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Federal Aviation Agency

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GENERAL OPERATING AND FLIGHT RULES
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ADVISORY CIRCULAR

SUBJECT: WATER, SLUSH, AND SNOW ON THE RUNWAY

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1. PURPOSE. This Circular provides background and guidelines concerning the operation of turbojet aircraft with water, slush, and/or snow on the runway.

2. BACKGROUND.

   a. Early in the operation of turbojet aircraft, it was determined that correction factors should be applied to the takeoff data in order to maintain the aircraft performance requirements as specified in the SR-422 series of the Civil Air Regulations and the Federal Aviation Regulations when water, slush, and/or snow are on the runway. The first test, using a Boeing 707 airplane, with slush depth of 6/10 inch on the runway, showed that retardation of acceleration on takeoff was of such consequence that an offload from the maximum gross weight should be made for a critical field length.

   b. In August 1961, further slush tests were conducted at the National Aviation Facilities Experimental Center (NAFEC) by the Federal Aviation Agency/National Aeronautics and Space Administration, using the Agency's Convair 880/22M type transport. The test program was designed to obtain data regarding the retardation effects of slush and the effects of aquaplaning on the aircraft's takeoff performance, as well as aircraft control problems and damage encountered when operating in a runway slush environment.

   c. The tests at NAFEC were conducted on a slush covered section of a 10,000-foot runway at depths of 0 to 2.0 inches and at velocities of 80 to 160 knots. The retardation forces measured from the deceleration data were considerably greater than those predicted from earlier wheel and tire drag tests and theoretical studies which neglected the factors of slush spray impingement

and aquaplaning. Impingement of slush against the aircraft and landing wheels contributed significantly to slush drag forces. At velocities above 120 knots, aquaplaning occurred and as a result, drag forces were reduced.

3. FAA GUIDELINES. Based on the available information, the following guidelines are basically sound:

   a. Takeoffs should not be attempted when standing water, slush or wet snow greater than 1/2 inch in depth covers an appreciable part of the runway.

   b. Since SR-422 series regulations are predicated on clean, dry runways, certain correction factors should be applied to the takeoff data when operating in wet snow, slush, or standing water in depths up to 1/2 inch.

   c. At the present time there are no validated engineering data available on which to establish accurate correction factors; however, a considerable amount of information and experience has been accumulated and is available to operators. The following tables show examples of corrections currently being used by operators which are consistent with tests conducted by the Agency. These tables are based on approximately 1/2 inch of wet slush on the runway. The first table shows how a compensating correction is applied by increasing the required runway. For example, the required runway for a DC-8 weighing 251,000 pounds is 6,500 feet under certain takeoff conditions (wind, runway temperature, pressure altitude, etc.). The correction factor in the table for that weight is 10 percent which equals 650 feet to be added to 6500 feet. The total required runway with 1/2 inch of wet slush is now increased to 7,150 feet.

Type Aircraft	Takeoff Weight	Required Runway Increase (Approximate)
Douglas DC-8	251,000	10%
Boeing 707/100 Series	247,000	15%
Douglas DC-8	296,000	14%
Boeing 707/300 Series	296,000	15%
Convair 880/22M	150,000	15%

The following table shows how another operator applies a different correction factor by reducing the aircraft's takeoff weight. For example, the maximum allowable takeoff weight for a given (dry) runway under certain takeoff conditions (wind, runway temperature, pressure altitude, etc.) is 140,000 pounds. With

1/2 inch of wet slush on the runway, the aircraft's allowable takeoff weight must be reduced by 17,500 pounds. The new maximum allowable takeoff weight for that particular runway is now 122,500 pounds.

Type Aircraft	Takeoff Weight	Weight Reduction
Boeing 727	140,000	- 17,500
Boeing 727	152,000	- 19,800
Boeing 720	180,000	- 10,000
Boeing 720	190,000	- 11,000
Caravelle	110,000	- 11,000

Note: These are only samples and should not be used in computing takeoff data.

d. The operations manual of the air carrier and commercial operator or other appropriate documents for general aviation aircraft should include specific instructions for each type of turbojet aircraft showing the gross weight reduction and/or additional runway length required for the conditions described. These instructions should clearly outline details of the methods to be used in determining runway conditions as closely as possible to the planned departure time and this information should include the method by which the condition of the runway is determined.

for George S. Moore
Director
Flight Standards Service