U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

OBSOLETE

Subject: Change 1 to METHODS FOR THE DESIGN, CONSTRUCTION, AND MAINTENANCE OF SKID RESISTANT AIRPORT PAVEMENT SURFACES

Date: 9/22/83
Initiated by: AAS-200

AC No: 150/5320-12
Change: 1

1. PURPOSE. This change provides appendix 6 to be added to the subject advisory circular. Appendix 6 gives performance specifications for friction measuring equipment funded under Airport Improvement Program (AIP).

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		Appendix 6 1-3	9/22/83

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APPENDIX 6. PERFORMANCE SPECIFICATIONS FOR FRICTION MEASURING DEVICES

Friction measuring equipment may be self-contained or towed. If towed, the tow vehicle will be considered an integral part of the device. The friction measuring equipment and the tow vehicle shall meet the following conditions.

1. The friction measuring equipment shall:

a. Provide fast, continuous, accurate and reliable friction measurements for the entire length of the runway, less the differences required for accelerating and decelerating the vehicle at the runway ends.

b. Be designed to sustain rough usage and still function properly and provide efficient and reliable methods of equipment calibration.

c. Be capable of automatically providing the operator with a selection of average friction values for either each 500 foot (152 meters) or one-third segments of runway length. In addition, be capable of providing data whereby the average friction value for any length of runway can be manually calculated.

d. Be capable of producing a permanent trace of friction measurements versus pavement length at a convenient scale, such as 1 inch (25 mm) equals approxi-mately 300 feet (91 meters).

e. Be furnished with measuring tires which are designed for use in conducting friction surveys and which meet ASTM E 670, Standard Test Method for "Side Force Friction on Paved Surfaces Using the Mu Meter, Annex A1, Specification for the Mu Meter Tire." Nonribbed (blank) tire(s) shall be used to eliminate the effect of tire tread wear and provide greater sensitivity to variations in pavement surface texture. The equipment manufacturer shall assure supply of the tires will be maintained and at competitive market price levels. The equipment manufacturer shall also guarantee that the performance of the tire is met by statistical methods conducted on each batch produced by the tire manufacturer.

f. Be capable of consistently repeating friction averages throughout the friction range on all types of pavement surfaces. Friction averages for each 500 foot (152 meters) segment located on the pavement surface must be within a confidence level of 95.5 percent, or two standard deviations of $\pm$ 5 mu numbers.

g. Contain a selfwatering system that distributes water in front of the friction measuring wheel(s) at a uniform depth of 0.04 inches (1 mm) (may be located on the tow vehicle).

h. Be able to conduct friction surveys at speeds of 40 and 60 miles per hour (65 and 97 kilometers per hour), within a tolerance of $\pm$ 3 miles per hour ($\pm$ 5 kilometers per hour).

i. Include a complete set of operation and maintenance manuals including guidelines for training airport personnel.

j. Have electronic instrumentation (solid-state electronics) that will enhance the information gathering and analysis capability of the equipment, and provide the operator more convenience in equipment operation and performance. The information gathered during a friction survey would be stored in an internal microprocessor memory and readily visible to the operator of the vehicle. This will allow for the examination of data, printouts, and calculation of average friction values over all or any portion of the test run. Each printout of the chart produced by the microprocessor unit shall include the following recorded information; runway designation, date, time of friction survey, a continuous trace of the friction values obtained for the entire runway length minus the acceleration/deceleration distances, provide printed marks depicting each 100 foot (30 meters) increment of the runway length so easy reference can be made by the operator in identifying specific areas on the runway pavement surface, friction averages for either 500 foot (152 meters) or one-third segments of the runway length as preselected by the operator and average vehicle speed for that segment.

k. Be painted a color that has high visibility on the airport.

2. The vehicle used to tow the friction measuring equipment or in which the equipment is installed shall:

a. Be able to conduct friction surveys at speeds of 40 and 60 miles per hour (65 and 97 kilometers per hour), within a tolerance of $\pm$ 3 miles per hour ($\pm$ 5 kilometers per hour). The vehicle when fully loaded with the prescribed quantity of water shall be capable of accelerating to these speeds within 500 and 1000 feet (152 and 305 meters), respectively, from starting position.

b. Have cruise control to lock in the test speed.

c. Have a yellow rotating beacon installed on the top of the vehicle and shall be equipped with radio communications with airport operations and ground control, as a minimum.

d. Be equipped with a water tank constructed of strong lightweight material, such as fiberglass or reinforced plastic. In addition, the water tank shall have the capacity to complete a friction survey on a 14,000 foot (4,267 meters) runway in one direction and all necessary appurtenances to deliver the required water flow rate to the friction measuring wheel(s).

e. Have appropriate heavy-duty shock absorbers and heavy-duty suspension to adequately handle imposed loads.

f. Be equipped with a device that will regulate the water flow within the confines of the vehicle near the driver's position. In the case where flow regulation is automatic, no device is required in the vehicle.

g. Be equipped with a heater and air conditioner.

h. Be equipped with mounted spot lights on each side of the vehicle with one controlled from the driver's position and the other from the passenger's position.

3. The tow vehicle (if a separate tow vehicle is used) shall:

a. Be equipped with not fewer than two high wattage halogen floodlights mounted such that the friction measuring device and rear portion of the tow vehicle is illuminated to a level of not less than 20 foot candles within an area bounded by lines not less than 5 feet (2 meters) either side of the friction measuring device and not less than 5 feet (2 meters) in front of and behind the friction measuring device.

Notes:

1. Existing mechanical/hydraulic friction measuring devices that are in good operating condition may be retrofitted with electronic instrumentation meeting this specification.

2. High pressure tires may also be included, in addition to the specified tire, when recommended by the manufacturer for use on ice and compacted snow covered surfaces.

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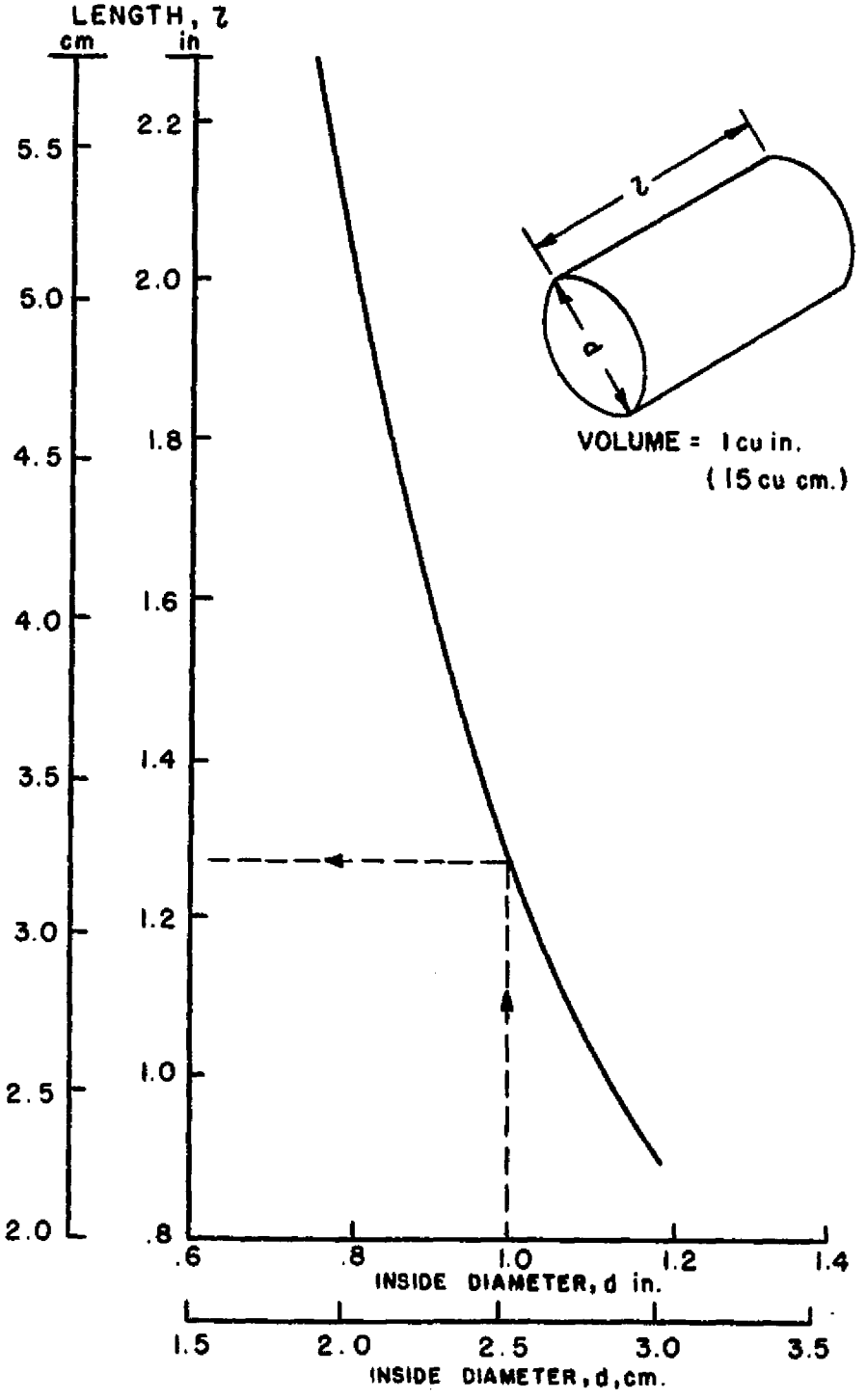

FIGURE 2. MEASURING TUBE DIMENSIONS TO MEASURE ONE INCH OR FIFTEEN CUBIC CENTIMETERS

FIGURE 3. MEASURING TUBE FILLED WITH GREASE

APPENDIX 5. INTERIM ITEM P-626, ASPHALTIC EMULSION SLURRY SEAL SURFACE TREATMENT

Description

626-1.1 This item shall consist of a mixture of emulsified asphalt, mineral aggregate, and water; properly proportioned, mixed and spread evenly on a prepared underlying course or existing wearing course in accordance with these specifications and shall conform to the dimensions and typical cross sections shown on the plans and with lines and grades established by the engineer.

Materials

626-2.1 MINERAL AGGREGATE. The mineral aggregate shall meet the designated gradation(s) given in Table 1. The test for gradation shall be made in accordance with ASTM C-386.

TABLE 1. REQUIREMENTS FOR GRADATION OF AGGREGATE
PERCENTAGE BY WEIGHT PASSING SIEVES

Sieve Designation (Square Openings)	Type I	Type II	Type III
3/8	100	100	100
No. 4	100	98-100	70-90
No. 8	90-100	65-90	45-70
No. 16	65-90	45-70	28-50
No. 30	40-60	30-50	19-34
No. 50	25-42	18-30	12-25
No. 100	15-30	10-21	7-18
No. 200	10-20	5-15	5-15
Asphalt content percent, dry aggregate	10-16	7.5-13.5	6.5-12
Pounds of aggregate per square yard	6-10	10-15	15-20

Type I. This aggregate blend is used to seal cracks, fill voids, and correct moderate surface conditions. An approximate application rate of 6 to 10 pounds per square yard based on dry aggregate weight is used when standard aggregates are utilized. The fineness of this design provides it with maximum crack penetrating properties. A typical example of this type of slurry surface would be on airfields or other areas where only protection from the elements is desired.

Type II. This aggregate blend is used where it is desired to fill surface voids, correct severe surface conditions, and provide sealing and an adequate skid resistant surface. An approximate application rate of 10 to 15 pounds per square yard based on dry aggregate weight is used when standard aggregates are utilized. A typical example of this type of slurry surface would be on pavements with medium textured surfaces which would require this size of aggregate to fill in the cracks and provide a good skid resistant surface. Another example would be placing a general slurry on flexible base, stabilized base, or soil cement as a sealer prior to final paving.

Type III. The aggregate blend is used to give crown correction and an effective skid resistant surface. It is applied at a rate of 15 pounds per square yard, or more, based on dry aggregate weight for normal aggregate. A typical example of this type of slurry surface is the first and/or second course of a two-course slurry treatment on flexible base, stabilized base, or soil cement. Another example of this type of slurry surface would be on pavements which have highly textured surfaces and require this size of aggregate to fill in the voids and provide an effective braking friction coefficient for the surface.

The final gradation decided on within the limits designated in the table shall not vary from the low limit on one sieve to the high limit on adjacent sieves, or vice versa.

The mineral aggregate shall consist of sound and durable natural or manufactured sand, slag, crushed stone or crushed stone and rock dust, or a combination thereof. The aggregate shall be free from dirt, organic matter, clay balls, adherent films of clay, dust, vegetable matter, and any other deleterious substances. Smooth-textured sand of less than 1.25 percent water absorption shall not exceed the total combined aggregate.

The aggregate shall contain no free water and shall be nonplastic as determined by ASTM D-423 and ASTM D-424. Aggregate retained on the No. 50 sieve shall be 100 percent crushed. Material passing the No. 50 sieve shall be 90 percent crushed.

TABLE 11. AIRCRAFT PERFORMANCE, TAKEOFF (BOEING 727-200 SERIES) JT8D-9 ENGINE, 15° FLAPS

MAXIMUM ALLOWABLE TAKEOFF WEIGHT (1000 LBS)

TEMP	AIRPORT ELEVATION (FEET)								
°F	0	1000	2000	3000	4000	5000	6000	7000	8000
50	181.4	190.0	183.6	176.9	170.3	164.0	157.9	152.0	146.3
55	190.0	187.7	180.6	174.1	167.7	161.6	155.6	149.8	144.2
60	190.0	185.5	178.6	172.0	165.8	159.7	153.9	148.2	142.7
65	190.0	185.5	178.6	172.0	165.8	159.7	153.9	148.2	142.7
70	190.0	185.5	178.6	172.0	165.8	159.7	153.9	148.2	142.7
75	190.0	185.5	178.6	172.0	165.8	159.7	153.9	148.2	142.7
80	190.0	185.5	178.6	172.0	165.8	159.7	153.9	148.2	142.7
85	190.0	184.7	177.8	171.3	165.0	159.0	153.2	147.5	142.0
90	187.4	180.6	174.0	167.7	161.6	155.6	149.9	144.3	138.7
95	183.0	176.5	170.2	164.0	158.0	152.2	146.6	141.1	135.7
100	178.8	172.4	166.3	160.3	154.4	148.8	143.2	137.9	132.8
105	174.6	168.4	162.4	156.5	150.8	145.3	139.9	134.7	129.8
110	170.5	164.4	158.5	152.7	147.1	141.7	136.5	131.5	

REFERENCE FACTOR "R"

TEMP	AIRPORT ELEVATION (FEET)								
°F	0	1000	2000	3000	4000	5000	6000	7000	8000
50	41.1	42.7	45.9	49.5	53.4	57.7	62.4	67.5	73.0
55	41.5	43.8	47.2	50.9	54.9	59.3	64.1	69.3	75.0
60	41.8	44.9	48.4	52.1	56.3	60.8	65.8	71.1	76.9
65	42.1	45.3	48.8	52.6	56.8	61.3	66.3	71.7	77.6
70	42.5	45.6	49.1	53.0	57.2	61.8	66.8	72.3	78.2
75	42.8	46.0	49.5	53.4	57.7	62.3	67.4	72.9	78.9
80	43.1	46.4	49.9	53.8	58.1	62.8	67.9	73.5	79.6
85	43.7	47.1	50.7	54.6	58.9	63.7	68.8	74.5	80.7
90	45.2	48.6	52.3	56.4	60.9	65.8	71.2	77.1	83.5
95	46.7	50.2	54.1	58.3	63.0	68.1	73.7	79.8	86.4
100	48.2	51.9	55.9	60.4	65.2	70.5	76.3	82.6	89.6
105	49.9	53.8	58.0	62.5	67.6	73.1	79.1	85.7	93.0
110	51.8	55.8	60.1	64.9	70.1	75.8	82.1	89.1	

RUNWAY LENGTH (1000 FEET)

WEIGHT	REFERENCE FACTOR "R"											
1000 LBS	40	45	50	55	60	65	70	75	80	85	90	95
110	4.00	4.00	4.00	4.24	4.62	5.00	5.38	5.75	6.12	6.48	6.84	7.19
115	4.00	4.00	4.22	4.65	5.07	5.48	5.89	6.30	6.71	7.11	7.51	7.90
120	4.00	4.14	4.61	5.07	5.52	5.98	6.43	6.88	7.33	7.78	8.23	8.67
125	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.01	9.52
130	4.33	4.87	5.42	5.96	6.50	7.05	7.60	8.15	8.71	9.28	9.86	10.45
135	4.67	5.26	5.85	6.44	7.03	7.63	8.23	8.85	9.48	10.13	10.80	11.49
140	5.02	5.66	6.30	6.94	7.59	8.25	8.92	9.61	10.32	11.06	11.83	12.64
145	5.39	6.09	6.78	7.48	8.19	8.91	9.66	10.43	11.24	12.08		
150	5.77	6.53	7.28	8.05	8.82	9.63	10.46	11.33	12.24			
155	6.17	6.99	7.81	8.65	9.50	10.39	11.32	12.30				
160	6.57	7.47	8.37	9.29	10.23	11.22	12.26					
165	7.00	7.98	8.96	9.97	11.02	12.11						
170	7.44	8.51	9.59	10.70	11.86							
175	7.89	9.06	10.25	11.47								
180	8.37	9.64	10.95	12.30								
185	8.85	10.25	11.69									
190	9.36	10.90	12.47									

TABLE 12. AIRCRAFT PERFORMANCE, TAKEOFF (BOEING 727-200 SERIES) JT8D-9 ENGINE, 5° FLAPS

MAXIMUM ALLOWABLE TAKEOFF WEIGHT (1000 LBS)

TEMP	AIRPORT ELEVATION (FEET)								
°F	0	1000	2000	3000	4000	5000	6000	7000	8000
50	190.0	190.0	190.0	184.6	178.0	171.4	165.0	158.9	153.0
55	190.0	190.0	188.7	182.0	175.3	168.7	162.4	156.4	150.6
60	190.0	190.0	186.6	179.8	173.1	166.6	160.4	154.4	148.7
65	190.0	190.0	186.6	179.8	173.1	166.6	160.4	154.4	148.7
70	190.0	190.0	186.6	179.8	173.1	166.6	160.4	154.4	148.7
75	190.0	190.0	186.6	179.8	173.1	166.6	160.4	154.4	148.7
80	190.0	190.0	186.6	179.8	173.1	166.6	160.4	154.4	148.7
85	190.0	190.0	185.7	178.8	172.3	165.9	159.8	153.8	148.1
90	190.0	188.5	181.5	174.8	168.4	162.2	156.3	150.6	145.1
95	190.0	184.2	177.4	170.9	164.6	158.6	152.8	147.2	141.8
100	186.5	179.8	173.3	167.0	160.9	155.1	149.3	143.8	
105	182.0	175.6	169.3	163.2	157.3	151.6	146.0	140.5	
110	177.8	171.5	165.4	159.4	153.7	148.1	142.6	137.4	

REFERENCE FACTOR "R"

TEMP	AIRPORT ELEVATION (FEET)								
°F	0	1000	2000	3000	4000	5000	6000	7000	8000
50	60.7	63.4	68.8	74.7	81.1	88.1	95.8	104.3	113.5
55	61.3	65.2	70.7	76.8	83.4	90.6	98.5	107.2	116.7
60	61.9	67.0	72.6	78.7	85.5	92.9	101.1	110.1	120.0
65	62.4	67.6	73.2	79.4	86.3	93.8	102.0	111.1	121.0
70	63.0	68.2	73.9	80.2	87.0	94.6	102.9	112.1	122.1
75	63.6	68.8	74.6	80.9	87.8	95.4	103.8	113.1	123.2
80	64.1	69.5	75.3	81.6	88.6	96.3	104.7	114.0	124.2
85	64.9	70.3	76.1	82.6	89.7	97.5	106.1	115.5	125.9
90	67.2	72.7	78.7	85.4	92.8	100.9	109.8	119.6	130.2
95	69.8	75.4	81.7	88.6	96.3	104.7	113.9	124.0	134.9
100	72.5	78.4	85.0	92.2	100.1	108.8	118.4	128.8	
105	75.4	81.6	88.4	95.9	104.2	113.2	123.2	134.1	
110	78.3	84.8	91.8	99.6	108.3	117.8	128.4	140.0	

RUNWAY LENGTH (1000 FEET)

WEIGHT	REFERENCE FACTOR "R"								
1000 LBS	60	70	80	90	100	110	120	130	140
110	5.50	5.50	5.50	5.50	5.50	5.95	6.50	7.03	7.53
115	5.50	5.50	5.50	5.50	5.97	6.59	7.18	7.76	8.31
120	5.50	5.50	5.50	5.91	6.58	7.24	7.90	8.53	9.14
125	5.50	5.50	5.75	6.48	7.21	7.93	8.64	9.33	10.01
130	5.50	5.50	6.28	7.07	7.86	8.65	9.42	10.18	10.93
135	5.50	5.98	6.83	7.69	8.54	9.39	10.24	11.08	11.91
140	5.55	6.48	7.41	8.33	9.26	10.18	11.10	12.02	12.93
145	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.01	14.02
150	6.47	7.55	8.62	9.70	10.78	11.86	12.95	14.05	15.16
155	6.95	8.11	9.27	10.43	11.60	12.77	13.95	15.15	
160	7.45	8.70	9.95	11.20	12.45	13.72	15.01		
165	7.97	9.32	10.66	12.00	13.36	14.73			
170	8.51	9.95	11.40	12.84	14.30	15.78			
175	9.07	10.62	12.17	13.73	15.30				
180	9.65	11.31	12.97	14.65					
185	10.24	12.03	13.82	15.62					
190	10.85	12.77	14.70						

CHAPTER 5. AIRPORT MANAGEMENT RESPONSIBILITY

11. RECOGNITION OF THE PROBLEM. Each airport operator should be aware of the surface condition of runway pavements at all times. Nature can change runway surface conditions in a short period of time causing a good dry surface to become slippery when wet.

12. ESTABLISHMENT OF A SURFACE FRICTION MAINTENANCE PROGRAM. The airport manager should establish an active runway maintenance program and make necessary improvements based on values obtained in friction surveys.

13. SUGGESTED MAINTENANCE SCHEDULE. For any maintenance program to succeed, runways should be inspected frequently. Observations noted during visual inspections of pavement surfaces will help determine if a friction survey is required. Table 5-1 suggests a schedule for friction surveys based on annual aircraft operations.

TABLE 5-1

SUGGESTED SCHEDULE FOR FRICTION SURVEYS

Annual Aircraft Operations	Friction Survey
less than 12,000	when required
12,000 - 30,000	once every 2 months
30,000 - 50,000	once every month
50,000 - 100,000	once every 2 weeks
100,000 - 200,000	once every week
200,000 and above	twice a week or more as required

14. TRAINING OF FRICTION SURVEY PERSONNEL. When initiating the runway friction survey for the first time, the airport operator should seek advice from the equipment manufacturer's representative as to the operation of the friction-measuring device and training of the airport personnel who will be responsible for conducting the friction tests.