AC NO: 150/5370-8

DATE: 16 Mar 71

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: GROOVING OF RUNWAY PAVEMENTS

1. PURPOSE. This advisory circular provides guidance for the design, installation, and maintenance of grooves in asphaltic concrete and portland cement concrete runway pavement at airport facilities.

2. REFERENCES. Appendix 1, Bibliography, lists those publications which were used as a source for much of the data contained herein.

3. BACKGROUND. The Federal Aviation Administration (FAA), National Aeronautics and Space Administration (NASA), and the United States Air Force (USAF) have conducted a series of tests which prove that grooving effectively reduces hydroplaning and improves the frictional characteristics of pavement surfaces. Hydroplaning and runway slipperiness are particularly adverse to turbojet operations where wheel/pavement contact is most significant to stopping and directional control of aircraft movement.

   The FAA has urged airport sponsors to groove those runways where an analysis indicates a potentially hazardous situation. Grooving of runway pavement for turbojet operations has been recognized as a most important safety item and carries the highest program priority in the Airport Development Aid Program (ADAP).

4. IMPLEMENTATION. The following physical conditions should be considered in justifying grooving of runways.

   a. Wetness frequency.

   b. Ponding conditions.

   c. Surface texture quality as to slipperiness under dry or wet conditions. Polishing of aggregate, improper seal coating, and contaminant build-up are some examples of conditions which affect the loss of surface friction.

Initiated by: AS-580

d. Terrain limitations such as runway end drop-offs or adverse runway safety area conditions.

e. Adequacy of number and length of available runways.

f. Crosswind effects can be significant when a low friction factor prevails.

5. GROOVE PATTERN. The recommended groove is $\frac{1}{4}$" x $\frac{1}{4}$" with a center-to-center spacing of $1\frac{1}{4}$". The grooves should be evenly spaced not less than 1 1/8" and not more than 2" center-to-center. Tolerances for grooves cut in existing pavement and preformed grooves are given in paragraphs 7b(1) and 7c(1), respectively. Grooves should be continuous for the complete length of the runway and normal to its centerline. The grooves may be terminated within ten feet of the runway pavement edge to allow adequate space for the operation of the grooving equipment.

6. PAVEMENT EVALUATION SURVEY. As a preliminary to design, a pavement evaluation survey should be made in accordance with the provisions in Advisory Circular 150/5320-6A. The results of the investigation could show that the existing pavement may require an overlay for strengthening or rehabilitation prior to grooving.

a. Reconnaissance. A thorough survey should be made of the entire width and length of the runway. Depressed areas and badly cracked and/or spalled areas in the pavement should not be grooved until such sections are adequately repaired or replaced according to methodology as described in references 5 and 6 of Appendix 1. To verify the condition of the pavement, tests should be taken in support of the visual observations.

(1) Tests. The strength of the runway pavement should be evaluated and tested according to the procedures specified in Advisory Circular 150/5370-1A and Advisory Circular 150/5320-6A. Future aircraft loads and trafficking should also be considered when making the evaluation.

(a) Core samples should be taken in asphaltic concrete pavement to determine the stability of the bituminous hot mix. ASTM Standards D 1559 and D 1560 provide methods for the Marshall or Hveem tests. Experienced engineering judgement should be exercised when employing these methods in determining the stability readings. These tests are recommended to be used for guidance only. Other factors

should be considered in determining how long grooves will remain effective in asphaltic concrete pavements. Some of the factors to be considered are kinds and frequency of traffic, maximum operational pavement surface temperature, effective tire pressure, frequency of braking action in given areas, mix composition, and aggregate properties.

(b) Core samples must be precisely 4" in diameter as improper seating of the Marshall breaking head during the tests could have variable and substantial effects on the values.

(c) If the field core is taken in a low density area, (less than 98 percent of laboratory maximum) it is recommended that the core sample be remolded at the proper temperature and compacted to the specified compactive effort and then tested according to ASTM standards.

(2) Overlays. If the survey shows that the existing pavement is not suitable from a strength standpoint, an overlay, either flexible or rigid, will be required using the procedures as given in Advisory Circular 150/5320-6A. IT IS VERY IMPORTANT THAT THE OLD SURFACES BE COMPLETELY AND THOROUGHLY CLEANED OF ALL DIRT, FILM, AND CONTAMINANTS BEFORE PLACING THE OVERLAY. Care should be taken in selecting nonpolishing type aggregate for the mix.

7. CONSTRUCTION.

a. Plans. Details should show the dimensions and spacing of the grooves and the nature of the aggregate materials to be grooved.

b. Specifications. An operational procedure should be established and coordinated with the airport management, airlines, and other users. Communications equipment required should be explicitly stated. The contractor should be required to construct a test section before approval is given.

(1) Tolerances should be spelled out to define groove alignment, depth, width and spacing. Suggested tolerances are ±2" in alignment for 70 feet; minimum depth 3/16", maximum depth 5/16"; minimum width 3/16", maximum width 5/16"; minimum spacing 1 3/16", maximum spacing 2". IN SPECIFYING TOLERANCES IT SHOULD BE KEPT IN MIND THAT SURFACE WAVES AND IRREGULARITIES MAY LIMIT THE WHEELBASE AND TREAD OF EQUIPMENT PERMITTED AND MAY PRECLUDE CLOSE TOLERANCES IN SOME AREAS. Do not cut

grooves closer than 3" to transverse paving joints. Avoid grooving through longitudinal or diagonal saw kerfs where lighting cables are installed. Grooves may be continued through longitudinal construction joints. Extreme care must be exercised when grooving near in-runway lighting fixtures and subsurface wiring. A two-foot easement on each side of the light fixture is recommended to avoid contact by grooving machine. Contracts should specify the contractor's liability for damage to light fixtures and cables. Bidding should be based on the linear foot of groove, or per square foot or square yard of the grooved area.

(2) Cleanup is extremely important and should be continuous throughout the grooving operation. The waste material collected during the grooving operation must be disposed of by either flushing with water, sweeping, or vacuuming. If waste material is flushed, the specifications should state whether the airport owner or contractor is responsible for furnishing water for cleanup operations. FAILURE TO REMOVE THE MATERIAL CAN CREATE CONDITIONS THAT WILL BE HAZARDOUS TO AIRCRAFT OPERATIONS.

c. Preformed grooving in plastic portland cement concrete is a recognized method still in the development stage. The contractor should be required to construct a test section and demonstrate that his equipment will provide the required groove and surface configuration.

(1) The grooving equipment should be capable of forming and finishing transverse grooves in plastic concrete with the following characteristics:

(a) The width of the top of the groove should not exceed 5/16" or be less than 3/16".

(b) The width of the bottom of the groove should not exceed the top of the groove or be less than 1/8".

(c) The depth of the groove should not exceed 5/16" or be less than 3/16".

(d) The grooves should be parallel to each other and perpendicular to the centerline of the runway with allowable variation from the perpendicular limited to ±2" in alignment for 70 feet.

(2) The junction of groove face and pavement surface should be squared or slightly rounded or chamfered. Upon completion of the grooving, the pavement should conform to the tolerances specified for surface smoothness as stated in Advisory Circular 150/5320-6A.

(3) Hand-finishing tools should be provided, shaped to match the grooved surface. The contractor should furnish a "bridge" for workmen to work from to repair any imperfect areas.

(4) The equipment should be designed and constructed so that it can be controlled to grade and be capable of producing the finish required.

(5) If pavement grinding is used to meet specified surface tolerances, it should be accomplished in a direction parallel to the formed grooves; and, regrooving to tolerance depth should be saw cut at the contractor's expense.

(6) The airport management should reserve the right to discontinue grooving operations at any time during the contract when it is apparent that the contractor cannot produce the specified groove.

8. MAINTENANCE. Badly cracked areas of runways which have been grooved may have more than the normal number of pop-outs or spalls. Follow normal practice for maintenance of these areas, except that patched surfaces may be slightly higher than the surrounding pavement and regrooved to provide continuous surface drainage across the pavement. Do not use slurry or chip seals to seal the entire surface after grooving because of their tendency to fill in the grooves. Fog seals will seal asphalt surfaces without destroying the effect of the grooves. CAUTION MUST BE TAKEN WITH FOG SEALS SO AS NOT TO USE MORE ASPHALT EMULSION THAN CAN BE ABSORBED BY THE SURFACE.

9. OBTAIN ADDITIONAL COPIES of this Advisory Circular 150/5370-8 , Grooving of Runway Pavements, dated 16 March 1971 , from Department of Transportation, Distribution Unit, TAD 4843, Washington, D.C. 20590.

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APPENDIX 1. BIBLIOGRAPHY

1. The following publications may be obtained from the Government Printing Office for the prices indicated. Check or money order should be made payable to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

   a. Federal Aviation Regulations, Volume X, Dated September 1969. Price $4.50.

   b. Standard Specifications for Construction of Airports, Advisory Circular 150/5370-1A, dated May 1968. Price $3.50.

2. Copies of the following publications can be obtained from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

   a. Airport Paving, Advisory Circular 150/5360-6A, dated May 1967, including change 1, dated June 1968; change 2, dated February 1970; change 3, dated April 1970.

   b. Removal of Contaminants from Pavement Surfaces, Advisory Circular 150/5380-3A, dated October 1970.

3. The American Society for Testing and Materials Standards, Part 11, dated 1970, price $30.00. Copies can be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103. Copies of ASTM Standards D 1559 and D 1560 may also be obtained from the above address free of charge.

4. Copies of the following publications can be obtained from the National Technical Information Service, Springfield, Virginia 22151.

   a. Pavement Grooving and Traction Studies, Report No. SP-5073, dated November 1968, price $3.00.

   b. A Comparison of Aircraft and Ground Vehicle Stopping Performance on Dry, Wet, Flooded, Slush, Snow, and Ice-Covered Runways, Report No. NASA TN D-6098, dated November 1970, price $3.00.

5. Copies of Asphalt in Pavement Maintenance (MS-16) can be obtained from the Asphaltic Institute, Institute Headquarters Office, College Park, Maryland 20740.

6. Copies of Maintenance Practices for Concrete Pavements can be obtained from the Portland Cement Association, 33 West Grand Avenue, Chicago, Illinois 60610.

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