



NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

AIRWORTHINESS GROUP FACTUAL REPORT ADDENDUM 2

March 26, 2007

A. ACCIDENT DCA06FA058

Location: Memphis, Tennessee
Date: July 28, 2006
Time: 1125 Central Daylight Time (CDT)
Aircraft: FedEx Express Flight 630, McDonnell-Douglas (Boeing) MD-10-10F,
 N391FE

B. AIRWORTHINESS GROUP

Chairman: Clinton R. Crookshanks
 National Transportation Safety Board
 Denver, Colorado

Member: Jim Fortner
 Fortner Engineering and Manufacturing, Inc.
 Glendale, California

Member: Neal Gilleran
 The Boeing Company
 Long Beach, California

C. SUMMARY

On July 28, 2006, about 1125 Central Daylight Time, FedEx Express (FedEx) flight 630, a McDonnell-Douglas (Boeing) MD-10-10F (MD-10), N391FE, crashed while landing at Memphis International Airport (MEM), Memphis, Tennessee. The left main landing gear collapsed after touchdown on runway 18R, and the airplane came to rest on the runway. After the gear collapsed, a fire developed on the left side of the airplane. The two flight crewmembers received minor injuries during the evacuation, and one nonrevenue FedEx pilot was not injured. The postcrash fire substantially damaged the airplane's left wing and portions of the left side of the fuselage. Flight 630 departed from Seattle-Tacoma International Airport (SEA), Seattle, Washington, and was operating under the provisions of 14 *Code of Federal Regulations* (CFR)

Part 121 on an instrument flight rules flight plan.

D. DETAILS OF THE INVESTIGATION

The two Dual Brake Control Valves (DBCV) were removed from the accident airplane after the accident and shipped to Crane Aerospace, Hydro-Aire Division, in Burbank, CA. Full anti-skid simulator testing and some basic testing of the DBCV's was performed at Hydro-Aire¹. The DBCV's were then sent to Fortner Engineering and Manufacturing, Inc., for additional acceptance testing. The group met at the Fortner facility in Glendale, CA, on November 6, 2006.

Prior to the testing, the group reviewed the standard acceptance test plan provided by Fortner and elected to perform 19 of the 24 individual tests in an order different from the standard. The test plan and results for each DBCV are included in Appendices 1 and 2. The proof pressure, compensation, and duplicate functional tests were not performed as noted on the test plans. The test numbers below refer to the renumbered test as shown in the test plans. Figures 1 and 2 show simplified schematics of the valve in the non-actuated and actuated positions.

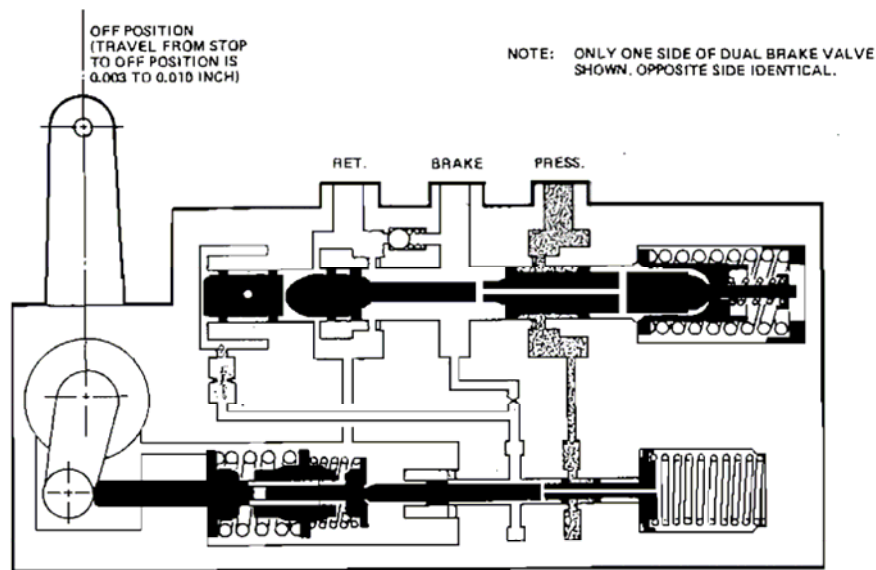


Figure 1 – DBCV Schematic, Non-Actuated Position

¹ See Addendum 1 to the Airworthiness Group Factual Report for the details of this testing.

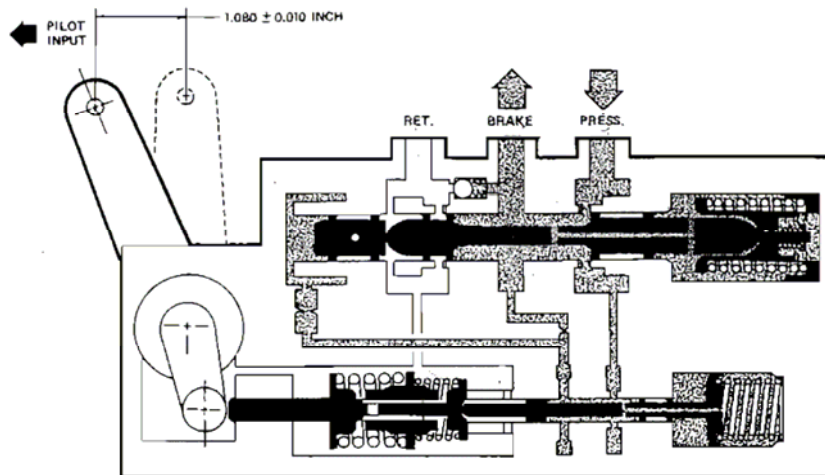


Figure 2 – DBCV Schematic, Actuated Position

DBCV (P/N 35950-505, S/N 438942)

This DBCV was removed from the right side of the aircraft, and operates in hydraulic system three. All of the test results were satisfactory with the exceptions noted below.

- ➔ Test number 1, Functional Operation - The input lever travel of the left valve required to obtain pressure at the brake was slightly higher than the limit value for the 70 psi and 250 psi test points.
- ➔ Test number 1, Functional Operation - The input lever travel of the right valve required to obtain pressure at the brake was slightly lower than the limit value for the 1200 psi and 2500 psi test points.
- ➔ Test number 1, Functional Operation - The input force on the right valve was above the limit value at the 2500 psi and 3000 psi test points.
- ➔ Test number 10, Internal Leakage - The leakage for the parking test exceeded the allowable limit by 2.1 cc.

The valve was disassembled for detail part inspection. There was light scratching/scoring of the first and second stage shuttles consistent with normal operation. There was some contamination noted inside the left second stage sensing assembly and some moderate to heavy scratching/scoring on the plunger. The right second stage sensing assembly exhibited only light scratching/scoring on the plunger. See Figures 3 and 4. There were no other anomalies noted in the detail parts.

DBCV (P/N 35950-505, S/N 444076)

This DBCV was removed from the left side of the aircraft and operates in hydraulic system one. All of the test results were satisfactory with the exceptions noted below.

- ➔ Test number 1, Functional Operation – The input lever travel of the left valve required to obtain pressure at the brake was slightly lower than the limit value for the 250 psi, 600 psi, 1200 psi, and 2500 psi test points.
- ➔ Test number 1, Functional Operation – The input lever travel of the right valve required to obtain pressure at the brake was slightly higher than the limit value for the 70 psi test point.
- ➔ Test number 1, Functional Operation – The input lever travel of the right valve required to obtain pressure at the brake was slightly lower than the limit value for the 1200 psi, and 2500

psi test points.

- Test number 1, Functional Operation - The input force on the right valve was above the limit value at the 2500 psi test point.
- Test number 3, Functional Operation - The input force on the right valve exceeded the comparison limit to test number 1 at the 1200 psi test point.
- Test number 9, Internal Leakage - The leakage exceeded the allowable limit by 0.5 cc.

The valve was disassembled for detail part inspection. There was light scratching/scoring of the first and second stage shuttles consistent with normal operation. Both the left and right second stage sensing assemblies exhibited moderate to heavy scratching/scoring on the plunger. See Figures 5 and 6. There were no other anomalies noted in the detail parts.



Figure 3 – DBCV (S/N 438942) Left Second Stage Plunger and Guide



Figure 4 – DBCV (S/N 438942) Right Second Stage Plunger and Guide

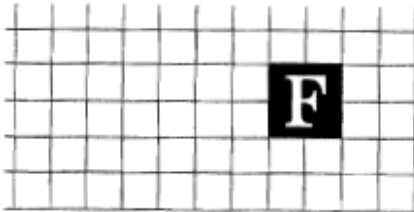


Figure 5 – DBCV (S/N 444076) Left Second Stage Plunger and Guide



Figure 6 – DBCV (S/N 444076) Right Second Stage Plunger and Guide

APPENDIX 1
Test Plan and Results
S/N 438942



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CERTIFICATED F.A.A. REPAIR STATION #PUSR776L

CLASS 1 ACCESSORY RATING

HOLDER OF SFAR 36 AUTHORITY

This assembly was repaired in accordance with applicable sections of Standard Overhaul Procedures for hydraulic units DC-10 and certifications are on file at this Repair Station.

918 thompson avenue
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 fax (818) 240-1009

DACO S/N 438942

F.E. S/N _____

Page 1 of 8
 (TS35950A.DWG) Certificate of Compliance and Test Data

Test Fluid - Skydrol 500B
 Fluid Temp. - 80° to 120°

35950-505 Dual Brake Metering Valve Assembly

Job # _____

Model DC-10 Customer FEOLX

Chapter 32-44-03

Eff. Date 01/30/98

Revision N/C

Revised _____

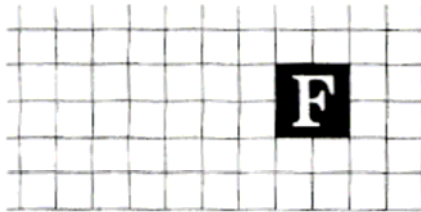
TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results
1	SKIPPED Proof Pressure	75 then 4500	Pres.	Gages@ Brake Ports	With levers in the full OFF position apply pressure for (3) minutes. There shall be no external leakage, failure, or permanent deformation. Leakage from Return Port shall not exceed 14.3 cc/minute.	OK R/W OK
2	SKIPPED	4500			With pressure applied, adjust needle valve at Return port to build 1500 psi @ Return port. (There shall be 4500 psi at Brake Ports). Maintain pressure for (2) minutes. There shall be no external leakage or or evidence of failure or permanent set.	OK R/W OK
9	Internal Leakage	3000			With levers in the full OFF position apply pressure. After a (5) minute wait, leakage from Return Port shall not exceed 9.5 cc per minute in a (2) minute test.	3.6 cc
10		Noted			With levers in the full OFF position apply 3000 psi. Move levers to obtain 2200±200 psi at Brake ports. Reduce input pressure to 1800 psi. After a (5) minute wait leakage from Ret. Port shall not exceed 4.1 cc/minute in a (2) minute test.	6.2 cc

Test each side of Valve separately for the following tests. Connect the Brake Port being tested to bench return with needle valve in line. Install a pressure gage between needle valve and Brake Port.

5	Compensation SKIPPED	3000	Pres.	Gages@ Brake Ports w/inline Needle Valve	With lever in the full OFF position apply pressure. Move lever to obtain 2200 psi at Brake Port. Slowly open needle valve to obtain 60cc leakage from Brake Port. Pressure at Brake Port shall not fall below 2000 psi.	Left Brake psi	Right Brake psi
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Certificate of Compliance and Test Data

35950-505 Dual Brake Metering Valve Assembly

Job # _____

Eff. Date 01/30/98

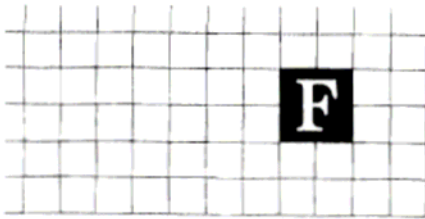
Revision N/C

Revised _____

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results	
						Left Brake	Right Brake
6	Compensation <i>SKIPPED</i>	3000	Pres.	Gages@ Brake Ports	Connect a hand pump to needle valve of Brake Port under test. With pressure applied move lever to obtain 2200 psi at brake port. Open needle valve and apply hand pump pressure. Brake Port pressure must not exceed: 2550 for 35950 & 35950-503 2500 for 35950-501 & 35950-505	psi	psi
7	Dynamic Functional			Gages@ Brake Ports Ret. to Bench	With pressure applied fully actuate each lever at least (10) times at rates that range from very slow to very fast. There shall be no evidence of binding, sticking, or chattering.	<input checked="" type="checkbox"/> OK	<input type="checkbox"/> R/W <input checked="" type="checkbox"/> OK
12	Pressure Drop	Noted	Left Brake	Right Brake & Pres. Ret. to Bench	With levers in the full OFF position apply pressure to produce (8) GPM. Pressure drop shall not exceed 350 psi. (Minus Tare)	275	psi
13			Right Brake	Left Brake & Pres. Ret. to Bench	With levers in the full OFF position apply pressure to produce (8) GPM. Pressure drop shall not exceed 350 psi. (Minus Tare)	260	psi
14		3000	Pres.	Right Brake Ret. to Bench Left Brake to Flowmeter w/Needle Valve Inline	With pressure applied rapidly actuate & maintain input lever at 0.89 inch travel. Open needle valve at Left Brake to produce a flow of 16 GPM. The pressure drop (Minus Tare) shall not exceed the following: Basic & -503: 1200 psi -501 & -505: 100 psi Pressure at Pressure Port shall not fall below the following: Basic & -503: 2500 psi -501 & -505: 2950 psi	Pressure Drop <input checked="" type="checkbox"/> OK	<input type="checkbox"/> R/W <input checked="" type="checkbox"/> OK Minimum Inlet Pressure <input checked="" type="checkbox"/> OK

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 (TS35950C.DWG)

Certificate of Compliance and Test Data

35950-55 Dual Brake Metering Valve Assembly Job # _____

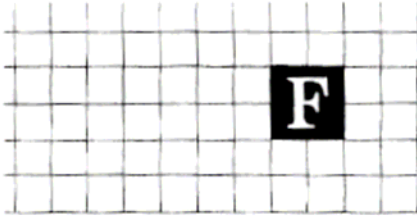
Eff. Date 01/30/98 Revision N/C Revised _____

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results
14 15				Right Brake Ret. to Bench Left Brake to Flowmeter w/inline Needle Valve	With pressure applied rapidly actuate & maintain input lever at 1.08 inch travel. Open needle valve at Left Brake to produce a flow of 16 GPM. The pressure drop (minus tare) shall not exceed the following: Basic & -503: 600 psi -501 & -505: 100 psi	<input checked="" type="checkbox"/> OK <input type="checkbox"/> R/W <input checked="" type="checkbox"/> OK
16	Pressure Drop	3000	Pres.	Left Brake Ret. to Bench Right Brake to Flowmeter	With pressure applied rapidly actuate & maintain input lever at 0.89 inch travel. Open needle valve at Right Brake to produce a flow of 16 GPM. The pressure drop (minus tare) shall not exceed the following: Basic & -503: 1200 psi -501 & -505: 100 psi Pressure at Pressure Port shall not fall below the following: Basic & -503: 2500 psi -501 & -505: 2950 psi	Pressure Drop <input checked="" type="checkbox"/> OK <input type="checkbox"/> R/W <input checked="" type="checkbox"/> OK Minimum Inlet Pressure <input checked="" type="checkbox"/> OK <input type="checkbox"/> R/W <input checked="" type="checkbox"/> OK
17					With pressure applied rapidly actuate & maintain input lever at 1.08 inch travel. Open needle valve at Right Brake to produce a flow of 16 GPM. The pressure drop (minus tare) shall not exceed the following: Basic & -503: 600 psi -501 & -505: 100 psi	<input checked="" type="checkbox"/> OK <input type="checkbox"/> R/W <input checked="" type="checkbox"/> OK
18		500	Return	Left Brake & Right Brake to Flowmeter	With levers in the Full OFF position apply pressure. Flow from each Brake Port shall be steady and greater than 4.5 GPM with no tendency to block flow.	Left Brake <input checked="" type="checkbox"/> OK <input type="checkbox"/> R/W <input checked="" type="checkbox"/> OK Right Brake <input checked="" type="checkbox"/> OK <input type="checkbox"/> R/W <input checked="" type="checkbox"/> OK

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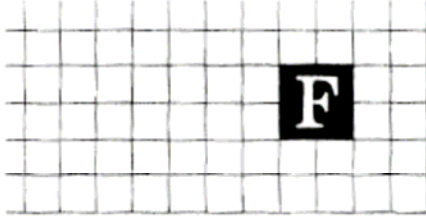
Certificate of Compliance and Test Data

35950-505 Dual Brake Metering Valve Assembly Job # _____
 Eff. Date 01/30/98 Revision N/C Revised _____

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results			
16 1	Functional Operation	3000	Pres.	Gages @ Brake Ports 60 psi Relief @Return	Drain all fluid from the end caps by removing bleeder valves. Replace bleeder valves; torque bleeder valves to 10-15 ft.-lbs. Apply pressure. After a one minute wait record input lever travel & input force vs. gage pressure at the following pressures:				
					Ascending Pressure	Lever Travel (Inches)	Input Force (Pounds)	Left Brake	Right Brake
					LEFT	183	5	OK	OK
					70 psi	.129-.179	3.15-7.18	R/W	R/W
					RIGHT	174	6	OK	OK
					250 psi	.203-.254	5.84-10.36	OK	OK
						.216	9	R/W	R/W
					600 psi	.345-.400	11.08-16.55	OK	OK
						.356	15	R/W	R/W
					1200 psi	.590-.650	20.06-27.16	OK	OK
	.571	26	R/W	R/W					
	.770	50	OK	OK					
2500 psi	.766-.825	39.52-50.16	R/W	R/W					
	.745	55	OK	OK					
3000 psi	(Basic & -503) .833-.892	47.00-59.00	OK	OK					
	(-501 & -505) .766-.825	63	R/W	R/W					
			OK	OK					

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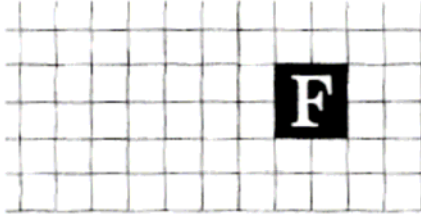
35950-305 Dual Brake Metering Valve Assembly Job # _____

Eff. Date 01/30/98 Revision N/C Revised _____

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results																														
216					With the lever force at 67 lbs., the lever travel must be 1.070/1.090 in. Adjust and lock the Full On screw.	OK R/W OK																														
					From Full On allow levers to retract to give noted pressures. Compare data with that recorded in Test #15. Hysteresis shall not exceed noted values.																															
					<table border="1"> <thead> <tr> <th>Declining Pressure</th> <th>Lever Travel (Inches)</th> <th>Input Force (Pounds)</th> <th>Left Brake</th> <th>Right Brake</th> </tr> </thead> <tbody> <tr> <td>2500 psi</td> <td>7.90711 Within ±.100 of Test 15</td> <td>46.92 Within ±11.30 of Test 15</td> <td>OK R/W OK</td> <td>OK R/W OK</td> </tr> <tr> <td>1200 psi</td> <td>1.000 Within ±.100 of Test 15</td> <td>22.5 Within ±6.88 of Test 15</td> <td>OK R/W OK</td> <td>OK R/W OK</td> </tr> <tr> <td>600 psi</td> <td>.398 Within ±.100 of Test 15</td> <td>15 Within ±4.84 of Test 15</td> <td>OK R/W OK</td> <td>OK R/W OK</td> </tr> <tr> <td>250 psi</td> <td>.250 Within ±.100 of Test 15</td> <td>10 Within ±3.65 of Test 15</td> <td>OK R/W OK</td> <td>OK R/W OK</td> </tr> <tr> <td>70 psi</td> <td>.167 Within ±.100 of Test 15</td> <td>7 Within ±3.03 of Test 15</td> <td>OK R/W OK</td> <td>OK R/W OK</td> </tr> </tbody> </table>	Declining Pressure	Lever Travel (Inches)	Input Force (Pounds)	Left Brake	Right Brake	2500 psi	7.90711 Within ±.100 of Test 15	46.92 Within ±11.30 of Test 15	OK R/W OK	OK R/W OK	1200 psi	1.000 Within ±.100 of Test 15	22.5 Within ±6.88 of Test 15	OK R/W OK	OK R/W OK	600 psi	.398 Within ±.100 of Test 15	15 Within ±4.84 of Test 15	OK R/W OK	OK R/W OK	250 psi	.250 Within ±.100 of Test 15	10 Within ±3.65 of Test 15	OK R/W OK	OK R/W OK	70 psi	.167 Within ±.100 of Test 15	7 Within ±3.03 of Test 15	OK R/W OK	OK R/W OK	
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327	Functional Operation	3000	Pres.	Gages @ Brake Ports 60 psi Relief @ Return																																

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 (TS35950F.DWG)

Certificate of Compliance and Test Data

35950-505 Dual Brake Metering Valve Assembly Job # _____
 Eff. Date 01/30/98 Revision N/C Revised _____

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements			Results			
					Ascending Pressure	Lever Travel (Inches)	Input Force (Pounds)	Left Brake	Right Brake		
18	Functional Operation	3000	Pres.	Gages @ Brake Ports 60 psi Relief @ Return	Drain all fluid from the end caps by removing bleeder valves. Replace bleeder valves; torque bleeder valves to 10-15 ft.-lbs. Apply pressure. WITHOUT waiting, record input lever travel & input force vs. gage pres. at the following pressures:						
					70 psi	.129-.179	3.15-7.18	OK R/W OK	OK R/W OK		
					250 psi	.203-.254	5.84-10.36	OK R/W OK	OK R/W OK		
					600 psi	.345-.400	11.08-16.55	OK R/W OK	OK R/W OK		
					1200 psi	.590-.650	20.06-27.16	OK R/W OK	OK R/W OK		
					2500 psi	.766-.825	39.52-50.16	OK R/W OK	OK R/W OK		
					3000 psi	(Basic & -503) .833-.892 (-501 & -505) .766-.825	47.00-59.00	OK R/W OK	OK R/W OK		

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 (TS35950G.DWG)

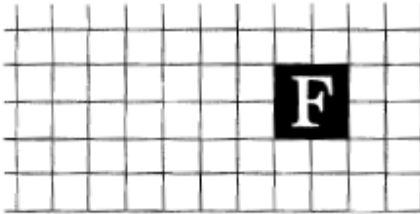
Certificate of Compliance and Test Data

35950-505 Dual Brake Metering Valve Assembly Job # _____
 Eff. Date 01/30/98 Revision "A" Revised 01/26/00

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results					
19	Functional Operation <i>SKIPPED</i>	3000	Pres.	Gages® Brake Ports ----- 60 psi Relief ®Return	From Full On allow levers to retract to give noted pressures. Compare data with that recorded in Test #15. Hysteresis shall not exceed noted values.	Left Brake	Right Brake				
					Declining Pressure			Lever Travel (Inches)	Input Force (Pounds)	<input type="checkbox"/> OK	<input type="checkbox"/> OK
					2500 psi			Within ±.100 of Test 15	Within ±11.30 of Test 15	<input type="checkbox"/> R/W	<input type="checkbox"/> R/W
					1200 psi			Within ±.100 of Test 15	Within ±6.88 of Test 15	<input type="checkbox"/> OK	<input type="checkbox"/> OK
					600 psi			Within ±.100 of Test 15	Within ±4.84 of Test 15	<input type="checkbox"/> R/W	<input type="checkbox"/> R/W
					250 psi			Within ±.100 of Test 15	Within ±3.65 of Test 15	<input type="checkbox"/> OK	<input type="checkbox"/> OK
70 psi	Within ±.100 of Test 15	Within ±3.03 of Test 15	<input type="checkbox"/> R/W	<input type="checkbox"/> R/W							
4/20	Binding	3500		T [®] to Return Between Gage ® Brake	Cycle levers to obtain 3500 PSI at Brake Port. Slowly move levers towards Off position. Lap assemblies shall return as indicated by normal leakage at Return Ports.	<input type="checkbox"/> OK	<input type="checkbox"/> OK				
5/21					Cycle levers to obtain 3000 PSI @16 GPM at Brake Port. Slowly move levers towards Off position. Lap assemblies shall return as indicated by normal leakage at Return Ports.	<input type="checkbox"/> R/W	<input type="checkbox"/> R/W				

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 (TS35950H.DWG)

Certificate of Compliance and Test Data

35950-605 Dual Brake Metering Valve Assembly Job # _____
 Eff. Date 01/30/98 Revision "A" Revised 01/26/00

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results
22 6	Lever Travel	None	None	None	Open bleed valves on 1st stage end caps and with zero inlet pressure, actuate levers from Full Off to Full On. Lever travel shall be 0.99±.010, and force required shall not exceed 9.0 lbs. at each lever.	Left Brake <input checked="" type="checkbox"/> OK <input checked="" type="checkbox"/> R/W <input checked="" type="checkbox"/> OK Right Brake <input checked="" type="checkbox"/> OK <input checked="" type="checkbox"/> R/W <input checked="" type="checkbox"/> OK

NOTE: The following tests are a re-test of Tests #5&6.

23 7	Compensation	3000	Pres.	Gages@ Brake Ports w/inline Needle Valve	With lever in the full OFF position apply pressure. Move lever to obtain 2200 psi at Brake Port. Slowly open needle valve to obtain 60cc leakage from Brake Port. Pressure at Brake Port shall not fall below 2000 psi.	Left Brake 2750 psi	Right Brake 2150 psi
24 8					Connect a hand pump to needle valve of Brake Port under test. With pressure applied move lever to obtain 2200 psi at brake port. Open needle valve and apply hand pump pressure. Brake Port pressure must not exceed: 2550 for 35950 & 35950-303 2500 for 35950-501 & 35950-505	Left Brake 2450 psi	Right Brake 2450 psi

Left Brake Lap Assys.

35555-35068 Lap Assy.
 L/A S/N _____
36905 Lap Assy.
 L/A S/N _____

Right Brake Lap Assys.

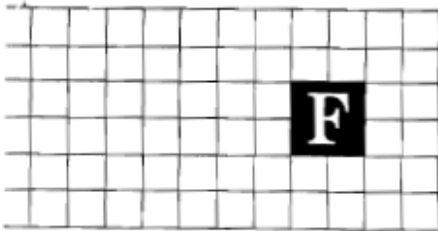
35555-35068 Lap Assy.
 L/A S/N _____
36905 Lap Assy.
 L/A S/N _____

Date 11/08/06

Test Operator: [Signature] Inspector: [Signature]

Note: Not all testing done. Part not ready for installation.

APPENDIX 2
Test Plan and Results
S/N 444076



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This assembly was repaired in accordance with applicable sections of Standard Overhaul Procedures for hydraulic units DC-10 and certifications are on file at this Repair Station.

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F.E. S/N _____

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 (TS35950A.DWG) Certificate of Compliance and Test Data

Test Fluid - Skydrol 500B
 Fluid Temp. - 80° to 120°F

35950-505 Dual Brake Metering Valve Assembly

Job # _____

Model DC-10 Customer Fed Ex

Chapter 32-44-03

Eff. Date 01/30/98

Revision N/C

Revised _____

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results
1	SKIPPED Proof Pressure	75 then 4500	Pres.	Gages@ Brake Ports	With levers in the full OFF position apply pressure for (3) minutes. There shall be no external leakage, failure, or permanent deformation. Leakage from Return Port shall not exceed 14.3 cc/minute.	OK R/W OK
2	SKIPPED	4500			With pressure applied, adjust needle valve at Return port to build 1500 psi @ Return port. (There shall be 4500 psi at Brake Ports). Maintain pressure for (2) minutes. There shall be no external leakage or evidence of failure or permanent set.	OK R/W OK
9	Internal Leakage	3000			With levers in the full OFF position apply pressure. After a (5) minute wait, leakage from Return Port shall not exceed 9.5 cc per minute in a (2) minute test.	10 cc
10		Noted			With levers in the full OFF position apply 3000 psi. Move levers to obtain 2200±200 psi at Brake ports. Reduce input pressure to 1800 psi. After a (5) minute wait leakage from Ret. Port shall not exceed 4.1 cc/minute in a (2) minute test.	2 cc

Test each side of Valve separately for the following tests. Connect the Brake Port being tested to bench return with needle valve in line. Install a pressure gage between needle valve and Brake Port.

11	Compensation SKIPPED	3000	Pres.	Gages@ Brake Ports w/inline Needle Valve	With lever in the full OFF position apply pressure. Move lever to obtain 2200 psi at Brake Port. Slowly open needle valve to obtain 60cc leakage from Brake Port. Pressure at Brake Port shall not fall below 2000 psi.	Left Brake 2150 psi	Right Brake 2000 psi
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 (TS35950B.DWG)

Certificate of Compliance and Test Data

35950-505 Dual Brake Metering Valve Assembly Job # _____

Eff. Date 01/30/98 Revision N/C Revised _____

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results
12	Compensation	3000	Pres.	Gages@ Brake Ports	Connect a hand pump to needle valve of Brake Port under test. With pressure applied move lever to obtain 2200 psi at brake port. Open needle valve and apply hand pump pressure. Brake Port pressure must not exceed: 2550 for 35950 & 35950-503 2500 for 35950-501 & 35950-505	Left Brake 2400 psi Right Brake 2380 psi
13	Dynamic Functional			Gages@ Brake Ports Ret. to Bench	With pressure applied fully actuate each lever at least (10) times at rates that range from very slow to very fast. There shall be no evidence of binding, sticking, or chattering.	OK R/W OK
14	Pressure Drop	Noted	Left Brake	Right Brake & Pres. Ret. to Bench	With levers in the full OFF position apply pressure to produce (8) GPM. Pressure drop shall not exceed 350 psi. (Minus Tare)	350 psi
15			Right Brake	Left Brake & Pres. Ret. to Bench	With levers in the full OFF position apply pressure to produce (8) GPM. Pressure drop shall not exceed 350 psi. (Minus Tare)	250 psi
16		3000	Pres.	Right Brake Ret. to Bench Left Brake to Flowmeter w/Needle Valve Inline	With pressure applied rapidly actuate & maintain input lever at 0.89 inch travel. Open needle valve at Left Brake to produce a flow of 16 GPM. The pressure drop (Minus Tare) shall not exceed the following: Basic & -503: 1200 psi -501 & -505: 100 psi Pressure at Pressure Port shall not fall below the following: Basic & -503: 2500 psi -501 & -505: 2950 psi	Pressure Drop OK R/W OK Minimum Inlet Pressure OK R/W OK

(Continued on Next Page)



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 (TS35950C.DWG)

Certificate of Compliance and Test Data

35950-505 Dual Brake Metering Valve Assembly Job # _____

Eff. Date 01/30/98 Revision N/C Revised _____

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results
17				Right Brake Ret. to Bench Left Brake to Flowmeter w/Inline Needle Valve	With pressure applied rapidly actuate & maintain input lever at 1.08 inch travel. Open needle valve at Left Brake to produce a flow of 16 GPM. The pressure drop (minus tare) shall not exceed the following: Basic & -503: 600 psi -501 & -505: 100 psi	OK R/W OK
18	Pressure Drop	3000	Pres.	Left Brake Ret. to Bench Right Brake to Flowmeter	With pressure applied rapidly actuate & maintain input lever at 0.89 inch travel. Open needle valve at Right Brake to produce a flow of 16 GPM. The pressure drop (minus tare) shall not exceed the following: Basic & -503: 1200 psi -501 & -505: 100 psi Pressure at Pressure Port shall not fall below the following: Basic & -503: 2500 psi -501 & -505: 2950 psi	Pressure Drop OK R/W OK Minimum Inlet Pressure OK R/W OK
19				Right Brake Ret. to Bench Left Brake to Flowmeter	With pressure applied rapidly actuate & maintain input lever at 1.08 inch travel. Open needle valve at Right Brake to produce a flow of 16 GPM. The pressure drop (minus tare) shall not exceed the following: Basic & -503: 600 psi -501 & -505: 100 psi	OK R/W OK
20		500	Return	Left Brake & Right Brake to Flowmeter	With levers in the Full OFF position apply pressure. Flow from each Brake Port shall be steady and greater than 4.5 GPM with no tendency to block flow.	Left Brake OK R/W OK Right Brake OK R/W OK

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 (TS35950D.DWG)

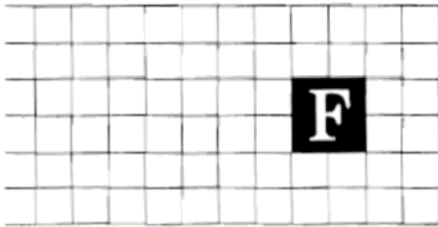
Certificate of Compliance and Test Data

35950-505 Dual Brake Metering Valve Assembly Job # _____
 Eff. Date 01/30/98 Revision N/C Revised _____

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results																																																																																											
#1 (AA)	Functional Operation	3000	Pres.	Gages @ Brake Ports 60 psi Relief @Return	Drain all fluid from the end caps by removing bleeder valves. Replace bleeder valves; torque bleeder valves to 10-15 ft.-lbs. Apply pressure. After a one minute wait record input lever travel & input force vs. gage pressure at the following pressures: <table border="1"> <thead> <tr> <th>Ascending Pressure</th> <th>Lever Travel (Inches)</th> <th>Input Force (Pounds)</th> <th>Left Brake</th> <th>Right Brake</th> </tr> </thead> <tbody> <tr> <td>LEFT 70 psi</td> <td>145 .129-.179</td> <td>5 3.15-7.18</td> <td>OK R/W</td> <td>OK R/W</td> </tr> <tr> <td>RIGHT</td> <td>181</td> <td>5</td> <td>OK</td> <td>OK</td> </tr> <tr> <td>250 psi</td> <td>195 .203-.254</td> <td>7 5.84-10.36</td> <td>OK R/W</td> <td>OK R/W</td> </tr> <tr> <td></td> <td>243</td> <td>8</td> <td>OK</td> <td>OK</td> </tr> <tr> <td>600 psi</td> <td>340 .345-.400</td> <td>12 11.08-18.55</td> <td>OK R/W</td> <td>OK R/W</td> </tr> <tr> <td></td> <td>367</td> <td>15</td> <td>OK</td> <td>OK</td> </tr> <tr> <td>1200 psi</td> <td>528 .590-.650</td> <td>23 20.06-27.16</td> <td>OK R/W</td> <td>OK R/W</td> </tr> <tr> <td></td> <td>560</td> <td>26</td> <td>OK</td> <td>OK</td> </tr> <tr> <td>2500 psi</td> <td>720 .766-.825</td> <td>46 39.52-50.16</td> <td>OK R/W</td> <td>OK R/W</td> </tr> <tr> <td></td> <td>743</td> <td>52</td> <td>OK</td> <td>OK</td> </tr> <tr> <td>3000 psi</td> <td>789 (Basic & -503) .833-.892</td> <td>57 47.00-59.00</td> <td>OK R/W</td> <td>OK R/W</td> </tr> <tr> <td></td> <td>776 (-501 & -505) .766-.825</td> <td>59</td> <td>OK</td> <td>OK</td> </tr> </tbody> </table>	Ascending Pressure	Lever Travel (Inches)	Input Force (Pounds)	Left Brake	Right Brake	LEFT 70 psi	145 .129-.179	5 3.15-7.18	OK R/W	OK R/W	RIGHT	181	5	OK	OK	250 psi	195 .203-.254	7 5.84-10.36	OK R/W	OK R/W		243	8	OK	OK	600 psi	340 .345-.400	12 11.08-18.55	OK R/W	OK R/W		367	15	OK	OK	1200 psi	528 .590-.650	23 20.06-27.16	OK R/W	OK R/W		560	26	OK	OK	2500 psi	720 .766-.825	46 39.52-50.16	OK R/W	OK R/W		743	52	OK	OK	3000 psi	789 (Basic & -503) .833-.892	57 47.00-59.00	OK R/W	OK R/W		776 (-501 & -505) .766-.825	59	OK	OK	<table border="1"> <thead> <tr> <th>Left Brake</th> <th>Right Brake</th> </tr> </thead> <tbody> <tr><td>OK</td><td>OK</td></tr> <tr><td>R/W</td><td>R/W</td></tr> <tr><td>OK</td><td>OK</td></tr> <tr><td>OK</td><td>OK</td></tr> <tr><td>R/W</td><td>R/W</td></tr> <tr><td>OK</td><td>OK</td></tr> <tr><td>OK</td><td>OK</td></tr> <tr><td>R/W</td><td>R/W</td></tr> <tr><td>OK</td><td>OK</td></tr> <tr><td>OK</td><td>OK</td></tr> <tr><td>R/W</td><td>R/W</td></tr> <tr><td>OK</td><td>OK</td></tr> </tbody> </table>	Left Brake	Right Brake	OK	OK	R/W	R/W	OK	OK	OK	OK	R/W	R/W	OK	OK	OK	OK	R/W	R/W	OK	OK	OK	OK	R/W	R/W	OK	OK
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 (TS35950E.DWG)

Certificate of Compliance and Test Data

35950-505 Dual Brake Metering Valve Assembly Job # _____
 Eff. Date 01/30/98 Revision N/C Revised _____

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results			
18 2					With the lever force at 67 lbs., the lever travel must be 1.070/1.090 in. Adjust and lock the Full On screw.	<input checked="" type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK			
19 3	Functional Operation	3000	Pres.	Gages @ Brake Ports 60 psi Relief Return	From Full On allow levers to retract to give noted pressures. Compare data with that recorded in Test #15. Hysteresis shall not exceed noted values.				
					Declining Pressure	Lever Travel (Inches)	Input Force (Pounds)	Left Brake	Right Brake
					2500 psi	720 Within ±.100 of Test 15	41 Within ± 11.30 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK
					1200 psi	725 530 Within ±.100 of Test 15	42 20 Within ± 6.88 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK
					800 psi	560 355 Within ±.100 of Test 15	17.5 12.5 Within ± 4.84 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK
					250 psi	370 190 Within ±.100 of Test 15	12 6 Within ± 3.65 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK
					70 psi	220 180 Within ±.100 of Test 15	7 3 Within ± 3.03 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK

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 (TS35950F.DWG)

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35950-505 Dual Brake Metering Valve Assembly Job # _____

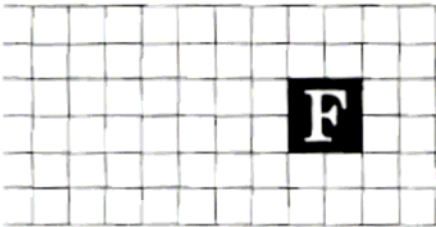
Eff. Date 01/30/98 Revision N/C Revised _____

TEST DATA

Test #	Test Por	Pressure psi	Test Port	Closed Port	Requirements			Results	
					Ascending Pressure	Lever Travel (Inches)	Input Force (Pounds)	Left Brake	Right Brake
18	Functional Operation	3000	Pres.	Gages Brake Ports 60 psi Relief Return	Drain all fluid from the end caps by removing bleeder valves. Replace bleeder valves; torque bleeder valves to 10-15 ft.-lbs. Apply pressure. WITHOUT waiting, record input lever travel & input force vs. gage pres. at the following pressures:				
					70 psi	.129-.179	3.15-7.18	OK	OK
					250 psi	.203-.254	5.84-10.36	R/W	R/W
					600 psi	.345-.400	11.08-16.55	OK	OK
					1200 psi	.590-.650	20.06-27.16	R/W	R/W
					2500 psi	.766-.825	39.52-50.16	OK	OK
					3000 psi	(Basic&-503) .833-.892 (-501&-505) .766-.825	47.00-59.00	R/W	R/W
								OK	OK

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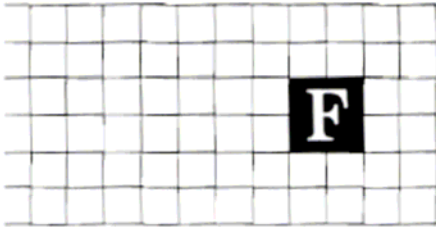
35950-505 Dual Brake Metering Valve Assembly Job # _____
 Eff. Date 01/30/98 Revision "A" Revised 01/28/00

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results																														
19	Functional Operation	3000	Pres.	Gages Brake Ports 60 psi Relief Return	From Full On allow levers to retract to give noted pressures. Compare data with that recorded in Test #15. Hysteresis shall not exceed noted values.	<table border="1"> <tr> <th>Declining Pressure</th> <th>Lever Travel (Inches)</th> <th>Input Force (Pounds)</th> <th>Left Brake</th> <th>Right Brake</th> </tr> <tr> <td>2500 psi</td> <td>Within ±.100 of Test 15</td> <td>Within ±11.30 of Test 15</td> <td><input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK</td> <td><input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK</td> </tr> <tr> <td>1200 psi</td> <td>Within ±.100 of Test 15</td> <td>Within ±6.88 of Test 15</td> <td><input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK</td> <td><input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK</td> </tr> <tr> <td>600 psi</td> <td>Within ±.100 of Test 15</td> <td>Within ±4.84 of Test 15</td> <td><input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK</td> <td><input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK</td> </tr> <tr> <td>250 psi</td> <td>Within ±.100 of Test 15</td> <td>Within ±3.65 of Test 15</td> <td><input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK</td> <td><input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK</td> </tr> <tr> <td>70 psi</td> <td>Within ±.100 of Test 15</td> <td>Within ±3.03 of Test 15</td> <td><input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK</td> <td><input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK</td> </tr> </table>	Declining Pressure	Lever Travel (Inches)	Input Force (Pounds)	Left Brake	Right Brake	2500 psi	Within ±.100 of Test 15	Within ±11.30 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	1200 psi	Within ±.100 of Test 15	Within ±6.88 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	600 psi	Within ±.100 of Test 15	Within ±4.84 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	250 psi	Within ±.100 of Test 15	Within ±3.65 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	70 psi	Within ±.100 of Test 15	Within ±3.03 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK
					Declining Pressure		Lever Travel (Inches)	Input Force (Pounds)	Left Brake	Right Brake																										
					2500 psi		Within ±.100 of Test 15	Within ±11.30 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK																										
					1200 psi		Within ±.100 of Test 15	Within ±6.88 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK																										
					600 psi		Within ±.100 of Test 15	Within ±4.84 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK																										
					250 psi		Within ±.100 of Test 15	Within ±3.65 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK																										
70 psi	Within ±.100 of Test 15	Within ±3.03 of Test 15	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK																																
30 4	Binding	3500		T ¹ to Return Between Gage & Brake	Cycle levers to obtain 3500 PSI at Brake Port. Slowly move levers towards Off position. Lap assemblies shall return as indicated by normal leakage at Return Ports.	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK																													
					Cycle levers to obtain 3000 PSI @16 GPM at Brake Port. Slowly move levers towards Off position. Lap assemblies shall return as indicated by normal leakage at Return Ports.	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK	<input type="checkbox"/> OK <input type="checkbox"/> R/W <input type="checkbox"/> OK																													

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fortner engineering and manufacturing, inc.

HYDRAULICS / PNEUMATICS / ELECTRO MECHANICAL ASSEMBLIES

CERTIFICATED F.A.A. REPAIR STATION #PU3R776L
 CLASS 1 ACCESSORY RATING
 HOLDER OF SFAR 36 AUTHORITY

Customer FEW Ex DACO S/N 444076

Chapter 32-44-03 F.E. S/N _____

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 glendale, california 91201-2079
 (818) 240-7740 / (213) 245-4591

Page 8 of 8 fax (818) 240-1009
 (TS35950H.DWG)

Certificate of Compliance and Test Data

35950-505 Dual Brake Metering Valve Assembly Job # _____
 Eff. Date 01/30/98 Revision "A" Revised 01/26/00

TEST DATA

Test #	Test For	Pressure psi	Test Port	Closed Port	Requirements	Results
26 6	Lever Travel	None	None	None	Open bleed valves on 1st stage end caps and with zero inlet pressure, actuate levers from Full Off to Full On. Lever travel shall be 0.99±.010, and force required shall not exceed 9.0 lbs. at each lever.	Left Brake <input checked="" type="checkbox"/> OK <input type="checkbox"/> R/W <input checked="" type="checkbox"/> OK Right Brake <input checked="" type="checkbox"/> OK <input type="checkbox"/> R/W <input checked="" type="checkbox"/> OK

NOTE: The following tests are a re-test of Tests #5&6.

23 7	Compensation	3000	Pres.	Gages @ Brake Ports w/inline Needle Valve	With lever in the full OFF position apply pressure. Move lever to obtain 2200 psi at Brake Port. Slowly open needle valve to obtain 80cc leakage from Brake Port. Pressure at Brake Port shall not fall below 2000 psi.	Left Brake _____ psi Right Brake _____ psi
24 8					Connect a hand pump to needle valve of Brake Port under test. With pressure applied move lever to obtain 2200 psi at brake port. Open needle valve and apply hand pump pressure. Brake Port pressure must not exceed: 2550 for 35950 & 35950-503 2500 for 35950-501 & 35950-505	Left Brake _____ psi Right Brake _____ psi

Left Brake Lap Assys.

35555-35068 Lap Assy.

L/A S/N _____

36905 Lap Assy.

L/A S/N _____

Right Brake Lap Assys.

35555-35068 Lap Assy.

L/A S/N _____

36905 Lap Assy.

L/A S/N _____

Date 11/06/06

Test Operator [Signature]



Inspector [Signature]



Note: Not all testing was accomplished.
 Unit not ready for installation.