NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Washington, D.C. 20594

May 8, 2003

Digital Flight Data Recorder Factual

ADDENDUM II

By Sarah McComb

A. ACCIDENT

Location:	Rancho Cordova, California
Date:	February 16, 2000
Time:	1951 pacific standard time (PST)
Aircraft:	Emery Worldwide Airlines, DC-8-71F, N8079U
NTSB Number:	DCA00MA026

B. GROUP

N/A

C. SUMMARY

On February 16, 2000, at 1951 Pacific Standard Time (PST), a Douglas DC-8-71F, N8079U, registered to and operated by Emery Worldwide Airlines as flight 17 for the 14 CFR Part 121 scheduled cargo service from Sacramento, California, to Dayton, Ohio, crashed shortly after takeoff from Mather Field, Rancho Cordova, California. Visual meteorological conditions prevailed and an instrument flight rules flight plan was filed. The airplane was destroyed by impact forces and a post-crash fire. The three flight crew members were fatally injured.

D. ADDENDUM

This Addendum to the Digital Flight Data Recorder (DFDR) Factual (dated June 12, 2001) contains additional flight data recorder information regarding the parameters recorded on the accident airplane, N8079U, and also on two other Emery DC-8 airplanes, N8076U and N8084U.

1. N8079U

A. Documentation

The Safety Board initially received an electronic file provided by Emery through L2 Consulting Services, Inc. The file contained information on the 17 parameters recorded on the accident airplane's DFDR. The file contained either equations for converting a parameter's raw recorded values to engineering units or a listing of a parameter's raw recorded values versus measured engineering units. Raw recorded decimal values versus engineering units provided a basis for the elevator conversion in the laboratory's software program.

Upon request, L2 Consulting Services, Inc., provided a copy of the the work card used for the parameter correlation performed on N8079U. Attachments I-1 to I-16 contain a copy of the Emery Worldwide Airlines Work Card, "F800 DFDR Correlation Test Procedure - 17 Parameters," dated November 2, 1999, for N8079U. The work card contained a description of the test procedure and correlation information for each of the 17 parameters recorded. For the elevator correlation, a table of raw recorded octal values versus measured elevator position (in degrees) was included. This information was the same as in the file originally provided to the Safety Board.

B. Elevator Conversion

The Safety Board's subsequent conversion of the recorded elevator data based on this relationship resulted in a potential range of elevator positions from 12.8° trailing edge up (TEU) to 26.6° trailing edge down (TED). A DC-8 elevator's normal operating range is from 27° TEU to 16.5° TED. Further examination of the converted elevator data indicated that the recorded elevator position was 11° TED when the gust lock was engaged. However, with the gust lock engaged, by design the elevator should be in its neutral, or 0°, position. The Board further noted that during the airplane's departure from Reno, the elevators displayed a TED deflection while the control columns were near their rigged neutral position, which normally corresponds to a neutral elevator position of about 0°. Further, the elevator's range of motion above and below neutral appeared to be accurate but the total range of motion was offset from its normal

range. As a result, an 11° offset in the TEU direction was applied to the converted elevator position data. The table below summarizes the correlation information for the elevator position, as well as the elevator position with the 11° TEU offset for comparison.

Correlation: Raw Elevator Values, Recorded (decimal)	**Correlation: Elevator Position, Measured (degrees, + = TEU)**	**Elevator Position with 11 degree offset (degrees, + = TEU)**
1760	-26.6	-15.6
1920	-20	-9
2078	-15	-4
2230	-10	1
2462	0	11
2566	5	16
2666	10	21
2726	12.8	23.8

C. Control Column Position

The Safety Board's evaluation of the recorded control column position indicated that a shift had occurred in the range of the raw control column position data between the time of the correlation and the accident. The lower and upper bounds of the raw control column position data for the correlation were lower than those recorded on the DFDR.[1] However, the range recorded on the DFDR was not close to either the upper or lower limit of the sensor range. The table below summarizes the lower and upper bounds of the raw control column position data for the correlation and as recorded on the DFDR.

	Correlation: Raw Control Column Values (decimal)	**DFDR: Raw Control Column Values (decimal)**
Lower bound	1162	1414
Upper bound	1640	1797

[1] Control column position was only recorded once per second of the DFDR. As a result, and depending on the speed of control column inputs, it is possible that the DFDR did not record the peak lower and upper values of raw control column position.

Using the conversion based on the correlation, control column position recorded on the DFDR was 15 deg. forward of vertical when the gust lock was engaged. This established a known relationship between the geometry of the control column system and the data recorded on the DFDR. Further, in reviewing the control column correlation, the Safety Board noted that the total range of control column position measured was 29.6 deg., very close to the design total range of 30.25 deg. As a result, no adjustment was made to the control column position conversion provided by the operator for this airplane.

2. N8076U

The Safety Board received an electronic file from Emery with information on the 17 parameters recorded on the DFDR installed on N8076U; the Systems Group ground test airplane and also the airplane involved in a landing incident (MIA01IA129). Attachment II-1 contains a copy of, "AVSCAN PARAMETER FORMULAS FOR N8076U." As with the accident airplane, the file contained either equations for converting a parameter's raw recorded values to engineering units or a listing of a parameter's raw recorded values versus measured engineering units. For those parameters with a listing of raw recorded values versus measured engineering units, only the minimum, neutral, and maximum engineering units and their corresponding raw recorded values were provided. When looking at the file in comparison to the information provided for the accident airplane, the Board noted that the minimum, neutral, and maximum engineering units for those parameters were the same as for the accident airplane. However, the corresponding raw recorded values were not the same.

The Safety Board used the information provided in the file as a basis for the parameter conversions. When applied to the data recorded during the ground test, the Board noted that the converted FDR elevator and control column values did not match the elevator and control column positions physically measured on the airplane during the ground test. Since the measurements taken during the ground test essentially provided a correlation, the measured elevator and control column position values were then used as the basis for the conversions and subsequent examination of the ground test data.

3. N8084U

The Safety Board received a copy of the verification test procedure information on the 17 parameters recorded on the DFDR installed on N8084U; an airplane involved in an incident (SEA01IA039). Attachments III-1 to III-11 contain a copy of the Emery Worldwide Airlines Work Card, "F800 DFDR Ground Test Procedure - 17 Parameters," dated January 14, 2000,

for N8084U. When looking at the verification test procedure in comparison to the information provided for the accident airplane, the Board noted that for control surface and control input parameters, only the minimum, neutral, and maximum raw recorded values were documented. The Board inquired of L2 as to what the corresponding engineering units should be for those parameters. The response was that the engineering units from the correlation performed on the accident airplane, N8079U, should be used. L2 further stated that a full correlation was only performed on the first Emery DC-8 that was upgraded to record additional parameters, the accident airplane, N8079U. Those airplanes that were subsequently upgraded were only subject to a verification test, during which the control surface and control input raw values on the DFDR were verified to be in similar ranges of those documented during the full correlation. The control surfaces and control inputs were moved to minimum, neutral, and maximum positions, but those positions were never physically measured during the verification test. Using the raw values from N8084's verification test and the engineering units from N8079U's correlation test to convert elevator and control column positions, the Board found that the parameters' values were not within the parameters' normal operating ranges, nor were the values similar to those of the accident airplane.

Sarah L. McComb
Mechanical Engineer

Attachments:

Attachments I-1 to I-16:	Emery Worldwide Airlines Work Card, "F800 DFDR Correlation Test Procedure - 17 Parameters"
Attachment II-1:	AVSCAN PARAMETER FORMULAS FOR N8076U
Attachments III-1 to III-11:	Emery Worldwide Airlines Work Card, "F800 DFDR Ground Test Procedure - 17 Parameters"

Attachment I

Emery Worldwide Airlines Work Card,
“F800 DFDR Correlation Test Procedure - 17 Parameters”

11/6/99 80790

I. GENERAL

DATA COLLECTED BY MARK LEBOVITZ 11/6 & 11/7/99

This ground test collects correlation data for the EWA 70 series F800 configuration of DACO 1 through 6 parameters, ASM 7 through 11 parameter and FSE 12 through 17 parameter configuration .

A. EQUIPMENT REQUIRED FOR TEST:

1. Avionica, Inc. RSU DFDR Tester/Transcriber, Fairchild/Loral Portable Display Unit (PDDU), or Equivalent
2. Digital Protractor ✓
3. Tilt Table and DG/VG Extender Harnesses (Optional) ✓
4. Pitot-static test equipment ✓
5. Signal Generator HP204D or equivalent ✓
6. Work-stand capable of reaching the aft side of the horizontal stabilizer. ✓

B. The DFDR monitors and records 17 parameters:

1. TIME
2. VERTICAL ACCEL.
3. LONGITUDINAL ACCEL.
4. ELEVATOR SURFACE
5. RADIO TRANSMISSIONS
6. AIRSPEED
7. PITCH ATTITUDE
8. ROLL ATTITUDE
9. ENGINE THRUST
10. HEADING/ COMPASS
11. ALTITUDE
12. AUTOPILOT ENGAGE
13. CONTROL WHEEL POSITION
14. RUDDER PEDAL POSITION
15. AILERON SURFACE
16. CONTROL COLUMN POSITION
17. RUDDER SURFACE

II. TEST SETUP

A. Record the following:

Aircraft Serial Number/ Tail Number:	45947 N8079U
DFDR Part Number:	17M303-282
DFDR Serial Number:	04018
Biaxial Accelerometer Part Number (Left Wheel Well):	3001-01-101-2
Biaxial Accelerometer Serial Number:	

TTS WILL CHANGE OUT UNIT MISSING DATA PLATE

B. Check that the following aircraft systems are powered: DFDR power, 115 VAC Left Emergency Buss, 28 VAC Instrument Buss 2 & 3, 28 VDC Left Emergency Buss, Pilots & Co-pilots Horizon & Heading, VHF Communication Equipment

C. Connect front connector J1 on the DFDR to the DFDR test equipment

WARNING: WHEN POWER TO THE DFDR IS ON, THE DFDR WILL RECORD OVER PREVIOUSLY RECORDED DATA (25 HOURS EARLIER). TO MINIMIZE DESTRUCTION OF PREVIOUSLY RECORDED DATA, ONLY HAVE DFDR ON DURING TESTING.

D. Turn **ON** DFDR Switch and verify that the FLIGHT RECORDER OFF light extinguishes.

E. Verify FDR ON/OFF switch panel lighting works from bright to off using the FE panel light control.

III. SYNC WORD

A. Select Word 1. ✓

B. Verify the following SYNC Octal reading by Frame ✓

FRAME #	WORD #1
1	1107 ✓
2	2670 ✓
3	5107 ✓
4	6670 ✓

Mark Below 11/6/99

IV. TIME

A. Select Word 17. ✓

B. Verify that Word 17 counts upward. ✓ 11/10/99

V. MICROPHONE KEY

A. Select Word 16. ✓

B. Set power to Captain's and First Officer's VHF and HF Radios. ✓

NOTE: Skip HF testing if HF systems deactivated.

C. Verify that Bit 1 (counting from the right) is "1." ✓

NOTE: Use unused VHF and HF frequencies for keying tests. ✓

D. Select and key Captain's Audio Panel on VHF 1 and verify that Bit 1 toggles to "0" or the OCTAL number changes down by 1. ✓

E. Repeat steps C and D for the Captain's Audio Panel with HF 1. ☑

F. Verify that Bit 3 (counting from the right of the 12 bit word) is "1." Key F./O.'s Audio Panel on VHF 2 and verify that Bit 3 toggles to "0" or the OCTAL number changes down by 4. ✓

G. Key F./O.'s Audio Panel on HF 2 and verify that Bit 3 toggles to "0." ☑

FIXED A/C FOR HF 1&2

VI. AUTOPILOT ENGAGE STATUS

A. Select Word 16

B. Verify that Bit 2 (second from right of 12 bit Word) is "0."

C. Engage Autopilot and verify that Bit 2 toggles to "1." (or the OCTAL number changes up by 2)

AUTOPILOT POSITION	OCTAL READING
ENGAGED	0507
DISENGAGED	0505

☑

A P CKT NOW ENGAGED

VII. ALTITUDE

A. Select Word 13 for Course and Word 29 for Fine. ✓

B. Connect Pitot-static test equipment to the Pitot tube and static port of the Pitot-static system that is connected to Air Data Compute (ADC Shelf 5 Outboard) and Captain's pitot-static system for reference. Reference the Pitot-static section of the DC-8 Maintenance Manual for test procedure standards. Record Pitot and Static system source used for ADC air data. ✓

Static: PTC
Pitot: ALTERNATE

D. Using the Pitot-static test box, step through the following altitudes. Verify that the altitude displayed on the Captain's Altimeter is the expected value. ✓

ELECTRIC ALTITUDE
Word 13 Course Altitude
Frames 1 thru 4

ALTITUDE ±100 Feet	CAPTAIN'S ALTITUDE	ACTUAL OCTAL VALUE
2000	2000	0141
4000	4010	0250
8000	8000	0445
13500	13500	0671
16000	16000	0761
22000	22000	1203
29500	29500	1537
34200	34200	2035

[redacted] 11/6/99

Word 29 Fine Altitude
Frames 1 thru 4

ALTITUDE ±100 Feet	CAPTAIN'S ALTITUDE	ACTUAL OCTAL VALUE
2000	2000	3207
4000	4010	6460
8000	8000	4747
13500	13500	5561
16000	16000	1517
22000	22000	3200
29500	29500	7300
34200	34200	6766

[redacted] 11/6/99

VIII. AIRSPEED

A. Select Word 19. ✓

B. Verify that Pitot-static test equipment still is connected to ADC and Captain's pitot-static system ✓

C. Using the Pitot-static test box, step through the following airspeeds. Correlate to the airspeed that is displayed on Captain's airspeed indicator is the expected value. ✓

ELECTRIC AIRSPEED
Word 19
Frames 1 thru 4

AIRSPEED ±5 Knots	ACTUAL AIRSPEED	ACTUAL OCTAL VALUE
100	100	0030
150	150	0630
200	200	1347
250	250	2147
300	300	2770
350	350	3436

[redacted] 11/6/99

IX. HEADING/COMPASS

A. Select Word 3. ✓

B. Apply electrical power to the directional gyro compass system and either rotate the aircraft on a compass rose or manually position the First Officer's MHR Indicator to the following: ✓

HEADING
Word 3
Frames 1 thru 4

HEADING ±1 °	ACTUAL HEADING	ACTUAL OCTAL VALUE
0	0	0007
10	10	0237
20	20	0430
30	30	0574
40	40	0730
50	50	1057
60	60	1217
70	70	1363
80	80	1557
90	90	1777
100	100	2227
110	110	2407
120	120	2560
130	130	2707
140	140	3045
150	150	3204
160	160	3343
170	170	3530
180	180	3776
190	190	4227
200	200	4421
210	210	4573
220	220	4727
230	230	5063
240	240	5217
250	250	5367
260	260	5547
270	270	5777
280	280	6222
290	290	6410
300	300	6560
310	310	6714
320	320	7047
330	330	7207
340	340	7347
350	350	7540
360	360	0007

[redacted] 11/6/99

X. ROLL ATTITUDE

A. Remove power to Vertical Gyro #2. ✓

B. Remove Vertical Gyro #2 and set on tilt table or employ extender harness to keep Vertical Gyro on mounting bracket. Reset power to Vertical Gyro #2. ✓

C. Using a digital protractor, tilt Vertical Gyro #2 to the following angles. Verify that roll is shown on the F.O.'s Horizon Indicator. ✓

D. Select Word 20. ✓

ROLL ATTITUDE
Word 20
Frames 1 thru 4

ROLL ±1 °	ACTUAL ROLL	ACTUAL OCTAL VALUE
0°	0°	0001
10° right	10° right	0237
20° right	20° right	0423
30° right	30° right	0577
40° right	40° right	0727
50° right	50° right	1057
60° right	60° right	1217
10° left	10° left	7547
20° left	20° left	7354
30° left	30° left	7203
40° left	40° left	7050
50° left	50° left	6716
60° left	60° left	6560

[redacted] 11/6/99

XI. PITCH ATTITUDE

A. Ensure that Vertical Gyro #2 is still sitting on tilt table or employ extender harness to keep the Vertical Gyro on the mounting bracket. ✓

B. Using a digital protractor, tilt Vertical Gyro #2 to the following angles. Verify that pitch is indicated on the F.O.'s Horizon Indicator. ✓

C. Select Word 4. ✓

PITCH ATTITUDE
Word 4
Frames 1 thru 4

PITCH ±1 °	ACTUAL PITCH	ACTUAL OCTAL VALUE
Neutral	~~0023~~ 0°	~~0023~~ 0007
10° Up	10° up	0237
20° Up	20° up	0423
30° Up	30° up	0570
40° Up	40° up	0723
50° Up	50° up	1057
60° Up	60° up	1217
10° Down	10° Down	7550
20° Down	20° Down	7360
30° Down	30° Down	7210
40° Down	40° Down	7064
50° Down	50° Down	6720
60° Down	60° Down	6574

[redacted] 11/6/99

XII. N1

A. Using the signal generator, inject the signal at N1 Speed Probe (Tach Generator) pins 1 and 2 (or by running engines), record N1 for the following Frame and Word.

B. Monitor the N1 indicator for the engine under test for N1 settings.

N1
FRAME 1

N1% +/- 1	ENGINE #1 FRAME 1 WORD 11 OCTAL	ENGINE #2 FRAME 1 WORD 27 OCTAL
20	4704	4702
30	4207	4204
40	3671	3716
50	3412	3374
60	3202	3214
70	3055	3061
80	2724	2724
90	2532	2544
100	2407	2420
110	2267	2303

[redacted] 11/4/99

N1
FRAME 2

N1% +/- 1	ENGINE #3 FRAME 2 WORD 11 OCTAL	ENGINE #4 FRAME 2 WORD 27 OCTAL
20	4707	4733
30	4202	4206
40	3701	3706
50	3401	3405
60	3205	3205
70	3050	3053
80	2707	2712
90	2524	2537
100	2401	2406
110	2300	2277

[redacted] 11/7/99

XIII. **ACCELERATION**

A. With the biaxial accelerometer (left hand wheel well) in the normal position, verify the following while aircraft is approximately level:

ACCELERATION

ACCEL.	Word	ACTUAL OCTAL VALUE
Vert.	2	3615
Long.	7	4055

$V_{DC} = \frac{DEC-1404}{416}$

B. Forward +1g Pointed Up

$Long_{DC} = \frac{DEC*5.25}{4095} - 2.6$

2.4

ACCELERATION

ACCEL.	Word	ACTUAL OCTAL VALUE
Vert.	2	2762
Long.	7	3312

XIV. CONTROL WHEEL POSITION

A. Provide main system hydraulic power following General Precautions in Douglas DC8 MM chapter 27-00-00 Maintenance Practices. ✓

B. Select Word 24. ✓

C. Enter octal values for various control wheel positions indicated below. ✓

CONTROL WHEEL POSITION	OCTAL READING WORD 24	DEC
Neutral	4776	2558
10° right	5104	
20° right	5202	
30° right	5304	
40° right	5406	
50° right	5504	2995
60° right	5607	
Full right (86°)	6056	3118
10° left	4700	
20° left	4600	
30° left	4501	
40° left	4377	
50° left	4277	
60° left	4177	2175
Full left (89.5°)	3713	1995

[redacted] 4/6/99

RIGHT CONTROL WHEEL IS LEFT AILERON DOWN.

MAY BE CONFUSING DURING ANALYSIS ?

Degrees = $\frac{\text{DEC} - 2558}{6.55}$ + right − left

XV. AILERON SURFACE (LEFT)

A. Select Word 8. ✓

B. Enter octal values for the aileron surface positions indicated below. ✓

AILERON SURFACE POSITION	OCTAL READING WORD 8
Trailing Position	0660
3° Up	0634
6° Up	0576
9° Up	0540
12° Up	0501
15° Up	0443
Full Up (17.0 °)	0417
3° Down	0730
6° Down	0761
9° Down	1017
12° Down	1047
15° Down	1107
Full Down (16.9 °)	1147

432

291

583

[redacted] 11/6/99

USED INNER AILERON AS REF POINT

D

XVI. CONTROL COLUMN POSITION

A. Select Word 12. ✓

B. Enter octal values for various control column positions indicated below: ✓

CONTROL COLUMN POSITION	OCTAL READING WORD 12
Neutral Position	2473
5° Aft	2346
10° Aft	2261
15° Aft	2214
Full Aft (17 °)	2212
5° Forward	2645
10° Forward	3037
Full Forward (12.6 °)	3150

1339

1164

1567

[redacted] 11/6/99

AFT Degrees = ±[redacted]1339 - DEC / 11.66 +

FWD DEGREES [redacted] 1339 - DEC / 22.8 −

XVII. ELEVATOR SURFACE

A. Select Words 9 and 25. ✓

B. Using a digital protractor, move the Elevator to the following positions. ✓

C. Use Control Column Neutral pin position for the neutral elevator position (Ref. MM 27-30 page 506). ✓

ELEVATOR POSITION
Word 9 and 25
Frames 1 thru 4

PITCH ±1 °	ACTUAL PITCH	ACTUAL OCTAL VALUE	
Neutral	0°	4636	-145
5° Up	5° Up	5006	-135
10° Up	10° Up	5152	-123
Full Up (12.8 °)	12.8° Up	5246	-118
10° Down	10° Down	4266	-167.
15° Down	15° Down	4036	-177
Full Down (26.6 °)	26.6° Down	3340	+158
20° Down	20° Down	3600	+170

[redacted] 11/2/99

XVIII. RUDDER PEDAL POSITION

A. Provide main system hydraulic power following General Precautions in Douglas DC8 MM chapter 27-00-00 Maintenance Practices. ✓

B. Select Word 28. ✓

C. Enter octal values for various rudder pedal positions indicated below. ✓

Rudder Pedal POSITION	OCTAL READING WORD 28	
Level (even)	2524	1364
1" Right Pedal	2714	
2" Right Pedal	3150	1640
Full Right Pedal (4.4 " Deflection)	3603	
1" Left Pedal	2362	
2" Left Pedal	2231	1171
Full Left Pedal (4.5 " Deflection)	2017	

[redacted] 11/6/99

XIX. RUDDER SURFACE

A. Select Word 32. ✓

B. Enter octal values for the rudder surface positions indicated below: ✓

C. Set Flaps at 10 degrees. ✓

RUDDER SURFACE POSITION	OCTAL READING WORD 32	
Trailing Position	2743	1507
13" right	3673	
26" right	4541	
Full right (39.5")	5422	2934
13" left	1774	
26" left	1033	
Full left (39.5")	0050	40

[redacted] 11/7/99

XX. TEST CLOSEOUT

A. Remove all test equipment, secure all LRUs, and reinstall any panels that were removed to accomplish this test.

B. Review pages of the checkout for omissions, clarity or errors and return to the Operator's Quality Control Department for retention in aircraft records file.

Attachment II

AVSCAN PARAMETER FORMULAS FOR N8076U

AVSCAN PARAMETER FORMULAS FOR N8076U

17,0xf,0,0xfff,1.000000,0.000000,Time, ,lin_func_2,0,~
16,0xf,0,0x1,1.000000,0.000000,PTT#1, ,lin_func_2,0,~
16,0xf,2,0x1,1.000000,0.000000,PTT#2, ,lin_func_2,0,~
16,0xf,1,0x1,1.000000,0.000000,APEng, ,lin_func_2,0,~
13,0xf,0,0xfff,1.000000,0.000000,ALTcrs,ft ,inter_func_2,0,0/0 256/6938 512/16913 768/26850 1024/33750 1280/40688 1536/50663 1792/60600 2048/67500 2304/74438 2560/84413 2816/94350 3015/100000 4095/100000
29,0xf,0,0xfff,1.000000,0.000000,ALTfin,ft ,inter_func_2,0,0/0 256/257 512/626 768/994 1024/1250 1280/1507 1536/1876 1792/2244 2048/2500 2304/2757 2560/3126 2816/3494 3015/3704 3072/3750 3328/4007 3584/4376 3840/4744 4095/5000
19,0xf,0,0xfff,1.000000,0.000000,IAS,kts ,inter_func_2,0,0/100 256/128 512/168 768/207 1024/235 1280/263 1536/303 1792/342 2048/370 2304/398 2560/438 2816/477 3072/505 3328/533 3380/540 3381/0 3584/33 3840/72 4095/100
3,0xf,0,0xfff,1.000000,0.000000,HDG,Deg ,inter_func_2,1,0/0 159/10 256/18.5 380/30 512/45 655/60 768/71.6 1024/90 1280/108.5 1392/120 1536/135 1571/140 1763/160 2048/180 2304/198.5 2425/210 2560/225 2703/240 2816/251.6 3072/270 3328/288.5 3440/300 3584/315 3719/330 3840/341.6 4095/359.9
20,0xf,0,0xfff,1.000000,0.000000,ATTroll,Deg ,inter_func_2,1,0/0 159/10 216/15 275/20 383/30 508/45 655/60 1024/90 128 2047/180 2048/-180 2560/-135 3072/-90 3440/-60 3575/-45 3715/-30 3820/-20 3943/-10 4095/-0.1
4,0xf,0,0xffe,1.000000,0.000000,ATTpitch,Deg ,inter_func_2,1,0/0 154/10 275/20 376/30 520/45 655/60 1024/90 1536/135 2047/180 2048/-180 2560/-135 3072/-90 3452/-60 3583/-45 3720/-30 3824/-20 3944/-10 4095/-0.1
11,0x1,0,0xfff,1.000000,0.000000,ENG1n1,% ,inter_func,1,0/0 1/-999 2117/-999 2120/130 2201/120 2401/100 2526/90 2701/80 3045/70 3201/60 3401/50 3701/40 4201/30 4700/20 5677/10 7777/2.35
27,0x1,0,0xfff,1.000000,0.000000,ENG2n1,% ,inter_func,1,0/0 1/-999 2117/-999 2120/130 2201/120 2401/100 2526/90 2701/80 3045/70 3201/60 3401/50 3701/40 4201/30 4700/20 5677/10 7777/2.35
11,0x2,0,0xfff,1.000000,0.000000,ENG3n1,% ,inter_func,1,0/0 1/-999 2117/-999 2120/130 2201/120 2401/100 2526/90 2701/80 3045/70 3201/60 3401/50 3701/40 4201/30 4700/20 5677/10 7777/2.35
27,0xa,0,0xfff,1.000000,0.000000,ENG4n1,% ,inter_func,1,0/0 1/-999 2117/-999 2120/130 2201/120 2401/100 2526/90 2701/80 3045/70 3201/60 3401/50 3701/40 4201/30 4700/20 5677/10 7777/2.35
2,0xf,0,0xfff,0.002404,-3.375000,ACCvert,g ,lin_func_2,2,~
6,0xf,0,0xfff,0.002404,-3.375000,ACCvert_2,g ,lin_func_2,2,~
10,0xf,0,0xfff,0.002404,-3.375000,ACCvert_3,g ,lin_func_2,2,~
14,0xf,0,0xfff,0.002404,-3.375000,ACCvert_4,g ,lin_func_2,2,~
18,0xf,0,0xfff,0.002404,-3.375000,ACCvert_5,g ,lin_func_2,2,~
22,0xf,0,0xfff,0.002404,-3.375000,ACCvert_6,g ,lin_func_2,2,~
26,0xf,0,0xfff,0.002404,-3.375000,ACCvert_7,g ,lin_func_2,2,~
30,0xf,0,0xfff,0.002404,-3.375000,ACCvert_8,g ,lin_func_2,2,~
7,0xf,0,0xfff,0.000534,-1.083000,ACClong,g ,lin_func_2,2,~
15,0xf,0,0xfff,0.000534,-1.083000,ACClong_2,g ,lin_func_2,2,~
23,0xf,0,0xfff,0.000534,-1.083000,ACClong_3,g ,lin_func_2,2,~
31,0xf,0,0xfff,0.000534,-1.083000,ACClong_31,g ,lin_func_2,2,~
24,0xf,0,0xfff,1.000000,0.000000,Control Wheel,degrees ,inter_func,1,0/-100 4025/-89 4757/0 6074/89 7777/100
8,0xf,0,0xfff,1.000000,0.000000,Aileron,degrees ,inter_func,1,0/-20 47/-17 437/0 1017/17 7777/20
12,0xf,0,0xfff,1.000000,0.000000,Control Column,Degrees ,inter_func,1,0/21 1736/17 2470/0 2602/-12.6 7777/-15
32,0xf,0,0xfff,1.000000,0.000000,Rudder,degrees ,inter_func,1,0/-35 2206/-32.5 3056/0 4745/32.5 7777/35
9,0xf,0,0xfff,1.000000,0.000000,SFCelev,Deg ,inter_func,1,0/-30 3351/-26.6 4137/0 5107/12.8 7777/20
28,0xf,0,0xfff,1.000000,0.000000,Rudder Pedal,Inches ,inter_func,1,0/-5 2302/-4.5 2633/0 3364/4.5 7777/5
16,0xf,3,0x1,1.000000,0.000000,ADfault, ,lin_func_2,0,~
16,0xf,4,0x1,1.000000,0.000000,SDfault, ,lin_func_2,0,~
16,0xf,5,0x1,1.000000,0.000000,FDRfault, ,lin_func_2,0,~
16,0xf,6,0x1,1.000000,0.000000,SYNCHRO, ,lin_func_2,0,~
16,0xf,8,0x7,1.000000,0.000000,TRACK, ,lin_func_2,0,~

Attachment III

Emery Worldwide Airlines Work Card,
“F800 DFDR Ground Test Procedure - 17 Parameters”

N8084U

EMERY WORLDWIDE AIRLINES
Work Card Number: **1005-5003 70 SERIES**
Work Card Title: **F800 DFDR Ground Test Procedure - 17 Parameters**

MECH	INSP

I. GENERAL

This ground test verifies F800 DFDR inputs and the recording capability of the DFDR unit.

A. EQUIPMENT REQUIRED FOR TEST:

1. Avionica, Inc. RSU DFDR Tester/Transcriber, Fairchild/Loral Portable Display Unit (PDDU), or Equivalent
2. Digital Protractor
3. Tilt Table and DG/VG Extender Harnesses (Optional)
4. Pitot-static test equipment
5. Signal Generator HP204D or equivalent
6. Work-stand capable of reaching the aft side of the horizontal stabilizer.

B. The DFDR monitors and records 17 parameters:

1. TIME
2. VERTICAL ACCEL.
3. LONGITUDINAL ACCEL.
4. ELEVATOR SURFACE
5. RADIO TRANSMISSIONS
6. AIRSPEED
7. PITCH ATTITUDE
8. ROLL ATTITUDE
9. ENGINE THRUST
10. HEADING/ COMPASS
11. ALTITUDE
12. AUTOPILOT ENGAGE
13. CONTROL WHEEL POSITION
14. RUDDER PEDAL POSITION
15. AILERON SURFACE
16. CONTROL COLUMN POSITION
17. RUDDER SURFACE

II. TEST SETUP

A. Record the following:

Aircraft Serial Number/ Tail Number:	45974 N8084U
DFDR Part Number:	17M303-282
DFDR Serial Number:	04002
Biaxial Accelerometer Part Number (Left Wheel Well):	NO PART #
Biaxial Accelerometer Serial Number:	NO SERIAL NO#

ALL TAGS MISSING

AWP5A70E36?

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Released:

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B. Check that the following aircraft systems are powered: DFDR power, 115 VAC Left Emergency Buss, 28 VAC Instrument Buss 2 & 3, 28 VDC Left Emergency Buss, Pilots & Co-pilots Horizon & Heading, VHF Communication Equipment

C. Connect front connector J1 on the DFDR to the DFDR test equipment.

WARNING: WHEN POWER TO THE DFDR IS ON, THE DFDR WILL RECORD OVER PREVIOUSLY RECORDED DATA (25 HOURS EARLIER). TO MINIMIZE DESTRUCTION OF PREVIOUSLY RECORDED DATA, ONLY HAVE DFDR ON DURING TESTING.

D. Turn **ON** DFDR Switch and verify that the FLIGHT RECORDER OFF light extinguishes.

E. Verify FDR ON/OFF switch panel lighting works from bright to off using the FE panel light control.

III. SYNC WORD ✓

A. Select Word 1.

B. Verify the following SYNC Octal reading by Frame

FRAME #	WORD #1
1	1107
2	2670
3	5107
4	6670

IV. TIME ✓

A. Select Word 17.

B. Verify that Word 17 counts upward.

MECH INSP

V. MICROPHONE KEY ✓

A. Select Word 16.

B. Set power to Captain's and First Officer's VHF and HF Radios.

NOTE: Skip HF testing if HF systems deactivated.

C. Verify that Bit 1 (counting from the right) is "1."

NOTE: Use unused VHF and HF frequencies for keying tests.

D. Select and key Captain's Audio Panel on VHF 1 and verify that Bit 1 toggles to "0" or the OCTAL number changes down by 1.

E. Repeat steps C and D for the Captain's Audio Panel with HF 1.

F. Verify that Bit 3 (counting from the right of the 12 bit word) is "1." Key F./O.'s Audio Panel on VHF 2 and verify that Bit 3 toggles to "0" or the OCTAL number changes down by 4.

G. Key F./O.'s Audio Panel on HF 2 and verify that Bit 3 toggles to "0."

VI. AUTOPILOT ENGAGE STATUS ✓

A. Select Word 16

B. Verify that Bit 2 (second from right of 12 bit Word) is "0."

C. Engage Autopilot and verify that Bit 2 toggles to "1." (or the OCTAL number changes up by 2)

AUTOPILOT POSITION	OCTAL READING
ENGAGED	0002
DISENGAGED	0000

MECH INSP

VII. ALTITUDE

A. Select Word 13 for Course and Word 29 for Fine.

B. Connect Pitot-static test equipment to the Pitot tube and static port of the Pitot-static system that is connected to CADC-1 and Captain's pitot-static system for reference. Reference the Pitot-static section of the DC-8 Maintenance Manual for test procedure standards.

C. Record Pitot and Static system source used for CADC-1 air data.

Static: PTC
Pitot: ALT

D. Using the Pitot-static test box, step through the following altitudes. Verify that the altitude displayed on the Captain's Altimeter is the expected value.

ELECTRIC ALTITUDE

Word 13 Course Altitude
Frames 1 thru 4

ALTITUDE ±100 Feet	CAPTAIN'S ALTITUDE	EXPECTED OCTAL MIN MAX	ACTUAL OCTAL VALUE
4000	4000	0235 to 0250	0247
8000	8000	0430 to 0445	0443
22000	22000	1165 to 1177	1175

Word 29 Fine Altitude
Frames 1 thru 4

ALTITUDE ±100 Feet	CAPTAIN'S ALTITUDE	EXPECTED OCTAL MIN MAX	ACTUAL OCTAL VALUE
4000	4000	6244 to 6507	6463
8000	8000	4553 to 4757	4742
22000	22000	3020 to 3244	3136

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VIII. AIRSPEED ✓

A. Select Word 19.

B. Verify that Pitot-static test equipment still is connected to CADC-1 and Captain's pitot-static system

C. Using the Pitot-static test box, step through the following airspeeds. Correlate to the airspeed that is displayed on Captain's airspeed indicator is the expected value.

ELECTRIC AIRSPEED
Word 19
Frames 1 thru 4

AIRSPEED ±5 Knots	ACTUAL AIRSPEED	EXPECTED OCTAL MIN MAX	ACTUAL OCTAL VALUE
100	100	7110 to 0075	7761
200	200	1250 to 1361	1342
300	300	2721 to 3020	3014
350	350	3417 to 3546	3463

IX. HEADING/COMPASS ✓

A. Select Word 3.

B. Apply electrical power to the directional gyro compass system, manually position the ~~First Officer's~~ RMI and verify reading on ~~CAPT~~ MHR Indicator to the following: CAPTS FO's

HEADING
Word 3
Frames 1 thru 4

HEADING ±1 °	ACTUAL HEADING	EXPECTED OCTAL MIN MAX	ACTUAL OCTAL VALUE
0	0	7755 to 0022	7757
90	90	1755 to 2022	1760
180	180	3755 to 4064	3774
270	270	5755 to 6064	5760

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X. ROLL ATTITUDE

A. Remove power to Vertical Gyro #2.

B. Remove Vertical Gyro #2 and set on tilt table or employ extender harness to keep Vertical Gyro on mounting bracket. Reset power to Vertical Gyro #2.

C. Using a digital protractor, tilt Vertical Gyro #2 to the following angles. Verify that roll is shown on the F.O.'s Horizon Indicator.

D. Select Word 20.

ROLL ATTITUDE
Word 20
Frames 1 thru 4

ROLL ±1 °	ACTUAL ROLL	EXPECTED OCTAL MIN MAX	ACTUAL OCTAL VALUE
0°	0°	7745 to 0022	0000
30° right	30° R	0545 to 0600	0570
60° right	60° R	1157 to 1222	1207
30° left	30° L	7167 to 7224	7203
60° left	60° L	6535 to 6600	6560

MECH INSP

XI. PITCH ATTITUDE

A. Ensure that Vertical Gyro #2 is still sitting on tilt table or employ extender harness to keep the Vertical Gyro on the mounting bracket.

B. Using a digital protractor, tilt Vertical Gyro #2 to the following angles. Verify that pitch is indicated on the F.O.'s Horizon Indicator.

C. Select Word 4.

PITCH ATTITUDE
Word 4
Frames 1 thru 4

PITCH ±1 °	ACTUAL PITCH	EXPECTED OCTAL MIN MAX	ACTUAL OCTAL VALUE
Neutral	0°	7745 to 0022	0000
30° Up	30° up	0545 to 0600	0570
60° Up	60° up	1157 to 1222	1216
30° Down	30° dn	7167 to 7222	7210
60° Down	60° dn	6535 to 6600	6574

XII. N1

A. Using the signal generator, inject the signal at N1 Speed Probe (Tach Generator) pins 1 and 2 (or by running engines), record N1 for the following Frame and Word.

B. Monitor the N1 indicator for the engine under test for N1settings.

MECH | INSP

N1
FRAME 1

N1% Target	ENGINE #1 FRAME 1 WORD 11 OCTAL	ENGINE #2 FRAME 1 WORD 27 OCTAL
30	4200	4203
60	3176	3174
90	2524	2525

N1
FRAME 2

N1% Target	ENGINE #3 FRAME 2 WORD 11 OCTAL	ENGINE #4 FRAME 2 WORD 27 OCTAL
30	4200	4200
60	3201	3177
90	2526	2539

XIII. ACCELERATION ✓

A. With the biaxial accelerometer (left hand wheel well) in the normal position, verify the following. Note expected values assume that the aircraft is approximately level:

[redacted] TTS 14

ACCELERATION

ACCEL.	Word	EXPECTED OCTAL MIN MAX	ACTUAL OCTAL VALUE
Vert.	2,6,10, 14,18,22,26,30	3022 to 3715	3603
Long.	7,15,23,31	3640 to 4277	4142

B. Verify values change when the accelerometer is tilted vertically and longitudinally respectively.

[redacted] TTS 14

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XIV. CONTROL WHEEL POSITION

A. Provide main system hydraulic power following General Precautions in Douglas DC8 MM chapter 27-00-00 Maintenance Practices.

B. Select Word 24.

C. Enter octal values for various control wheel positions indicated below.

CONTOL WHEEL POSITION	OCTAL READING WORD 24
NEUTRAL	4765
FULL LEFT	3626
FULL RIGHT	6123

XV. AILERON SURFACE

A. Select Word 8.

B. Enter octal values for the aileron surface positions indicated below.

AILERON SURFACE POSITION	OCTAL READING WORD 8
NEUTRAL	0446
FULL LEFT (AILERON UP)	0120
FULL RIGHT (AILERON DOWN)	0777

XVI. CONTROL COLUMN POSITION

A. Select Word 12.

B. Enter octal values for various control column positions indicated below:

CONTROL COLUMN POSITION	OCTAL READING WORD 12
NEUTRAL	2475
FULL FORWARD	2761
FULL AFT	1742

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XVII. ELEVATOR SURFACE

A. Select Words 9 and 25.

B. Use Control Column Neutral pin position for the Neutral elevator position (Ref. MM 27-30 page 506).

ELEVATOR POSITION
Word 9 and 25
Frames 1 thru 4

PITCH	ACTUAL OCTAL VALUE
NEUTRAL	4214
FULL UP (Control Column Forward)	5270
FULL DOWN (Control Column Aft)	3347

XVIII. RUDDER PEDAL POSITION

A. Provide main system hydraulic power following General Precautions in Douglas DC8 MM chapter 27-00-00 Maintenance Practices.

B. Select Word 28.

C. Enter octal values for various rudder pedal positions indicated below.

RUDDER PEDAL POSITION	OCTAL READING WORD 28
NEUTRAL	2723
FULL LEFT	2410
FULL RIGHT	3411

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XIX. RUDDER SURFACE

A. Select Word 32.

B. Enter octal values for the rudder surface positions indicated below:

RUDDER SURFACE POSITION	OCTAL READING WORD 32
NEUTRAL	3132
FULL LEFT	2232
FULL RIGHT	4011

XX. TEST CLOSEOUT

A. Remove all test equipment, secure all LRUs, and reinstall any panels that were removed to accomplish this test.

B. Review pages of the checkout for omissions, clarity or errors and return to the Operator's Quality Control Department for retention in aircraft records file.