COVERED, 4 USALS ARE CSD.					RECEIVING TEST AND/OR INSPECTION RESULTS RECEIVING DIELECTRIC O.K. 9/21/92 <i>Unable To Rec Test Due To Damage At Port End</i>				
59600 5003 S/N C/5532 75130 S/N 33193, N/GM1032 S/N 15928 CONDITION REPORT COMPLETED INSPECTED BY  STAMP DATE 9-21-92					SEE CONTINUATION SHEET FOR ADDITIONAL RESULTS TEST / INSPECTION BY  DATE 9/22/92 WITNESSED BY QC _____ DATE _____ DCAS _____ DATE _____ ENG _____ DATE _____ CUST _____ DATE _____				
CFE AS RECEIVED									

55155 12289
PU-4

USAir

MATERIAL SERVICES

MATERIAL SERVICES DEPARTMENT
GREATER PITTSBURGH INT'L AIRPORT
USAIR BUILDING #4, PIT/K130
PITTSBURGH, PA 15231
(412) 747-3116

RETURN MATERIAL TO

REPAIR
SHIPPING RELEASE

USAIR, INC.
STORES/RECEIVING
HANGAR #6 - Q105
GREATER PITTSBURGH INT'L AIRPORT
PITTSBURGH, PA 15231

DOCUMENTATION REQUIREMENT
REFER TO STANDARD CONDITIONS ON REVERSE SIDE

PENNSYLVANIA SALES AND USE
TAX NUMBER 99-04364-2
FEDERAL I.D. NUMBER 53-0218143

ISSUED TO
PARKER HANNIFIN CORPORATION
CUSTOMER SUPPORT OPERATIONS
16666 VON KARMAN AVENUE

IRVINE, CA 92714-4917

MATERIAL SHIPPED TO

FAX 714-660-8390

CASH TERMS		FOB POINT		VENDOR/FSC		SUBJECT TO TERMS AND CONDITIONS ON BACK HEREOF WHICH ARE INCORPORATED AND MADE A PART HEREOF.		ORDER DATE	SPECIFIED NEED DATE	USAIR ORDER NUMBER	
2X15/N30		DEST.		RR315				09/17/92	09/27/92	0032754-44S	
QUANTITY	UNIT	TAG NO.		VENDOR PART NUMBER			DESCRIPTION				
1	EA	G92094		65-44861-9			UNIT RUDDER POWER CONTROL				
MFG. SERIAL NUMBER		USAIR S/N		DATE INSTLD.	OFF A/C NO.	DATE REMOVED	TSLR	TSO	TSN		
1596A				05/11/87	349	09/08/92			15912		
ORIG. A/C OR P.O.		DATE ORIG. RCVD.		LAST RPO		REASON FOR REMOVAL (SEE DECODING ON REVERSE SIDE)		CODE 25	DISPOSITION INSTRUCTIONS (SEE DECODING ON REVERSE SIDE)		
									SPL		
UNIT PRICE SHALL NOT EXCEED WITHOUT PRIOR AUTHORIZATION				\$ 14000.000				SHOW USAIR ORDER NUMBER ON ALL INVOICES, PACKING LISTS, SHIPPING LABELS, AND BILLS OF LADING.			
SPECIAL INSTRUCTIONS				SHIPPING METHOD				ALL MATERIAL SUBJECT TO USAIR INSPECTION			
REP AS NEC IAW MFG SPC IF NOT PREV DONE ACCMP ROE SB 737-22-1069; 737-27-1127, -1145; REID AS 65-44861-9. CERT-RTN W/CRTF. LEAKS. OBF3=SHIP 2ND DAY AIR.				AIR FREIGHT-SECOND DAY/COLLECT. SELECT CARRIER PER USAIR SHIPPING INSTRUCTIONS IN YOUR POSSESSION.				ACKNOWLEDGE CHANGES ONLY AT ONCE USING ATTACHED COPY			
				USAIR, INC. BUYER MARTIN C. MAVRICH				INVOICE IN DUPLICATE TO USAIR, ATTN: ACCOUNTS PAYABLE DEPT., CRYSTAL PARK FOUR, 234S CRYSTAL DRIVE, ARLINGTON, VA. 22227, UNLESS OTHERWISE NOTED.			
				AUTHORIZED SIGNATURE:							

PACKING LIST

SEP 11 1992

VSR 2 VENDOR HOLD

VENDOR SERVICES (SIGNATURE) REQUIRED		DATE		VENDOR SERVICES COPY		REPO BIN LOC. N/A	
INSTLD. USAIR STOCK *		INSTLD S/N		PART NAME		REC CODE	
0032754		01395A		UNIT		86	
UNSERVICEABLE COMPONENT						USAir	
MFG. PART * (USE FULL P/N)		USAIR STOCK *		S.O.S. MACH *		UNSERVICEABLE SERIAL *	
65-44861-9		32754		☐ Y ☐ N		1596A	
W.O. #/P.O. *		REASON		A/C * - NHA		POSITION	
		02		349		BOS	
						SHIP STATION	
						EMP *	
						62829	
MFG S/N (USE FULL S/N)		UNSERVICEABLE DUE TO:		DATE UNSERVICEABLE		MO DAY YEAR	
1596A		Leaks!					
USAIR SERIAL NO.							
AL							
REP. VENDOR		DATE ORIG. RCVD.		LAST RPO		TSR	
ORIG. A/C OR P.O.		DATE INSTLD.		TSO ☐ TSN ☐		WARRANTY	
						☐ YES ☐ NO	



692094

TEST INSPECTION CARD



DATE 9/30/92 F.T. 2049591-100

ASSEMBLY NO 65-41861-9
SERIAL NO. 15964

8 HR. DUTY CYCLE @ 3000 P.S.I.

28 HR. STATIC TEST @ 45 TO 55 P.S.I.

START TIME Q.C. APPROVAL 3:00

START TIME Q.C. APPROVAL 8:30

	LEAKAGE	CSO	REJ	NO LEAKAGE ALLOWED	CSO	REJ
EYE END OF CYL.	0	35		EYE END OF CYL. <i>None</i>	35	
AFT END OF CYL.	0	35		AFT END OF CYL. <i>None</i>	35	
CENTER VENT	0	35		CENTER VENT <i>None</i>	35	
INPUT SHAFT	0	35		INPUT SHAFT <i>None</i>	35	
OTHER				OTHER		
OTHER						

DEAD WEIGHT CARD

FROM EXTEND TO RETRACT	FROM RETRACT TO EXTEND
SNUB LBS.	SNUB LBS.
MID LBS.	MID LBS.
SNUB LBS.	SNUB LBS.



TEST DATA RECORD

Customer Support Operations

Rev. EDrawn J.H. KuegelDate 5/22/89Test Approval [Signature]Date 5/22/89Eng. Approval [Signature]Date 5/19/89Date 5/14/89Overhaul Manual 27-20-01☐ Overhaul☒ In-Service

Work Order

704 9591-100PART NO. 65-44861-9 SERIAL NO. 1576A DATE OF TEST SEP 29 '92PART NAME RUDDER ACTUATOR PCUINSPECTOR [Signature]☒ PHOSPHATE ESTER☐ MIL-H-5606☐ MIL-H-83282☐ AIR☐ PD680

TEST & REF.	REQUIREMENT	RESULTS	ACC	REJ.																				
11.A. Continuity Check	Check Continuity per wiring diagram (Fig. 403, Fig. 403A)	No Rewire Done OK																						
11.B. Pin to Pin Resistance	Check pin to pin resistance at 70°F and record. Must comply with noted valve. <table border="1"><thead><tr><th>Pins</th><th>Resistance</th></tr></thead><tbody><tr><td>1-2</td><td>71-87 OHMS (Solenoid PN 59600)</td></tr><tr><td>1-2</td><td>49-62 OHMS (Solenoid PN 45080 @ 77°F)</td></tr><tr><td>1-2</td><td>79-115 OHMS (Solenoid PN 45080-1 @ 77°F)</td></tr><tr><td>5-6</td><td>900-1100 OHMS</td></tr><tr><td>7-8</td><td>900-1100 OHMS</td></tr><tr><td>1-4</td><td>0 OHMS (Short)</td></tr><tr><td>9-10</td><td>80-165 OHMS</td></tr><tr><td>11-12</td><td>60-135 OHMS</td></tr><tr><td>3-Other</td><td>Infinite (No Connection)</td></tr></tbody></table>	Pins	Resistance	1-2	71-87 OHMS (Solenoid PN 59600)	1-2	49-62 OHMS (Solenoid PN 45080 @ 77°F)	1-2	79-115 OHMS (Solenoid PN 45080-1 @ 77°F)	5-6	900-1100 OHMS	7-8	900-1100 OHMS	1-4	0 OHMS (Short)	9-10	80-165 OHMS	11-12	60-135 OHMS	3-Other	Infinite (No Connection)	(-5, -6 & -7. 1 system only) Sys "A" Sys "B" 77 1004 1004 0 104 93 =		
Pins	Resistance																							
1-2	71-87 OHMS (Solenoid PN 59600)																							
1-2	49-62 OHMS (Solenoid PN 45080 @ 77°F)																							
1-2	79-115 OHMS (Solenoid PN 45080-1 @ 77°F)																							
5-6	900-1100 OHMS																							
7-8	900-1100 OHMS																							
1-4	0 OHMS (Short)																							
9-10	80-165 OHMS																							
11-12	60-135 OHMS																							
3-Other	Infinite (No Connection)																							
11.C. Dielectric Strength	Slowly apply noted voltages and hold for a period of 5 seconds (Fig. 403), 1 min (Fig. 403A). There must be no arcing or insulation failure. 1500 VAC Body to Pin 2 (Fig. 403) 1000 VAC Body and Pins 2,5,7 connected to common lead to Pin 9 (Fig. 403) 1000 VAC Body and Pins 2,5,7 connected to common lead to Pin 11 (Fig. 403) 1500 VAC Body to Pin 1 (Fig. 403A)	(-5 Thru -9 Fig. 403A only) ✓ OK ✓ OK ✓ OK ✓ OK																						

FINAL TEST



TEST DATA RECORD (CONTINUATION)

Customer Support Operations

Rev. EOverhaul Manual 27-20-01☐ Overhaul☒ In-ServiceWork Order 7049591-100PART NO. 65-44861-9 SERIAL NO. 1596A DATE OF TEST SEP 29 '92PART NAME RUDDER ACTUATOR PCU INSPECTOR [Signature]☒ PHOSPHATE ESTER ☐ MIL-H-5606 ☐ MIL-H-83282 ☐ AIR ☐ PD680

TEST & REF.	REQUIREMENT	RESULTS	ACC	REJ.
11.C. Dielectric Strength (Continued)	1000 VAC Body and Pins 1,5,7 connected to common lead to Pin 11. 1000 VAC Body and Pins 1,5,7 connected to common lead to Pin 9 800 VAC between Pins 5 and 7 800 VAC between Pins 9 and 11 (Fig. 403A)	<u>✓</u> OK <u>✓</u> OK <u>✓</u> OK <u>✓</u> OK		
11.D. Insulation Resistance	500 VDC between noted pins 100 Megohms min resistance 10 megohms min in-service. (Fig. 403) <u>Pins</u> 1,5,7,9 & 11 to Body 1 to 5,7,9 & 11 5 to 7,9, & 11 7 to 9 & 11 9 to 11	(-5 Thru -9 1 system only). Sys "A" Sys "B" <u>> 10</u> <u>> 10</u> <u>> 10</u> <u>> 10</u>		
12.B. Proof Pressure	No external leakage or permanent set, each test. No intersystem leakage.	5400 3 ± 2 Sys A <u>None</u> <u>None</u> Sys B <u>None</u> <u>None</u>		
12.C. Return Proof	No external leakage or permanent set, each test. No intersystem leakage. FINAL TEST	3000 3 ± 2 Sys A <u>None</u> <u>None</u> Sys B <u>None</u> <u>None</u>		



TEST DATA RECORD (CONTINUATION)

Customer Support Operations

Rev. EOverhaul Manual 27-20-01☐ Overhaul☒ In-ServiceWork Order 704 9591-100PART NO. 65-44861-7 SERIAL NO. 1576A DATE OF TEST SEP 29 '92PART NAME RUDDER ACTUATOR PCU INSPECTOR L☒ PHOSPHATE ESTER☐ MIL-H-5606☐ MIL-H-83282☐ AIR☐ PD680

TEST & REF.	REQUIREMENT	RESULTS	ACC	REJ.
12.D. Rig Neutral Cylinder Stroke and Clearance Test	Output Rig Pin must fit. (27.46 - 27.54 Ref.)	Rig Pin <u>G.K.</u> Surface Indicator at 0° <u>G.K.</u>		
	No binding or interference at 3000 PSI. Stroke 26° ± 1/2° each direction. Visual snubbing.	Binding Yes No Ext. <u>26</u> ° Ret. <u>25.5</u> ° Snubbing <u>✓</u> OK		
	No binding or interference at 0 PSI.	<u>✓</u> OK		
12.E. Linkage Breakout Friction	19 oz. maximum to start extend. 1 oz. minimum in extend direction to start retract.	Ext. <u>15</u> Oz. Ret. <u>2</u> Oz.		
12.F. Input Force vs. Input Travel	Force plot must fall within limits shown on Fig. 723.	<u>✓</u> OK		
12.G. Cylinder Rod Leakage	1 drop/25 cycles max at each End Gland (In-Service 1 drop/5 cycles) 2 drops/25 cycles max at Center Gland (In-Service 2 drops/5 cycles) 1 drop/100 cycles max at Input Shaft (In-Service 1 drop/25 cycles)	Rod End <u>6</u> drops Aft End <u>6</u> drops Center <u>6</u> drops Input Shaft <u>6</u> drops		
12.H. Internal Leakage	(1) Rig neutral leakage at RA & RB 300 cc/min overhaul 3000 cc/min In-Service.	Neutral RA RB <u>200</u> <u>200</u>		



TEST DATA RECORD (CONTINUATION)

Customer Support Operations

Rev. EOverhaul Manual 27-20-01☐ Overhaul☒ In-ServiceWork Order 704 9591-100PART NO. 65-44861-9 SERIAL NO. 1596A DATE OF TEST SEP 29 '92PART NAME RUDDER ACTUATOR PCU INSPECTOR LM☒ PHOSPHATE ESTER ☐ MIL-H-5606 ☐ MIL-H-83282 ☐ AIR ☐ PD680

TEST & REF.	REQUIREMENT	RESULTS	ACC	REJ.
12.H. Internal Leakage (Continued)	(2) Input lever at extend & retract stops 300-700 cc/min - overhaul. 300-1085 cc/min - In-Service.	RA RB Ext. <u>450</u> <u>470</u> Ret. <u>450</u> <u>420</u>		
	(3) (For -2,-3,-4 only) System A energized 1370 cc/min - overhaul 2000 cc/min above leakage measured in step (1) (b) In-Service	Neutral RA RB 		
	(4) (For -2,-3,-4 only) System A energized 1370 cc/min - overhaul 2000 cc/min above leakage measured in step (2) (b) In-Service	RA RB Ext. _____ Ret. 		
	(5) (For -2,-3,-4 only) System B energized 1370 cc/min - overhaul. 2000 cc/min above leakage measured in step (1) (b) In-Service (For -5 Thru -9 Only) 300 cc/min @ RA 1370 cc/min @ RB 3000 cc/min @ RA & 2000 cc/min above leakage in step (1) (b) at port RB In-Service.	RA RB Neutral  RA RB Neutral <u>200</u> <u>700</u>		
	(6) (For -2,-3,-4 only) 1370 cc/min 2000 cc/min above leakage measured in step (1) (b) for unit In-Service	RA RB Extend _____ Retract 		
FINAL TEST				



TEST DATA RECORD (CONTINUATION)

Customer Support Operations

Rev. EOverhaul Manual 27-20-01☐ Overhaul ☒ In-ServiceWork Order 704 9591-100

PART NO.	<u>65-44861 -9</u>	SERIAL NO.	<u>1596A</u>	DATE OF TEST	<u>SEP 29 '98</u>
PART NAME	<u>RUDDER ACTUATOR PCU</u>		INSPECTOR <u>6</u>		
☒ PHOSPHATE ESTER ☐ MIL-H-5606 ☐ MIL-H-83282 ☐ AIR ☐ PD680					
TEST & REF.	REQUIREMENT	RESULTS	ACC	REJ.	
12.H. (6) Internal Leakage (Continued)	(For -5 Thru -9 Only) : 300 cc/min. max @ RA 1370 cc/min @ RB 300-1085 cc/min @ RA 2000 cc/min above leakage measured in step (2) (b) @ RB for In-Service	RA RB Ext <u>210</u> <u>700</u> Ret <u>205</u> <u>820</u>			
12.J. Intersystem Leakage	Combined leakage from PB and RB 10 cc/min maximum.	<u>6</u> cc/min			
12.K. Transducer Output	4.2 - 4.8 VAC (-2, sys A & B) 1.95 - 2.55 VAC (-3 & -4 sys A & B) 1.95 - 2.55 VAC (-5, -8 Sys B) 3.07 - 3.67 VAC (-6, -7, -9 Sys B)	"A" Extend VAC Retract VAC "B" Extend <u>3.60</u> VAC Retract <u>3.55</u> VAC			
12.L. Transducer Null	50 MV maximum at null for each system. 150 MV maximum at null for each system In-Service (-5 Thru -9, 1 system only)	"A" Null VAC "B" Null <u>020</u> VAC			
12.M. Yaw Damper Authority	STROKE: Each direction for individual systems; (-5 Thru -9, Sys B only) (-2) .314 ± .020" - overhaul. .314 ± .040" - In-Service. (-3, -4, -5, -8) .157" ± .020" - overhaul .157" ± .040" - In-Service (-6, -7, -9) .236 ± .020" - overhaul .236 ± .040" - In-Service. (-2) .355" ± .020" .355" ± .040" In-Service (-3, -4) .314" ± .020" .314" ± .040" In-Service Actuator must be stable and within .050" of neutral.	Sys "A" Ext. Ret. Sys "B" <u>.237</u> / <u>.238</u> Sys "A & B" Stable YES NO Position from "ZERO" Ext. Ret. Stable YES NO Position from "ZERO" Ext. Ret.			



TEST DATA RECORD (CONTINUATION)

Customer Support Operations

Rev. E

Overhaul Manual 22-20-01

☐ Overhaul

☒ In-Service

Work Order 704 9591 - 100

PART NO. 65-44861-9 SERIAL NO. 1576A DATE OF TEST SEP 29 '82

PART NAME RUDDER ACTUATOR PCU INSPECTOR h

☒ PHOSPHATE ESTER ☐ MIL-H-5606 ☐ MIL-H-83282 ☐ AIR ☐ PD680

TEST & REF.	REQUIREMENT	RESULTS	ACC	REJ.
12.N. Manual Hysteresis 4.3.14	Hysteresis shall not exceed .004 inch each direction. .006 inch each direction In-Service	Extend <u>.001</u> Inch Retract <u>.001</u> Inch	CSO 21 ATT	
12.P. Yaw Damper System Phase Lag	Phase shift to be 25° maximum. Sin 0 to be .423 maximum or 30° Sin 0 to be .500 for In-Service For each system. No crossovers in plots (-5 Thru -9, 1 Sys Only)	"A" sin 0 <u>EXPLAIN</u> "B" sin 0 <u>.263</u> Crossovers: YES <u>NO</u>	CSO 21 ATT	
12.Q. Yaw Damper System Repeatability and Linearity	Pattern must repeat within 0.8" (.008" at actuator) 1.2" (.012" at actuator) In-Service Overshoot at reversal must be 0.2" maximum (.002" at actuator) Slope of each 10% segment must fall within the indicated minimum and maximum limits. (-5 Thru -9, 1 Sys Only).	"A" <u>in max</u> "B" <u>.002</u> in max "A" <u>in max</u> "B" <u>.0015</u> in max. "A" YES NO "B" YES NO	CSO 21 ATT	
12.R. Phase Check	Manual control "retract", actuator must retract. Manual control "extend", actuator must extend. Operation smooth and stable for A and B.	RETRACT "A" <u>O.K.</u> "B" <u>O.K.</u> EXTEND "A" <u>O.K.</u> "B" <u>O.K.</u> STABLE: YES NO	CSO 21 ATT	

FINAL TEST



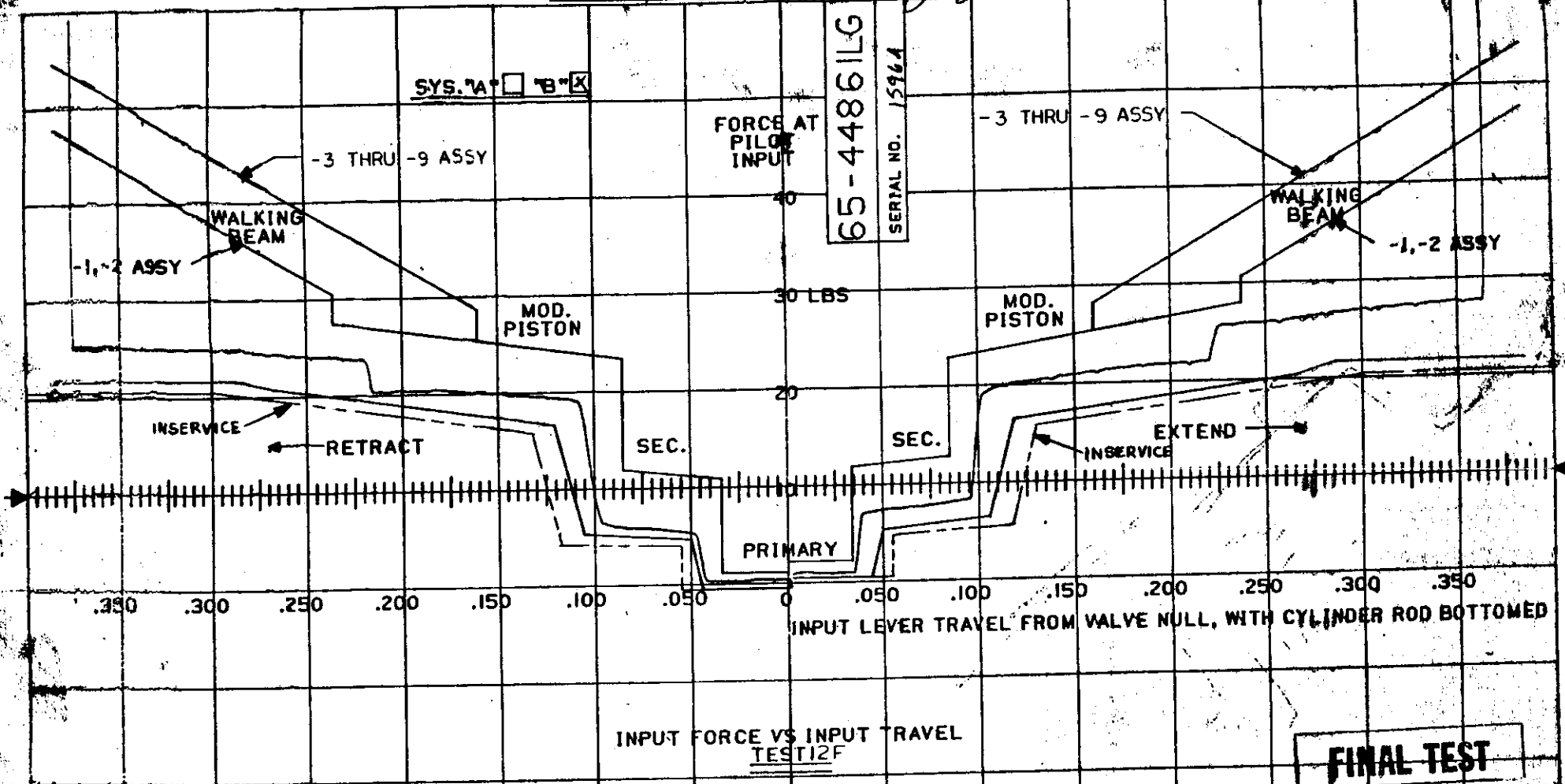
TEST DATA RECORD (CONTINUATION)

Customer Support Operations

Rev. EOverhaul Manual 27-20-01☐ Overhaul☒ In-ServiceWork Order 749591-100PART NO. 65-44861-7 SERIAL NO. 1596A DATE OF TEST SEP 29 '92PART NAME RUDDER ACTUATOR PCU INSPECTOR L☒ PHOSPHATE ESTER ☐ MIL-H-5606 ☐ MIL-H-83282 ☐ AIR ☐ PD680

TEST & REF.	REQUIREMENT	RESULTS	ACC	REJ.
12.S. Yaw Damper Engage 4.3.17	(-5 Thru -9, 1 Sys Only) .004" maximum movement-overhaul .010" maximum movement-In-Service.	"A" <u>0.002</u> in "B" <u>0.002</u> in	GSO 21 ATT	
12.T. By-Pass Valve Operation	No piston movement at 250 PSI for either system. Noticeable decrease in flow at less than 460 PSI. Piston rod movement of 1.00 inch or more in either direction.	"A" YES <u>NO</u> "B" YES <u>NO</u> "A" <u>355</u> PSI "B" <u>355</u> PSI Ext. <u>✓</u> OK Ret. <u>✓</u> OK	GSO 21 ATT	
12.U. Duty Cycle (optional) Not Required for In-Service Unless Actuator Seals Were Replaced	3.0 cc/8 hours maximum at End Glands - Overhaul. 1.8 cc/hr In-Service 6.0 cc/8 hours at Center Gland-O/H 3.6 cc/hr In-Service	Output End <u>0</u> cc/8 hrs Fixed End <u>0</u> cc/8 hrs Center <u>0</u> cc/8 hrs	GSO 35 ATT	
12.V. Low Pressure Leakage (not same as 12.U)	No external leakage in 8 hours.-O/H. No external leaks in one hour In-Service. FINAL TEST	<u>None</u>	GSO 35 ATT	

DRAWN: *W. M. D. 10-5-57* APPR: *W. M. D. 10-5-57* TEST APPR: *W. M. D. 10-5-57*



FINAL TEST

PAGE 8 OF 10 ACCEPTANCE TEST DATA SHEETS

DATE TESTED: 9/30/52	SIZE B	BERTEA/COOPER
INSP: Thomas	FSCM NO. 82106	65-44861LG (1)
704 9591-100	PART NO. 65-44861-9	PROJECT 737
A DASH NO.		PAGE 243

OHM 27-20-01

DRAWN: 7/1/80

DATE: 10-2-80 ENG. APPR: [Signature]

DATE: 10-2-80

TEST APPR: [Signature]

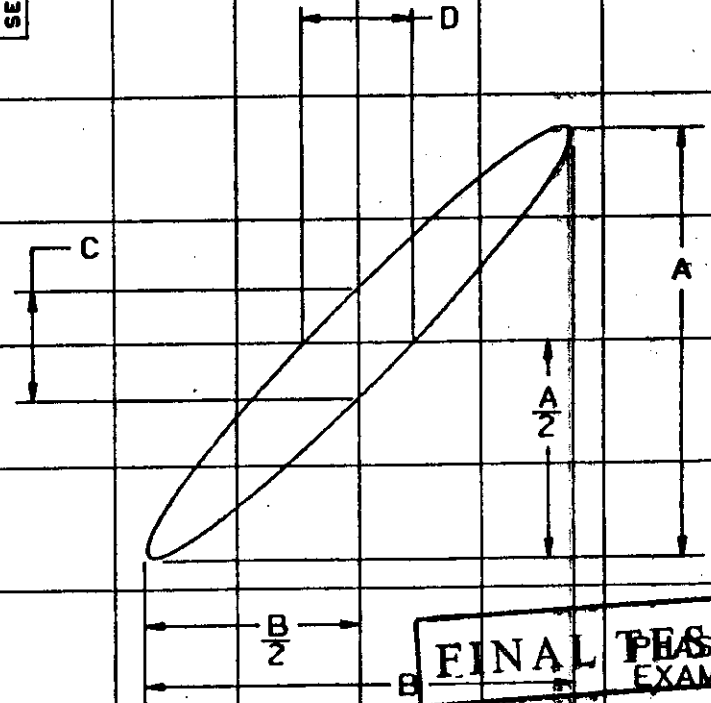
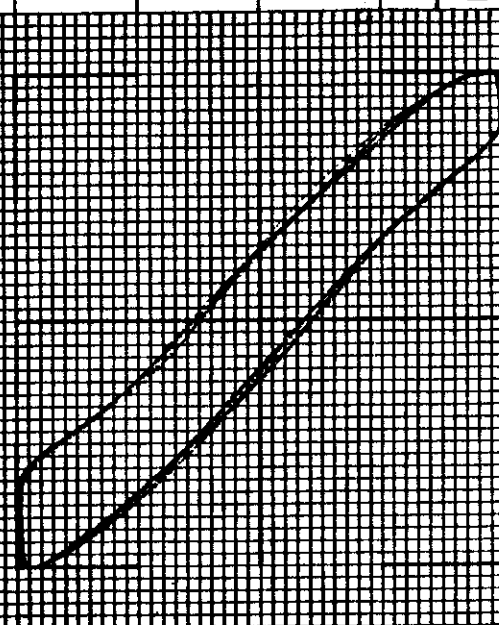
DATE: 10-2-80

SINE Ø MAXIMUM PER TEST REQ'T .423 OVERHAUL .500 IN SERVICE

65-44861LG

SERIAL NO. 15961

$2 \frac{C}{A + \frac{D}{B}} = \text{SINE } \phi$
CALCULATION



SYS A

TEST 12P

SYS B

PHASE LAG

SINE Ø



SINE Ø .262



(-5 ASSY, 1 SYSTEM ONLY)

PAGE 9 OF 10 ACCEPTANCE TEST DATA SHEETS

DATE TESTED: 9/30/82

SIZE B

BERTEA CORPORATION

INSP: Thomas

35

FSCM NO. 82106

65-44861LG (2) F

2049591-100

PART NO. & DASH NO. 65-44861-9

PROJECT 737

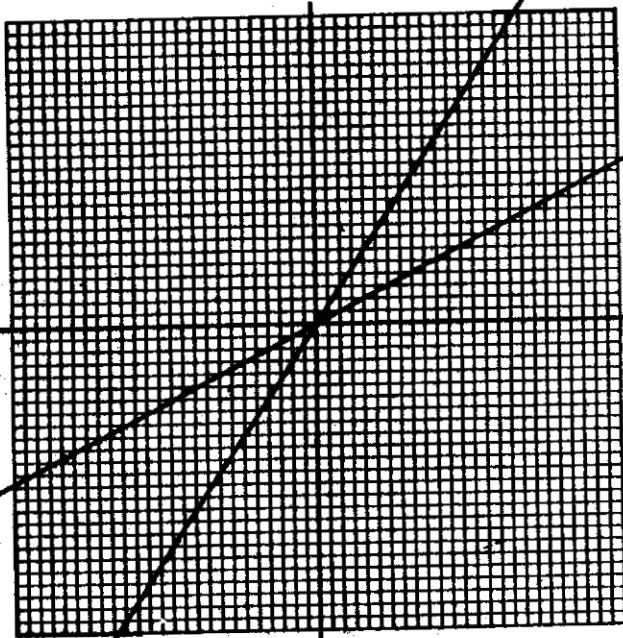
PAGE 750

OHM 27-20-01

DRAWN: 78 m... DATE: 10-2-82 APPR: ... DATE: 10-2-82 TEST APPR: E. Cogan 10-2-82

65-4486ILG

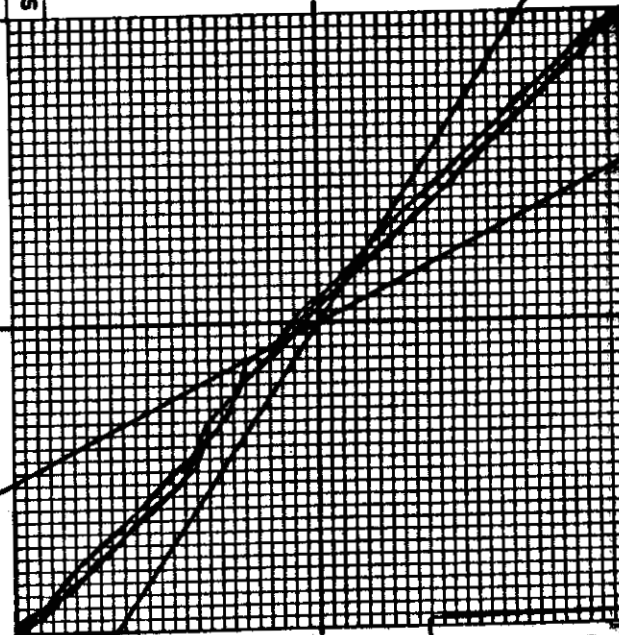
SERIAL NO. 1596A



SYSTEM A



TEST 12Q
REPEATABILITY AND LINEARITY
(-5 ASSY, 1 SYSTEM ONLY)



SYSTEM B

FINAL TEST



PAGE 10 OF 10 ACCEPTANCE TEST DATA SHEETS

DATE TESTED: 9/30/82	SIZE B	BERTEA CORPORATION DIVISION - CALIFORNIA	
INSP: Thomas	FSCM NO. 82106	65-4486ILG (3)	REV E
PART NO. & DASH NO. 65-44861-9	PROJECT 737		PAGE 751

OHM 27-20-01

BERTER

DATE 3-12-55
DATE

ITEM NO.	TEST	TESTING INSTRUMENTS	POSITIVE	NEGATIVE	TEST
1	INTERNAL LEAKAGE 4.3.9	ELECT. POWER "OUT"; NEUTRAL: 300 CC/MIN MAX. EXT & RETR: 300/700 CC/MIN.	NEUT. 100 100 EXT'D 100 100 EXT'R 300 700		
		SYSTEM "A" ON NEUTRAL: RA 1370 CC/MIN MAX. RB 300 CC/MIN MAX.	NEUT. N/A N/A EXT'D N/A N/A EXT'R N/A N/A	(F) 128	
		Y.D. EXT & RETR: RA 1370 CC/MIN MAX. RB 300 CC/MIN MAX.			
		SYSTEM "B" ON (-5, -6, -7) 1 SYSTEM ONLY NEUTRAL: RA 300 CC/MIN MAX. RB 1370 CC/MIN MAX.	NEUT. 175 650 EXT'D 180 650 EXT'R 180 700		
		Y.D. EXT & RETR: RA 300 CC/MIN MAX. RB 1370 CC/MIN MAX.			
8	INTERSYSTEM LEAKAGE 4.3.10	COMBINED LEAKAGE AT PB & KB 10 CC/MIN MAX. (NOT CORRECTABLE)	.0 CC/MIN	(F) 128	
9	TRANSDUCER OUTPUT 4.3.12	(-1 & -2) 4.50 ± .3 VAC EACH SYSTEM, EACH DIRECTION. (-3, -4, -5) 2.25 ± .3 VAC EACH SYSTEM, EACH DIRECTION. (-5, 1 SYSTEM ONLY) (-6, -7) 3.375 ± .3 VAC EACH DIRECTION (1 SYSTEM ONLY)	"A" EXTEND N/A VAC "A" RETRACT N/A VAC "B" EXTEND 3.557 VAC "B" RETRACT 3.482 VAC	(F) 128	
10	TRANSDUCER NULL 4.3.12	50 MV MAX. AT NULL FOR EACH SYSTEM.	"A" NULL N/A MV "B" NULL 12.5 MV	(F) 128	
11	STABILITY AUGMENTATION SYSTEM AUTHORITY 4.3.13	STROKE: EACH DIRECTION, FOR INDIVIDUAL SYSTEMS: (-5, -6, -7) 1 SYS. ONLY (-1, -2) .314 ± .020" (-3, -4, -5) .157 ± .020" (-6, -7) .236 ± .020" FOR COMBINED SYSTEMS: (-5, -6, -7, N/A) (-1, -2) .315 ± .020" (-3, -4) .314 ± .020" ACTUATOR MUST BE STABLE AND WITHIN .050" OF NEUTRAL.	EXTD RETR SYS "A" N/A N/A SYS "B" .236 .236 SYS "C" N/A N/A STABLE: YES NO POSITION Y/N N/A STABLE: YES NO POSITION Y/N N/A	(F) 128	
12	HANDAL HYSTERESIS 4.3.14	HYSTERESIS SHALL NOT EXCEED .004 IN. EACH DIRECTION	EXTEND .004 INCH RETRACT .004 INCH	(F) 128	

19844-59 820 20.23 65-44861-T AE

TEST	DESCRIPTION	RESULTS	128	129
1 PROOF PRESSURE 4.3.4	NO EXTERNAL LEAKAGE OR PERMANENT SET, EACH TEST. NO BREAK THROUGH OF SYSTEMS. ("BREAK THROUGH" IS INDICATED BY LEAKAGE IN EXCESS OF 400 CC/MIN. FROM THE OPEN PORTS.)	SYS. A 3400 1 ± 2 EXT'D NONE NONE RET'D NONE NONE SYS. B 3400 1 ± 2 EXT'D NONE NONE RET'D NONE NONE SYS. C YES ☒ NO ☐	(128)	
2 RETURN PROOF 4.3.4	NO EXTERNAL LEAKAGE OR PERMANENT SET, EACH TEST. NO BREAK THROUGH OF SYSTEMS.	SYS. A 3600 1 ± 2 EXT'D NONE NONE RET'D NONE NONE SYS. B 3600 1 ± 2 EXT'D NONE NONE RET'D NONE NONE SYS. C YES ☒ NO ☐	(128)	
3 RIG NEUTRAL, CYLINDER STROKE AND CLEARANCE CHECK 4.3.5	-22 OUTPUT RIG PIN MUST FIT.	RIG PIN GO ☒ NO GO ☐		
	NO BINDING OR INTERFERENCE @ 3000 PSI. STROKE 26" ± 1/2" EACH DIRECTION.	BINDING YES ☐ NO ☒	(128)	
	NO BINDING OR INTERFERENCE @ 0 PSI.	BINDING YES ☐ NO ☒		
	PRIMARY: 19 OZ. MAX. TO START EXTEND 1 OZ. MIN. IN EXTEND DIRECTION TO START RETRACT	EXTEND @ 14 OZ. RETRACT @ 6.0 OZ.	(128)	
	SECONDARY: EXTEND - 13 LBS. MAXIMUM RETRACT - 12 LBS. MAXIMUM	EXTEND @ 10.0 LBS. RETRACT @ 2.5 LBS.	(128)	
4 LINEAGE BREAKOUT FRICTION 4.3.6	19 OZ. MAX. TO START EXTEND 1 OZ. MIN. IN EXTEND DIRECTION TO START RETRACT	EXTEND @ 14 OZ. RETRACT @ 5.0 OZ. EXTEND	(128)	
5 INPUT FORCE VS. INPUT TRAVEL 4.1.7	FORCE PLOTS MUST FALL WITHIN LIMITS SHOWN ON PAGE 24.	OK	(128)	
6 CYLINDER END LEAKAGE 4.3.6	1 DROP/25 CYCLES MAX. AT EACH END GLAND 2 DROPS/25 CYCLES MAX. AT EACH CENTER GLAND 1 DROP/100 CYCLES MAX. AT EACH INPUT AND SHAFT SEAL	OUTSIDE END 0 DROPS FIXED END 0 DROPS INPUT SHAFT 0 DROPS CENTER 0 DROPS	(128)	

65-44861-59
 REF. BOEING SPEC: 65-44861, SHEET 3.
 PG. 22 OF 28
 65-44861

ENTER

65-44861-1

65-44861-1

65-44861-1

65-44861-1

TEST NO.	SERIAL NO.	VALVE NO.	DATE
65-44861-1	15740	1005	8-2-11
TEST NAME	TESTER		
65-44861-1	Robinson		
TEST	REQUIREMENTS	RESULTS	TESTER
11 DELETED			
14 PHASE LAG YAW DAMPER SYSTEM 4.3.16	PHASE SHIFT TO BE 250 MAX. OR 610 S TO BE 410 MAX. FOR EACH SYSTEM. NO CROSSOVERS IN FLOW (-5, -6 & -7, 1 SYSTEM ONLY)	"A" SIN 8 <u>N/R</u> "B" SIN 8 <u>419</u> CROSSOVERS: YES ☐ NO ☒	(128)
15 REPEATABILITY AND LINEARITY 4.3.15	PATTERN MUST REPEAT WITHIN 0.8" (.008" AT ACTUATOR) OVERSHOOT AT REVERSAL MUST BE 0.2" MAX (.002" AT ACTUATOR) SLOPE OF EACH 10% SEGMENT MUST FALL WITHIN THE INDICATED MINIMUM AND MAXIMUM LIMITS. (-5, -6 & -7, 1 SYSTEM ONLY)	"A" <u>N/R</u> IN. MAX. "B" <u>1250</u> IN. MAX. "A" <u>N/R</u> IN. MAX. "B" <u>1250</u> IN. MAX. "A" YES <u>N/R</u> NO ☐ "B" YES ☒ NO ☐	(128)
16 PHASE CHECK	MANUAL CONTROL "RETRACT", ACTUATOR MUST RETRACT. MANUAL CONTROL "EXTEND", ACTUATOR MUST EXTEND. OPERATION SMOOTH AND STABLE.	"RETRACT" "A" <u>OK</u> "B" <u>OK</u> "EXTEND" "A" <u>OK</u> "B" <u>OK</u> STABLE: YES ☒ NO ☐	(128)
17 YAW DAMPER ENGAGE 4.3.17	.004" MAX. ACTUATOR MOVEMENT, (-5, -6 & -7, 1 SYSTEM ONLY)	"A" <u>N/R</u> IN. "B" <u>001</u> IN.	(128)
18 BYPASS VALVE OPERATION	NO OUTPUT MOVEMENT AT 250 PSI. NOTICEABLE DECREASE IN FLOW AT LESS THAN 450 PSI. MANUAL MOVEMENT OF ACTUATOR OUTPUT INDICATES BYPASS OPEN.	"A" ☒ YES NO ☐ "B" ☒ YES NO ☐ "A" <u>390</u> PSI "B" <u>400</u> PSI EXT (OK) ☒ RETR (OK) ☒	(128)
19 DUTY CYCLE	3.0 CC/8 HRS MAX. AT END GLANDS, AT EACH END GLAND 6.0 CC/8 HOURS AT CENTER GLAND 15.0 DROPS/8 HOURS AT INPUT SHAFT SEAL	OUTPUT END <u>0</u> CC/8 HRS FIXED END <u>0</u> CC/8 HRS CENTER <u>0</u> CC/8 HRS INPUT END <u>0</u> DROPS/8 HOURS	(128)

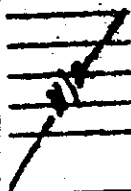
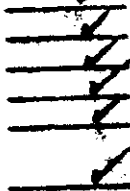
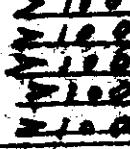
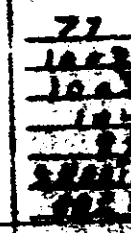
65-44861-1

pg. 24 of 28

65-44861-1

AE

BEPTER

PART NO.		QPL NO.		DATE																	
65-44861-1		1005		10-17																	
TEST		TEST		TEST																	
20 LOW PRESSURE LEAKAGE		NO EXTERNAL LEAKAGE IN 1 HOUR		✓																	
21 FLASKING		FLASK AND FILL WITH PINS 1-11 FLUID, CAP BODY AND ELEC. RECEPTACLE.		✓																	
22 TEST ACCEPTANCE		INK STAMP BODY WITH DATA AND TEST ACCEPTANCE STAMP.		✓																	
ELECTRICAL TESTS - PERFORM IN SEQUENCE SHOWN																					
23	DIELECTRIC STRENGTH 4.3.2	SLOWLY APPLY NOTED VOLTAGE. NO ARCING OR INSULATION FAILURE IN ONE MINUTE. REDUCE VOLTAGE TO ZERO BEFORE DISCONNECTING. BODY TO PIN 1 AT 1500 VAC PIN 1, 5, 7, 9 BODY TO PIN 11 PIN 1, 5, 7, 9 BODY TO PIN 9 PIN 1 & BODY TO PIN 5 PIN 1 & BODY TO PIN 7 AT 1000 VAC PIN 5 TO PIN 7 AT 800 VAC PIN 9 TO PIN 11		-5, -6 & -7, 1 SYSTEM ONLY SYS "A"	SYS "B"																
																					
24	INSULATION RESISTANCE 4.3.3	APPLY 500 VDC BETWEEN NOTED PINS. 100 MEGOHMS MIN RESISTANCE (REQUIREMENT) PINS 1, 5, 7, 9, 11 TO BODY PINS 5, 7, 9, 11 TO 1 PINS 7, 9, 11 TO 5 PINS 9, 11 TO 7 PINS 11 TO 9		-5, -6 & -7, 1 SYS. ONLY SYS "A"	SYS "B"																
																					
25	PIN TO PIN RESISTANCE	CHECK PIN TO PIN RESISTANCE AT 700F AND RECORD. MUST COMPLY WITH NOTED VALUE <table border="1"> <thead> <tr> <th>PINS</th> <th>RESISTANCE</th> </tr> </thead> <tbody> <tr> <td>1-2</td> <td>71-87 OHMS</td> </tr> <tr> <td>5-6</td> <td>900-1100 OHMS</td> </tr> <tr> <td>7-8</td> <td>900-1100 OHMS</td> </tr> <tr> <td>9-10</td> <td>80-165 OHMS</td> </tr> <tr> <td>11-12</td> <td>60-135 OHMS</td> </tr> <tr> <td>1-4</td> <td>SHORTED</td> </tr> <tr> <td>3</td> <td>OPEN</td> </tr> </tbody> </table>		PINS	RESISTANCE	1-2	71-87 OHMS	5-6	900-1100 OHMS	7-8	900-1100 OHMS	9-10	80-165 OHMS	11-12	60-135 OHMS	1-4	SHORTED	3	OPEN	SYS "A"	SYS "B"
PINS	RESISTANCE																				
1-2	71-87 OHMS																				
5-6	900-1100 OHMS																				
7-8	900-1100 OHMS																				
9-10	80-165 OHMS																				
11-12	60-135 OHMS																				
1-4	SHORTED																				
3	OPEN																				
																					

10054-59

NO. 25-28

65-44861-1

65-44861T

SERIAL NO. 12552

FORCE AT
PILOT
INPUT

-3 THRU -7 ASSY

WALKING
BEAM

-1, -2 ASSY

30 LBS

MOD.
PISTON

20

SEC.

EXTEND →

PRIMARY

0 .050 .100 .150 .200 .250 .300 .350
INPUT LEVER TRAVEL FROM VALVE NULL, WITH CYLINDER ROD BOTTOMED

VS INPUT TRAVEL
EST 5

PAGE 5 OF 7 ACCEPTANCE TEST DATA SHEETS

DATE TESTED 872-11

BY
B

BERT & COMPANY

TESTER ROBINSON

ESCM
NO.
12106

65-44861T

REV

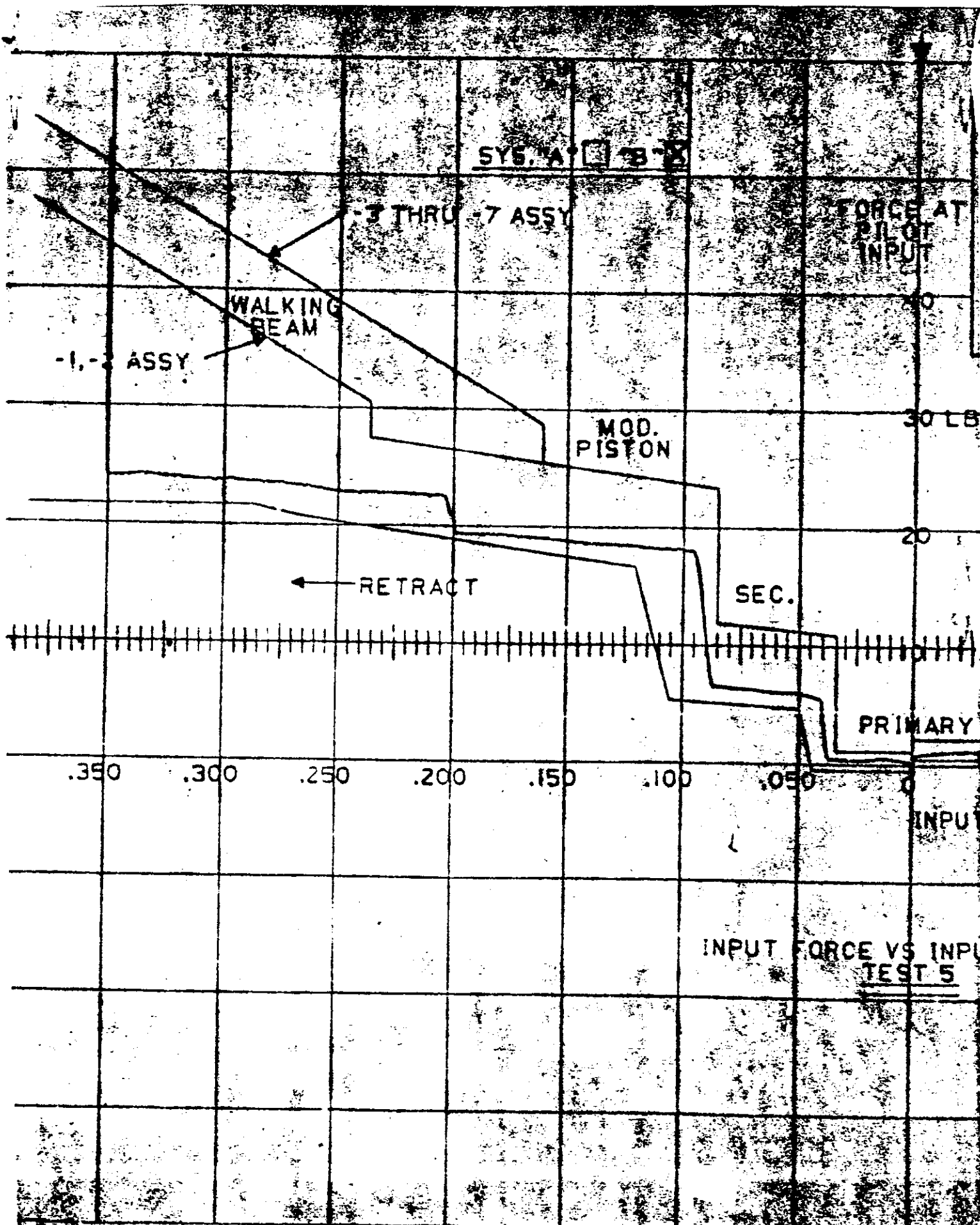
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PART NO.

DATE N 65-44861T

PROJECT 12106 25 OF 1

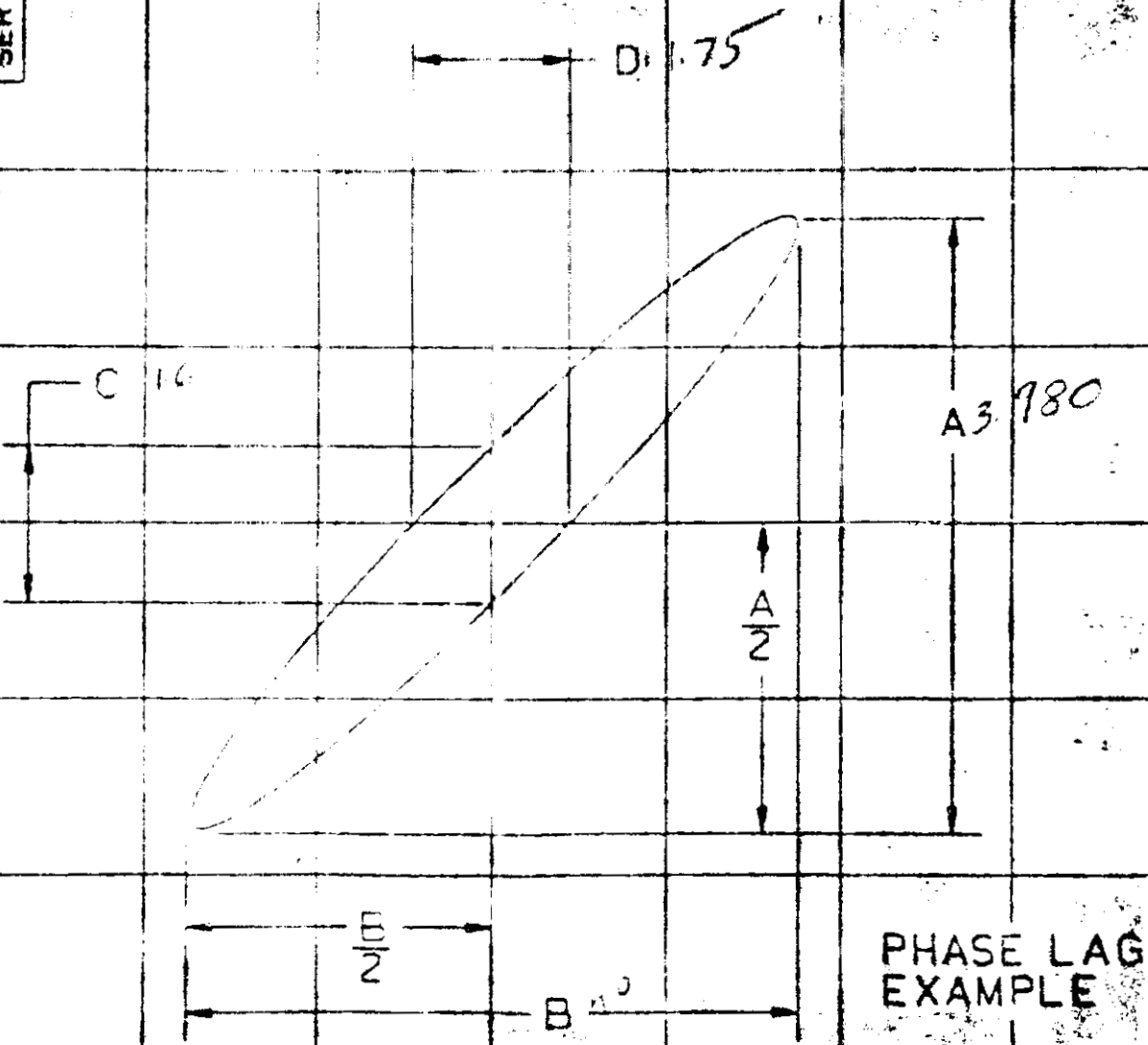
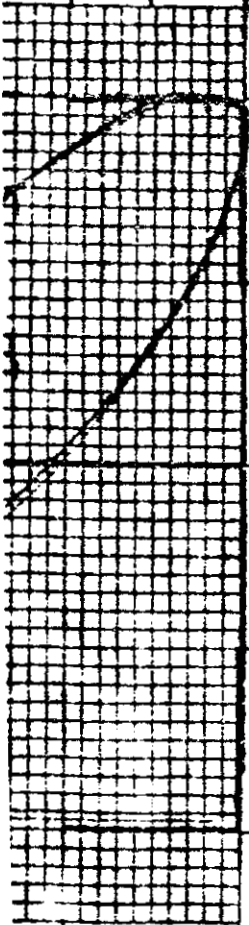
DATA BASE - BERT & COMPANY



65-44861T

SERIAL NO. J598A

$2\sqrt{\frac{C}{A} \cdot \frac{D}{B}} = \text{SINE } \phi$
CALCULATION



119

PAGE 6 OF 7 ACCEPTANCE TEST DATA SHEETS

DATE TESTED 87-2-11

SIZE
B

BERTEA CORPORATION
IRVINE, CALIFORNIA

INSP: ROBINSON



FSCM
NO.
82106

65-44861T

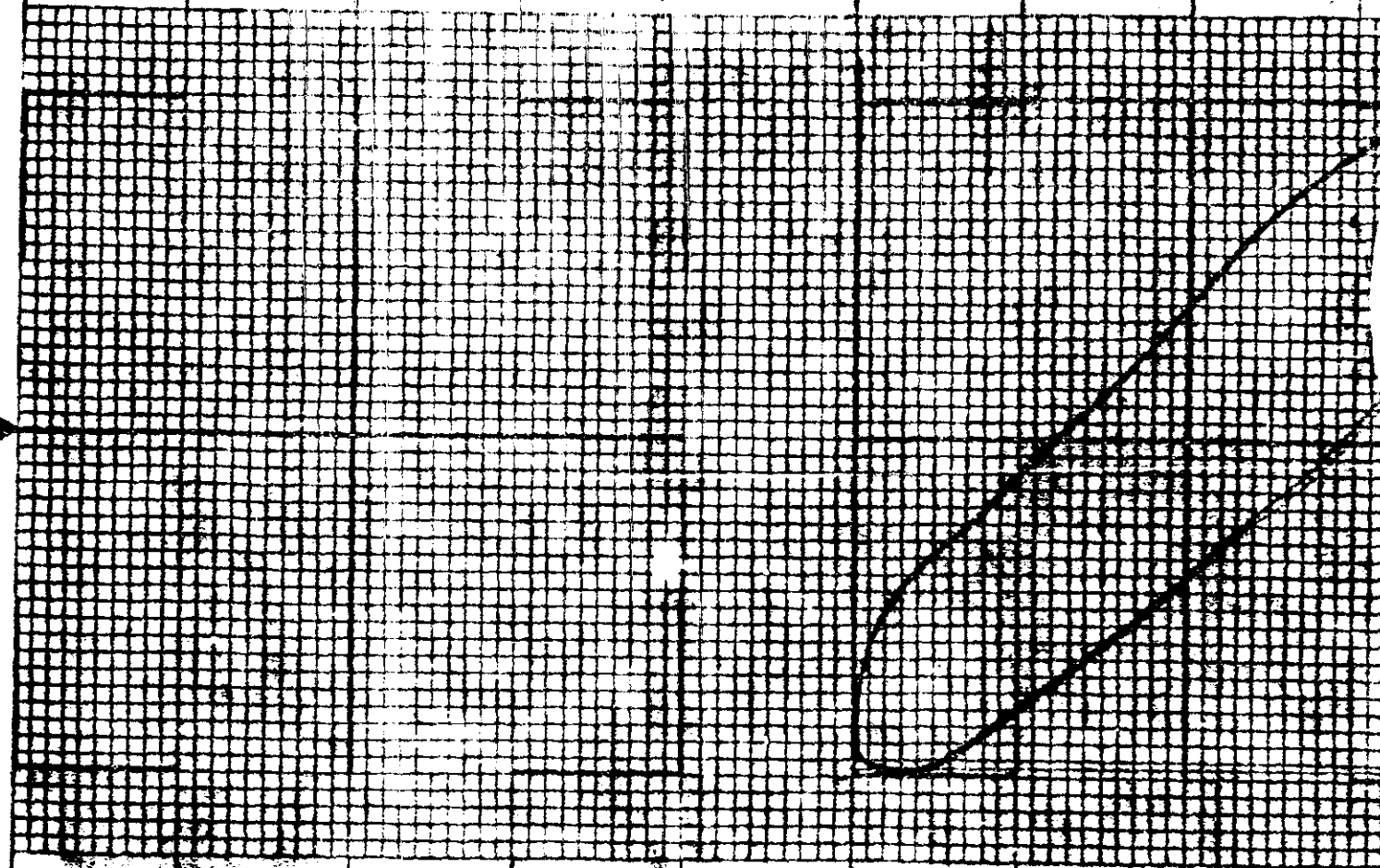
REV
AE

1065 12255

PART NO.
12 CASH NO. 65-44861-2CFF

PROJECT 737 106527 9528

SINE Ø MAXIMUM PER IES REQ MT 423



SYS A (28)

TEST 14

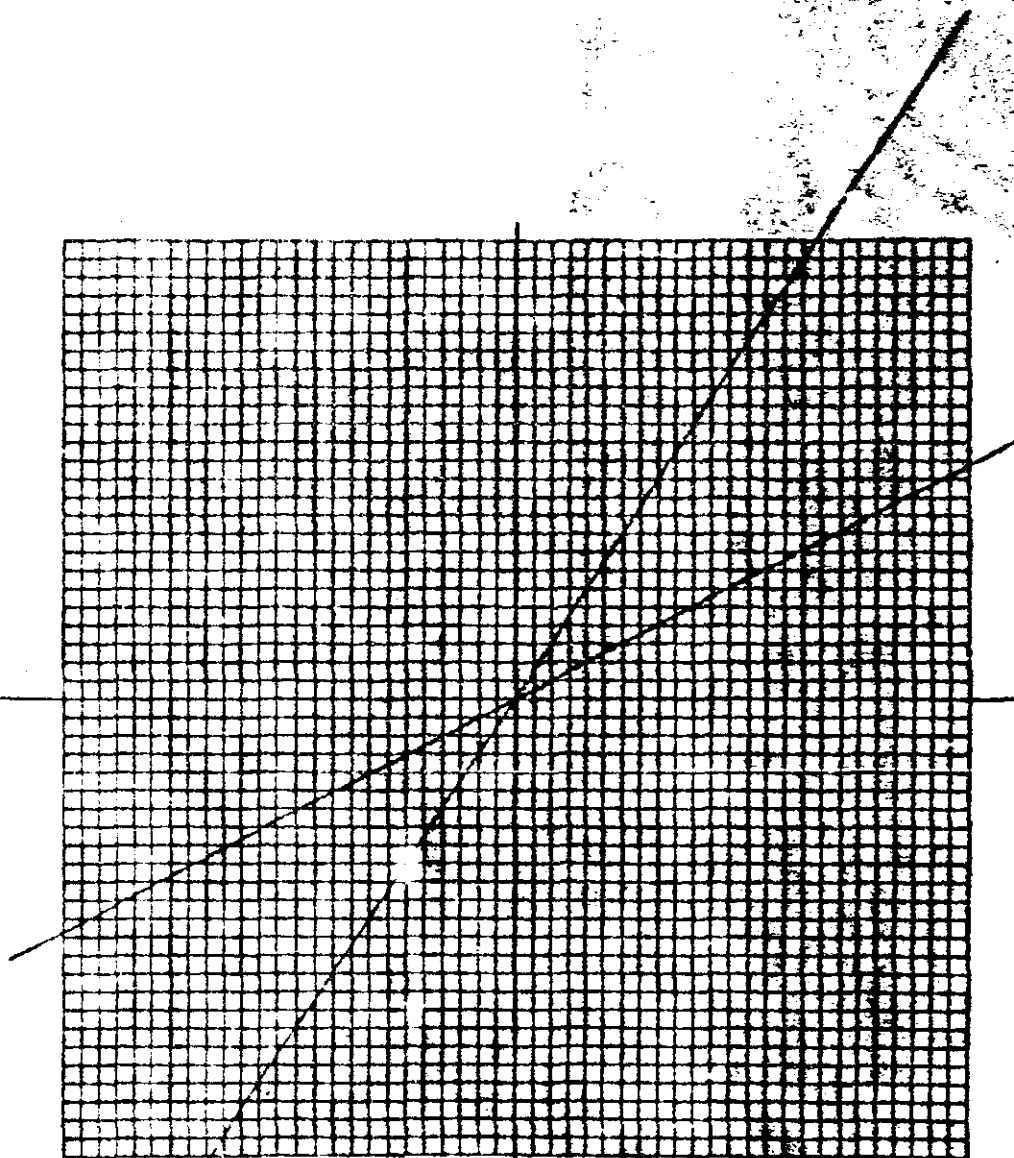
SYS B (128)

PHASE LAG

SINE Ø N/R

SINE Ø .419

-5 THRU -7.1 SYSTEM ONLY



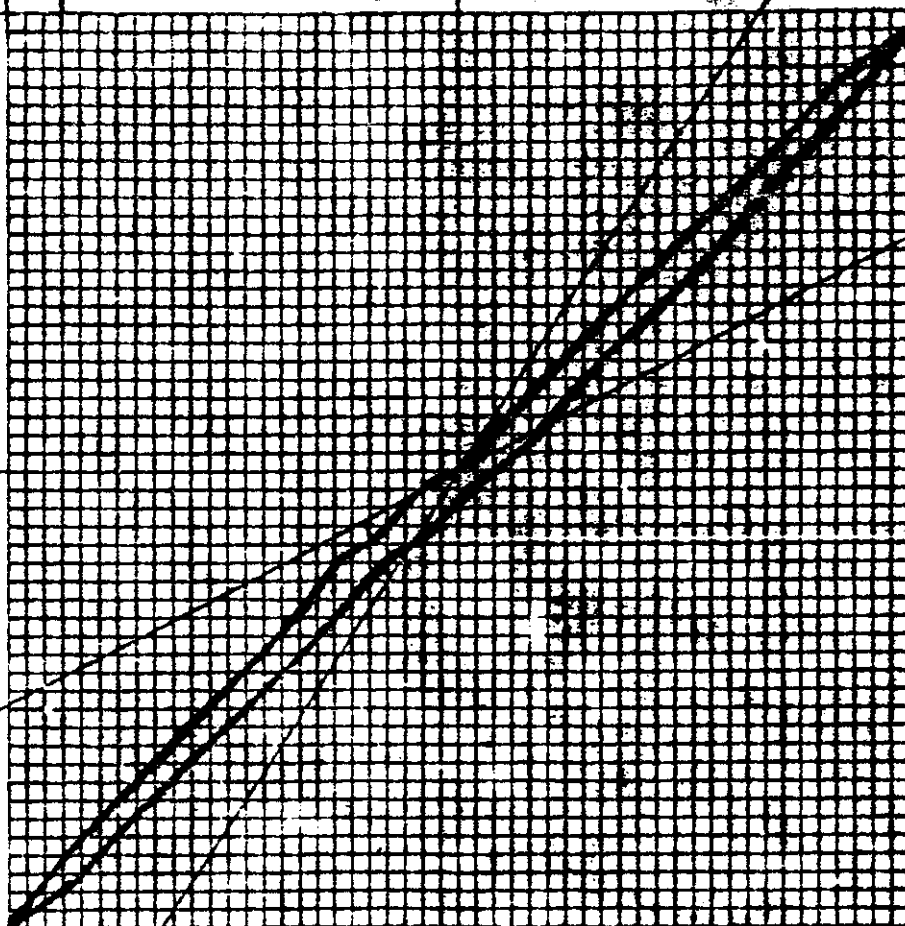
SYSTEM A N/A



TEST 15
REPEATABILITY AND LINEARITY
(-5, -6 AND -7 ASSY, 1 SYSTEM ONLY)

65-4486IT

SERIAL NO. 125700



SYSTEM B FOT 123

PAGE 7 OF 7 ACCEPTANCE TEST DATA SHEETS			
DATE TESTED: 872-11	SIZE B	BERTEA CORPORATION IRVINE, CALIFORNIA	
INSP: ROBINSON FOT 128	FSCM NO. 82106	65-4486IT	REV
MPS 12055			AE
PART NO. 65-44861-9C FE		PROJECT 737	PAGE 28 OF 28

DATA BASE-BERTEA RAD/RAL SYSTEM