Attachment I

runway_data

LONGITUDINAL DISTANCE FROM END OF RUNWAY 4R IN FEET, MINUS IS ON RUNWAY

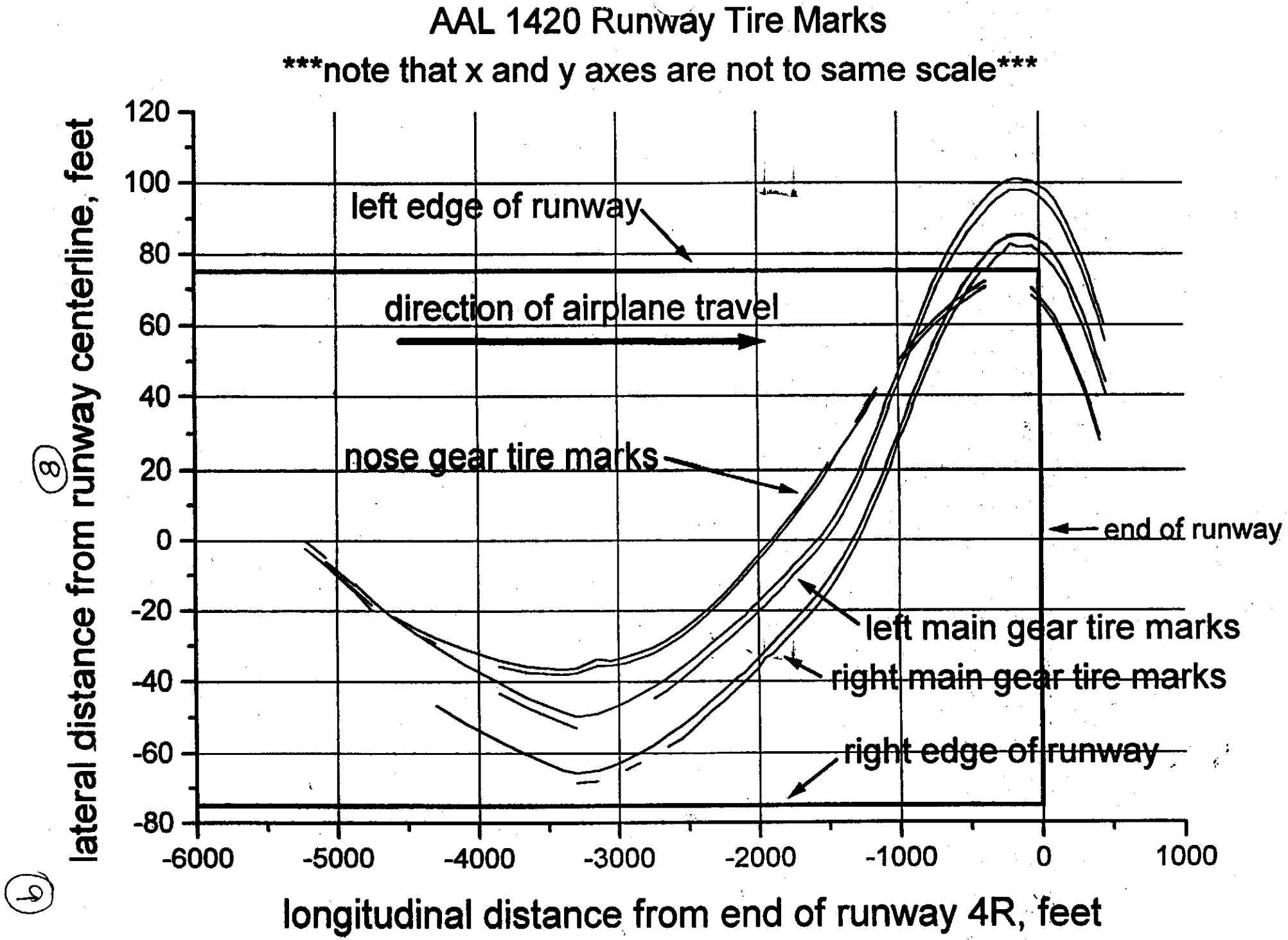
	LATERAL DISTANCE FROM RUNWAY CENTERLINE, FEET, MINUS IS RIGHT OF CENTERLINE					
x	mlg rt edge	nlg left edge	rmlg rt edge	rmlg left edge	lmlg rt edge	lmlg left edge
459			40.42	44	55.5	59.92
450			41.42	45	56.67	60.42
411	27.83	29.42	46.58	49.92	62.33	65.42
400	29	30.5	48.08	50.75	63.58	66.33
350	35.92	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

-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

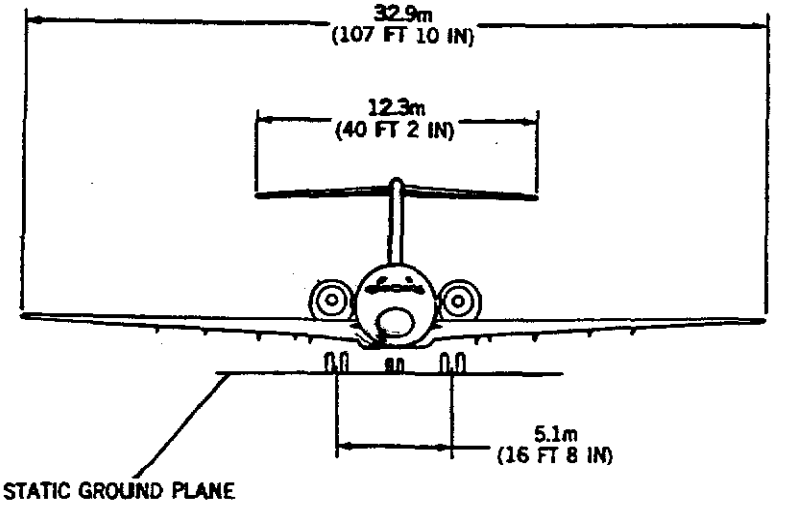
4L GLIDESLOPE ARRAY = -6097, -330

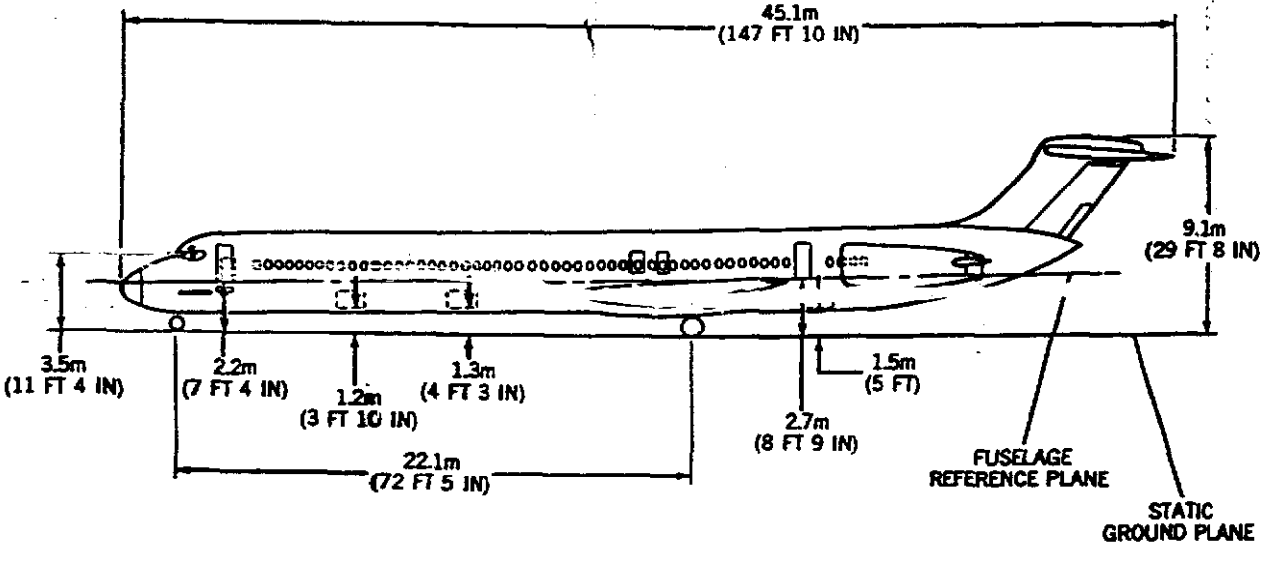
4R RVR #1 = -6009, -330

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
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
longitudinal distance from end of runway 4R, feet

AIRPLANE - DIMENSIONS





RA1-79

Attachment II

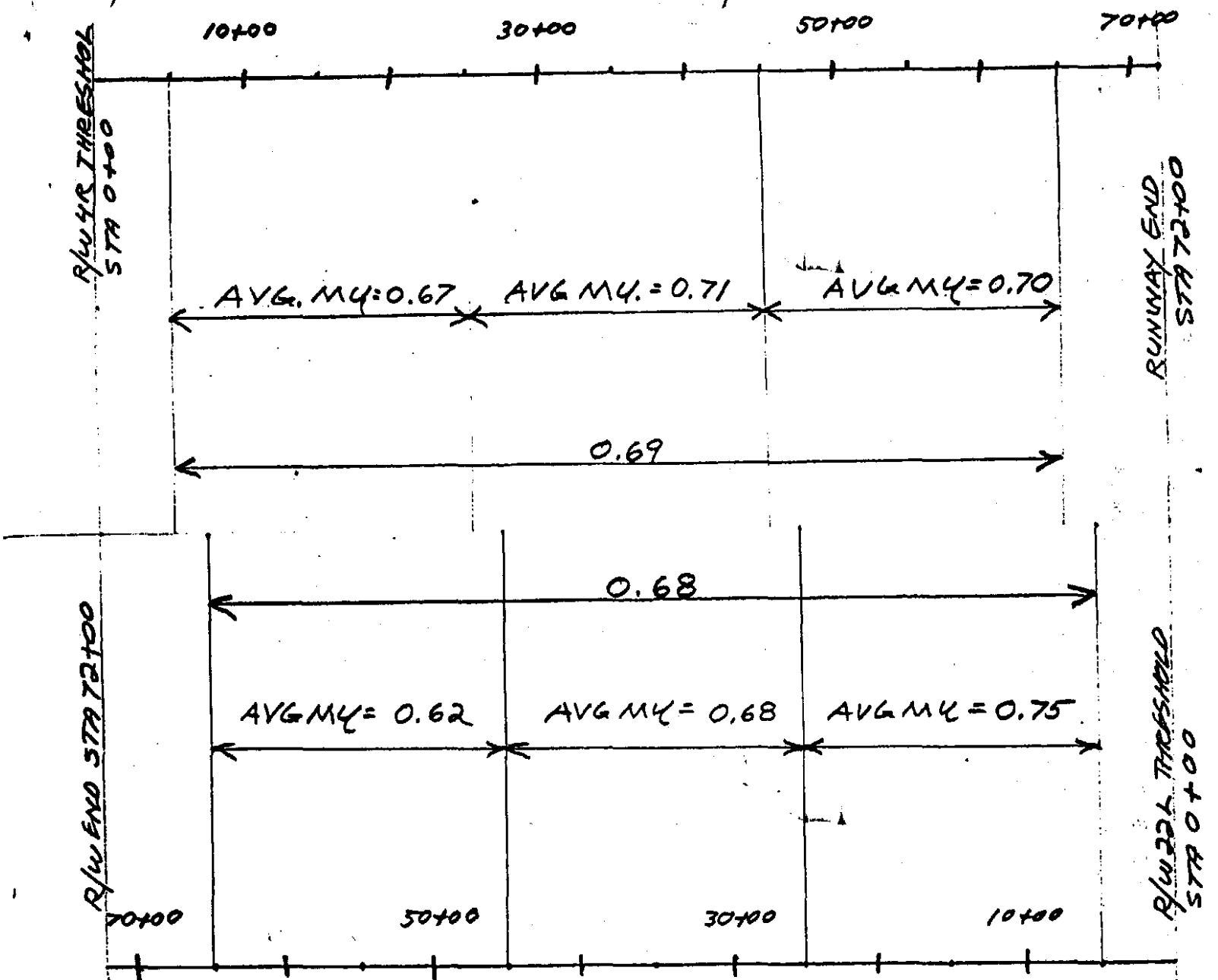
AA MD-82 Accident; R/W 04R; Little Rock, AR; June 1, 1999

General Observations

- Runway 04R touchdown area has less rubber deposits than 22L touchdown area
- 3/16" Depth of transverse grooving, 2in. spacing, 0.25in. width, varies ≈ 1/16 in.
- Transverse grooves end approximately 13 ft 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 about DATA ORDINATES)
- 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 of left side of runway centerline
- LMG turned 90° and back into wheel well on impac Only ≈25% circumference available for inspection at cra site. Both tires deflated with severe cut/tread abrasion e
- Red Cross did outstanding job providing food, drink medicine and appropriate advise at command hotel/crash

TOPS 35500

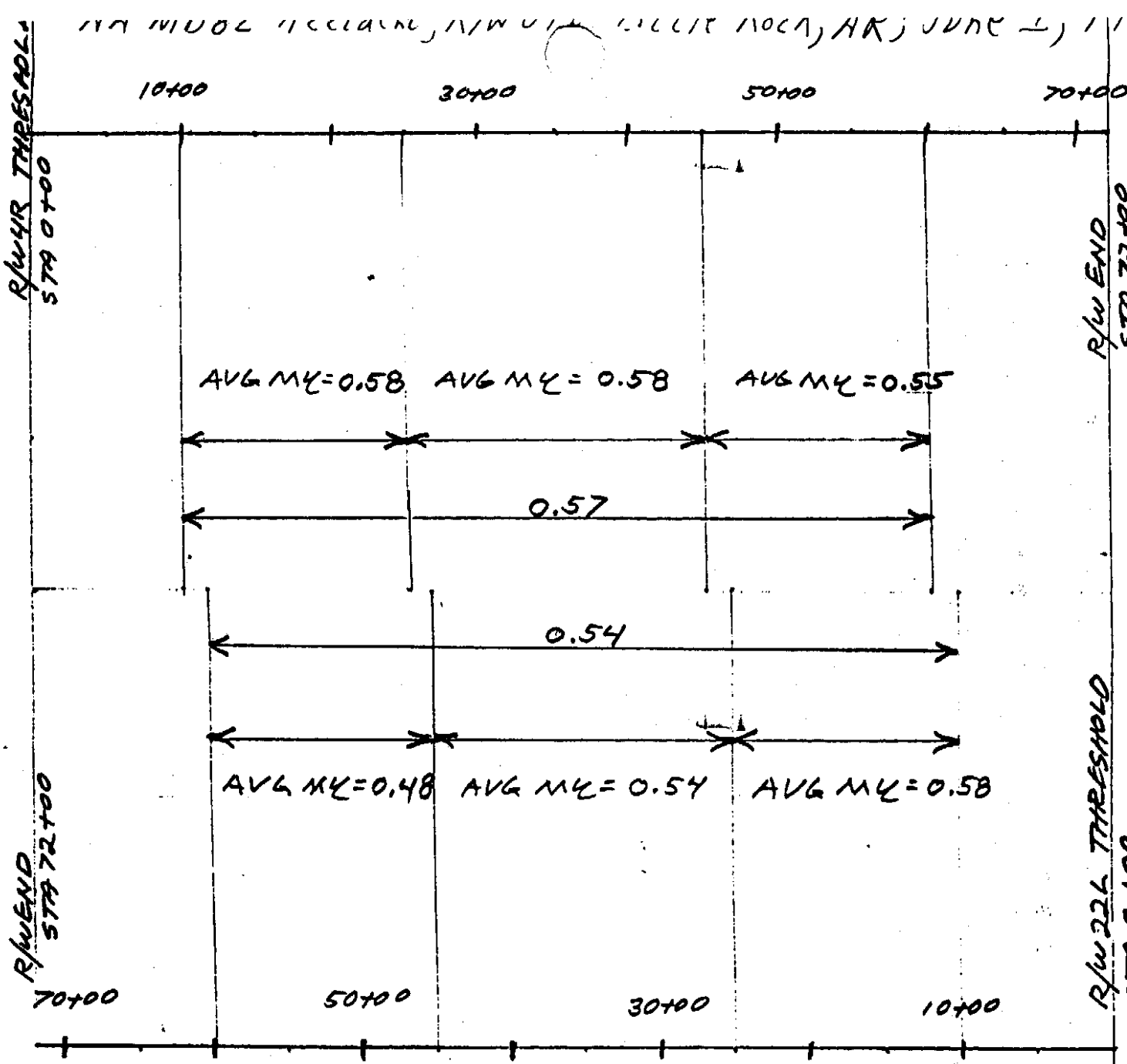
AA MD82 Accident; R/W 04 ... Little Rock, AR; June 1, 19...



(12)

(13)

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



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

(14)

AA MD-82 Accident; RWY 4L; Little Rock, AR; June 1, 1999

Grease Sample Texture Depth Measurements

Volume = 0.5 in³; ungrooved surfaces

RUNWAY POSITION*		SURFACE DESCRIPTION	GREASE SAMPLE			AVERAGE TEXTURE DEPTH	
LONG.	LAT.		Width, in	Length, in	Area, in²	INCH	MM
5500	10L	Light rubber	4.0	14.5	58.00	0.0086	0.2190
5500	10R	Light rubber	4.0	13.0	62.00	.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 RWY 04R

Transverse grooving extended 65 ft both sides of ℄

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. (0.826

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

Clean ungrooved concrete = 0.0145 in. (0.3679 mm)

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

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

$$T_G = \frac{T_U (P - W) + W \cdot D}{P}$$ 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 distance 0 is runway 22R threshold.

TOPS 3550C

AA MD-82 Accident; R/W 22; Little Rock, AR; June 1, 1

Runway Transverse Gradient Measurements

Used 10 ft straightedge and inclinometer

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

Notes: Longitudinal disbance 0 is runway 22R threshold

TOPS 35500

AA MD-82 Accident; R/W [illegible]

Runway Transverse Gradient Measurements

Used 10 ft straightedge and inclinometer

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

Notes: Longitudinal distance 0 is runway 22R threshold

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

(20)

(21)

AVERAGE FLOW RATE TO LEFT SHOULDER = 75 FT/97.77S = 0.767 FT/S

" " " " RIGHT " = 75 FT/99.77S = 0.752 FT/S

November 16, 1999 LIT runway 4R wate[illegible]w test, NTSB Airplane Performance Group
Wet Pavement

x	l5	l4	l3	l2	l1	r1	r2	r3	r4	r5	stick1	stick2	deltastick	notes
5608	296	78	57	37	16	22	41	61	87	345	2275	2120	155	taxiways
5228	289	84	65	40	18	24	51	77	100	320	1940	1805	135	touchdown
5105	241	81	62	39	18	23	48	70	93	310	1660	1530	130	5 marker
4605	280	82	63	40	19	22	42	69	86	326	1375	1240	135	
4105	279	90	68	43	20	21	44	70	91	360	1080	930	150	4 marker
3605	294	91	69	45	22	20	43	68	91	308	800	650	150	taxiway
3105	268	92	70	44	20	25	46	68	86	308	530	400	130	3 marker
2605	262	85	65	42	20	19	49	70	95	309	2410	2250	160	full tank, stick accuracy?
2105	258	84	64	40	19	22	47	72	95	290	2080	1925	155	2 marker
1605	282	83	63	43	18	22	47	75	95	316	1775	1630	145	
1105	280	84	63	42	18	21	42	63	82	307	1475	1330	145	1 marker
605	276	96	72	46	21	20	42	66	85	321	1185	1050	135	
105	321	116	92	51	22	18	40	64	91	310	915	775	140	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

21

22

AVERAGE FLOW RATE TO LEFT SHOULDER = 75 FT / 88.15 S = 0.851 FT/S
" " " " RIGHT " = 75 FT / 90.54 S = 0.828 FT/S

$$\text{RAINFALL RATE} = K\left[\frac{(\text{MACROTEXTURE DEPTH})^{.89}}{(\text{DISTANCE FROM RUNWAY } \ell)^{.43}\left(\frac{1}{\text{CROSS SLOPE}}\right)^{.42}}\right]^{1.695}$$

(FROM REF. 10)

WHERE:

K = 1253 for metric units; 15430 for U. S. Customary units

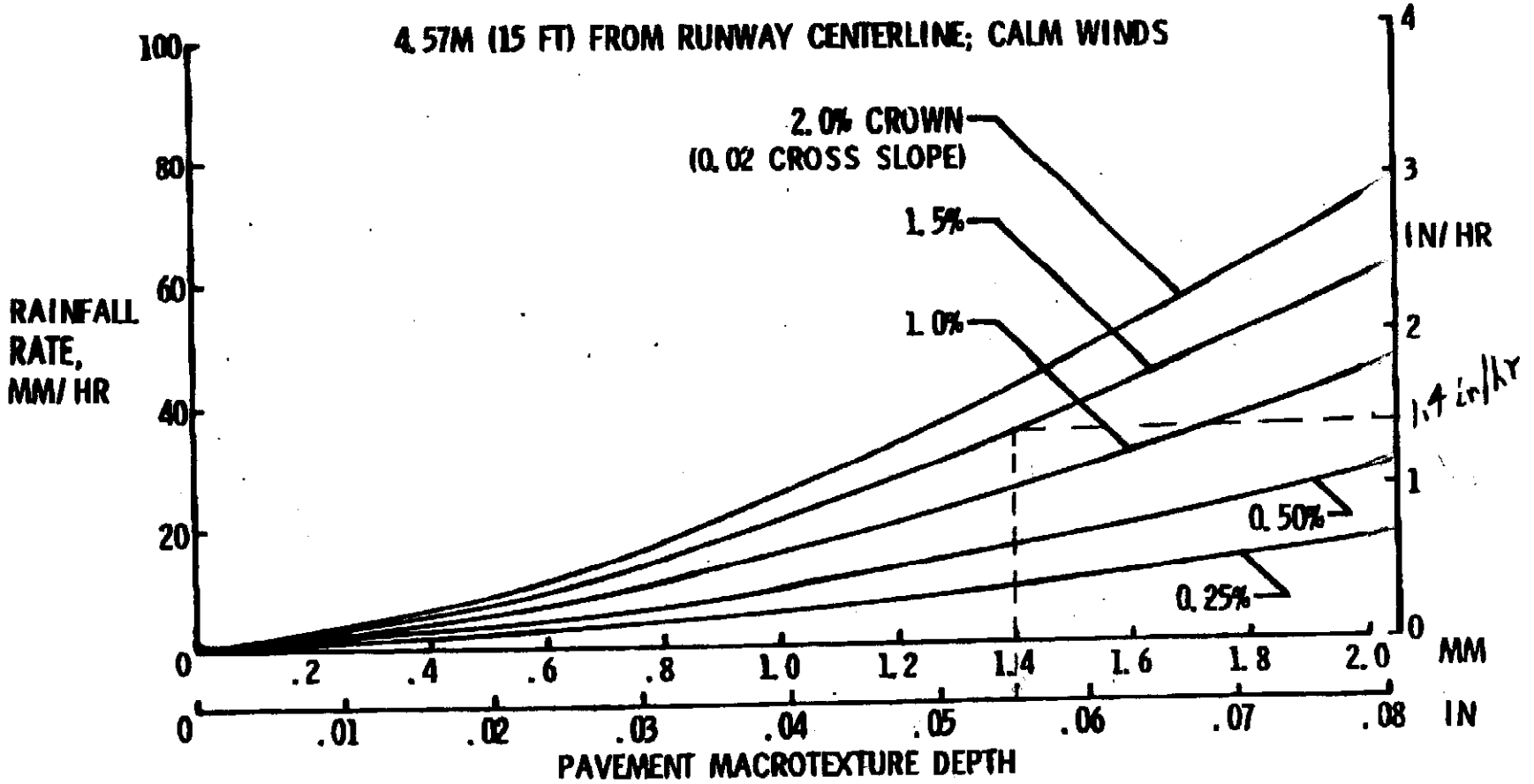


Figure 2.- Calculated rainfall rate required for flooding runway surfaces in typical transport aircraft main gear tire path.

Locating rubber deposit areas on runway 4R/22L

At runway 4R approach end:

At 6500 ft remaining, 15 ft both sides of centerline ℄
At 6000 ft remaining, 17 ft both sides of centerline ℄
At 5500 ft remaining, 17 ft both sides of centerline ℄
At 5000 ft remaining, 17 ft both sides of centerline ℄
At 4500 ft remaining, 15 ft both sides of centerline ℄

At runway 22L approach end:

At 2500 ft remaining (R/W 4); 13 ft both sides ℄; MR**
At 2000 ft remaining (R/W 4); 17 ft both sides ℄; MR
At 1500 ft remaining (R/W 4); 18 ft both sides ℄; MR
At 1000 ft remaining (R/W 4); 16 ft both sides ℄; MR

*LR = Light rubber coating

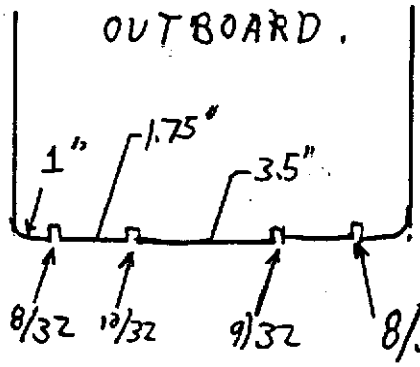
**MR = Medium rubber coating

Attachment III

MD-80 Tire Tread Depths

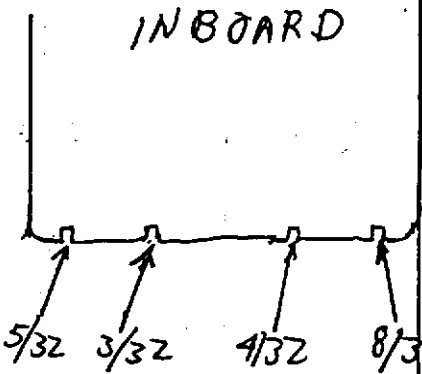
Right Main Gear:

Measured Inflation Pressure = 195 psi



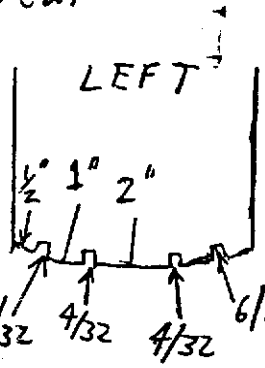
Avg. Depth 8/32 10/32 9/32 8/32

Deflated

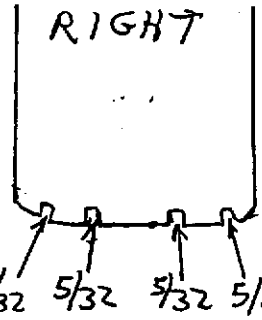


5/32 3/32 4/32 8/32

Nose Gear:



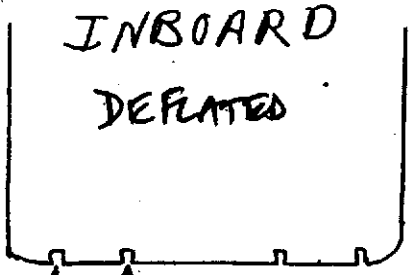
Avg. Depth 6/32 4/32 4/32 6/32



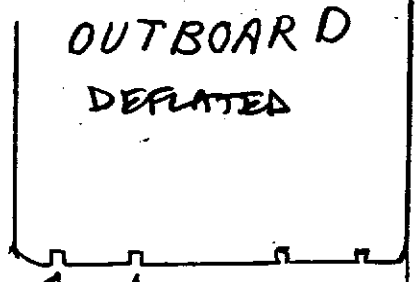
5/32 5/32 5/32 5/32

Left Main Gear:

Only 25% of circumference available for inspection & measurements. Both tire severely cut and abraided.



6/32 5/32



7/32 8/32