Docket No. **SA-519**

Exhibit No. **13A**

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

Airplane Performance Group Chariman's Factual Report

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

National Transportation Safety Board
Office of Research and Engineering
Washington, D.C.

November 22, 1999

Airplane Performance Group Chairman's Factual Report

DCA99MA060

I. Accident

Location:	Little Rock, Arkansas
Date:	June 1, 1999
Time:	Approx. 2351 CDT
Aircraft:	McDonnell Douglas MD-82, N215AA
Carrier:	American Airlines

II. Airplane Performance Group

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III. Summary

On June 1, 1999, at approximately 2351 Central Daylight Time (CDT), a McDonnell Douglas MD-82, N215AA, operated by American Airlines as flight 1420, regularly scheduled passenger service from Dallas, Texas, overran the end of runway 4R and collided with the approach light stanchion at the Little Rock National Airport, in Little Rock, Arkansas. The captain and 10 passengers sustained fatal injuries; the remaining 134 passengers and crewmembers sustained various non-life threatening injuries. The airplane was being operated in accordance with 14 CFR 121, and an instrument flight rules (IFR) flight plan had been filed.

Runway tire marks, ground scars, and wreckage positions were measured to the end of the wreckage distribution using tape measures, magnetic compass, and an inclinometer. Tabular and graphical versions of the runway tire mark and ground scar data are presented in Attachment I. The wreckage distribution data are presented in the **Structures Group Chairman's Factual Report**.

Runway surface data (runway grooving geometry, friction coefficients, surface texture depth, transverse and longitudinal gradient, transverse water flow characteristics, and location of rubber deposits) were compiled for runway 4R and are presented in Attachment II.

Landing gear tire tread depths and inflation pressures were also measured. These data are presented in Attachment III.

III. Details of Investigation

A. Runway Tire Marks, Ground Scars, and Wreckage Positions

The Airplane Performance Group arrived on-scene the day after the accident and began documenting runway tire marks, ground scars, and wreckage distribution. Tire marks were found leading from the wreckage area back through the rocks and grass and eventually onto the runway. A coordinate system was established with the origin (0,0) at the centerline of the departure end of the concrete surface of runway 4R. The location of the tire marks, ground scars, and wreckage distribution were then measured relative to this coordinate system. Runway 4R is approximately 7,200 feet long by 150 feet wide.

Tire marks consistent with those of the left main landing gear began 5,228 feet from the end of the runway's concrete surface. These tire marks continued for 149 feet before ending. Tire marks consistent with those of the left main landing gear began again at 4,872 feet from the end of the runway's concrete surface. These marks continued without further interruption until ending at the edge of a gravel downslope 459 feet beyond the end of the runway's concrete surface. The left main gear tire marks began crossing into the grass on the left edge of the runway about 710 feet before the end of the runway concrete surface.

Tire marks consistent with those of the nose landing gear began 5,079 feet from the end of the runway's concrete surface. These marks continued for 207 feet before ending. Tire marks consistent with those of the nose landing gear began again at 4,753 feet from the end of the runway's concrete surface. These marks continued with occasional interruptions until ending at the edge of the concrete ILS array pad 411 feet beyond the end of the runway's concrete surface. The nose gear tire marks remained on the runway concrete surface until reaching the end of the runway concrete surface approximately 67 feet left of runway centerline.

Tire marks consistent with those of the right main landing gear began 4,303 feet from the end of the runway's concrete surface. These marks continued without further interruption until ending at the edge of a gravel downslope 459 feet beyond the end of the runway's concrete surface. The right main gear tire marks began crossing into the grass on the left edge of the runway about 465 feet before the end of the runway concrete surface. The left and right main gear tire marks were approximately 98 and 82 feet left of runway centerline, respectively, when they crossed the end of the runway/taxiway concrete surface.

All runway/taxiway tire marks discussed above were more whitish in color than the surrounding off-white concrete surface. When the tire marks crossed white runway paint markings, the white paint was cleaner and whiter than the surrounding paint. When the tire marks crossed black runway paint markings, there were no white marks but the black paint was cleaner and blacker than surrounding paint. Most of the tire marks were more visible at their outer edges.

All tire mark and ground scar data are presented in Attachment I. The wreckage distribution data are presented in the **Structures Group Chairman's Factual Report**.

B. Runway Surface Data

Data concerning runway grooving geometry, friction coefficients, surface texture depth, transverse and longitudinal gradient, transverse water flow characteristics, and location of rubber deposits were compiled for runway 4R starting the day after the accident. Data concerning the runway's transverse water flow characteristics were compiled on November 16, 1999.

Runway 4R's transverse grooving extends from centerline to approximately 10 feet from each runway shoulder. Spacing between grooves is approximately 2 inches, average groove depth was 0.25 inches, and average groove width is approximately 0.25 inches.

Runway 4R's wet friction coefficients were measured using Dallas-Fort Worth Airport's SAAB test vehicle at 40 and 60 mph speeds. The average friction coefficient was 0.685 at 40 mph and 0.555 at 60 mph.

Average surface texture depths for runway 4R's clean, grooved and ungrooved sections were 0.0361 inches and 0.0145 inches, respectively. Average surface texture depth for runway 4R's rubber-coated, grooved touchdown area was 0.0326 inches. Average surface texture depth for runway 22L's rubber-coated, grooved touchdown area was 0.0302 inches.

Runway 4R's average transverse gradient was measured at 1.42%. Engineering drawings for runway 4R show varying longitudinal gradients between 0.000% and 0.318%.

Runway 4R's transverse water flow characteristics were measured via water drop test (see data contained in Attachment II).

Light to medium rubber deposits were observed on runway 4R, with the medium deposits located near the touchdown areas at both ends. The 22L touchdown area had more rubber deposits than the 4R touchdown area.

All runway surface data collected by the Airplane Performance Group are presented in Attachment II. Additional runway surface data is presented in the **Airport Group Chairman's Factual Report**.

C. Landing Gear Tire Tread Depths And Inflation Pressures

Landing gear tire tread depths and the inflation pressures were measured 3 days after the accident. Tread depths varied between 0.09375 and 0.3125 inches. Only the outboard right main gear tire was inflated upon inspection, and was found to have an inflation pressure of 195 pounds per square inch (psi). All other tires were deflated due to accident damage.

All landing gear tire tread depth and inflation pressure data collected by the Airplane Performance Group are presented in Attachment III

[redacted]

Charles Pereira
Aerospace Engineer

Attachments

Attachment I

runway_data

x	nlg rt edge	nlg left edge	rmlg rt edge	rmlg left edge	lmlg rt edge	lmlg left edge
459			40.42	44	55.5	59.92
450			41.42	45	56.67	60.42
411	27.83	29.42	46.58	49.92	62.33	65.42
400	29	30.5	48.08	50.75	63.58	66.33
350	35.92	37.58	54.16	58.16	69.58	73.58
300	42.08	43.75	59.92	63.58	75.5	79.16
250	47.33	48.75	64.42	68.33	80.16	83.83
200	52.33	53.83	69.92	72.83	84.75	88.42
150	57	59.08	73.16	76.75	89	92.33
100	61.16	62.92	76.33	80.08	92.08	95.83
50	63.83	65.42	78.5	82.42	94.5	98
0	66.58	67.92	80.5	83.75	96.5	99.33
-53	68.25	70.16	82.16	85	97.75	100.58
-103			82	85.25	98.16	100.92
-153			81.92	85.25	98	101.25
-203			82.75	85.08	98	100.92
-253			80.25	84.08	96.75	100
-303			78.83	82.75	95.25	98.58
-353			76.16	80.58	93.25	96.75
-375	70.58	72.08	75.08	79.42	92.08	95.58
-403	70	71.67	75	78	90.92	94.42
-453	68.75	70.25	72.42	75.67	88.5	92.08
-503	67.33	69	69.67	72.83	86.08	89.5
-553	66	67.75	66.58	69.83	82.92	86.5
-603	64.67	66.42	63.33	66.42	79.67	83.33
-653	63	64.58	59.58	62.67	76	79.58
-703	61.33	62.92	55.67	58.67	72.42	75.42
-753	59.58	61	51.25	54.42	68.08	71.25
-803	57.58	59.08	46.83	49.67	63.5	66.58
-853	55.42	57.08	41.83	44.75	58.5	61.58
-903	53.16	54.83	36.75	39.83	53.58	56.67
-953	50.92	52.33	31.92	34.92	48.5	51.75
-1003	48.33	50	27.83	29.92	43.58	46.83
-1053			21.75	25.08	38.75	41.83
-1103			17.08	20.08	33.75	36.92
-1153	40.58	42.08	12.25	15.5	28.83	31.75
-1203	37.67	39.16	7.75	11	23.75	26.83
-1253	34.83	36.08	3.25	6.33	19.58	22.42
-1303	31.92	33.16	-1	2.16	15	17.92
-1353	29		-4.83	-1.5	11.08	14.16
-1403	26.25		-8.33	-5.25	7.25	10.5
-1453	23.33		-11.5	-8.08	4.16	7.16
-1503	20.16	21.58	-14.5	-11.16	1.25	4.16
-1553	17.08	19.08	-17.08	-13.83	-1.25	1.33
-1603	14.25	15.92	-19.58	-16.42	-3.83	-0.75
-1653	11.67	13.33	-21.83	-18.75	-6	-3
-1703	9.08	10.42	-23.92	-20.92	-8	-5.33
-1753	6.5	7.92	-26	-23.08	-9.67	-7.16
-1803	3.92	5.42	-28.08	-25.16	-12.16	-9.58
-1853	1.58	3.08	-30.16	-27.16	-14.42	-11.5

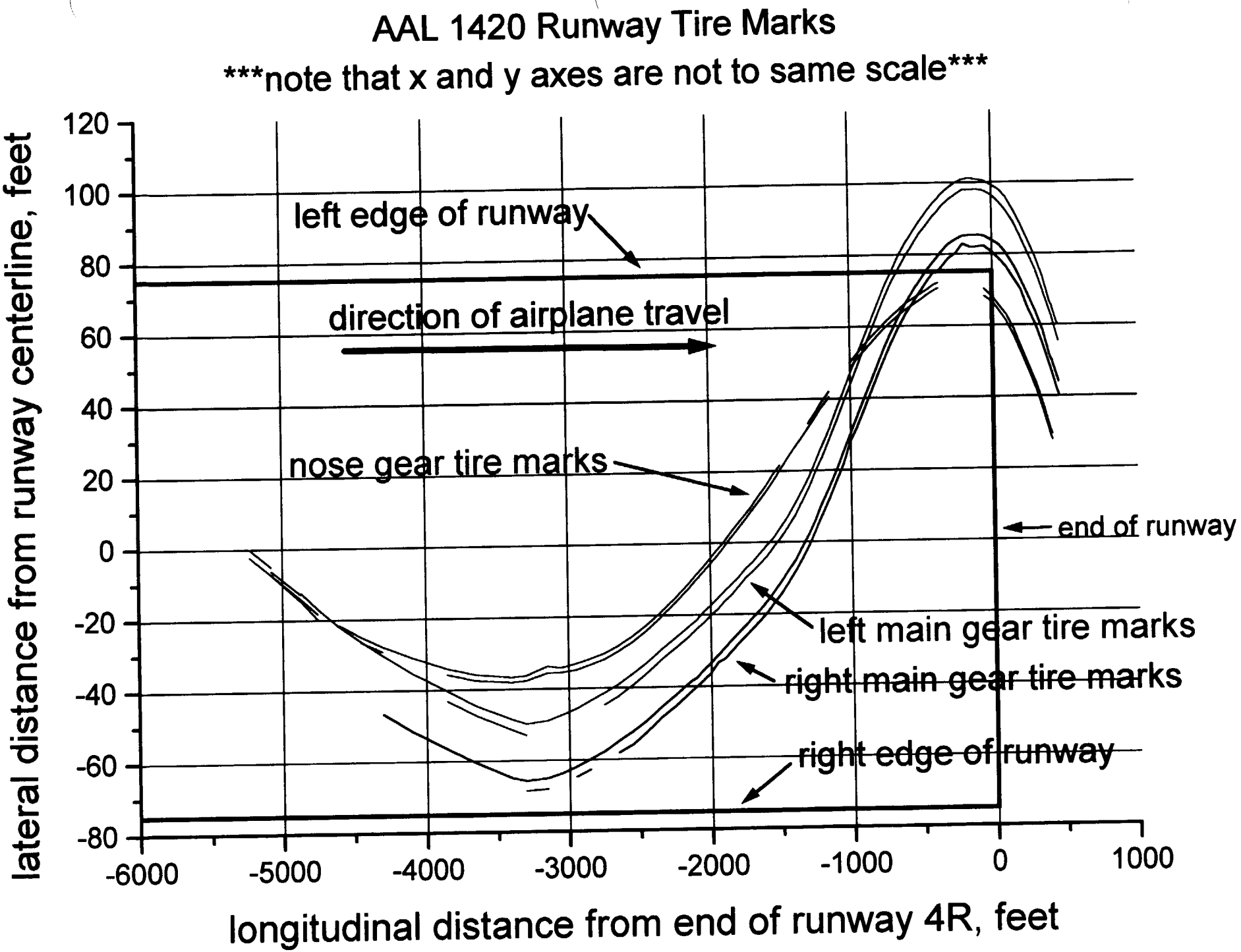
runway_data

-1903	-1	0.42	-32.33	-29.25	-16.16	-13.33
-1953	-3.5	-1.83	-33.33	-31.42	-18.42	-15.33
-2003	-5.75	-4.16	-36.33	-33.5	-20.25	-17.33
-2053	-8	-6.58	-38.16	-35.42	-22.25	-19.169
-2103	-10.16	-8.75	-40.08	-37.67	-23.92	-21.5
-2153	-12.42	-11	-41.75	-38.75	-25.83	-23.08
-2253	-16.58	-15.25	-45.42	-42.33	-29.16	-26.33
-2353	-20.5	-19.16	-48.58	-45.58	-32.42	-29.58
-2453	-24.08	-22.58	-52.33	-49.16	-35.92	-33
-2553	-27.25	-25.67	-55.92	-52.25	-39.25	-36.08
-2653	-29.75	-28.16	-58.08	-54.83	-42.16	-38.92
-2753	-31.92	-30.33		-57.58	-44.58	-41.25
-2853	-33.42	-31.75	-62.75	-59.75		-43.42
-2953	-34.75	-33.08	-64.75	-61.83	-48.33	-45.58
-3053	-35.42	-34.08		-63.67		-47.33
-3153	-35.5	-33.58	-68	-64.92		-48.83
-3303	-33.58	-36.25	-68.42	-65.58	-52.83	-49.67
-3403	-38	-36.58		-64.83	-51.33	-48.33
-3653	-37.33	-35.75	-63.42	-60.42	-47.16	-44.42
-3853	-35.67	-34		-56.58	-43.08	-40.16
-4103		-30.67		-51.42		-35
-4303	-29.08	-27.58		-46.58		-30.08
-4453	-26.33	-24.83				-26.08
-4603		-21.5				-22
-4753	-18.25				-19.75	-16.75
-4872	-14	-12.67			-14.58	-12.25
-5079	-7.08	-6.08			-7.08	-4.92
-5228					-2.16	0

4F GLIDESLOPE ARRAY = -6097, -330

4R RVR #1 = -6009, -330

4R RVR #2 = -1142, -245


AAL 1420 Runway Tire Marks
note that x and y axes are not to same scale
lateral distance from runway centerline, feet
120
100
80
60
40
20
0
-20
-40
-60
-80
-6000
-5000
-4000
-3000
-2000
-1000
0
1000
longitudinal distance from end of runway 4R, feet
left edge of runway
direction of airplane travel
nose gear tire marks
end of runway
left main gear tire marks
right main gear tire marks
right edge of runway

Attachment II

T.J. Yager

AA MD-82 Accident; R/W 04R; Little Rock, AR; June 1, 1999

General Observations

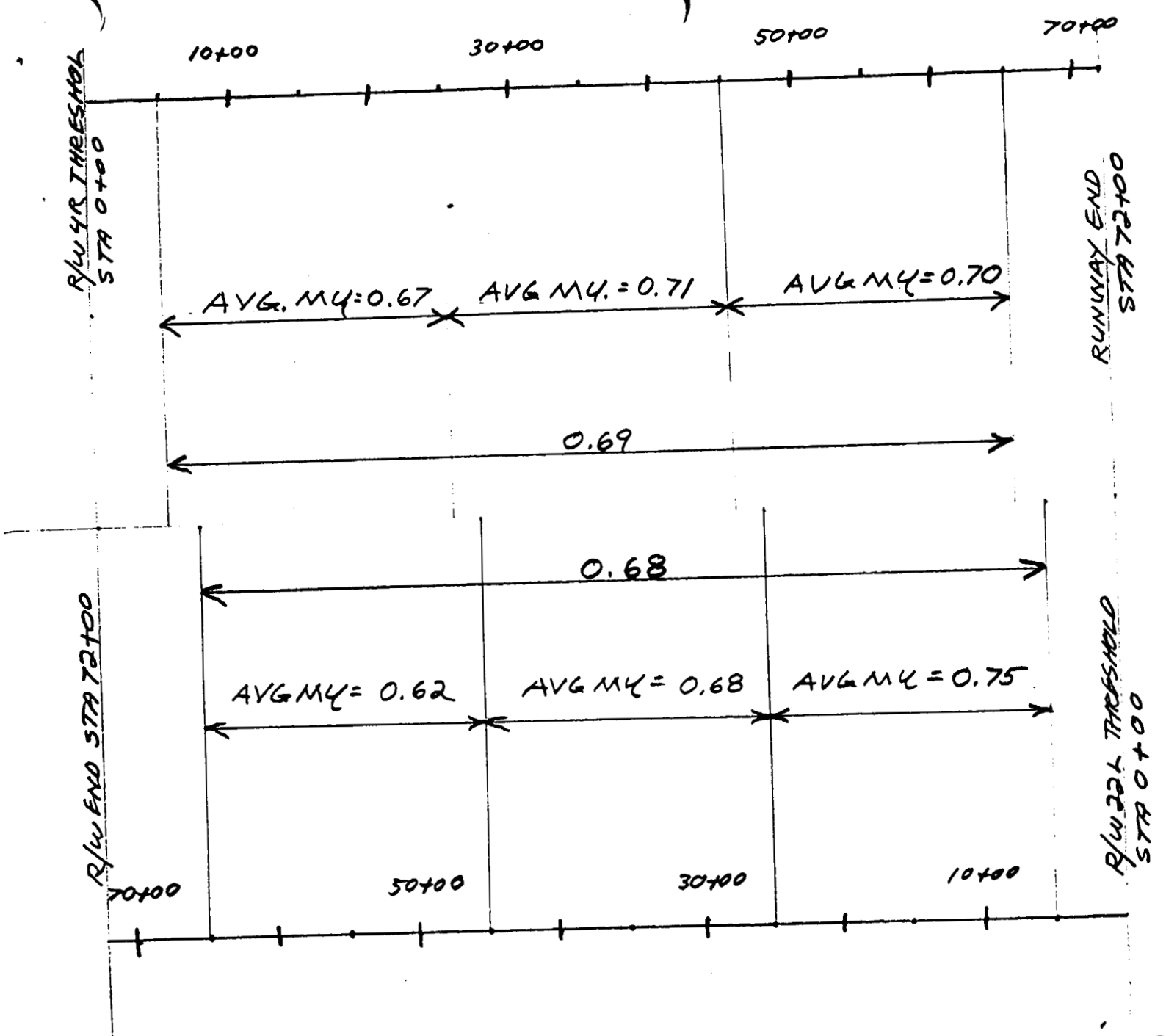
- Runway 04R touchdown area has less rubber deposits than 22L touchdown area
- Depth of transverse grooving, 2in. spacing, 0.25 in. width, varies ≈ 1/16 in.
- Transverse grooves end approximately 10.5ft from shoulder edge.
- Wind coming from pilots left; tree line left of runway 04R between 2000 and 1000 ft remaining
- Runway construction completed in 1991 with a width of 150 ft, length 7200 ft.
- No evidence of tread rubber reversions on nose and right main gear tire; LMG tires
- Friction values measured by DFW surface friction tester at 40 and 60 mph are very good (high)
- start point of runway surface white tire marks: Left main gear at 4978 ft remaining, Nose gear at 4915 ft remaining and right main gear approx 3500 ft remaining. These values based on nearest distance remaining marker

SEE ATT. I FOR GROUP DATA COORDINATES

- SCAN sensor located 3500 ft remaining and 26 ft right of runway centerline
- CFR units responding to crash site were equipped with tires inflated from 80 to 110 psi. They traveled from threshold of R/W 04R to 22L just off left side of runway centerline
- LMG turned 90° and back into wheel well on impact. Only ≈25% circumference available for inspection at crash site. Both tires deflated with severe cut + tread abrasion evide
- Red Cross did outstanding job providing food, drinks, medicine and appropriate advise at command hotel + crash si

TOPS 35503

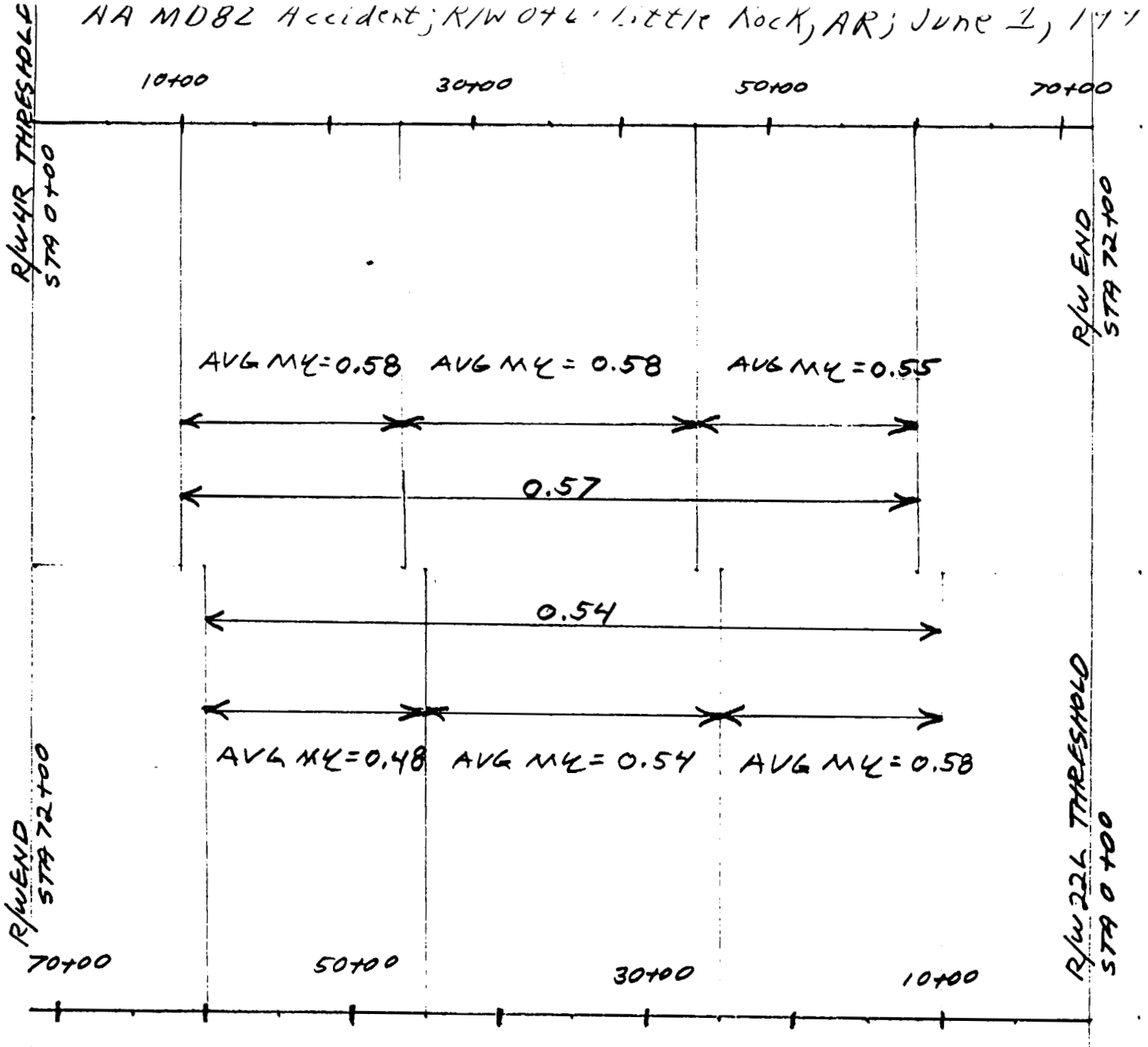
AA MD82 Accident; R/W 04R; Little Rock, AR; June 2, 1999



R/W 4R/22L CFME (SFT) @ 40 MPH WATER ON 10' ⊥ RIGHT

NA MD82 Accident; R/W 04, Little Rock, AR; June 1, 1999

Pg 2



R/W 4R/22L CFME(SFT) @ 60MPH WATER ON 10' ⊥ RIGHT

GLD

T.J. Yagler

AA MD-82 Accident; R/W 4L; Little Rock, AR; June 2, 1999

Grease Sample Texture Depth Measurements

Volume = 0.5 in^3; ungrooved surfaces

RUNWAY POSITION*		SURFACE DESCRIPTION	GREASE SAMPLE			AVERAGE TEXTURE DEPTH	
LONG.	LAT.		Width, in.	Length, in.	Area, in^2	INCH	MM
5500	10L	Light rubber	4.0	14.5	58.00	0.0086	0.2190
5500	10R	Light rubber	4.0	13.0	52.00	.0096	.2442
5000	30R	Clean	5.0	6.50	32.50	.0154	.3908
5000	10R	Light rubber		8.25	41.25	.0121	.3079
5000	10L	Light rubber		8.75	43.75	.0114	.2903
4000	52R	Clean		6.25	31.25	.0160	.4064
4000	70R	Clean		6.75	33.75	.0148	.3763
3000	50R	Clean		8.00	40.00	.0125	.3175
3000	68L	Clean	↓	6.75	33.75	.0148	.3763
3000	10L	Clean	4.0	10.00	40.00	.0125	.3175
2000	10R	Medium rubber	5.0	12.25	61.25	.0082	.2073
2000	10L	Medium rubber		12.50	62.50	.0080	.2032
1500	10R	Medium rubber		14.75	73.75	.0068	.1722
1500	10L	Medium rubber		12.25	61.25	.0082	.2074
1000	10L	Medium rubber		13.50	67.50	.0074	.1881
1000	30L	Clean		6.50	32.50	.0154	.3908
0	90L	Clean taxiway	↓	9.50	47.50	.0105	.2674

NOTES: * Longitudinal value is distance remaining R/W 04R

Transverse grooving extended 65 ft both sides of ℄

TOPS 35500

June 5, 1999
T. J. Yager

Runway 4R/22L; Little Rock, AR

Surface Texture Depth Measurements

Clean grooved concrete = 0.0361 in. (0.9169 mm)

Rubber-coated runway 04R touchdown area, grooved = 0.0326 in. (0.8268 mm)

Rubber-coated runway 22L touchdown area, grooved = 0.0302 in. (0.7668 mm)

Clean ungrooved concrete = 0.0145 in. (0.3679 mm)

Clean ungrooved taxiway R at 22 threshold = 0.0105 in. (0.2674 mm)

To calculate grooved area average texture depths, used following formula:

$$T_G = \frac{T_U (P-W) + WD}{P}$$ where:

P = Groove pitch, 2.0 in.
W = Groove width, 0.25 in.
D = Groove depth, 0.1875

AA MD-82 Accident; R/W 4L; Little Rock, AR; June 1, 1999

Runway Transverse Gradient Measurements

Used 10 ft straightedge and inclinometer

RUNWAY POSITION		ANGLE, MIN.	SIN	CROSSFALL, FT	% GRADIENT	REMARKS
LONG.	LATERAL					
0*	10L	30	0.00873	0.0873	0.87	
↓	30L	25	.00727	.0727	.73	
	50L	18	.00524	.0524	.52	
	70L	28	.00814	.0814	.81	In Nose track
	90L	25	.00727	.0727	.73	In RMG track
	110L	9	.00262	.0262	.26	In LMG track
	10R	50	.01454	.1454	1.45	
	30R	37	.01076	.1076	1.08	
	50R	58	.01666	.1666	1.67	
↓	70R	43	.01251	.1251	1.25	
1000 Remaining	10L	63	.01832	.1832	1.83	Rubber coated
↓	30L	54	.01577	.1577	1.58	
	50L	52	.01513	.1513	1.51	
	70L	58	.01666	.1666	1.67	
	10R	60	.01745	.1745	1.74	Rubber coated
	30R	42	.01222	.1222	1.22	
	50R	55	.01600	.1600	1.60	
↓	70R	43	.01251	.1251	1.25	
2000 Remaining	10L	62	.01803	.1803	1.80	Rubber coated
"	30L	60	.01745	.1745	1.74	
"	50L	50	.01454	.1454	1.45	

Notes: Longitudinal disbance 0 is runway 22R threshold

TOPS 35500

AA MD-82 Accident; R/W 4L; Little Rock, AR; June 1, 1999

Runway Transverse Gradient Measurements

Used 10 ft straightedge and inclinometer

RUNWAY POSITION		ANGLE, MIN.	SIN	CROSSFALL, FT	% GRADIENT	REMARK
LONG.	LATERAL					
2000 Remaining	70L	55	0.01600	0.1600	1.60	
	10R	60	.01745	.1745	1.74	Rubber coated
	30R	40	.01164	.1164	1.16	
	50R	37	.01076	.1076	1.08	
	70R	37	.01076	.1076	1.08	
3000 Remaining	10L	58	.01666	.1666	1.67	
	30L	52	.01513	.1513	1.51	
	50L	56	.01629	.1629	1.63	
	70L	48	.01396	.1396	1.40	
	10R	57	.01658	.1658	1.66	
	30R	24	.00698	.0698	.70	
	50R	48	.01396	.1396	1.40	
	70R	40	.01161	.1161	1.16	
4000 Remaining	10L	55	.01600	.1600	1.60	
	30L	48	.01396	.1396	1.40	
	50L	52	.01513	.1513	1.51	
	70L	48	.01396	.1396	1.40	
	10R	60	.01745	.1745	1.74	
	30R	38	.01105	.1105	1.10	
	50R	48	.01396	.1396	1.40	
	70R	50	.01454	.1454	1.45	

Notes: Longitudinal distance 0 is runway 22R threshold

TOPS 355300

AA MD-82 Accident; R/W 4L; Little Rock, AR; June 1, 1999

Runway Transverse Gradient Measurements

Used 10 ft straightedge and inclinometer

RUNWAY POSITION		ANGLE, MIN.	SIN	CROSSFALL, FT	% GRADIENT	REMARKS
LONG.	LATERAL					
5000 Remaining	10L	60	0.01745	0.1745	1.74	
	30L	50	.01454	.1454	1.45	
	50L	56	.01629	.1629	1.63	
	70L	50	.01454	.1454	1.45	
	10R	53	.01542	.1542	1.54	
	30R	38	.01102	.1102	1.10	
	50R	45	.01309	.1309	1.31	
↓	70R	52	.01513	.1513	1.51	
6000 Remaining	10L	60	.01745	.1745	1.74	
	30L	48	.01396	.1396	1.40	
	50L	55	.01600	.1600	1.60	
	70L	63	.01832	.1832	1.83	
	10R	55	.01600	.1600	1.60	
	30R	48	.01396	.1396	1.40	
	50R	45	.01309	.1309	1.31	
↓	70R	45	.01309	.1309	1.31	
	Total runway average transverse gradient = 1.42%					

Notes: Longitudinal distance 0 is runway 22R threshold

T, J. Yager

AA MD-82 Accident; R/W 4R; Little Rock, AR; June 1, 1999

Runway Longitudinal Profile

Taken from engineering drawings

Threshold runway 4R, elevation = 260.16 Ft

From 0 to 1900 Ft, +0.12 %

From 1900 to 4300, 0.00 %

From 4300 to 5000, +0.318 %

From 5000 to 7200, 0.00 %

November 16, 1999 LIT runway 4R water flow test, NTSB Airplane Performance Group
Dry Pavement

x	l5	l4	l3	l2	l1	r1	r2	r3	r4	r5	stick1	stick2	deltastick	notes
5608	278	87	61	39	17	22	43	72	90	330	2420	2275	145	taxiways
5228	300	93	65	40	17	23	53	80	108	394	2120	1940	180	touchdown
5105	258	89	66	42	18	23	51	75	101	294	1805	1660	145	5 marker
4605	296	92	68	44	19	18	43	71	98	300	1530	1375	155	
4105	284	101	74	45	20	21	44	78	96	280	1240	1080	160	4 marker
3605	291	101	75	47	23	18	42	72	101	280	930	800	130	taxiway
3105	270	104	76	47	22	24	42	71	99	305	650	530	120	3 marker
2605	275	94	69	43	20	23	49	78	104	311	2630	2410	220	full tank, stick accuracy?
2105	274	93	67	41	19	21	44	75	104	258	2250	2080	170	2 marker
1605	290	90	67	42	18	22	50	82	111	270	1925	1775	150	
1105	276	94	69	43	19	17	40	63	95	308	1630	1475	155	1 marker
605	282	107	79	49	21	21	45	72	96	306	1330	1185	145	
105	311	126	95	52	23	20	41	65	94	295	1050	915	135	touchdown zone paint

test involved water flow from tanker truck for approx 60 seconds at centerline of runway, for dry and wet conditions (sequential)
stick readings reflect approx number of gallons of water at start and end of 60 second water flow, using wooden dip stick
all times in seconds and approximate per second hand on watch
x is longitudinal distance (feet) from end of runway 4R pavement, plus = towards threshold
l5 is time to perception of no more water flow off left edge of runway
l4 is time when water flow first reached left edge of runway
l3 is time when water flow first reached 3rd pavement joint on left side of runway
l2 is time when water flow first reached 2nd pavement joint on left side of runway
l1 is time when water flow first reached 1st pavement joint on left side of runway
r1 is time when water flow first reached 1st pavement joint on right side of runway
r2 is time when water flow first reached 2nd pavement joint on right side of runway
r3 is time when water flow first reached 3rd pavement joint on right side of runway
r4 is time when water flow first reached right edge of runway
r5 is time to perception of no more water flow off right edge of runway
stick1 is tanker truck stick reading at start of water flow for test condition
stick2 is tanker truck stick reading at end of water flow for test condition
deltastick is number of gallons put on runway for test condition