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# Evaluation of Two Transport Aircraft and Several Ground Test Vehicle Friction Measurements Obtained for Various Runway Surface Types and Conditions

## *A Summary of Test Results From Joint FAA/NASA Runway Friction Program*

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# Contents

## Summary

A substantial number of tests with specially instrumented Boeing 737 and 727 aircraft together with several different ground friction measuring devices have been conducted for a variety of runway surface types and conditions. These tests are part of a Joint FAA/NASA Aircraft/Ground-Vehicle Runway Friction Program aimed at obtaining a better understanding of aircraft handling performance under adverse weather conditions and defining relationships between aircraft and ground-vehicle tire friction measurements. Aircraft braking performance for dry, wet, and snow- and ice-covered runway conditions is evaluated as well as ground-vehicle friction data obtained under similar runway conditions. A limited number of tests were conducted to evaluate aircraft engine reverser performance, snow-impingement drag on the aircraft, and the influence of runway chemical treatments on control of snow and ice contaminants. All the friction measurements taken during this program from aircraft and ground-vehicle test runs have been tabulated by major discriminators such as test site, runway condition, and vehicle type. Appendixes contain the aircraft/ground-vehicle friction data collected during tests with the two aircraft.

Results from this test program have made it possible to identify the relationship between ground-vehicle and aircraft friction data for a given contaminated runway condition. A better definition of both aircraft ground handling performance and ground-vehicle operational limits under adverse weather conditions has been obtained. The influence of major test parameters on tire-runway friction measurements such as speed, type and amount of surface contaminant, tire characteristics, and ambient temperature has been evaluated, and a substantial friction data base for further analysis and development has been established. Several recommendations are given, including the need for additional tests under winter runway conditions to further define the influence of several factors on aircraft and ground-vehicle friction measurements.

## Introduction

There is an imperative operational need for information on runways which may become slippery because of various forms and types of contaminants. Since the beginning of "all weather" aircraft operations, there have been landing and aborted-takeoff incidents and/or accidents each year in which aircraft have either run off the end or veered off the shoulder of low-friction runways. These incidents/accidents have provided the motivation for various government agencies and aviation industries to conduct extensive research to examine the factors involved in the problem of less-than-acceptable runway friction.

Research conducted by the National Aeronautics and Space Administration (NASA), the Federal Aviation Administration (FAA), the U.S. Air Force (USAF), the Army Cold Regions Laboratory (CREL), the United Kingdom Ministry of Transportation, the Canadian Ministry of Transport, and others has established that tire braking friction does diminish on contaminated runway surfaces. The degree of friction reduction is related to many factors, including depth of contaminant (water, snow, mixture) on the surface, pavement surface texture, tire inflation pressure, and brake application speed. Much of this research effort has been directed towards obtaining a better understanding of the runway slipperiness problem exemplified in the commercial-transport-aircraft, landing-overrun accidents at Erie, Pennsylvania, in February 1986 and at Charlotte, North Carolina, in October 1986.

In early 1983, shortly after the Air Florida accident at Washington National Airport and the World Airways accident at Boston Logan International Airport, congressional recommendations on aviation safety by the Glickman/Gore subcommittee led to an appropriations bill for FAA research and development programs in the area of runway friction measurements. This bill recommended a funding level of $400 000 and directed that "the FAA, in conjunction with NASA, study the correlation between aircraft stopping performance and runway friction measurements on wet and contaminated surfaces. This research will be aimed at determining if it is possible to predict aircraft stopping performance based on runway friction measurements using new technology friction measuring devices." The recommendation was supported by the Air Line Pilots Association (ALPA). Should the correlation between ground-vehicle and aircraft friction measurements be validated, the Glickman/Gore subcommittee further recommended that runway friction measurement devices be made available to airport operators through the Airport and Airway Trust Fund.

The FAA and NASA, working together in response to the congressional directive, have conducted extensive runway friction evaluation tests with two instrumented aircraft and several ground friction-measuring vehicles for a wide variety of runway surface types and conditions. Six different test sites were used during this 5-yr program, and 12 grooved and ungrooved concrete and asphalt runway surfaces were evaluated under dry, truck-wet and rain-wet, and snow-, slush-, and ice-covered conditions. Over 200 test runs were conducted with two specially instrumented aircraft, a NASA Boeing 737 and an FAA

Boeing 727, and over 1100 test runs were conducted with six different ground test vehicles. The ground friction-measuring devices used in this program were the Mu-Meter and BV-11 skiddometer trailers, the surface friction tester, the diagonal-braked vehicle, the runway friction tester, and the runway condition reading vehicle. The primary goals of this Joint FAA/NASA Aircraft/Ground-Vehicle Runway Friction Program were to obtain a better understanding of aircraft ground handling performance under adverse weather conditions and to define relationships between aircraft and ground-vehicle tire friction measurements. The following secondary objectives were also identified: obtain aircraft ground handling data which will enhance simulation software modeling; evaluate aircraft engine thrust reverser performance; investigate influence of runway chemical treatments on control of snow and ice runway contaminants; obtain aircraft and ground-vehicle tire friction measurements to further develop and validate computational methodology used to estimate tire friction performance for different surface conditions; and identify the best tools and test procedures to provide airport operators and users with an accurate assessment of runway friction capability under all weather conditions.

## Symbols

| | |
|---|---|
| $B_0$ | intercept value of dependent variable |
| $B_1$ | slope of linear regression equation |
| $g$ | acceleration due to gravity, $g$ units ($1g = 32.2$ ft/sec$^2$) |
| $p$ | tire inflation pressure, psi |
| $V_G$ | ground speed, knots |
| $W$ | aircraft gross weight, lb |
| $\mu$ | tire-pavement friction coefficient |
| $\mu_{\mathrm{eff}}$ | aircraft effective braking friction coefficient |
| $\sigma$ | standard deviation |

Abbreviations:

| | |
|---|---|
| A/C | aircraft |
| AFB | Air Force Base |
| ALPA | Air Line Pilots Association |
| ARINC | Aeronautical Radio, Inc. |
| ASTM | American Society for Testing and Materials |
| BNAS | Brunswick Naval Air Station |
| BOW | Bowmonk brakemeter |
| BV-11 | BV-11 skiddometer |
| CAL | calibration |
| c.g. | center of gravity |
| CPT | controlled position transducer |
| CREL | Army Cold Regions Laboratory |
| DBV | diagonal-braked vehicle |
| DECOM | decommutating equipment |
| EPR | engine pressure ratio |
| FAA | Federal Aviation Administration |
| FAATC | Federal Aviation Administration Technical Center |
| flt | flight |
| G | grooved |
| GMT | Greenwich mean time |
| INS | inertial navigation system |
| IRIG | Inter-Range Instrumentation Group |
| M.A.C. | mean aerodynamic chord |
| Mu-M | Mu-Meter |
| N/A | not applicable |
| NASA 36 | time-code system developed by NASA |
| NG | nongrooved |
| NTSB | National Transportation Safety Board |
| PCC | Portland cement concrete |
| PCM | pulse-code modulation |
| PFC | porous-friction-course overlay |
| P.R. | ply rating |
| RC filter | resistor capacitor filter |
| RCR | runway condition reading |
| RFT | runway friction tester (Model 6800 van) |
| R/W | runway |
| SFT | surface friction tester |
| SSA | slurry-seal asphalt |
| Sta. | station |
| TAP | Tapley meter |
| UCAR | liquid chemical used as a pavement deicing and anti-icing agent |

## Test Sites

### General

Selection of the different test sites used in this study was based on their proximity to Langley Research Center in Hampton, Virginia, and the FAA Technical Center near Atlantic City, New Jersey; the variety of runway surface treatments available for both aircraft and ground-vehicle friction tests; necessary support equipment and personnel; and weather conditions. The primary test sites were NASA Wallops Flight Facility, the FAA Technical Center, and Brunswick Naval Air Station (BNAS). The Wallops Flight Facility, located on the eastern shore of Virginia approximately midway between Langley and the FAA Technical Center, has 15 different test surfaces, and substantial aircraft and ground-vehicle friction data have been collected on these surfaces during previous investigations. (See refs. 1 to 10.) The FAA Technical Center airport runway was used because the asphalt runway has groove configurations which differ in spacing from those at Wallops. The winter runway test conditions were evaluated at BNAS, located approximately 40 miles northeast of Portland, Maine. Some limited aircraft and ground-vehicle test runs were conducted at three other test sites—Langley AFB, Virginia, Portland International Jetport, Maine, and Pease AFB, New Hampshire. The runway at Langley AFB has a Portland cement concrete (PCC) surface. Tests under rain-wet conditions were conducted with only the 727 aircraft on the porous-friction-course (PFC) runway surface treatments installed at Portland International Jetport and Pease AFB. Table I gives the test-runway designation at each of these test sites and a description of the test-surface treatment and average macrotexture depth values. Additional information on the runway test surfaces evaluated at the different test sites is contained in the following sections.

### Wallops Flight Facility

The three-runway layout at Wallops Flight Facility is shown in figure 1. Runway 17/35 was not used in this study. Runway 10/28 is 200 ft wide and 8000 ft long with a uniform, medium-macrotexture, slurry-seal asphalt surface that is 6000 ft long in the middle with 1000-ft-long PCC sections at each end. The average runway crown or cross slope is 1 percent. Dry, truck-wet, and rain-wet test conditions were evaluated on the slurry-seal asphalt surface shown in figure 2. Runway 4/22, also referred to as the landing research runway, is 150 ft wide and 8750 ft long. The specially constructed level (no crown) test section, 50 ft by 4140 ft, consists of four grooved and four nongrooved sections, each 350 ft long, one nongrooved transition section that is 650 ft long, and two new asphalt sections that are each 345 ft long. The groove configuration, transversely cut into the pavement, is 1/4 in. wide and 1/4 in. deep and is spaced 1 in. apart. Figure 3 shows schematically the test-surface arrangement on runway 4/22. Close-up views of test surface A, which has the lowest macrotexture depth (0.006 in.), and test surface B, which is grooved and has a higher macrotexture, are given in figure 4. The relatively new asphalt test surfaces, labeled J-1 and J-2, are shown in figure 5. Surface J-2 was obtained by using a grinding technique on a portion of surface J-1; this technique resulted in longitudinal ridges and valleys that resembled corduroy. The equipment used for grinding is similar to that used for surface grooving, but the cutting (diamond edged) blades are thinner and are spaced much closer together on the high-speed, rotating drum. The level test section constructed in the center of the runway provides a safety overrun at each end and along both sides. A channel cut 1/4 in. wide and 1 in. deep surrounds each test section and supports the rubber-belt dams used to control the water depth. Additional details and information concerning Wallops Flight Facility runway test surfaces are given in references 1 and 8 to 10.

### FAA Technical Center

The FAA Technical Center airport is similar to the one at Wallops, with a three-runway layout as shown in figure 6. Figure 7 is a schematic of the test-surface arrangement on runway 13/31. The overall runway is 10 000 ft long and 200 ft wide and has a 1.5-percent crown. The saw-cut, transverse grooving installed in the new asphalt overlay is 1/4 in. wide and 1/4 in. deep. Grooved surface C at the north end of the runway has a groove spacing of 1.5 in., whereas grooved surface D at the south end of the runway has a groove spacing of 3.0 in. Close-up photographs of these two grooved-surface configurations are shown in figure 8. A small portion of the new asphalt overlay was left ungrooved and was labeled surface B. (See fig. 7.)

### Brunswick Naval Air Station

The Brunswick Naval Air Station (BNAS) was selected as the winter test site because of its northern location in Maine and because of the parallel runway layout shown in figure 9. The nongrooved asphalt surface has a good macrotexture, as indicated in the close-up surface photograph inset in figure 9. Naval aircraft use the inboard runway, which is kept clear of snow and ice during the winter months. The outboard runway (1L/19R), which is not normally cleared of winter weather contaminants, was used as the test runway for most runs. The runway dimensions are 200 ft by 8000 ft, and there is a 1-percent crown.

### Langley Air Force Base

Langley Air Force Base, Hampton, Virginia, was selected as a test site because it is located adjacent to Langley Research Center. The main runway (7/25) is constructed of nongrooved Portland cement concrete, is 10 000 ft long by 150 ft wide, and has a 1-percent crown.

### Pease Air Force Base

The runway at Pease Air Force Base, Portsmouth, New Hampshire, was selected as a test site because of its proximity to BNAS, Maine, and because the PFC surface was relatively new (installed July 1985). This overlay surface treatment, approximately 3/4 in. thick, has a very open texture and is designed to permit internal water drainage to help minimize the potential for tire hydroplaning. As indicated by the overview photograph in figure 10(a), the PFC treatment was installed in the middle 150 ft of the 300-ft-wide runway and extended to within 1500 ft of the runway thresholds. Runway 16/34 at Pease AFB is 11 320 ft long and has a 1.5-percent crown and a 1000-ft-long overrun area at both ends. The PFC installation met both FAA and USAF specifications. A close-up view of the joint between the PFC and conventional asphalt surfaces under rain-wet conditions is shown in figure 10(b).

### Portland International Jetport

Runway 11/29 at Portland International Jetport, Maine, was also selected as a test site because of its proximity to BNAS and because the PFC surface had been in use for 11 years. The water drainage capability and the uniformity of the overlay surface matrix remain excellent; most of the changes in the touchdown areas are the result of traffic loading and rubber buildup. This runway has a 1-percent crown and is 6800 ft long and 150 ft wide.

## Test Apparatus

### Test Aircraft

***NASA Boeing 737 aircraft.*** The instrumented Boeing 737-100 jet transport test aircraft was operated by NASA Langley flight crews. Figure 11 shows the NASA 737 aircraft during a flooded-runway test at Wallops, and figure 12 depicts the external configuration and dimensions of this aircraft. The dual-wheel nose gear was equipped with 24 × 7.7, 16 P.R., type VII aircraft tires, and the dual-wheel main gear used 40 × 14, 24 P.R., type VII aircraft tires. The maximum authorized landing weight $W$ for this aircraft is 89 700 lb with 40° landing flaps. Maximum brake application ground speed $V_G$ varied with weight and with test-section length and conditions from 110 knots down to 25 knots. The test landing brake energy ranged from $1.039 \times 10^9$ lb-kt$^2$ down to $0.849 \times 10^9$ lb-kt$^2$. The brake-energy values were computed in these units to correspond to aircraft flight-manual plots.

Prior to the test program, the antiskid-brake-system components were removed and sent to the manufacturer for inspection, checkout, and refurbishment as needed. This check was made to insure that the aircraft braking system was within tolerance and at peak performance for the subsequent testing. The aircraft brake system has two operational, full-antiskid, braking modes. The first one is called "manual" because it relies on pilot brake-pedal deflection. For manual braking, the pilot used full brake-pedal deflection, which permitted the antiskid brake system to modulate pressure to a value commensurate with the friction level available. The manual braking mode was used for most of the test runs in this program. The other brake-system mode is "automatic"; braking automatically commences immediately after touchdown without pilot brake-pedal deflection. If the automatic mode is used, the pilot can select one of three levels of deceleration—minimum, medium, or maximum. The automatic system controls brake pressure to achieve the constant deceleration level selected. The few braking test runs conducted during this program in the automatic, full-antiskid, braking mode were all conducted at the maximum deceleration level.

New wheel brake units and new (unworn) tires were installed on the main gear prior to testing. The dual-wheel nose gear was also equipped with new tires prior to testing. The tire inflation pressures, maintained within ±5 lb/in$^2$ throughout the course of the test program, were 155 lb/in$^2$ for the main-gear tires and 135 lb/in$^2$ for the nose-gear tires. When tread wear reached 50 percent on a given tire, both tires on the landing gear were replaced with new ones.

An extensive instrumentation package was used aboard the aircraft to monitor the position of flight control surfaces, brake-system performance, engine speed and throttle settings, and aircraft acceleration, heading, attitude, and forward speed. The primary aircraft instrumentation pallet is shown in figure 13(a), and figure 13(b) is a data-acquisition flow chart. All instrumentation sensors and transducers were properly calibrated prior to conducting test runs and after completion of the program to document any change. The range and accuracy of all the aircraft parameters measured during the test runs are listed in table II(a). Although the NASA 737 aircraft system can provide a maximum data sample rate of 100 samples/sec, most parameter data were evaluated at a rate of 40 samples/sec. Additional details on the instrumentation features and equipment onboard the test aircraft are contained in reference 11.

***FAA Boeing 727 aircraft.*** The instrumented Boeing 727-100QC jet transport was equipped with a wide, side-opening, cargo door and served as a cargo airplane prior to FAA acquisition. Figure 14 shows the FAA 727 test aircraft during a wet-runway test at Wallops Flight Facility. The dual-wheel nose gear was equipped with 32 × 11.5-15, 12 P.R., type VII aircraft tires and the dual-wheel main gear used 49 × 17, 26 P.R., type VII aircraft tires. The external configuration and dimensions of this aircraft are depicted in figure 15. The maximum authorized landing weight $W$ for this aircraft is 142 500 lb with 30° landing flaps. Maximum brake application speed $V_G$ varied with aircraft weight and with test-section length and conditions. For the braking test runs conducted with the 727 aircraft in this program, ground speeds ranged from 105 knots to 5 knots. The brake energy ranged from $1.418 \times 10^9$ lb-kt$^2$ to $0.0033 \times 10^9$ lb-kt$^2$.

Prior to the test program, the antiskid-brake-system components were removed and sent to the manufacturer for inspection, checkout, and refurbishment as needed. This check was made to insure that the aircraft braking was within tolerance and at peak performance for the subsequent testing. The 727 test aircraft had a manually armed (switch in cockpit) nose-wheel braking feature in addition to the conventional main-wheel braking system. Most braking test runs were conducted with only main-wheel braking, but some runs were performed with nose-wheel braking active.

New wheel brake units and new (unworn) tires were installed on the main gear prior to testing. The dual-wheel nose gear was also equipped with new brakes and tires prior to testing. The tire inflation pressures, maintained within ±5 lb/in$^2$ throughout the course of the test program, were 145 lb/in$^2$ for the main-gear tires and 100 lb/in$^2$ for the nose-gear tires. When tread wear reached 50 percent on a given tire, both tires on the landing gear were replaced with new ones.

An extensive instrumentation package was used aboard the aircraft to monitor the position of flight control surfaces, brake-system performance, engine speed and throttle settings, and aircraft acceleration, heading, attitude, and forward speed. The primary aircraft instrumentation pallet is shown in figure 16(a). A three-axis accelerometer package is shown in figure 16(b), the inertial navigation system hookup is shown in figure 16(c), and figure 16(d) is a data-acquisition flow chart. All instrumentation sensors and transducers were properly calibrated prior to and after completion of program test runs. The range and accuracy of all the aircraft parameters measured during the test runs are listed in table II(b). This system is similar to the one used on the NASA 737 test aircraft, in that the maximum data sample rate is 100 samples/sec, but most parameter data were evaluated at a rate of 40 samples/sec.

### Ground Test Vehicles

***General.*** In the overall planning and implementation of this extensive test program, an effort was made to include as many of the different ground friction-measuring vehicles as possible. The diagonal-braked vehicle (DBV) was not available for tests at BNAS. The runway friction tester and the electronic Tapley meter were not available until after the 737 aircraft tests were completed. Except for the DBV and the Tapley meter/Bowmonk brakemeter/runway condition reading (RCR) vehicles, the ground test vehicles were equipped with self-wetting systems. These systems were not used during the program, however, since the test aircraft had to rely on truck- or rain-wetting of the test surfaces. The friction-measuring system on each ground test vehicle was carefully inspected and calibrated each day before conducting the scheduled test runs. If a vehicle was found to be out of calibration or in need of equipment repair, it was excluded from testing until the problem was corrected. Table III summarizes the test tire conditions for each friction-measuring vehicle. Photographs showing the tread pattern on the principal ground-vehicle test tires are presented in figure 17. Typical examples of the records produced by the different ground vehicles (except the RCR vehicle) during test runs on the slurry-seal asphalt surface at Wallops under truck-wet conditions are given in figure 18. Except for the DBV, which measured locked-wheel friction from 60 mph to a complete stop, the ground-vehicle, runway friction tests were normally conducted at 20, 40, and 60 mph. The following sections provide additional information on the equipment and instrumentation used on each of the ground test vehicles.

***Diagonal-braked vehicle.*** The diagonal-braked vehicle (DBV) is equipped with a high-performance engine for rapid acceleration to the normal test speed of 60 mph. This vehicle, shown in figure 19(a), has a specially modified braking system to provide locked-wheel braking on the diagonal wheel pair. With the remaining two freely rotating wheels, this braking configuration permits adequate vehicle stability and directional control when the diagonal wheels are locked at high speed. Figure 19(b) is a schematic of the diagonal-braked system. The diagonal-braked wheels are fitted with American Society for Testing and Materials (ASTM) smooth-tread test tires (specification E-524) inflated to 24 psi. (See fig. 17.) The unbraked wheels are equipped with standard road tires that have a good tread design and are inflated to 32 psi.

The key test parameters monitored by the instrumentation system onboard the DBV are speed, acceleration, and stopping distance from the point of braked-wheel lockup. The longitudinal accelerometer is mounted on the floor inside the vehicle near the center of gravity. Vehicle speed and distance sensors are mounted on the fifth wheel (bicycle wheel attached to rear bumper). Vehicle speed and stopping distance are displayed to the operator by digital counters mounted on the vehicle dashboard. These values of brake application speed and stopping distance are manually recorded by a test observer positioned in the back seat of the vehicle. Magnetic pickups on each wheel provide information on exactly when wheel lockup occurs. The vehicle speed, longitudinal acceleration, and braked-wheel revolutions are recorded on an analog tape recorder mounted inside the vehicle and within reach of the operator. Upon completion of a test-run series, the analog tape data are transferred to a strip chart for review and evaluation. An example of a typical DBV test-run time history is shown in figure 18(a). The upper plot shows the drop in vehicle speed from brake application down to a complete stop in approximately 7.5 sec. The variation in vehicle longitudinal deceleration from diagonal braking only during the test run is determined using the datum line that accounts for vehicle air-drag and rolling-resistance values. In other words, the datum line represents DBV deceleration on the given test surface and conditions in a free-rolling, nonbraking mode. The DBV test records also verify that the diagonal-braked wheels stop rotating and remain locked throughout the test run to the vehicle stop position. The DBV test runs conducted without complete lockup of the diagonal wheels were not accepted, and a repeat test run was conducted. Additional information on the DBV capabilities is given in references 12 and 13.

***Mu-Meter.*** The Mu-Meter is a side-force-measuring trailer pulled with an appropriate tow vehicle. Both the Mark III and the newer Mark IV model Mu-Meters shown in figure 20 were used in this program; these trailers each weigh approximately 540 lb. The older Mark III unit, with limited data readout capability in the tow vehicle cab, was used during tests with the 737 aircraft. The Mark IV unit, with a data computer readout display in the cab of the tow vehicle, was used during most of the 727 aircraft tests. The Mark IV unit works on the same principle as the Mark III unit, but uses solid-state electronic sensors instead of the hydraulic-load cell and the mechanical chart drive of the Mark III recorder. For similar test conditions and speeds, no significant difference was found in measurements collected with the two units. Figures 21(a) to (c) show the basic trailer configuration with two friction-measuring wheels positioned at 7.5°; this positioning produces an apparent wheel-slip ratio of 13.5 percent. A rear wheel is used for distance-traveled measurements and for trailer stability. A vertical load of 171 lb is produced by ballast from a shock absorber on each friction wheel. Smooth-tread tires, size 16 × 4, 6 ply, RL 2 (see fig. 17), are used on the friction-measuring wheels, and the rear wheel is a similar size but has a conventional tread design. The friction-wheel tires are maintained at an inflation pressure of 10 psi, and the rear-wheel tire is kept at 30 psi.

The main components of the Mu-Meter instrumentation system are the load cell and the distance sensor. When combined with real-time increments, trailer speed is determined from the distance sensor. The load cell reads minute tension variations from the friction-measuring wheels. The Mark III Mu-Meter recorder features are shown in figure 21(d). The newer, Mark IV Mu-Meter computer data display to the tow vehicle operator is shown in figure 21(e). An example of a Mu-Meter test-run record that shows the variation in friction coefficient with runway distance is given in figure 18(b). Additional information on the Mu-Meter trailer capability can be obtained from references 14 and 15.

***Surface friction tester.*** The surface friction tester (SFT) is equipped with front-wheel drive and a hydraulically retractable friction-measuring wheel installed behind the rear axle. (See fig. 22.) The measuring wheel is positioned at zero yaw in respect to rear vehicle wheels. Schematic views of the major SFT components are shown in figure 23. The friction-measuring-wheel arm (figs. 23(c) and (d)). consists of a chain-drive connection with the vehicle's rear axle and contains the torque gauge used to compute braking friction values. With this drive arrangement, the measuring wheel will operate at a slower speed than the vehicle and at a fixed braking slip ratio between 10 and 12 percent, depending on the tire configuration. The braking torque on the measuring wheel is fed back to the vehicle rear wheels by the chain drive, and consequently, little energy is required from the vehicle's drive train during test runs. A vertical load of 310 lb is applied on the friction-measuring wheel with a spring and shock absorber. For dry- and wet-runway friction surveys, a smooth-tread tire (16 × 4, 6 ply, RL 2) is used for the test wheel with an inflation pressure of 30 psi. For winter runway snow and ice conditions, a special high-pressure (100 psi), grooved-tread, 16 × 4, aero tire is used. (See fig. 17.)

The torque acting on the friction-measuring wheel during a test run at constant vehicle speed is input to a digital computer, where the information is converted into friction-coefficient form. These friction values, together with distance-traveled measurements, are continuously stored in the computer for strip-chart printout (fig. 18(c)) upon completion of a friction survey. The computer is programmed to calculate the average friction value of a preselected distance and the average vehicle speed over that distance. References 16 and 17 give additional information concerning the SFT equipment and test capabilities.

***BV-11 skiddometer.*** The BV-11 skiddometer trailer, pictured with the tow vehicle in figure 24, is equipped with a friction-measuring wheel designed to operate at a fixed slip ratio between 15 and 17 percent, depending on test-tire configuration. The trailer weighs approximately 795 lb and consists of a welded frame supported by three in-line wheels, of which two are independently sprung wheels. (See fig. 25(a).) The two trailer wheels and the middle (measuring) wheel are coupled together by roller chains and sprocket wheels with a gear ratio selected to force the center friction-measuring wheel to operate at the desired fixed braking slip ratio. A vertical load of 220 lb is applied to the friction-measuring wheel with a spring and shock absorber. A smooth-tread tire (16 × 4, 6 ply, RL 2) is used for the test with an inflation pressure of 30 psi for dry- and wet-pavement friction surveys. For winter pavement conditions with snow and ice, the special high-pressure (100 psi), grooved-tread, 16×4 aero tire is used. (See fig. 17.)

Trailer speed and torque applied to the test wheel by braking friction forces are data inputs to the skiddometer computer shown in figure 25(b). The trailer speed is measured by a tachometer generator driven by one of the roller chains. A special torque transducer continuously measures the torque applied to the middle braked wheel. The data obtained during a test run are processed by the computer and recorded on a strip chart as a continuous plot of friction values over the distance traveled. (See fig. 18(d).) Also printed on the chart are average friction values and trailer speed for each 500-ft segment surveyed during a given run. References 18 and 19 provide additional information on the test capabilities of the BV-11 skiddometer trailer.

***Runway friction tester.*** The runway friction tester (RFT) (Model 6800) was recently developed by an American company located in Michigan. A minivan with front-wheel drive was modified as shown in figure 26 with a friction-measuring wheel connected to the rear axle by a gear drive that produced a constant 13-percent braking slip ratio on the measuring wheel. The test-tire instrumentation includes a two-axis force transducer which measures both vertical and drag loads. Tire friction values can be computed directly without having to consider effects from vehicle oscillations and tire wear. A smooth-tread tire (16 × 4, 6 ply, RL 2, figs. 17 and 27(a)) is used on the friction-measuring wheel with an inflation pressure of 30 psi. A test-tire vertical load of 300 lb is applied by weights mounted on a double-shock-absorber spring assembly.

Measurement signals of test-tire drag and vertical loads are transmitted, together with vehicle speed, into a computer mounted near the vehicle operator's front seat. The computer calculates friction-coefficient values for each foot of runway traveled and can be programmed to compute average friction and speed values for a preselected distance. A digital printer can provide a tabulated listing of friction coefficient versus speed, and a plot of these two parameters can be generated for the distance traveled. (See fig. 18(e).) Figure 27(b) shows the computer keyboard installation inside the runway friction tester vehicle. The operator can use the keyboard to enter test-run information and conditions. Reference 20 provides additional information on the test capabilities and features of the runway friction tester.

***Runway condition reading vehicle.*** The Navy runway condition reading (RCR) vehicle is shown in figure 28. This conventional, rear-axle-drive, pickup truck is equipped with mud- and snow-grip tread, bias-ply tires on the rear wheels, and conventional, grooved and siped, bias-ply tires on the front wheels; all tires are inflated to 32 psi. The RCR vehicle operator accelerates the vehicle up to the desired test speed and applies hard braking to momentarily lock all four wheels. A decelerometer reading from either the Tapley meters shown in figure 29 or the Bowmonk brakemeter unit shown in figure 30 is manually recorded for the locked-wheel braking portion of the test run. There are two types of Tapley meters available—the original mechanical meter shown in figure 29(a) and the newer electronic airfield friction meter shown in figure 29(b). The mechanical meter is a small pendulum-based decelerometer that consists of a dynamically calibrated oil-damped pendulum in a sealed housing. The pendulum is magnetically linked to a lightweight gear mechanism to which is attached a circumferential scale that shows values as a percentage of $g$, $1g = 32.2$ ft/sec$^2$. A lightweight ratchet retains the maximum scale deflection reached upon completion of a test. The mechanism is enclosed in an aluminum case and the scale is covered with a glass face. The whole assembly is mounted in a cast base plate by means of a fork assembly. Each meter is statically tested and dynamically calibrated before being issued a calibration certificate. When the meter is used in a friction survey, it is placed on the floor of the vehicle. The data have to be visually read and recorded by the operator. The electronic Tapley airfield friction meter (fig. 29(b)) provides a recording of the data taken during a friction survey, including averages for each segment (one third) of the runway. The meter is a pendulum-activated, semiautomatic, recording decelerometer, and it operates on the same principles as the original Tapley mechanical decelerometer. When preparing to conduct a friction survey, the operator places the meter on the floor of the test vehicle. The actuating pad is fitted to the brake pedal, and the command module is attached to the vehicle window by a suction pad in front of the driver's side at another suitable location that is readily visible to the operator. The power leads are connected either to the vehicle battery or to a separate battery. The equipment is now ready for testing the runway. These devices should only be used on runway surfaces covered with ice and/or compacted snow, because, under dry and most wet-runway conditions, RCR vehicle wheel lockup becomes inconsistent and vehicle stability is degraded. Additional information on the operation and test capability of the Tapley meter can be obtained from references 19 and 21.

The Bowmonk brakemeter-dynometer used in the RCR vehicle is shown in figure 30. The unit consists of a finely balanced pendulum that is free to respond to any changes in speed and angle. The pendulum movement is coupled with a quadrant gear train to rotate the dial needle. The dial is calibrated as a percentage of $g$. The meter should always be installed in the vehicle with a floor-mounting stand, and, to damp out excessive vehicle vibrations, the instrument is cushioned with a fluid that is insensitive to temperature changes. Like the Tapley meter, the manufacturer of the Bowmonk meter recommends use only on runway surfaces covered with ice and/or compacted snow where vehicle wheel lockups are more consistent and controllable. Reference 22 contains additional details on the test capabilities and operation of the Bowmonk brakemeter.

### Supplemental Instrumentation and Data Measurements

***Portable three-axis accelerometer.*** The main components of this accelerometer package used onboard the test aircraft are shown in figure 31. The unit consists of a four-channel analog tape recorder and a three-axis (longitudinal, vertical, and lateral) linear-accelerometer package that can be operated from battery power or a 110-V ac power source. An audio recorder channel and microphone are available to annotate conditions and events of each aircraft test run. The nominal range of the three-axis accelerometer is $\pm 1g$ with a frequency response of 6 cycles/sec and an accuracy of $\pm 0.1g$. The RC filter is used in the cable that connects the accelerometer package to the tape-recorder input channels. Acceleration measurements with this portable unit were found to closely agree with readings obtained from the primary data-acquisition system of the test aircraft for a given run.

***Surface temperature gauge.*** For noncontact surface temperature measurements such as test-tire treads, wheel brake units, and runway pavement surfaces, an infrared pyrometer device was used during the test program. The unit used by ground test personnel (fig. 32) is a self-contained, battery-operated device that includes a sensing head and a display unit. The power source is a single 9-V alkaline battery or a 110-V ac power source for long-term monitoring. The sensing head contains a passive sensor that receives and measures heat radiation from an object. The display unit can indicate temperature values in either degrees Fahrenheit or Centigrade. The temperature range is 0° to 500°F or 0° to 260°C with a 1° resolution and an accuracy of ±1% + 1 digit. Temperature measurements can be taken from a distance of about 1/4 in. to 6 in. from the source.

***Portable wind anemometer.*** Prior to each aircraft test run, ground personnel located near the runway test section took a wind reading with the hand-held, portable wind anemometer shown in figure 33. The unit has a trigger-actuated, wind-speed dial gauge and, when the built-in compass rose is aligned with the runway heading, the wind direction can also be determined. These wind readings, together with the runway elevation, ambient temperature, and pressure altitude, were used in computing the aircraft ground handling performance. Additional environmental parameters were obtained for each aircraft test run using airport tower gauges and instrumentation.

***Water-depth gauge.*** Runway surface water depth was measured with a gauge designed by NASA (ref. 23) and shown in figure 34. The gauge works on the principle of reflectivity. Polished Plexiglas rods with adjustable protrusions through a black plastic disk are positioned in a circular arrangement. The disk is mounted on a small metal tripod. The base height of each rod above the plane of the tripod feet (corresponding to the surface on which the water depth is to be measured) is numerically indicated on the top of the disk. When the lower countersunk end of the clear Plexiglas rod contacts the water surface, a capillary effect is initiated. The effect is instantly visible by light refraction at the polished upper end of the rod. Water depth is indicated by the highest immersed rod. In figure 34, for example, the gauge indicates a water depth of 0.06 in.

***Texture-depth kit.*** A pavement surface texture-depth measuring kit, developed by NASA (refs. 24 and 25) and shown in figure 35, was used to measure the average depth of the surface macrotexture on the different test runways. For this measurement, a known volume of grease (usually 0.5 $\text{in}^3$) was spread on the surface with a rubber squeegee in an area between two strips of masking tape positioned at a known distance apart. After the grease was evenly spread as far as possible, the covered area was measured. The average surface macrotexture depth was computed by dividing the volume of grease that was spread by the area covered. The macrotexture-depth values recorded for the test surfaces evaluated during this program are listed in table I.

***Snow density data.*** During the snow- and slush-covered runway tests at BNAS, samples of the winter contaminant were obtained to determine density values. Known volumes of the snow or slush material were collected (fig. 36), weighed, and compared with the weight of an equivalent volume of water. In previous tests (refs. 26 and 27), snow and slush density values were shown to affect impingement drag levels on the aircraft.

***Rain gauge.*** Some tests were conducted under wet-runway conditions that resulted from light to moderate rainfall. The portable rain gauge, labeled in figure 33 and shown in figure 37, was used to measure the rain accumulation with time near the runway test section. Readings were normally taken at 15-min intervals during periods of steady rain. If the rainfall intensity changed noticeably, readings were taken more frequently.

### Support Equipment

***Runway markers.*** Aluminum tripods with painted nylon markers were set up as shown in figure 38 along the left side (as viewed by the pilot) of the runway at 500-ft intervals. These markers were used as visual aids to the pilot in entering the runway test section at the desired speed. These markers also served as reference points to the flight-test engineer for actuating the event marker on the airborne recorder and to the ground crew for locating the point of brake application and release.

***Snow removal equipment.*** The different types of snow removal equipment and the 737 test aircraft used during the tests at BNAS are shown in figure 39(a). Snow blowers were used to remove most of the snow from either end and both sides of the test runway (figs. 39(b) and (c)). Plows (fig. 39(d)) were used to reach bare pavement and to adjust the depth of snow in the test section. These plows were equipped with a secondary leveling bar located behind the front wheel. The person shown in figure 39(d) is pointing to this leveling bar.

***Runway water tankers.*** A variety of tanker trucks were used in obtaining both wet-surface conditions and solid-ice conditions. The large (6000-gal) tanker truck used at Wallops was equipped with a 30-ft spreader bar in the rear to help distribute the water. Figure 40(a) is a photograph of this tanker truck in operation. The water truck used at the FAA Technical Center airport had a spray nozzle located on the left side of the vehicle which permitted wetting an area as much as 50 ft in width. Figure 40(b) shows this tanker truck in operation. Two smaller (2000-gal) tanker trucks were used at BNAS to obtain wet-surface conditions and, when the temperature was below freezing, a solid-ice-covered surface condition. Figure 40(c) shows these two tanker trucks in operation.

***Photographic coverage.*** Extensive photographic coverage was used during the course of this program to help document test conditions, run sequence, aircraft and ground-vehicle performance, and support personnel. A motion-picture camera and television camera, each equipped with a zoom lens, were mounted on tripods and were operated adjacent to the runway test section near the midpoint. The tests at Wallops Flight Facility were covered with two additional, 16-mm color motion-picture cameras. A hydraulically operated camera mount (converted gun mount) with azimuth and elevation control was placed about 800 ft from the side of the runway near the test-section midpoint. This camera mount held two cameras. One, with a 4-in. lens that took 128 frames per second, was focused on the overall aircraft; the other, with a 10-in. lens that took 200 frames per second, was focused on the aircraft wheels. These cameras tracked the aircraft from just prior to touchdown to test-section exit. Numerous color still photographs were also taken to help document the test operations, conditions, and data measurements.

***Miscellaneous.*** Portable, battery-powered, handheld, two-way radios (fig. 32) were used by ground test personnel to help coordinate testing activities and the proper sequence of aircraft and ground-vehicle test runs. A tire tread depth gauge, marked in 1/32-in. increments, was used to monitor aircraft tire tread wear as shown in figure 41. When the aircraft tire tread groove depth reached 50-percent worn, the two tires on a given landing gear were replaced with new tires. A portable, battery-powered, optical pyrometer was used by aircraft ground crews to check tire and brake temperatures after braking test runs. Tire inflation pressure gauges were used daily to check both aircraft and ground-vehicle test-tire pressures. Appropriate tools, replacement parts, and repair kits were also available to accomplish on-site repair and maintenance of the test aircraft and ground vehicles. A plastic, 1-pint measuring cup with handle was used to collect runway snow samples for weight measurements and density computations. A 1/16-in. graduated folding ruler was used to determine average snow depth on the runway test surface at BNAS.

## Test Procedures

### General

All personnel were assigned duties and data collection tasks to help complete the required tests. For each test run conducted by the aircraft and ground vehicles, a run number, time of day, test-run heading, speed, and runway surface condition were recorded along with appropriate environmental measurements such as temperature, wind speed and direction, and rain rate.

### Dry Runways

Aircraft and ground-vehicle tests under dry conditions were not performed on every test surface because of tire wear considerations, weather restrictions, and the small effect of variation in surface type on dry friction performance. (See refs. 28 and 29.) Aircraft maximum-braking test runs were performed either from a start point at the end of the runway with the aircraft accelerating up to the desired speed prior to the test section, or from a landing on and rollout into the test section. When aircraft speed reached approximately 15 knots, the pilot was instructed to release the brake pedals, because the antiskid protection cuts off at that speed. For dry conditions, the aircraft tests were performed separately from the ground-vehicle test runs, because the friction data were not time dependent. Some nonbraking, baseline aircraft data runs were performed on runway 10/28 at Wallops Flight Facility and on the test runways at Langley AFB, the FAA Technical Center, and the BNAS. Upon aircraft arrival at a given test site, the initial landing was treated as a baseline data run with full reversers and no brakes. Also, some tare test runs were performed to determine aircraft aerodynamic drag and tire rolling resistance for each test configuration. Dry friction measurements were obtained at 20, 40, and 60 mph for all the vehicles except the DBV, which provided friction data from 60 mph down to a complete stop.

### Wet Runways

For runways under truck-wet test conditions, the following sequence of events and procedures were followed:

1. The test aircraft was positioned for beginning of a run, either at the end of runway or in the air.
2. Water trucks made two passes over the marked runway test section.
3. Surface water-depth measurements were collected. Depths of approximately 0.02 to 0.03 in. were used for most wet runway tests. For flooded runway tests, water depths between 0.1 and 0.2 in. were maintained.
4. One or more ground test vehicles made test runs at selected speeds.
5. Surface water-depth measurements were collected.
6. The aircraft made a test run with maximum wheel braking after entering the marked test section. The test ended when the aircraft exited the marked section or slowed to approximately 15 knots, whichever came first.
7. After exiting the test section, the aircraft (a) continued to a stop by using reverse thrust and/or brakes as required and awaited the next run;

(b) stopped, made a 180° turn, and took off for brake cooling if required; or (c) accelerated and took off for brake cooling. The action taken depended on the runway geometry, winds, and brake cooling requirements of a particular run.

8. Surface water-depth measurements were collected.
9. One or more ground test vehicles made test runs at selected speeds.
10. Surface water-depth measurements were collected. The above test sequence generally took between 5 and 10 min to complete.

For rain-wet runway conditions, step 2 above is not necessary, and rain-gauge readings versus time are collected in addition to surface water-depth measurements. Tests performed with both aircraft on the nongrooved slurry-seal asphalt surface at Wallops with a rainfall rate of 0.03 in/hr produced an average surface water depth of 0.01 to 0.02 in. During rain-wet tests with the 727 aircraft on the nongrooved asphalt surface at BNAS, the average surface water depth was 0.05 to 0.06 in. for a rainfall rate of 0.16 in/hr. Flooded test runs were performed only on surfaces A and B (nongrooved and grooved concrete) of runway 4/22 at Wallops. For a given aircraft run on runway 4/22, braking data were collected on two adjacent test surfaces because of their relatively short length (700 ft). Also, multiple aircraft runs in different directions on the same two surfaces of runway 4/22 are required at different brake application speeds to obtain sufficient friction-speed gradient data for both surfaces. This multiple-aircraft-run procedure was also used for the short (200-ft) nongrooved asphalt surface B at the FAA Technical Center. For all wet-runway braking test runs, ground-vehicle test runs were conducted before and after each aircraft test. Figures 42(a) and (b) show truck-wet and rain-wet runway surface conditions at Wallops.

### Snow- and Slush-Covered Runways

The winter runway test conditions were all evaluated at BNAS. The initial aircraft landing was made on the cleared inboard runway (1R/19L) using normal reversers and braking techniques as required. The outboard test runway (1L/19R) was cleared of snow and slush contaminants at both ends for 2000 ft and along the shoulder to provide a contaminated test section approximately 150 ft wide by 4000 ft long near the middle of the 8000-ft runway. (See fig. 9.) The cleared runway end sections provided adequate conditions for aircraft and ground-vehicle acceleration and stopping. Aircraft testing commenced after the contaminated runway characteristics were measured and documented by ground test team members. Figures 42(c) and (d) show typical compacted snow-covered and slush-covered runway surfaces at BNAS. An accelerate-stop procedure was used for the aircraft test runs, with the initial run of each test series conducted at low (approximately 60 knots) brake application speed. Subsequent test runs were conducted at gradually increasing brake application speeds up to a desired maximum ground speed of 100 knots. Ground-vehicle test runs at 20, 40, and 60 mph in both directions for a given winter runway condition were generally conducted after the aircraft test run series was completed. Several nonbraking aircraft test runs were performed to determine the magnitude of the drag produced on the aircraft from the winter runway conditions. The standard aircraft landing configuration was used for these nonbraking tests, and the aircraft engine thrust was set at idle throughout the contaminated test section. A landing on and rollout into the test section was required to collect sufficient aircraft test data at the higher operating speeds.

### Ice-Covered Runways

The procedure used to obtain an appropriate ice-covered runway test surface involved water application from the tanker trucks at BNAS. During nighttime hours, when ambient temperatures were well below freezing and the runway surface was bare (clear of contaminants), water was sprayed over an area approximately 60 ft wide and 2000 ft long near the middle of the runway. After several passes, the water that had collected on the surface froze and formed a solid ice-covered condition similar to that shown in figure 42(e). Aircraft braking test runs, starting at low speeds, were scheduled right after daybreak when the winds were nearly calm. Ground-vehicle test runs at 20, 40, and 60 mph were performed immediately after completion of the aircraft runs.

A limited number of 727 aircraft and ground-vehicle test runs were conducted to evaluate chemical treatments to remove compacted snow and ice or to act as an anti-icing treatment applied to bare pavement. Figure 43(a) shows the truck that was used to apply dry urea on compacted snow and ice at a rate of 0.008 lb/ft$^2$. The chemical distribution equipment shown in figure 43(b) was used to evaluate liquid UCAR as a pavement deicing and anti-icing agent. As a deicing treatment, the liquid UCAR was applied at a rate of 0.00146 gal/ft$^2$, but the application rate was 0.0005 gal/ft$^2$ as an anti-icing treatment.

## Compilation of Test Data

### General

The overall chronology of aircraft and ground-vehicle test runs is given in table IV. The NASA Boeing 737 aircraft with the DBV, the Mu-Meter (Mu-M), the SFT, and the BV-11 skiddometer were tested first followed by the FAA Boeing 727 aircraft with the same ground test vehicles. The runway friction tester and the Navy RCR vehicle equipped with both a Tapley meter and a Bowmonk brakemeter were also used during tests with the 727 aircraft. Appendix A contains tables that list the 737 aircraft and ground-vehicle friction data, and appendix B contains tables that list the 727 aircraft and ground-vehicle friction data. The first table in each of the appendixes (tables AI and BI) contains aircraft and ground-vehicle test-run sequence data obtained at each test site.

### Aircraft Braking Friction Data

Tables AII and BII contain compilations of 737 and 727 aircraft braking friction data by test-surface type and wetness condition. Run numbers and flight numbers are identified with the aircraft gross weight, center-of-gravity (c.g.) station, type of braking (either manual or automatic for 737 aircraft; main wheel only or main and nose wheel for 727 aircraft), and the effective braking friction coefficients at 5-knot ground speed increments. These aircraft effective braking friction coefficients, derived from aircraft test-run time-history performance data that was sampled at the rate of 40 samples per second, are average values and are determined from linear-regression-analysis procedures. These data are listed in tables AII and BII by test site, starting with Wallops.

### Ground-Vehicle Friction Data

All the ground-vehicle friction data were tabulated by test aircraft and test-surface condition. Tables AIII and BIII contain the dry-runway test-surface data obtained during 737 and 727 aircraft tests. Tables AIV and BIV list the wet-runway friction data that were obtained before and after the 737 and 727 aircraft braking test runs at each site. The ground-vehicle, wet-surface, friction data are grouped by test-vehicle type and test-run time relative to the time of the aircraft test run. Average friction-coefficient values are listed in 10-mph increments up to 60 mph. Supplemental ground-vehicle friction data obtained on wet-runway test surfaces without the test aircraft are contained in tables AV and BV. These friction data are given in 10-mph increments up to 60 mph and are arranged by ground test vehicle type and runway test site. Date of test and test run number are also given. Ground-vehicle friction data obtained during 737 aircraft tests at BNAS in March 1985 are given in table AVI by winter-runway surface condition. The diagonal-braking vehicle was not used during the tests at BNAS. Similar data collected during 727 aircraft tests at BNAS and Pease AFB are listed in table BVI. A total of 495 test runs by the different ground friction-measuring vehicles were included for analysis and evaluation with respect to 737 aircraft tire friction performance compared with 634 ground-vehicle test runs with the 727 aircraft. Friction data obtained only with the runway friction tester used during the 727 aircraft tests are included for analysis with the 737 aircraft and the other ground test vehicle friction data for similar surface type and wetness conditions.

## Data Reduction and Analysis

### Aircraft Data

Aircraft test-run parameter data (see table II) recorded on analog magnetic tape filtered at 100 Hz were transcribed into a digital format and processed into engineering unit (EU) tapes. From these EU tapes, time histories of all instrumented aircraft system parameters required for data analysis were generated. Uniformity in pilot brake application and proper aircraft configuration for a given series of test runs was determined from careful review of these time-history plots. A maximum sample rate of 40/sec was used in digitizing the aircraft parameter data. For a given runway surface condition, longitudinal acceleration data from nonbraking tare runs were analyzed to identify incremental components attributable to aerodynamic drag, tire rolling resistance, engine idle thrust, and a change in the zero value of the accelerometer as the result of runway contaminant displacement drag. These tare run values of aircraft longitudinal acceleration were then used to correct the measured values recorded during maximum-braking test runs. Tabulations of the empirical factors assigned to the various test conditions are given in tables AVII and BVII. The aircraft effective braking friction coefficients for a given run were derived by using an average percentage of the aircraft gross weight supported on the main-gear braking wheel; this percentage varied as a function of the nominal center-of-gravity position. A least-squares curve was fitted to the effective friction coefficient $\mu_{\text{eff}}$ data variation with ground speed $V_G$, and a statistical measure (standard deviation $\sigma$) of the dispersion of the measured $\mu_{\text{eff}}$ values about the least-squares curve fit was calculated. Figure 44 is a flow chart of this overall aircraft tire friction, data-reduction process. Tables AVIII and BVIII give the 737 and 727 aerodynamic and geometric data useful in determining the aircraft theoretical braking performance.

Examples of several 737 aircraft test-run parameter time histories and cross plots are provided in figures 45(a) to (r) for dry, snow-covered, and ice-covered runway conditions. Figures 45(a) to (l) present the data taken during nonbraking free-rolling tare runs of the 737 on the small aggregate asphalt runway at BNAS. The ground speed and longitudinal acceleration time histories and the cross plots of acceleration versus speed all display the steadily reducing speed and the low, steadily reducing deceleration values indicative of predominately aerodynamic-drag-induced velocity decay. The low, relatively steady values of brake-pedal position, brake valve control voltage, and brake pressure displayed on the time-history plots (figs. 45(a), (c), (e), (g), (i), and (k)) are indicative of a nonbraking test run, as is the fact that the wheel speed is synchronous with the ground speed. The cross plots of figures 45(f) and (h) show that the longitudinal deceleration during free-rolling tare runs on the 4-in. wet-snow-covered runway is slightly higher ($\approx 0.05$) than the dry runs shown in figures 45(b) and (d). The cross plots of figures 45(j) and (l) show that the longitudinal deceleration during free-rolling tare runs on the 6-in. loose-snow-covered runway, with a snow density less than that of the 4-in. wet snow, is lower than on the wet-snow case but higher ($\approx 0.03$) than the dry runs shown in figures 45(b) and (d). Figures 45(m) to (r) present the data taken during maximum anti-skid braking runs on the small aggregate asphalt runway at BNAS under dry, 6-in. loose-snow-covered and ice-covered conditions. By examining the time slice on these three runs, during which the brake-pedal position indicates a call for maximum brake application, several observations can be made. The deceleration values displayed during these three runs, taken over a speed range of 60 to 80 knots for ease of comparison, show a decrease from a range of 0.46 to 0.50 in the dry case to a range of 0.30 to 0.35 in the snow-covered case to a low for the ice-covered case of 0.10 to 0.12. The deceleration values in the ice-covered case are not significantly different from the dry nonbraking run values. As the friction level decreases, the reduced effective braking action can be seen by the increase in the average level and activity of the anti-skid brake valve control voltage (figs. 45(m), (o), and (q)), in the reduced average brake pressure, and in the depressed wheel speed compared with the ground speed that is indicative of an increased slip ratio.

Similar examples of test-run-parameter time histories and cross plots for the 727 aircraft are given in figures 46(a) to (r) for dry, truck-wet, loose-snow-covered, and ice-covered conditions. Figures 46(a) to (h) present the data taken during nonbraking, free-rolling tare runs of the 727 on the small aggregate asphalt runway at BNAS. The ground speed and longitudinal acceleration time histories and the cross plots of acceleration versus speed all display the steadily reducing speed and the low, steadily reducing deceleration values indicative of predominately aerodynamic-drag-induced velocity decay. The run data shown in figure 46(a) are indicative of one of two test procedures used whereby the aircraft was accelerated from a stop to the desired test speed and then proceeded under idle thrust for the remainder of the free-rolling or maximum-braking portion of the run. The longitudinal acceleration at the beginning of the test portion displayed is just finishing transitioning from the acceleration portion of the run to the free-rolling portion of the run. The run data shown in figure 46(c) are indicative of the second test procedure used, in which the test was conducted from a landing-on condition and then proceeded through the test section under idle thrust. The beginning data presented are at the end of the landing, and touchdown occurs at about 2.5 sec. The touchdown of the left outboard occurs at about 3 sec. The engines have spooled down and are at idle thrust about 9 sec into the run time history. The low, relatively steady values of brake-pedal position, brake-valve control voltage, and brake pressure displayed in figures 46(a), (c), (e), and (g) are indicative of a nonbraking test run, as is the fact that the wheel speed is synchronous with the ground speed. The cross plots of figures 46(f) and (h) show that the longitudinal deceleration during free-rolling tare runs on the 4.5-in. loose-snow-covered runway is slightly higher ($\approx 0.06$) than during the dry runs shown in figures 46(b) and (d). Figures 46(i) to (r) present the data taken during maximum anti-skid braking runs on the small aggregate asphalt runway at BNAS under dry, truck-wet, 4.5-in. loose-snow-covered, and UCAR on ice-covered conditions. By examining the time slice on these five runs, during which the brake-pedal position indicates maximum brake application, several observations can be made. The deceleration values displayed during these five runs, taken over a speed range of 40 to 80 knots for ease of comparison, show a decrease from a range of 0.4 to 0.5 in the dry case to 0.35 to 0.42 in the truck-wet case, to a range of 0.25 to 0.28 in the snow-covered case, to a low for the ice-covered case of 0.20 to 0.25. These values for the UCAR on ice-covered conditions are significantly higher than the values for the dry nonbraking free-rolling values. As a comparison is made between figures 46(i), (k), (m), and (o) to (q) and the previous two sets, going to an increasingly reduced-friction surface of dry to truck-wet to snow- and ice-covered, several observations should be made. As the friction level decreases, the reduced effective braking action can be seen in the increase in the average level and activity of the antiskid brake-valve control voltage, in the reduced average brake pressure, and in the depressed wheel speed compared with the ground speed and the increased frequency and depth of wheel spin-down.

### Ground-Vehicle Data

Each ground test vehicle operator was responsible for checking and tabulating the tire friction readings obtained during each test run. These values were further validated at NASA Langley during reexamination of the ground-vehicle test records. For the Tapley and Bowmonk brakemeter devices used on the RCR vehicle during winter runway tests, readings were taken and recorded manually by the test observer. These values were recorded on log sheets and were accepted as written. Values of RCR were determined by multiplying the decelerometer meter reading (percentage G) by 100 and dividing by 3.2. In analyzing the ground-vehicle snow- and ice-covered runway data, similar friction data reported in references 3, 7, 12 to 14, and 20 were also considered. For wet-runway data, test-tire inflation pressure and dynamic hydroplaning speed were considered together with the test-tire operational mode. Table V is a summary of the important test-tire characteristics for the two aircraft and the different ground test vehicles. The equations shown for computing the critical hydroplaning spin-down speeds together with the characteristic dry friction-coefficient values were defined in references 7, 28, 30, and 31.

### Correlation Methodology

A considerable amount of tire friction performance data has been collected by researchers at NASA Langley. (See refs. 1 to 10 and 24 to 36.) The test results from these studies have identified several major factors that influence tire friction behavior on dry, wet, flooded, snow-covered, and ice-covered surfaces. In analyzing the wet- and flooded-surface data, several empirical relationships have been derived to define the friction performance, either braking or cornering, of a generic pneumatic tire. A methodology to estimate the tire friction performance of a particular vehicle, whether for an aircraft or a ground vehicle, has been developed from this tire friction data-base analysis. This methodology to estimate the tire friction performance of one vehicle from the tire friction measurement of another vehicle through a speed range on a wet surface continues to be developed and modified, but the current data reduction and computational procedures are outlined below. For this report, the ground-vehicle measurements are used to calculate the estimated variation of 737 and 727 aircraft tire effective braking friction coefficient with ground speed.

Step 1. Determine the best-fit curve for the measured, ground-vehicle tire, friction-speed gradient data for a given test-surface type and condition.

Step 2. For each vehicle, calculate the minimum tire dynamic hydroplaning spin-down speed in knots by using the following equation (see table V and refs. 28, 31, and 32):

$$V_p = 9\sqrt{p} \tag{1}$$

where $p$ is the tire inflation pressure in psi. Experimental values obtained with the Mu-Meter tire indicate that instead of 28.5 knots of tire spin-down velocity calculated using equation (1), 39.1 knots is a better value. This higher value was used in estimating aircraft tire friction performance from Mu-Meter data.

Step 3. Determine experimentally from low-speed (<3 mph) braked rolling, yawed rolling, or locked-wheel sliding, the values of ground-vehicle tire maximum friction coefficient on a dry pavement. These values are identified as the characteristic dry friction coefficient $\mu_{cd}$ for a given tire. For aircraft tires, $\mu_{cd}$ may be calculated from the following equation (ref. 36):

$$\mu_{cd} = 0.93 - C_1 \times p \tag{2}$$

where $C_1 = 0.0011$ with $p$ expressed in psi.

Step 4. Determine the ratio of ground speed to hydroplaning speed $V_G/V_p$ associated with each ground-vehicle tire friction-speed gradient data set.

Step 5 Determine ground-vehicle tire hydroplaning parameter values using the following general relationship:

$$\overline{Y} = \frac{\mu_{\text{exp}}}{\mu_{cd}} \tag{3}$$

where

$\overline{Y}$ = Tire hydroplaning parameter

and

$\mu_{\mathrm{exp}}$ = Experimental or estimated wet-pavement friction coefficient

In determining the tire hydroplaning parameter, a distinction is made between two types of tire operating modes—nonrotating and rotating. For locked-wheel, sliding (nonrotating) tire friction data (e.g., DBV), the tire hydroplaning parameter is labeled $\overline{Y}_L$. For braked or yawed rolling (rotating) tire friction data (e.g., BV-11, SFT, RFT, and Mu-Meter), the tire hydroplaning parameter is labeled $\overline{Y}_R$. The relationship between $\overline{Y}_L$ and $\overline{Y}_R$, which was empirically derived from NASA track aircraft tire test data, is given in reference 32. Hence, knowing one tire hydroplaning parameter allows the determination of the other.

Step 6. Calculate aircraft tire maximum braking friction coefficient $\mu_{\mathrm{max}}$ by simply multiplying the $\overline{Y}_R$ values determined in step 5 by the aircraft tire characteristic dry friction coefficient determined from equation (2) in step 3 (see table V).

Step 7. Determine estimated aircraft tire effective braking coefficient $\mu_{\mathrm{eff}}$ by using the following equations:

$$\mu_{\mathrm{eff}} = 0.2\mu_{\mathrm{max}} + 0.7143\mu_{\mathrm{max}}^2 \qquad (\text{for } \mu_{\mathrm{max}} \lesssim 0.7) \qquad (4a)$$

$$\mu_{\mathrm{eff}} = 0.7\mu_{\mathrm{max}} \qquad (\text{for } \mu_{\mathrm{max}} > 0.7) \qquad (4b)$$

These relationships between aircraft tire maximum braking and effective braking friction coefficient are based on the assumption that the total aircraft braking-system (tires, brakes, hydraulics, gear, and antiskid) efficiency can be generated by a single curve defined by equations 4(a) and (b).

Step 8. Calculate an equivalent aircraft ground speed associated with each value of $\mu_{\mathrm{eff}}$ by multiplying the computed aircraft dynamic hydroplaning spin-down speed value (see step 2) by the appropriate ground-vehicle speed ratio obtained in step 4.

Step 9. The values derived from steps 7 and 8 can define the estimated friction-speed gradient of the aircraft tire from a particular set of ground-vehicle tire friction measurements through a speed range for a given wet-surface condition.

Tables VI and VII provide generalized listings of estimated $\mu_{\mathrm{eff}}$ variation with ground-vehicle friction measurements from 1.10 to 0 and for aircraft tire inflation pressures from 100 to 400 psi in 20-psi increments. For the ground vehicles which measure a rolling-tire friction coefficient ($\overline{Y}_R$ parameter), e.g., the RFT, SFT, BV-11, and Mu-Meter, equivalent aircraft ground speed values for each aircraft tire inflation pressure and ground-vehicle speed are listed in table VI. For the diagonal-braked vehicle, which measures locked-wheel tire friction coefficient ($\overline{Y}_L$ parameter), table VII lists equivalent aircraft ground speed values for each aircraft tire inflation pressure and DBV speed.

For winter runway conditions of compacted snow- or ice-covered surfaces, a more simple and direct aircraft tire friction estimation procedure appears reasonable from ground-vehicle friction data collected for the same surface condition. Available data suggest that, with the low shear strength of snow and ice, the tire friction-speed characteristics are determined by the physical properties of the snow and ice contaminant. It is assumed that friction variations from speed, tire size, vertical load, and inflation pressure are insignificant for compacted snow- and ice-covered surfaces. Hence, estimated aircraft tire effective braking friction coefficients can be determined directly from the following equation:

$$\mu_{\mathrm{eff}} = 0.2\mu_{GV} + 0.7143(\mu_{GV})^2 \qquad (5)$$

where

$\mu_{GV}$ = Ground-vehicle tire friction coefficient

For DBV locked-wheel, sliding friction-coefficient values, the computed values of $\overline{Y}_R$ should be used in equation (5) for $\mu_{GV}$.

## Statistical Analysis

Data presented in this report have been analyzed in various ways as an aid to a clearer presentation and as a tool to further analysis in support of conclusions. On data presentation plots such as figure 47, a curve is shown which represents the least-squares linear regression of the data. This first-order, least-squares, linear regression of the form $y = B_0 + B_1 x$ has been used to represent the trends in the data sets throughout this report. The primary relationship used in the correlation methodology between aircraft and ground-vehicle friction data is the relationship between the experimental wet-pavement friction coefficient and the characteristic dry friction coefficient. Because $\mu_{\mathrm{exp}}$ is more sensitive to runway wetness conditions than to speed (within the speed range tested), and because the constant term in the regression analysis is also more sensitive to runway wetness conditions, the term chosen to indicate the appropriateness of the fit of this regression curve to the fitted data is the square root of the variance about the regression $\sigma$. The coefficients $B_0$ and $B_1$ for the regression curves and associated values of $\sigma$ appear in table VIII.

## Results and Discussion

### General

With the exception of the ground-vehicle, dry-surface friction data, the 737 aircraft and ground-vehicle friction data are discussed first, followed by the 727 aircraft and ground-vehicle friction data. Most of the plots (e.g., fig. 47) show the variation in tire friction coefficient with ground speed for a given test vehicle and surface condition. Some data comparisons are given to indicate the effect of one or more parameters on tire friction performance. For wet, snow-covered, and ice-covered runway conditions, four-graph, composite figures that show the test aircraft and one ground-test vehicle, tire friction performance are combined with the estimated aircraft braking friction performance based on the ground-vehicle friction data. An assessment of the agreement between the estimated and actual aircraft braking performance is given in the fourth graph in these composite figures. Aircraft ground performance parameters of snow impingement drag, engine thrust-reverser performance, and braking configuration are discussed separately for each test aircraft. Some supplemental data analysis plots are also presented that concern ground-vehicle and aircraft friction correlation on compacted snow- and ice-covered runways, 727 aircraft braking performance on porous friction course surfaces, and effects of runway chemical treatments and temperature on winter runway tire friction measurements. Some limited data are described which indicate surface water drainage and accumulation characteristics for a particular runway surface. Plots of aircraft stopping distance versus brake energy are not included in this report, because other factors, such as aircraft configuration, wind speed and direction, and runway slope gradients influence aircraft ground handling performance and stopping capability.

### Boeing 737 Aircraft and Ground-Vehicle Data Evaluation

***Dry runways.*** The variation of the 737 effective friction coefficient with ground speed on different dry-runway surfaces is given in figure 47. For dry-surface conditions, ground speed has a small effect on tire friction performance. The friction value varies from approximately 0.44 at 100 knots to approximately 0.47 at 20 knots. Surface type or macrotexture characteristics also appear to have little effect on dry-runway tire friction performance with both nongrooved and grooved asphalt and concrete surfaces included in the data shown in figure 47. The linear-regression equation of the best-fit data curve and the calculated standard deviation $\sigma$ are given in the figure. All the 737 aircraft dry-surface friction data shown in figure 47 were derived from only manual-braking test runs.

All the ground-vehicle friction measurements obtained on dry-runway surfaces during the course of the entire test program (both airplanes) are given in figure 48 as functions of speed and test-vehicle type. The linear-regression equation and standard-deviation values for each of these ground-vehicle, friction-versus-speed curves are listed in table VIII, starting with the Mu-Meter and followed, in order, by the BV-11 skiddometer, the surface friction tester, the runway friction tester, and the diagonal-braked vehicle. These ground-vehicle, tire friction measurements are similar to the 737 friction data, in that speed and surface type (macrotexture) appear to have little effect. The fixed-slip braking devices (BV-11, SFT, and RFT) produced the highest dry-surface friction values, and the Mu-Meter (side force) and diagonal-braked vehicle (locked wheel) produced the lowest values. For a given dry test surface, tire temperature effects were most noticeable on the DBV data that were collected during a continuous test run from 60 mph down to a complete stop. The test method and mode of test-tire operation on the other ground vehicles helped minimize the effect of tire temperature on the friction data.

A comparison of the 737 aircraft and ground-vehicle data collected at various runway surface conditions is given in figure 49, with the dry runway surface data shown in figure 49(a). Because of differences in tire characteristics (tables III and V), test operational mode, and brake-system control, the ground-vehicle friction-coefficient variations with speed were all well above the 737 friction-speed curve. The slightly negative slopes of the ground-vehicle and friction-speed data are similar, except for the Mu-Meter, which indicated a slightly positive slope (increasing friction with increasing speed).

***Wet runways.*** The range of wet-runway friction data for the ground vehicles and for the 737 is shown in figure 49(b) for rain-wet, slurry-seal asphalt, in figure 49(c) for truck-wet, nongrooved and grooved surfaces, and in figure 49(d) for flooded, nongrooved surface A and grooved surfaces B and C. For these wet surfaces, the data indicate that both speed and surface macrotexture significantly affect the tire friction performance. Decreasing macrotexture and increasing speed decrease the friction level. The grooved surfaces provided much higher friction levels than similar nongrooved surfaces. In general, the ground vehicles measured higher friction than the 737 for rain-wet and truck-wet conditions, but the 737 tire friction was higher for flooded conditions at high (>60 knots) speed. This latter result was probably attained because the inflation pressure used in the aircraft tire was much higher than that used in the ground-vehicle test tires. (See table V.)

Figures 50 to 52 are composite plots that show tire friction performance comparison between one ground-test vehicle and the 737 on wet-runway surfaces that are grouped as follows: truck-wet, nongrooved surfaces (fig. 50); truck-wet, grooved surfaces (fig. 51); and rain-wet, nongrooved slurry-seal asphalt surfaces (fig. 52). A data point and curved-line code are used to distinguish between friction data collected on the different surfaces. For the data in figures 50 and 51, an average of all the nongrooved surface values (fig. 50) and all the grooved surface values (fig. 51) is also plotted for each aircraft and ground-vehicle data set. In these composite figures, the upper left plots show the variation of 737 effective friction coefficient with speed, and the upper right plots show the variation of comparable ground-vehicle average friction coefficient with speed. The lower left plots give the variation of estimated aircraft effective friction coefficient with speed derived from the ground-vehicle friction measurements by using the tire friction methodology discussed previously. The lower right plots show the agreement between the estimated and actual aircraft effective friction coefficient for speeds between 10 and 110 knots. A ±0.1 effective coefficient band is indicated by dashed lines on this plot, and a solid line indicates perfect agreement. For most of the truck- and rain-wet surface data, the plots in figures 50 to 52 indicate that the agreement between estimated and actual aircraft tire friction performance is within this ±0.1 friction-coefficient bandwidth.

***Snow- and ice-covered runways.*** The range of 737 aircraft and ground-vehicle data collected on snow- and ice-covered runway surfaces at BNAS is indicated in figures 49(e) and (f). For tests with the 737 aircraft, only the BV-11 skiddometer and the Mu-Meter were available to collect comparable friction measurements. An increase in 737 tire friction coefficient as speed increases is shown in figure 49(e), but the opposite tire friction performance is indicated on glare ice. (See fig. 49(f).) The BV-11 skiddometer data are similar for both the snow- and ice-covered surfaces, but the 737 data show a significant decrease on the glare ice when compared with the 1.5-in. new-wet-snow condition. These test results are also indicated in the upper plots of the composite figure 53, which also gives the estimated 737 tire friction performance from a given ground-vehicle data set. The agreement between estimated and actual 737 tire friction performance is well within the ±0.1 friction-coefficient band for the glare-ice condition and mostly within the bandwidth for the snow-covered condition, based on both ground-vehicle friction measurements.

### Boeing 737 Aircraft Snow-Impingement Drag

A series of free-rolling, idle-thrust, landing-configuration test runs were conducted with the 737 in a 6-in-deep, loose-snow-covered runway condition at BNAS to determine the magnitude of impingement drag (ref. 37) developed on the aircraft. The variation of 737 deceleration with ground speed for this snow-covered condition is shown in figure 54. The deceleration varies from nearly $0.3g$ at 80 knots down to $0.08g$ at 40 knots. Based on 737 aircraft engine thrust data, the aircraft could not achieve the required rotational speed for takeoff under these conditions. The specific gravity of the loose snow was relatively low (0.32), and additional test runs are recommended to determine the effect of this factor and snow depth on aircraft impingement drag.

### Boeing 737 Aircraft Engine Thrust-Reverser Performance

Several test runs were made with the 737 in a landing configuration and using engine reverse thrust combined with aerodynamic drag and tire rolling resistance to slow the aircraft down to taxi speeds. These tests were performed on dry-runway surfaces at NASA Wallops Flight Facility and at the FAA Technical Center. The head-wind component during these runs varied from 0 to 17 knots. The variation of 737 aircraft deceleration with ground speed using only engine reverse thrust (no wheel braking) is shown in figure 55 for 18 different runs. These test runs vary in engine-pressure-ratio (EPR) settings from 1.9 to 1.12; the higher EPR settings produce the higher aircraft deceleration values. An approximate variation of 0.15$g$ longitudinal aircraft deceleration was measured for this range of EPR settings. Four different, best-fit, linear-regression curves, distinguished by line codes, were used for the following EPR ranges: 1.79 to 1.9; 1.6 to 1.65; 1.39 to 1.55; and 1.12 to 1.28. The magnitude of the aircraft deceleration performance caused by engine reverse thrust, aerodynamic drag, and tire rolling resistance becomes extremely significant on low-friction surfaces, where wheel braking produces little drag force, particularly at high speeds. Hence, the pilot procedure recommended for landing on slippery runways is to first deploy the spoilers, then apply full engine thrust reversers, and then apply maximum wheel braking.

### Comparison of Boeing 737 Aircraft Braking Techniques

During most of the braking test runs with the 737 aircraft, the full manual antiskid braking control mode was used. Some runs were made using a special, automatic, full antiskid braking, control mode onboard the aircraft with the pilot selecting the maximum deceleration level of approximately 10 ft/sec$^2$. For the nongrooved slurry-seal asphalt under truck-wet conditions, a comparison of 737 manual and automatic braking modes is shown in figure 56. The variation of effective friction-coefficient data with ground speed measured for each braking mode indicates that the manual mode produces approximately 25 percent higher tire friction performance than the automatic braking mode. Although the automatic braking mode relieves some of the pilot work load after touchdown, the manual braking mode is recommended, particularly on critical-balanced-field-length runways.

### Boeing 727 Aircraft and Ground-Vehicle Data Evaluation

***Dry runways.*** Variation of effective friction coefficient with ground speed for seven nongrooved and grooved runway test surfaces under dry conditions is shown in figure 57 for the 727 aircraft. These dry-surface aircraft tire friction data are similar to the 737 data, in that speed and surface macrotexture appear to have little effect. All the 727 data in figure 57 were obtained with only main-wheel braking and with the aircraft in the standard braking configuration. The standard deviation and the equation for the best-fit, linear-regression curve are given. For dry-runway conditions, the two test aircraft are nearly identical in effective friction-coefficient variation with ground speed. For comparison, the 727 dry-runway friction data are replotted in figure 58(a), along with the ground-vehicle friction measurements. (See fig. 48.) All the ground-vehicle, dry-surface friction measurements are about twice as much as those measured by the instrumented 727 aircraft. Figure 58 contains 727 aircraft and ground-vehicle friction data comparisons for each runway test-surface condition.

***Wet runways.*** The range of 727 aircraft and ground-vehicle friction data for rain- and truck-wet surface conditions is shown in figures 58(b) to (e). For rain-damp conditions on the porous-friction-course (PFC) surface at Pease AFB, the variation of friction coefficient with speed shown in figure 58(b) does not differ much from that indicated for dry-surface conditions (fig. 58(a)). The PFC surface provides excellent internal water drainage and, as a consequence, both aircraft and ground-vehicle tire friction measurements are relatively high. Similar 727 tire friction performance was obtained on a rain-damp, slurry-seal asphalt surface. (See fig. 58(c).) The DBV data, however, show a much greater influence of speed, which is attributed to the low (24 psi) tire pressure, smooth test-tire tread, and locked-wheel braking mode. For rain-wet conditions with a water depth between 0.04 and 0.06 in. on the nongrooved small aggregate asphalt runway at BNAS, 727 aircraft tire friction performance was lower than for rain-damp conditions. (See fig. 58(d).) The ground-vehicle friction data on this rain-wet asphalt remained higher than that for the 727 aircraft, but the friction-speed gradient is higher than that for the rain-damp PFC surface. (See fig. 58(b).) All the truck-wet, nongrooved- and grooved-surface friction data collected with the 727 aircraft and the five different ground vehicles are shown in figure 58(e). In general, the grooved-surface friction data are higher than those measured on the nongrooved surfaces for all vehicles, and the influence of speed is less.

All the rain- and truck-wet data are replotted in figures 59 to 62 to show the 727 aircraft and individual ground-vehicle friction variations with speed (upper two plots). The estimated 727 aircraft tire friction performance based on a given ground-vehicle friction measurement is shown in the lower left plot. The lower right plot indicates the agreement between estimated and actual 727 aircraft tire friction performance. Dashed lines indicate a ±0.1 friction-coefficient band, and a solid line indicates perfect agreement. Most of the 727 aircraft estimated tire friction performance for rain- and truck-wet conditions is within this friction-coefficient band for data between speeds of 10 and 110 knots, except for the rain-wet small aggregate asphalt surface at BNAS. (See fig. 61.) For this particular wet-surface condition, the estimated 727 aircraft tire friction performance from SFT, BV-11, RFT friction measurements is considerably higher than the actual 727 measurements.

***Snow- and ice-covered runways.*** The range of 727 aircraft and ground-vehicle friction data collected for a variety of winter runway conditions is shown in figures 58(f) to (m). For most of these winter runway conditions, the ground-vehicle friction measurements are higher than for the 727 aircraft except on loose dry snow (fig. 58(f)) and 0.25 in. of slush (fig. 58(m)). The higher pressure aircraft tires, apparently pushed through these two types of winter contaminants and regained contact with the relatively high-macrotexture, small-aggregate asphalt surface. Consequently, the 727 tire friction values are higher than most of the ground-vehicle data. For these winter runway conditions, the highest 727 tire friction performance was measured on the 0.25-in-deep slush condition, and the lowest values were obtained on the solid-ice condition. (See fig. 58(e).) The urea dry-chemical treatment on ice resulted in less improvement in 727 friction performance (fig. 58(i)) than that measured for the UCAR liquid chemical treatment on ice (fig. 58(k)). Other factors that influenced these measurements besides the type of chemical treatment were the ambient temperature, solar heating, and elapsed time after chemical application. These winter runway test results for the 727 aircraft and a given ground test vehicle are also indicated in the upper two plots of figure 63 for five different snow- and ice-covered runway conditions. The derived estimated 727 tire friction performance from each of the ground test vehicles is shown to be in good agreement with the actual 727 tire friction performance. (See lower right plots in figs. 63(a) to (d).)

### Boeing 727 Aircraft Snow-Impingement Drag

A series of free-rolling, idle-thrust, landing-configuration test runs were conducted for the 4.5-in. loose snow-covered runway condition at BNAS to determine the magnitude of impingement drag developed on the 727 aircraft. The variation of aircraft deceleration with ground speed for the snow-covered condition is shown in figure 64. The deceleration varies from nearly $0.2g$ at 80 knots down to 0.05 at 40 knots. These 727 deceleration values are slightly less, as expected, than the measured values for the 737 traveling through 6 in. of loose snow. (See fig. 54.) The specific gravity of the loose snow was measured at 0.27 for the 727 aircraft tests, which is less than the 0.32 measured during the 737 impingement drag tests.

### Boeing 727 Aircraft Engine Thrust-Reverser Performance

Several test runs were performed with the 727 in a landing configuration using engine thrust reversers combined with aerodynamic drag and tire rolling resistance to slow the aircraft down to taxi speeds. These tests were made on dry-runway surfaces with a range of engine pressure ratios from 2.0 down to 1.5. The variation of 727 deceleration with ground speed using only engine thrust reversers (no wheel braking) is shown in figure 65 for 10 different runs. The head-wind components during these runs varied from 2.6 to 24.6 knots. Two best-fit, linear-regression curves, distinguished by line codes, were determined for a range of EPR from 1.75 to 2.0 (solid line) and 1.5 to 1.7 (dashed line). Like the data collected with the 737 aircraft (fig. 55), higher values of EPR and higher ground speed produced higher 727 aircraft deceleration. For equivalent EPR settings, the two-engine (wing mounted) 737 thrust reversers were slightly more effective than the three-engine (fuselage mounted) 727 thrust reversers.

### Comparison of Boeing 727 Aircraft Braking Techniques

The majority of the 727 braking test runs were performed with conventional braking with the main wheel only. Since the test aircraft was also equipped with on-command, nose-wheel braking, several main and nose-wheel-braking test runs were made for comparison. This comparison of the 727 aircraft tire friction-coefficient variation with speed for both braking test modes is given in figure 66. These data were collected on the nongrooved, slurry-seal asphalt surface under truck-wet conditions, and the difference between the two braking techniques is not considered significant.

### Supplemental Data Analysis

The variation of 737 and 727 effective friction coefficient with ground speed for different runway conditions is shown in figure 67. The values for both aircraft range from near 0.5 for dry surfaces down to 0.01 on glare ice. Friction measurements with both aircraft indicated that, for the snow-covered-runway condition, the friction level increased with increasing speed; this trend was opposite from data trends collected on other surface conditions. Under wet-runway conditions, different surface water depths produce different aircraft tire friction performance, as indicated by the wet (0.02-in. to 0.03-in. water depth) and the flooded (0.1-in. to 0.2-in. water depth) data shown in figure 67(a) for the 737 aircraft. As a consequence of this effect of surface water depth on tire friction performance, the correlation between ground-vehicle and aircraft friction measurements is affected. Significant changes in rainfall rates at an airport, such as 1 in/hr, would merit additional ground-vehicle friction measurements to document the effect of increased surface water depth on tire friction performance.

During the tests at NASA Wallops Flight Facility on the nongrooved slurry-seal asphalt surface, a number of surface water-depth measurements were taken after truck wetting or during natural rainfall. These surface water-depth values are presented in figure 68 to indicate the water drainage rate after truck wetting and the water accumulation rate with rainfall rate. The winds were calm during these measurements, and the runway surface has a 1-percent crown and an average texture depth of 0.0263 in. For these test conditions, the data indicate a water drainage rate of 0.0043 in/min, and the surface water depth increases with increasing rainfall at a rate of 0.041 in/in/hr. These data indicate that runway-surface water depth can vary rapidly not only under artificial (truck) wetting conditions, but also under natural rain conditions.

Test results from several previous aircraft and ground-vehicle runway friction programs (refs. 1 to 3, 7, and 38) have indicated the porous-friction-course (PFC) pavements offer wet friction performance comparable to grooved surfaces and dry conditions. During testing with the 727 aircraft, an opportunity to collect comparable braking performance data on two PFC surfaces was available. The variation of 727 tire friction with ground speed on these two rain-damp runways is shown in figure 69. The Pease AFB runway had just been resurfaced within a year of testing, and the Portland International Airport runway PFC surfaces had been installed and used for 11 years. Evidently, traffic and weathering have had a smoothing effect on the PFC surface at Portland—the 727 tire friction measurements were somewhat lower than those measured on the newly installed PFC surface at Pease AFB. At Pease AFB, the 727 aircraft braking performance on the rain-damp PFC surface was almost equal to dry-surface performance, as indicated by the solid line in figure 69.

The effectiveness of dry urea and UCAR liquid chemical treatments on compacted snow- and ice-covered runways is difficult to evaluate, because factors such as ambient temperature, wind, solar heating, and elapsed time after chemical application influence the performance of the chemical treatment. Some limited data were collected with the 727 aircraft at BNAS, and a data comparison is shown in figure 70. Both chemical types increased the 737 tire friction performance, and the magnitude of the increase was directly related to the elapsed time from chemical application. Additional tests are needed to better define the effects of these factors and others on using chemicals both as deicing and anti-icing runway treatments.

Some limited ground-vehicle friction data, collected using the Tapley meter, have been evaluated in an effort to better define the effects of ambient temperature and solar heating on tire friction performance. These data are given in figure 71; the solid line indicates the variation in friction readings with temperature during overcast conditions or at night (minimum solar heating). The dashed curve indicates tire friction variation with temperature measured during daylight hours with bright sunlight (maximum solar heating). These comparable data indicate that solar heating has a significant effect on tire friction performance and that only temperature is significant near (±5°F) the freezing point.

The friction measurements obtained with the different ground vehicles operating on compacted snow- and ice-covered conditions at BNAS indicated that speed had little effect on the magnitude of the friction values. (See figs. 49(e) and (f), 53(a) and (b), 58(h) to (l), and 63(a) to (d).) For these two winter conditions, the ground-vehicle friction measurements showed little difference. Table IX is a listing of the range of friction readings for four braking-action classifications derived from the tests conducted at BNAS and other similar winter runway test results (refs. 2, 9, 16, 18, 19, and 22) obtained at other locations. The vehicle test-tire conditions, range of ambient temperatures, and test speeds are included in table IX. Qualitative verbal braking-action terms—namely, excellent, good, marginal, and poor—were used to identify four distinct levels or ranges in friction readings for each device. The correlations between each of the ground-vehicle friction measurements and the Tapley meter readings (TAP) are as follows:

| Regression equation | $\sigma$ | Correlation coefficient |
|---|---|---|
| Mu-M = −0.08 + 1.26TAP | 0.024 | 0.976 |
| BOW = −0.01 + 0.96TAP | .021 | .984 |
| BV-11/SFT = −0.024 + 1.19TAP | .028 | .964 |
| RFT = −0.05 + 1.13TAP | .012 | .989 |
| RCR = 100/3.2(TAP) | 0 | 1.000 |

In general, the excellent friction readings were close to some wet-surface values (e.g., 0.5 and above), but the poor friction readings were normally below 0.25 and were found on the solid glare ice. The data contained in table IX are plotted in figure 72 to illustrate the friction relationship between the different ground-vehicle devices. The format for this figure was derived from a chart contained in reference 18 and used by European countries. The Mu-Meter and the runway friction tester, which measured similar friction values, are plotted together. The four lines represent sample derivations of the vehicle friction measurements that are comparable or equivalent to RCR values of 5, 10, 15, and 20. The range of friction values at each of these four levels is nearly the same for the Mu-Meter, runway friction tester, Tapley meter, and Bowmonk meter. Slightly higher values of friction for each level were obtained with the surface friction tester and the BV-11 skiddometer mainly because a higher test-tire inflation pressure was used (100 psi versus 30 psi or less) combined with a grooved tread pattern on the tire instead of a smooth (blank) tread.

The variation of both the 727 and 737 aircraft effective friction-coefficient values with ground speed for compacted snow- and ice-covered runway conditions is shown in figure 73. The data symbols and line codes distinguish between the different test runs and surface conditions. The best-fit linear curve for the compacted snow-covered surface friction data (solid line) is nearly four times greater than that measured on the solid ice-covered surface. With increasing speed, the level of aircraft braking performance decreased on the ice-covered surface but slightly increased on the compacted snow-covered runway. These slight variations in $\mu_{\text{eff}}$ with speed, however, are not considered significant.

Since both aircraft indicated a significant tire friction performance difference between the compacted snow-covered and ice-covered surface conditions, two ranges of aircraft friction data were selected to define the relationship with the ground-vehicle friction measurements. The resulting aircraft and ground-vehicle friction-correlation chart is shown in figure 74, where the compacted snow-covered and ice-covered surface conditions are delineated for the two aircraft. For the compacted snow-covered surface condition, an aircraft effective friction coefficient of 0.21 was selected for the excellent-braking-action level and 0.12 was used for the poor-braking-action level. For the ice-covered surface condition, an effective friction-coefficient range from 0.055 to 0.010 was selected for comparable aircraft braking-action levels. Again, the four lines represent sample derivations of vehicle friction measurements comparable or equivalent to RCR values of 5, 10, 15, and 20. The relationships shown in figure 74 between the various ground-vehicle and aircraft friction measurements were derived from the range of values collected from a variety of tests that were conducted under compacted snow- and ice-covered conditions. Not all the winter runway test conditions were evaluated with either or both aircraft. Consequently, a distinct regression equation and correlation coefficient values between the two test aircraft and six ground-vehicle friction values cannot be determined.

From the viewpoint of an aircraft operator, these values of friction for a snow- or ice-covered runway must be considered with respect to the actual runway geometry and several environmental conditions, such as pressure and altitude, winds, and ambient temperature at the time of a particular aircraft operation. It is also recognized that aircraft operations can occur on runways which have a nonuniform mixture of compacted snow-covered area and exposed solid ice-covered surfaces. In such circumstances, additional ground-vehicle friction measurements need to be taken to adequately determine average friction numbers for each portion (surface condition change) of the runway. How well this established relationship between aircraft and ground-vehicle friction values holds for other aircraft types is somewhat questionable, although the available data tend to suggest a similar correlation (refs. 16 and 19). The use of actual friction numbers in place of qualitative braking-action terms is strongly recommended, because, with experience, these runway friction values measured by a ground vehicle provide the pilot a more precise and accurate gauge on the safety margins available for landing on a given runway. Proper and timely use of snow removal equipment and runway chemical treatments to minimize and/or remove snow and ice contaminants is still recognized as a necessity to return, as soon as possible, runway friction levels back up to near dry surface performance.

## Concluding Remarks

A substantial number of tests with specially instrumented Boeing 737 and 727 aircraft, together with several different ground friction-measuring devices, have been conducted on a variety of runway surface types and conditions. These tests were identified as part of a Joint FAA/NASA Aircraft/Ground-Vehicle Runway Friction Program to obtain a better understanding of aircraft ground handling performance under adverse weather conditions and to define relationships between aircraft and ground-vehicle tire friction measurements. Aircraft braking performance on dry, rain-damp and rain-wet, truck-wet, and flooded, snow-, slush-, and ice-covered runway conditions has been discussed, together with ground-vehicle friction data obtained under similar runway conditions. Additional tests were conducted to evaluate aircraft engine reverser performance, snow-impingement drag on the aircraft, and the influence of runway chemical treatments on control of snow and ice contaminants. The major test findings, conclusions, and recommendations are summarized in the following sections.

## Major Test Findings

1. For wet-runway conditions, the estimated aircraft braking performance from the ground-vehicle friction measurements was within ±0.1 friction-coefficient value of the measured values, except for some rain-wet data.
2. For snow- and ice-covered runway conditions, the estimated aircraft braking performance from the ground-vehicle friction measurements was within ±0.1 friction-coefficient value of the measured values.
3. A reasonable method of estimating aircraft tire wet, snow-covered, and ice-covered runway braking performance from different ground-vehicle friction measurements has been established, and available data show good agreement.
4. Speed, water depth, surface type and texture, tire tread design, inflation pressure, and test operating mode were identified as major factors that influence wet-runway tire friction performance.
5. The grooved and porous friction course surfaces provided the highest tire friction levels and the nongrooved concrete surface with the lowest macrotexture value gave the lowest tire friction level for wet conditions.
6. The ground-vehicle and aircraft tire friction correlations derived from the available wet-runway data suggest that the friction relationships change with surface water depth.
7. Solar heating appears to affect tire friction performance on snow- and ice-covered surfaces as well as at ambient temperatures near (±5°F) the freezing point.
8. Runway-surface snow depth $\geq 2$ in. prevented towed-trailer friction measuring devices from maintaining constant speed, and trailer instability was observed.
9. Impingement drag from tire-displaced snow and slush can significantly degrade aircraft takeoff performance.
10. The two-engine, wing-mounted Boeing 737 thrust-reverser performance was slightly more effective than the three-engine, rear-fuselage-mounted Boeing 727.
11. The liquid chemical deicing treatment appeared to be more effective than the dry chemical treatment, but additional tests are required.
12. Aircraft and ground-vehicle friction measurements showed little influence of speed and type of surface for dry-runway condition.

## Conclusions

1. With proper maintenance, equipment checkout, and instrument calibration performed on a regular schedule, each ground friction measuring device operated satisfactorily and produced consistent, repeatable, and accurate friction data.
2. Water ponding, effect of surface winds, and elapsed time after water application from tanker trucks are factors which greatly influence scatter and repeatability of tire friction-measurement data.
3. Tire friction measurements should be obtained for a range of rainfall rates on a given runway to identify the influence of surface water depth.
4. The range of friction values measured by the different ground vehicles under compacted snow- and ice-covered runway conditions could reasonably be divided into four distinct levels of braking action— excellent, good, marginal, and poor.
5. Ground-vehicle friction measurements have been shown to correlate with aircraft tire friction data; consequently, vehicle friction data collected under adverse weather conditions should be routinely reported to all air traffic using the airport facility.

## Recommendations

1. Proper and timely use by airport operators of snow and ice removal equipment and chemical treatments is essential to restore runway friction levels to near-dry surface performance as soon as possible.
2. Additional tests are recommended to better evaluate the various runway chemical treatments used for anti-icing and deicing the runway surfaces.
3. Widespread usage of ground-vehicle friction measurements is strongly recommended for runway surface maintenance and is a valuable tool for monitoring current runway friction conditions.
4. Additional tests under winter runway conditions are recommended so as to further define the influence of temperature, aircraft type, chemical treatments, and type of surface contamination on the friction correlation between aircraft and ground vehicles.

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Table I. Runway Test-Surface Description and Average Macrotexture-Depth Values

| Test site | Test R/W | Test surface | | |
|---|---|---|---|---|
| | | Description | Groove[1] spacing, in. | Macrotexture depth, in. |
| NASA Wallops Flight Facility | 10/28 | Slurry-seal asphalt (SSA) | None | 0.019 |
| | 4/22 | Canvas-belt-finished concrete | None | 0.006 |
| | | Canvas-belt-finished and burlap-drag-finished concrete | 1 | 0.072 |
| | | Large-aggregate asphalt | None | 0.015 |
| | | Modified (longitudinal grinding treatment) large-aggregate asphalt | None | 0.162 |
| FAA Technical Center | 13/31 | Dryer-drum-mix asphalt overlay, aggregate size <1 in. | None | 0.008 |
| | | Dryer-drum-mix asphalt overlay, aggregate size <1 in. | 1.5 | 0.049 |
| | | Dryer-drum-mix asphalt overlay, aggregate size <1 in. | 3 | 0.028 |
| BNAS | 1/19 | Small aggregate asphalt | None | 0.017 |
| Pease AFB | 16/34 | Porous friction course overlay (PFC)[2] | None | 0.049 |
| Langley AFB | 7/25 | Portland cement concrete (PCC) | None | 0.027 |

[1] Transverse, saw-cut grooves of equal 0.25-in. width and depth.

[2] Evaluated similar PFC surface on runway 11/29 at Portland International Jetport, with Boeing 727 test aircraft.

Table II. Test Aircraft Instrumentation Parameter Listing, Range, and Accuracy

(a) NASA Boeing 737; maximum data sample rate, 100/sec; frequency response, 5 cps

| Parameter | Range | Accuracy |
|---|---|---|
| Computed airspeed | 20 to 150 knots | ±2 knots |
| True airspeed | 20 to 150 knots | ±2 knots |
| Ground speed (INS) | 20 to 150 knots | ±2 knots |
| Ground speed expanded | | |
| Nose-wheel speed | 0 to 150 knots | ±2 knots |
| Nose-wheel angle | ±20° | ±0.2° |
| Forward[1] throttle handle 1 | −150 to +70° | ±1.3° |
| Forward[1] throttle handle 2 | −150 to +70° | ±1.3° |
| Forward[1] speed brake | 8 positions | ±0.2% |
| Magnetic heading | ±180° | ±0.72° |
| Normal acceleration, c.g. | ±1.0*g* | ±0.005*g* |
| Lateral acceleration, c.g. | ±0.5*g* | ±0.002*g* |
| Longitudinal acceleration, c.g. | ±1.0*g* | ±0.005*g* |
| Nose-gear weight | 0 to 25 512 lb | ±128 lb |
| Left main-gear weight | 0 to 66 744 lb | ±334 lb |
| Right main-gear weight | 0 to 66 744 lb | ±334 lb |
| Weight c.g. voltage reference | | |
| Left brake-pedal deflection | 0 to 100% | ±6.5% |
| Right brake-pedal deflection | 0 to 100% | ±6.5% |
| Left outboard brake temperature | 0 to 200°C | ±0.4°C |
| Right outboard brake temperature | 0 to 200°C | ±0.4°C |
| Left outboard brake antiskid command | 0 to 10 V | ±0.5 V |
| Left inboard brake antiskid command | ↓ | ↓ |
| Right inboard brake antiskid command | | |
| Right outboard brake antiskid command | | |

[1] Reference to forward cockpit of NASA Boeing 737.

Table II. Continued

(a) Concluded

| Parameter | Range | Accuracy |
|---|---|---|
| Left outboard brake pressure | 0 to 3600 psia | ±19.0 psia |
| Left inboard brake pressure | ↓ | ↓ |
| Right inboard brake pressure | | |
| Right outboard brake pressure | | |
| Left outboard wheel speed | 0 to 150 knots | ±2 knots |
| Left inboard wheel speed | ↓ | ↓ |
| Right inboard wheel speed | | |
| Right outboard wheel speed | | |
| Engine pressure ratio 1 | 0 to 3 | ±1.5% |
| Engine pressure ratio 2 | 0 to 3 | ±1.5% |
| Yaw rate | ±28°/sec | ±0.2°/sec |
| Roll attitude 2 | ±45° | ±0.18° |
| Pitch 2 | ±22.5° | ±0.09° |
| Rudder position 1 | ±25° | ±0.15° |
| Stabilizer position | −8 to +9° | ±0.73° |
| Left trailing-edge flap | 0 to 63° | ±0.13° |
| Right trailing-edge flap | 0 to 63° | ±0.13° |
| Right aileron position | ±20° | ±0.4° |
| Left aileron position | ±20° | ±1.8° |
| Left elevator position | ±22° | ±0.61° |
| Flight spoiler 2 | 0 to 40° | ±0.6° |
| Flight spoiler 3 | ↓ | ↓ |
| Flight spoiler 6 | | |
| Flight spoiler 7 | | |
| Event marker | Full scale | |

Table II. Concluded

(b) FAA Boeing 727 aircraft; maximum data sample rate, 40/sec; frequency response, 5 cps

| Parameter | Range | Accuracy |
|---|---|---|
| Rudder position | −20 to +20° | −2 to +2° |
| Flap position | 0 to 40° | −1 to +1° |
| Throttle handle no. 1 position | 0 to 100% | −2 to +2% |
| Throttle handle no. 2 position | ↓ | ↓ |
| Throttle handle no. 3 position | ↓ | ↓ |
| Nose gear, brake position | ↓ | ↓ |
| Left brake-pedal deflection | ↓ | ↓ |
| Right brake-pedal deflection | ↓ | ↓ |
| Left outboard wheel speed | 20 to 120 knots | −2 to +2 knots |
| Left inboard wheel speed | ↓ | ↓ |
| Right inboard wheel speed | ↓ | ↓ |
| Right outboard wheel speed | ↓ | ↓ |
| Nose wheel speed | ↓ | ↓ |
| Left outboard antiskid valve | 0 to 10 V | −50 to 50 mV |
| Left inboard antiskid valve | ↓ | ↓ |
| Right inboard antiskid valve | ↓ | ↓ |
| Right outboard antiskid valve | ↓ | ↓ |
| Nose-wheel antiskid valve | ↓ | ↓ |
| Event mark | Full scale | N/A |
| Roll attitude, INS | −40 to +40° | −0.5 to +0.5° |
| Pitch attitude, INS | −20 to +20° | −0.5 to +0.5° |
| Heading, INS | 0 to 360° | −2 to +2° |
| Left outboard brake pressure | 0 to 3000 psi | −30 to 30 psi |
| Left inboard brake pressure | ↓ | ↓ |
| Right inboard brake pressure | ↓ | ↓ |
| Right outboard brake pressure | ↓ | ↓ |
| Nose-wheel brake pressure | ↓ | ↓ |
| Engine pressure ratio 1 | 1 to 3 | −0.03 to +0.03 |
| Engine pressure ratio 2 | 1 to 3 | −0.03 to +0.03 |
| Engine pressure ratio 3 | 1 to 3 | −0.03 to +0.03 |
| Longitudinal acceleration, c.g. | −1 to +1*g* | −0.005 to +0.005*g* |
| Lateral acceleration, c.g. | −0.5 to +0.5*g* | −0.002 to +0.002*g* |
| Normal acceleration, c.g. | 0 to 2*g* | −0.005 to +0.005*g* |
| Computed ground speed, INS | 20 to 120 knots | −2 to +2 knots |

Table III. Test-Tire Conditions on Ground-Friction-Measuring Vehicles

| Ground test vehicle | Tire test mode | Test tires | | | |
|---|---|---|---|---|---|
| | | Type | Tread design | Inflation pressure, psi | Vertical load, lb |
| Mu-Meter | 7.5° yawed rolling | RL 2 | Smooth | 10 | 171 |
| Navy RCR vehicle (pick-up truck) equipped with Tapley meter and Bowmonk brakemeter[1] | Locked wheel | Light truck, bias-ply | Grooved and siped | 32 | 1000 |
| Surface friction tester[2] | Fixed slip, 10 to 12% | RL 2<br>Aero | Smooth<br>3-groove | 30<br>100 | 310 |
| Runway friction tester | Fixed slip, 13% | RL 2 | Smooth | 30 | 300 |
| BV-11 skiddometer[2] | Fixed slip, 15 to 17% | RL 2<br>Aero | Smooth<br>3-groove | 30<br>100 | 220 |
| Diagonal-braked vehicle[3] | Locked wheel | ASTM E 524 | Smooth | 24 | 1300 |

[1] RCR vehicle data only collected at BNAS and Pease AFB.

[2] Used RL 2 smooth tire, 30 psi, for dry- and wet-runway tests; aero tire used for winter runway conditions.

[3] Diagonal-braked vehicle used only at Wallops Flight Facility and FAA Technical Center.

Table IV. Overall Chronology of Aircraft and Ground-Vehicle Test Runs

| Date | Test site | Test aircraft | | Aircraft flight number | Ground test vehicles |
|---|---|---|---|---|---|
| | | 737 | 727 | | |
| 6-15-83 | Wallops | X | | 409 | DBV, Mu-M |
| 6-17-83 | Wallops | X | | 410 | DBV, Mu-M |
| 6-21-83 | Wallops | X | | 412 | DBV, Mu-M, SFT, BV-11 |
| 6-23-83 | FAATC | X | | 413 | DBV, Mu-M, SFT, BV-11 |
| 6-24-83 | FAATC | X | | 414 | DBV, Mu-M, SFT, BV-11 |
| 6-28-83 | Wallops | X | | 415 | DBV, Mu-M |
| 11-20-84 | Wallops | X | | 426 | None |
| 2-5-85 | Langley AFB | X | | 429 | DBV |
| 3-6-85 | BNAS | X | | 430 | RCR |
| 3-7-85 | BNAS | X | | 431 | RCR, Mu-M, BV-11 |
| 3-8-85 | BNAS | X | | 432 | RCR, Mu-M, BV-11 |
| 3-9-85 | BNAS | X | | 433 | RCR, Mu-M, BV-11 |

Table IV. Continued

| Date | Test site | Test aircraft | | Aircraft flight number | Ground test vehicles |
|---|---|---|---|---|---|
| | | 737 | 727 | | |
| 3-22-85 | Wallops | X | | 434 | DBV |
| 3-22-85 | Wallops | | X | 003 | DBV |
| 3-27-85 | BNAS | | X | 004 | Mu-M, BV-11 |
| 3-27-85 | BNAS | | X | 005 | Mu-M, BV-11 |
| 3-28-85 | BNAS | | X | 006 | None (dry conditions) |
| 4-10-85 | Langley AFB | | X | 007 | None (dry conditions) |
| 4-18-85 | Wallops | | X | 008 | DBV, Mu-M, SFT, BV-11 |
| 8-12-85 | Wallops | | X | 011 | DBV, Mu-M, SFT, RFT, BV-11 |
| 8-13-85 | Wallops | | X | 012 | DBV, Mu-M, SFT, RFT, BV-11 |
| 8-15-85 | FAATC | | X | 013 | DBV, Mu-M |
| 8-21-85 | FAATC | | X | 014 | Mu-M, SFT, BV-11 |
| 8-22-85 | FAATC | | X | 015 | None (dry conditions) |

Table IV. Concluded

| Date | Test site | Test aircraft | | Aircraft flight number | Ground test vehicles |
|---|---|---|---|---|---|
| | | 737 | 727 | | |
| 1-28-86 | BNAS | | X | 019 | Mu-M, SFT, RFT, BV-11, RCR |
| 1-29-86 | BNAS | | X | 020 | Mu-M, SFT, BV-11, RCR |
| 1-30-86 | BNAS | | X | 021 | Mu-M, SFT, BV-11, RCR |
| 2-18-86 | BNAS | | X | 022 | Mu-M, SFT, BV-11, RCR |
| 2-19-86 | BNAS | | X | 023 | SFT, RFT, BV-11, RCR |
| 2-19-86 | BNAS | | X | 024 | SFT, RFT, BV-11, RCR |
| 2-20-86 | BNAS | | X | 025 | SFT, RFT, BV-11, RCR |
| 3-19-86 | BNAS | | X | 026 | Mu-M, SFT, RFT, BV-11, RCR |
| 3-19-86 | Portland International Jetport | | X | 027 | None |
| 3-19-86 | Pease AFB | | X | 027 | Mu-M, SFT, RFT, BV-11, RCR |
| 3-21-86 | BNAS | | X | 028 | Mu-M, SFT, RFT, BV-11, RCR |
| 3-21-86 | BNAS | | X | 029 | Mu-M, SFT, RFT, BV-11, RCR |

Table V. Compilation of Test-Aircraft and Ground-Vehicle Tire Friction Parameters

| Parameter | Test aircraft | | Ground test vehicles | | | |
|---|---|---|---|---|---|---|
| | 737 | 727 | Diagonal braked | Mu-Meter | Friction testers, SFT and RFT | BV-11 skiddometer |
| Tire: | Main gear | Main gear | ASTM E 524 | RL 2 | RL 2 | RL 2 |
| Size | 40 × 14 | 49 × 17 | G78 × 15 | 4.00-8 | 4.00-8 | 4.00 8 |
| Inflation pressure, psi | 155 | 145 | 24 | 10 | 30 | 30 |
| Tread design | 4-groove | 6-groove | Smooth | Smooth | Smooth | Smooth |
| Braking method | Maximum antiskid | Maximum antiskid | Locked wheel | None (7.5° yaw) | Constant slip | Constant slip |
| Friction reading | $\mu_{\text{eff}}$ | $\mu_{\text{eff}}$ | $\mu_{\text{skid}}$ | $\mu_{\text{side}}$ | $\mu_{\text{drag}}$ | $\mu_{\text{drag}}$ |
| Spin-down hydroplaning speed, $V_p$, knots (mph) | $^a$112<br>(129) | $^a$108.4<br>(124.8) | $^a$44.1<br>(50.8) | 39.1<br>(45) | $^a$49.3<br>(56.7) | $^a$49.3<br>(56.7) |
| Low-speed characteristic dry friction, $\mu_{cd}$ | $^b$0.76 | $^b$0.77 | 1.20 | 1.10 | 1.10 | 1.10 |

[a] $V_p$ (spin-down) in knots $= 9\sqrt{p}$.

[b] $\mu_{cd} = 0.93 - 1.1 \times 10^{-3} p$.

Table VI. Estimated Aircraft Effective Braking Friction Coefficients for Range of Tire Inflation Pressures Based on Runway Friction Tester, Surface Friction Tester, BV-11 Skiddometer, and Mu-Meter Friction Measurements for Wet-Runway Surface Conditions

| Ground-vehicle $\mu$ | Estimated aircraft $\mu_{\text{eff}}$ | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 psi | 120 psi | 140 psi | 160 psi | 180 psi | 200 psi | 220 psi | 240 psi | 260 psi | 280 psi | 300 psi | 320 psi | 340 psi | 360 psi | 380 psi | 400 psi |
| 1.10 | 0.644 | 0.614 | 0.585 | 0.557 | 0.529 | 0.502 | 0.476 | 0.450 | 0.425 | 0.401 | 0.377 | 0.354 | 0.332 | 0.310 | 0.290 | 0.270 |
| 1.05 | 0.594 | 0.567 | 0.540 | 0.514 | 0.488 | 0.464 | 0.439 | 0.416 | 0.393 | 0.371 | 0.349 | 0.328 | 0.307 | 0.288 | 0.268 | 0.250 |
| 1.00 | 0.546 | 0.521 | 0.497 | 0.473 | 0.449 | 0.427 | 0.405 | 0.383 | 0.362 | 0.341 | 0.322 | 0.302 | 0.284 | 0.265 | 0.248 | 0.231 |
| 0.95 | 0.500 | 0.477 | 0.455 | 0.433 | 0.412 | 0.391 | 0.371 | 0.351 | 0.332 | 0.314 | 0.295 | 0.278 | 0.261 | 0.244 | 0.228 | 0.213 |
| 0.90 | 0.456 | 0.435 | 0.415 | 0.395 | 0.376 | 0.357 | 0.339 | 0.321 | 0.304 | 0.287 | 0.270 | 0.254 | 0.239 | 0.224 | 0.209 | 0.195 |
| 0.85 | 0.414 | 0.395 | 0.377 | 0.359 | 0.342 | 0.325 | 0.308 | 0.292 | 0.276 | 0.261 | 0.246 | 0.232 | 0.218 | 0.204 | 0.191 | 0.178 |
| 0.80 | 0.373 | 0.357 | 0.340 | 0.324 | 0.309 | 0.294 | 0.279 | 0.264 | 0.250 | 0.237 | 0.223 | 0.210 | 0.198 | 0.185 | 0.174 | 0.162 |
| 0.75 | 0.335 | 0.320 | 0.306 | 0.292 | 0.278 | 0.264 | 0.251 | 0.238 | 0.226 | 0.213 | 0.201 | 0.190 | 0.178 | 0.168 | 0.157 | 0.147 |
| 0.70 | 0.299 | 0.286 | 0.273 | 0.260 | 0.248 | 0.236 | 0.224 | 0.213 | 0.202 | 0.191 | 0.180 | 0.170 | 0.160 | 0.150 | 0.141 | 0.132 |
| 0.65 | 0.265 | 0.253 | 0.242 | 0.231 | 0.220 | 0.210 | 0.199 | 0.189 | 0.180 | 0.170 | 0.161 | 0.152 | 0.143 | 0.134 | 0.126 | 0.118 |
| 0.60 | 0.232 | 0.222 | 0.213 | 0.203 | 0.194 | 0.185 | 0.176 | 0.167 | 0.158 | 0.150 | 0.142 | 0.134 | 0.126 | 0.119 | 0.112 | 0.104 |
| 0.55 | 0.202 | 0.194 | 0.185 | 0.177 | 0.169 | 0.161 | 0.153 | 0.146 | 0.138 | 0.131 | 0.124 | 0.117 | 0.111 | 0.104 | 0.098 | 0.092 |
| 0.50 | 0.174 | 0.167 | 0.159 | 0.152 | 0.146 | 0.139 | 0.132 | 0.126 | 0.120 | 0.114 | 0.108 | 0.102 | 0.096 | 0.091 | 0.085 | 0.080 |
| 0.45 | 0.147 | 0.141 | 0.135 | 0.130 | 0.124 | 0.118 | 0.113 | 0.108 | 0.102 | 0.097 | 0.092 | 0.087 | 0.082 | 0.078 | 0.073 | 0.069 |
| 0.40 | 0.123 | 0.118 | 0.113 | 0.109 | 0.104 | 0.099 | 0.095 | 0.090 | 0.086 | 0.082 | 0.078 | 0.074 | 0.070 | 0.066 | 0.062 | 0.058 |
| 0.35 | 0.101 | 0.097 | 0.093 | 0.089 | 0.085 | 0.082 | 0.078 | 0.074 | 0.071 | 0.068 | 0.064 | 0.061 | 0.058 | 0.055 | 0.052 | 0.049 |
| 0.30 | 0.080 | 0.077 | 0.074 | 0.071 | 0.068 | 0.066 | 0.063 | 0.060 | 0.057 | 0.054 | 0.052 | 0.049 | 0.047 | 0.044 | 0.042 | 0.039 |
| 0.25 | 0.062 | 0.060 | 0.057 | 0.055 | 0.053 | 0.051 | 0.049 | 0.047 | 0.045 | 0.043 | 0.041 | 0.039 | 0.037 | 0.035 | 0.033 | 0.031 |
| 0.20 | 0.046 | 0.044 | 0.042 | 0.041 | 0.039 | 0.038 | 0.036 | 0.035 | 0.033 | 0.032 | 0.030 | 0.029 | 0.028 | 0.026 | 0.025 | 0.023 |
| 0.15 | 0.031 | 0.030 | 0.029 | 0.028 | 0.027 | 0.026 | 0.025 | 0.024 | 0.023 | 0.022 | 0.021 | 0.020 | 0.019 | 0.018 | 0.017 | 0.017 |
| 0.10 | 0.019 | 0.018 | 0.018 | 0.017 | 0.016 | 0.016 | 0.015 | 0.015 | 0.014 | 0.014 | 0.013 | 0.012 | 0.012 | 0.011 | 0.011 | 0.010 |
| 0.05 | 0.008 | 0.008 | 0.008 | 0.008 | 0.007 | 0.007 | 0.007 | 0.007 | 0.006 | 0.006 | 0.006 | 0.006 | 0.006 | 0.005 | 0.005 | 0.005 |
| 0.00 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Vehicle speed, mph | Equivalent aircraft ground speed, knots, based on RFT, SFT, and BV-11 skiddometer | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 31.7 | 34.8 | 37.6 | 40.2 | 42.6 | 44.9 | 47.1 | 49.2 | 51.2 | 53.1 | 55.0 | 56.8 | 58.5 | 60.2 | 61.9 | 63.5 |
| 30 | 47.6 | 52.2 | 56.3 | 60.2 | 63.9 | 67.3 | 70.6 | 73.8 | 76.8 | 79.7 | 82.5 | 85.2 | 87.8 | 90.4 | 92.8 | 95.2 |
| 40 | 63.5 | 69.6 | 75.1 | 80.3 | 85.2 | 89.8 | 94.2 | 98.4 | 102.4 | 106.2 | 110.0 | 113.6 | 117.1 | 120.5 | 123.8 | 127.0 |
| 50 | 79.4 | 86.9 | 93.9 | 100.4 | 106.5 | 112.2 | 117.7 | 123.0 | 128.0 | 132.8 | 137.5 | 142.0 | 146.3 | 150.6 | 154.7 | 158.7 |
| 60 | 95.2 | 104.3 | 112.7 | 120.5 | 127.8 | 134.7 | 141.3 | 147.5 | 153.6 | 159.4 | 165.0 | 170.4 | 175.6 | 180.7 | 185.7 | 190.5 |

| Vehicle speed, mph | Equivalent aircraft ground speed, knots, based on Mu-Meter speed | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 40.0 | 43.8 | 47.3 | 50.6 | 53.7 | 56.6 | 59.3 | 62.0 | 64.5 | 66.9 | 69.3 | 71.6 | 73.8 | 75.9 | 78.0 | 80.0 |
| 30 | 60.0 | 65.7 | 71.0 | 75.9 | 80.5 | 84.9 | 89.0 | 93.0 | 96.7 | 100.4 | 103.9 | 107.3 | 110.6 | 113.8 | 117.0 | 120.0 |
| 40 | 80.0 | 87.6 | 94.7 | 101.2 | 107.3 | 113.1 | 118.7 | 123.9 | 129.0 | 133.9 | 138.6 | 143.1 | 147.5 | 151.8 | 155.9 | 160.0 |
| 50 | 100.0 | 109.5 | 118.3 | 126.5 | 134.2 | 141.4 | 148.3 | 154.9 | 161.2 | 167.3 | 173.2 | 178.9 | 184.4 | 189.7 | 194.9 | 200.0 |
| 60 | 120.0 | 131.5 | 142.0 | 151.8 | 161.0 | 169.7 | 178.0 | 185.9 | 193.5 | 200.8 | 207.8 | 214.7 | 221.3 | 227.7 | 233.9 | 240.0 |

Table VII. Estimated Aircraft Effective Braking Friction Coefficients for Range of Tire Inflation Pressures Based on Diagonal-Braked Vehicle Friction Measurements for Wet-Runway Surface Conditions

| Ground-vehicle $\mu$ | Estimated aircraft $\mu_{\mathrm{eff}}$ | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 psi | 120 psi | 140 psi | 160 psi | 180 psi | 200 psi | 220 psi | 240 psi | 260 psi | 280 psi | 300 psi | 320 psi | 340 psi | 360 psi | 380 psi | 400 psi |
| 1.00 | 0.606 | 0.578 | 0.550 | 0.524 | 0.498 | 0.472 | 0.448 | 0.424 | 0.400 | 0.377 | 0.355 | 0.334 | 0.313 | 0.293 | 0.273 | 0.254 |
| 0.95 | 0.595 | 0.567 | 0.541 | 0.514 | 0.489 | 0.464 | 0.440 | 0.416 | 0.393 | 0.371 | 0.349 | 0.328 | 0.308 | 0.288 | 0.269 | 0.250 |
| 0.90 | 0.584 | 0.557 | 0.531 | 0.505 | 0.480 | 0.456 | 0.432 | 0.409 | 0.386 | 0.364 | 0.343 | 0.322 | 0.302 | 0.283 | 0.264 | 0.246 |
| 0.85 | 0.563 | 0.537 | 0.512 | 0.487 | 0.463 | 0.439 | 0.417 | 0.394 | 0.373 | 0.352 | 0.331 | 0.311 | 0.292 | 0.273 | 0.255 | 0.237 |
| 0.80 | 0.542 | 0.517 | 0.493 | 0.469 | 0.446 | 0.423 | 0.401 | 0.380 | 0.359 | 0.339 | 0.319 | 0.300 | 0.282 | 0.263 | 0.246 | 0.229 |
| 0.75 | 0.516 | 0.493 | 0.470 | 0.447 | 0.425 | 0.404 | 0.383 | 0.363 | 0.343 | 0.323 | 0.305 | 0.287 | 0.269 | 0.252 | 0.235 | 0.219 |
| 0.70 | 0.482 | 0.460 | 0.438 | 0.417 | 0.397 | 0.377 | 0.358 | 0.339 | 0.320 | 0.302 | 0.285 | 0.268 | 0.252 | 0.236 | 0.220 | 0.205 |
| 0.65 | 0.434 | 0.414 | 0.395 | 0.377 | 0.358 | 0.340 | 0.323 | 0.306 | 0.290 | 0.274 | 0.258 | 0.243 | 0.228 | 0.214 | 0.200 | 0.186 |
| 0.60 | 0.393 | 0.376 | 0.358 | 0.342 | 0.325 | 0.309 | 0.293 | 0.278 | 0.263 | 0.249 | 0.235 | 0.221 | 0.208 | 0.195 | 0.182 | 0.170 |
| 0.55 | 0.354 | 0.339 | 0.323 | 0.308 | 0.293 | 0.279 | 0.265 | 0.251 | 0.238 | 0.225 | 0.212 | 0.200 | 0.188 | 0.177 | 0.165 | 0.154 |
| 0.50 | 0.321 | 0.307 | 0.293 | 0.280 | 0.267 | 0.254 | 0.241 | 0.229 | 0.217 | 0.205 | 0.194 | 0.182 | 0.172 | 0.161 | 0.151 | 0.141 |
| 0.45 | 0.290 | 0.277 | 0.265 | 0.253 | 0.241 | 0.229 | 0.218 | 0.207 | 0.196 | 0.186 | 0.175 | 0.165 | 0.156 | 0.146 | 0.137 | 0.128 |
| 0.40 | 0.257 | 0.246 | 0.235 | 0.224 | 0.214 | 0.203 | 0.194 | 0.184 | 0.174 | 0.165 | 0.156 | 0.147 | 0.139 | 0.130 | 0.122 | 0.115 |
| 0.35 | 0.222 | 0.212 | 0.203 | 0.194 | 0.185 | 0.176 | 0.168 | 0.160 | 0.151 | 0.144 | 0.136 | 0.128 | 0.121 | 0.114 | 0.107 | 0.100 |
| 0.30 | 0.193 | 0.184 | 0.176 | 0.169 | 0.161 | 0.154 | 0.146 | 0.139 | 0.132 | 0.125 | 0.119 | 0.112 | 0.106 | 0.100 | 0.094 | 0.088 |
| 0.25 | 0.156 | 0.150 | 0.144 | 0.137 | 0.131 | 0.125 | 0.120 | 0.114 | 0.108 | 0.103 | 0.097 | 0.092 | 0.087 | 0.082 | 0.077 | 0.073 |
| 0.20 | 0.116 | 0.112 | 0.107 | 0.103 | 0.098 | 0.094 | 0.090 | 0.085 | 0.081 | 0.077 | 0.074 | 0.070 | 0.066 | 0.062 | 0.059 | 0.055 |
| 0.15 | 0.077 | 0.074 | 0.071 | 0.068 | 0.066 | 0.063 | 0.060 | 0.058 | 0.055 | 0.052 | 0.050 | 0.047 | 0.045 | 0.043 | 0.040 | 0.038 |
| 0.10 | 0.043 | 0.042 | 0.040 | 0.039 | 0.037 | 0.036 | 0.034 | 0.033 | 0.032 | 0.030 | 0.029 | 0.028 | 0.026 | 0.025 | 0.024 | 0.022 |
| 0.05 | 0.017 | 0.017 | 0.016 | 0.016 | 0.015 | 0.015 | 0.014 | 0.014 | 0.013 | 0.013 | 0.012 | 0.012 | 0.011 | 0.011 | 0.010 | 0.010 |
| 0.00 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Vehicle speed, mph | Equivalent aircraft ground speed, knots | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 35.4 | 38.8 | 41.9 | 44.8 | 47.5 | 50.1 | 52.6 | 54.9 | 57.1 | 59.3 | 61.4 | 63.4 | 65.3 | 67.2 | 69.1 | 70.9 |
| 30 | 53.1 | 58.2 | 62.9 | 67.2 | 71.3 | 75.2 | 78.8 | 82.3 | 85.7 | 88.9 | 92.1 | 95.1 | 98.0 | 100.8 | 103.6 | 106.3 |
| 40 | 70.9 | 77.6 | 83.8 | 89.6 | 95.1 | 100.2 | 105.1 | 109.8 | 114.3 | 118.6 | 122.7 | 126.8 | 130.7 | 134.5 | 138.1 | 141.7 |
| 50 | 88.6 | 97.0 | 104.8 | 112.0 | 118.8 | 125.3 | 131.4 | 137.2 | 142.8 | 148.2 | 153.4 | 158.5 | 163.3 | 168.1 | 172.7 | 177.2 |
| 60 | 106.3 | 116.4 | 125.8 | 134.5 | 142.6 | 150.3 | 157.7 | 164.7 | 171.4 | 177.9 | 184.1 | 190.2 | 196.0 | 201.7 | 207.2 | 212.6 |

Table VIII. Statistical Description of Friction-Speed Data Curves in Summary Figures

[Refer to figures 3 and 7 for test-surface letter-code identification]

| Figure | Runway/vehicle type | Curve label | $B_0$ | $B_1$ | $\sigma$ |
|---|---|---|---|---|---|
| 47 | Nongrooved | 737 | 0.48 | −0.000438 | 0.0296 |
| 48 | Nongrooved | Mu-M | 0.847 | 0.000705 | 0.0272 |
| | | BV-11 | 1.083 | −.00188 | .0532 |
| | | SFT | .999 | −.00176 | .0649 |
| | | RFT | 1.0068 | −.00312 | .0821 |
| | | DBV | .841 | −.000376 | .0886 |
| 49(a) | Nongrooved | 737 | 0.48 | −0.000438 | 0.0296 |
| | | Mu-M | .847 | .000705 | .0272 |
| | | BV-11 | 1.083 | −.00188 | .0532 |
| | | SFT | .999 | −.00176 | .0649 |
| | | RFT | 1.0068 | −.00312 | .0821 |
| | | DBV | .841 | −.000376 | .0886 |
| 49(b) | Nongrooved | 737 | 0.317 | 0.001896 | 0.0183 |
| | | Mu-M | .825 | .000633 | .0156 |
| | | BV-11 | .996 | −.00143 | .0722 |
| | | SFT | 1.0953 | −.0056 | .0592 |
| | | DBV | .961 | −.00888 | .0416 |
| 49(c) | Nongrooved | 737 | 0.499 | −0.00479 | 0.0691 |
| | | Mu-M | .954 | −.00877 | .192 |
| | | BV-11 | 1.132 | −.0141 | .158 |
| | | SFT | 1.128 | −.0131 | .127 |
| | | RFT | .929 | −.00688 | .12 |
| | | DBV | .756 | −.00987 | .114 |
| | Grooved | 737 | 0.449 | −0.00162 | 0.0504 |
| | | Mu-M | .851 | −.000876 | .0703 |
| | | BV-11 | .997 | −.00206 | .0651 |
| | | SFT | 1.011 | −.00283 | .0477 |
| | | RFT | .927 | −.00365 | .0514 |
| | | DBV | .837 | −.00715 | .0879 |
| 49(d) | Nongrooved | 737 | 0.255 | −0.00233 | 0.0107 |
| | | Mu-M | .999 | −.0214 | .074 |
| | | BV-11 | 1.05 | −.018 | .0671 |
| | | SFT | 1.154 | −.0194 | .0623 |
| | | DBV | .505 | −.00679 | .018 |
| | Grooved | 737 | 0.549 | −0.00396 | 0.0161 |
| | | DBV | .843 | −.00917 | .0324 |
| 49(e) | Nongrooved | 737 | 0.0936 | 0.000995 | 0.0177 |
| | | Mu-M | .18 | −.0035 | 0 |
| | | BV-11 | .19 | 0 | 0 |

Table VIII. Continued

| Figure | Runway/vehicle type | Curve label | $B_0$ | $B_1$ | $\sigma$ |
|---|---|---|---|---|---|
| 49(f) | Grooved | 737 | 0.0474 | −0.000542 | 0.0101 |
| | | Mu-M | .191 | −.0006 | .00316 |
| | | BV-11 | .238 | −.0018 | .00118 |
| 50 | Aircraft | SSA | 0.498 | −0.0028 | 0.0228 |
| | | A | .295 | −.0029 | .013 |
| | | J-1 | .507 | −.00516 | .0206 |
| | | B, FAATC | .489 | −.00356 | .0208 |
| | | NG | .499 | −.00479 | .0691 |
| 50(a) | DBV | SSA | 0.795 | −0.00882 | 0.071 |
| | | A | .626 | −.0092 | .0843 |
| | | J-1 | .787 | −.01 | .0733 |
| | | B, FAATC | .899 | −.013 | .11 |
| | | NG | .756 | −.00987 | .115 |
| 50(b) | Mu-Meter | SSA | 0.93 | −0.00403 | 0.0568 |
| | | A | .912 | −.0121 | .163 |
| | | J-1 | 1.01 | −.013 | .125 |
| | | B, FAATC | 1.13 | −.0149 | .0835 |
| | | NG | .954 | −.00877 | .192 |
| 50(c) | SFT | SSA | 1.161 | −0.011 | 0.0663 |
| | | A | 1.03 | −.0159 | .0742 |
| | | J-1 | 1.128 | −.0126 | .054 |
| | | B, FAATC | 1.105 | −.142 | .0911 |
| | | NG | 1.128 | −.0131 | .127 |
| 50(d) | BV-11 | SSA | 1.155 | −0.0103 | 0.049 |
| | | A | 1.124 | −.0168 | .0853 |
| | | J-1 | 1.059 | −.0133 | .0872 |
| | | B, FAATC | 1.205 | −.0189 | .0913 |
| | | NG | 1.132 | −.0141 | .159 |
| 51 | Aircraft | B/C | 0.488 | −0.0233 | 0.0451 |
| | | J-2 | .555 | −.0039 | .0371 |
| | | C, FAATC | .43 | −.000714 | .019 |
| | | D, FAATC | .326 | .000121 | .0137 |
| | | G | .449 | −.00162 | .0504 |
| 51(a) | DBV | B/C | 0.711 | −0.00429 | 0.0348 |
| | | J-2 | 1.14 | −.0144 | .0623 |
| | | C, FAATC | .818 | −.00753 | .0247 |
| | | D, FAATC | .897 | −.0065 | .0257 |
| | | G | .837 | −.00715 | .0879 |

Table VIII. Continued

| Figure | Runway/vehicle type | Curve label | $B_0$ | $B_1$ | $\sigma$ |
|---|---|---|---|---|---|
| 51(b) | Mu-Meter | B/C | 0.842 | −0.00148 | 0.0797 |
| | | J-2 | .965 | −.0018 | .0442 |
| | | C, FAATC | .799 | .000168 | .00921 |
| | | D, FAATC | .819 | −.000184 | .0128 |
| | | G | .85 | −.000876 | .0703 |
| 51(c) | SFT | B/C | 1.087 | −0.0057 | 0.0739 |
| | | J-2 | 1.205 | −.008 | .0466 |
| | | C, FAATC | .98 | −.00164 | .00909 |
| | | D, FAATC | .985 | −.00197 | .0158 |
| | | G | 1.011 | −.00283 | .0477 |
| 51(d) | BV-11 | B/C | 1.256 | −0.009 | 0.0707 |
| | | J-2 | 1.266 | −.0087 | .0448 |
| | | C, FAATC | .903 | .000475 | .0546 |
| | | D, FAATC | .96 | −.0012 | .298 |
| | | G | .997 | −.00206 | .0652 |
| 52 | Aircraft | 737 | 0.317 | 0.001896 | 0.0183 |
| (a) | Ground vehicle | DBV | .961 | −.00888 | .0416 |
| (b) | | Mu-M | .825 | .000633 | .0156 |
| (c) | | SFT | 1.095 | −.0056 | .0592 |
| (d) | | BV-11 | .996 | −.00143 | .0722 |
| 53 | Aircraft | Snow | 0.0936 | 0.000995 | 0.0177 |
| | | Ice | .0474 | −.000542 | .0101 |
| 53(a) | Mu-Meter | Snow | 0.18 | −0.0035 | 0 |
| | | Ice | .191 | −.0006 | .00316 |
| 53(b) | BV-11 | Snow | 0.19 | 0 | 0 |
| | | Ice | .238 | −.0018 | .00118 |
| 55 | Nongrooved | 1.8 | 0.11 | 0.002 | 0.0166 |
| | | 1.6 | .059 | .00239 | .0109 |
| | | 1.5 | .07 | .00167 | .0236 |
| | | 1.2 | .022 | .0016 | .109 |
| 56 | Nongrooved | Manual | 0.507 | −0.00292 | 0.0204 |
| | | Auto | .318 | −.00169 | .048 |
| 57 | Nongrooved | 727 | 0.497 | −0.000604 | 0.0327 |
| 58(a) | Nongrooved | 727 | 0.497 | −0.000604 | 0.0327 |
| | | Mu-M | .847 | .000705 | .0272 |
| | | BV-11 | 1.083 | −.00188 | .0532 |
| | | SFT | .99869 | −.001759 | .0649 |
| | | RFT | 1.0068 | −.00312 | .0821 |
| | | DBV | .841 | −.000376 | .0886 |

Table VIII. Continued

| Figure | Runway/vehicle type | Curve label | $B_0$ | $B_1$ | $\sigma$ |
|---|---|---|---|---|---|
| 58(b) | Nongrooved | 727 | 0.449 | −0.000572 | 0.021 |
| | | Mu-M | .787 | −.00125 | .0204 |
| | | BV-11 | 1.06 | −.0035 | |
| | | SFT | 1.005 | −.00325 | 0 |
| | | RFT | .933 | −.00375 | .0204 |
| 58(c) | Nongrooved | 727 | 0.554 | −0.00172 | 0.0427 |
| | | DBV | 1.00117 | −.00941 | .026 |
| 58(d) | Nongrooved | 727 | 0.382 | −0.00114 | 0.0434 |
| | | Mu-M | .823 | −.00225 | .00408 |
| | | BV-11 | .95 | −.0055 | .0245 |
| | | SFT | 1.007 | −.004 | .0408 |
| | | RFT | .933 | −.00375 | .0204 |
| 58(e) | Nongrooved | 727 | 0.445 | −0.00141 | 0.104 |
| | | Mu-M | .823 | −.00596 | .141 |
| | | BV-11 | 1.019 | −.00715 | .209 |
| | | SFT | 1.106 | −.0083 | .184 |
| | | RFT | .929 | −.00688 | .12 |
| | | DBV | .949 | −.0117 | .145 |
| | Grooved | 727 | 0.551 | −0.00237 | 0.0446 |
| | | Mu-M | .765 | −.00127 | .0424 |
| | | BV-11 | 1.078 | −.00431 | .082 |
| | | SFT | 1.0428 | −.00396 | .0778 |
| | | RFT | .927 | −.00365 | .0514 |
| | | DBV | .805 | −.00714 | .0661 |
| 58(f) | Nongrooved | 727 | 0.0701 | 0.000501 | 0.014 |
| | | Mu-M | .26 | −.00185 | .0201 |
| | | BV-11 | .22 | .0005 | .0245 |
| | | SFT | .227 | .00025 | .00408 |
| | | RFT | .36 | −.0015 | 0 |
| 58(g) | Nongrooved | 727 | 0.166 | 0.000313 | 0.0149 |
| | | Mu-M | .247 | −.00175 | .0204 |
| | | BV-11 | .177 | .0015 | .0163 |
| | | SFT | .245 | −.000125 | .00968 |
| | | RFT | .338 | −.00112 | .0151 |
| 58(h) | Nongrooved | 727 | 0.114 | 0.000454 | 0.0137 |
| | | Mu-M | .232 | −.000667 | .02 |
| | | BV-11 | .211 | .00117 | .0707 |
| | | SFT | .175 | .00128 | .121 |
| 58(i) | Nongrooved | 727 | 0.14 | −0.000657 | 0.0351 |
| | | Mu-M | .18 | 0 | |
| | | BV-11 | .102 | .00221 | .0134 |
| | | SFT | .0969 | .000486 | .00586 |

Table VIII. Continued

| Figure | Runway/vehicle type | Curve label | $B_0$ | $B_1$ | $\sigma$ |
|---|---|---|---|---|---|
| 58(j) | Nongrooved | 727 | 0.114 | 0.000454 | 0.0137 |
| | | Mu-M | .103 | −.00075 | .00408 |
| | | BV-11 | .107 | .00075 | .00408 |
| | | SFT | .14 | −.00075 | .0122 |
| 58(k) | Nongrooved | 727 | 0.203 | −0.00072 | 0.026 |
| | | BV-11 | .243 | .00025 | .0204 |
| | | SFT | .223 | −.00025 | .0204 |
| | | RFT | .287 | −.00075 | .00408 |
| 58(l) | Nongrooved | 727 | 0.0397 | −0.000143 | 0.0176 |
| | | Mu-M | .158 | .000536 | .0184 |
| | | BV-11 | .187 | −.000656 | .0228 |
| | | SFT | .186 | −.00047 | .00619 |
| | | RFT | .128 | .000264 | .0158 |
| 58(m) | Nongrooved | 727 | 0.354 | −0.000286 | 0.0685 |
| | | Mu-M | .683 | −.004 | .139 |
| | | BV-11 | .81 | −.00775 | .11 |
| 59 | Aircraft | SSA | 0.533 | −0.00188 | 0.0342 |
| | | A | .381 | −.00371 | .0196 |
| | | B, FAATC | .32 | −.00094 | .0252 |
| | | NG | .445 | −.00141 | .104 |
| 59(a) | DBV | SSA | 0.967 | −0.00947 | 0.0385 |
| | | A | .671 | −.0102 | .0403 |
| | | B, FAATC | .934 | −.014 | .0411 |
| | | NG | .949 | −.0117 | .145 |
| 59(b) | Mu-Meter | SSA | 0.826 | −0.0046 | 0.0582 |
| | | A | .977 | −.0153 | .0618 |
| | | B, FAATC | .772 | −.00275 | .0525 |
| | | NG | .823 | −.00596 | .141 |
| 59(c) | SFT | SSA | 1.096 | −0.00552 | 0.0348 |
| | | A | 1.113 | −.0159 | .0872 |
| | | B, FAATC | 1.332 | −.0122 | .0925 |
| | | NG | 1.106 | −.0083 | .184 |
| 59(d) | BV-11 | SSA | 1.042 | −0.0036 | 0.0757 |
| | | A | 1.197 | −.0168 | .0962 |
| | | B, FAATC | 1.257 | −.0172 | .0794 |
| | | NG | 1.019 | −.00715 | .209 |
| 59(e) | RFT | SSA | 0.94 | −0.00531 | 0.0435 |
| | | A | .477 | 0 | |
| | | B, FAATC | 1.007 | −.011 | .00816 |
| | | NG | .93 | −.00688 | .12 |

Table VIII. Continued

| Figure | Runway/vehicle type | Curve label | $B_0$ | $B_1$ | $\sigma$ |
|---|---|---|---|---|---|
| 60 | Aircraft | B, FAATC | 0.605 | −0.0037 | 0.0159 |
| | | C, FAATC | .543 | −.00185 | .187 |
| | | D, FAATC | .556 | −.00235 | .0463 |
| | | G | .551 | −.00237 | .0446 |
| 60(a) | DBV | B | 0.699 | −0.0057 | 0.0519 |
| | | C, FAATC | .832 | −.0069 | .0415 |
| | | D, FAATC | .836 | −.00589 | .0186 |
| | | G | .805 | −.00714 | .0661 |
| 60(b) | Mu-Meter | B | 0.809 | −0.0025 | 0.0574 |
| | | C, FAATC | .706 | 0 | .0296 |
| | | D, FAATC | −.769 | −.001 | .0264 |
| | | G | −.765 | −.00127 | .0414 |
| 60(c) | SFT | B | 1.064 | −0.0057 | 0.0718 |
| | | C, FAATC | 1.036 | −.0025 | .0301 |
| | | D, FAATC | 1.054 | −.00325 | .0665 |
| | | G | 1.043 | −.00396 | .0778 |
| 60(d) | BV-11 | W-B | 1.237 | −0.009 | 0.0676 |
| | | C, FAATC | 1.01 | −.00125 | .0122 |
| | | D, FAATC | .997 | −.0015 | .00816 |
| | | G | 1.078 | −.00431 | .082 |
| 60(e) | RFT | B | 0.735 | 0 | |
| | | C, FAATC | .987 | −.00375 | 0.00408 |
| | | D, FAATC | .9 | −.0025 | |
| | | G | .927 | −.00365 | .0514 |
| 61 | Aircraft | 727 | 0.382 | −0.00114 | 0.0434 |
| (a) | Ground vehicle | SFT | 1.007 | −.004 | .0408 |
| (b) | | BV-11 | .95 | −.0055 | .0245 |
| (c) | | RFT | .933 | −.00375 | .0204 |
| 62 | Aircraft | 727 | 1.356 | −0.0109 | 0.0973 |
| (a) | Ground vehicle | DBV | .702 | −.0047 | .0237 |
| (b) | | Mu-M | .823 | −.00225 | .00408 |
| 63 | Aircraft | 1.5-in. snow | 0.0701 | 0.000501 | 0.014 |
| | | 2.0-in. snow | .0719 | .000811 | .0115 |
| | | Dry snow | .114 | .000454 | .0137 |
| | | Packed | .166 | .000313 | .0149 |
| | | Ice | .0397 | −.000143 | .0176 |
| 63(a) | Mu-Meter | 1.5-in. snow | 0.26 | −0.00185 | 0.02 |
| | | 2.0-in. snow | .103 | −.00075 | .00408 |
| | | Dry snow | .232 | −.000667 | .02 |
| | | Packed | .247 | −.00175 | .0204 |
| | | Ice | .158 | .000536 | .0184 |

Table VIII. Concluded

| Figure | Runway/vehicle type | Curve label | $B_0$ | $B_1$ | $\sigma$ |
|---|---|---|---|---|---|
| 63(b) | SFT | 1.5-in. snow | 0.227 | 0.00025 | 0.00408 |
| | | 2.0-in. snow | .14 | −.00075 | .0122 |
| | | Dry snow | .175 | .00128 | .121 |
| | | Packed | .245 | −.000125 | .00968 |
| | | Ice | .186 | −.00047 | .00619 |
| 63(c) | BV-11 | 1.5-in. snow | 0.22 | 0.0005 | 0.0245 |
| | | 2.0-in. snow | .107 | .00075 | .00408 |
| | | Dry snow | .211 | .00117 | .0708 |
| | | Packed | .177 | .0015 | .0163 |
| | | Ice | .187 | −.000656 | .0228 |
| 63(d) | RFT | 1.5-in. snow | 0.36 | −0.0015 | 0 |
| | | Packed | .338 | −.00112 | .0151 |
| | | Ice | .128 | .000264 | .0158 |
| 65 | Nongrooved | 2.0 | 0.0385 | 0.00279 | 0.0114 |
| | | 1.7 | .0714 | .00183 | .0159 |
| 66 | Nongrooved | 727 | 0.532 | −0.00188 | 0.0339 |
| 69 | Nongrooved | Dry | 0.497 | −0.000604 | 0.0327 |
| | | Pease | .446 | −.000531 | .0217 |
| | | Portland | .439 | −.0016 | .0291 |
| 70 | Nongrooved | Flt 29 | 0.204 | −0.000718 | 0.025 |
| | | Flt 25 | .368 | −.00114 | .0228 |
| | | Flt 21 | .14 | −.000648 | .0347 |
| 74 | Nongrooved | Snow | 0.144 | 0.000268 | 0.0265 |
| | | Ice | .039 | .000227 | .016 |

Table IX. Ground-Vehicle Friction Correlation for Compacted Snow- and Ice-Covered Runway Conditions

[Ambient-air temperature range of 5 to 41°F; test-speed range of 20 to 60 mph]

| Braking-action level | Ground-vehicle friction readings | | | | | | |
|---|---|---|---|---|---|---|---|
| | Mu-Meter[1] | Tapley meter | Runway condition readings (RCR)[2] | Bowmonk meter | Surface friction tester[3] | Runway friction tester[4] | BV-11 skiddometer[3] |
| Excellent | 0.50 and above | 0.53 and above | 17 and above | 0.51 and above | 0.53 and above | 0.50 and above | 0.58 and above |
| Good | 0.47 to .35 | 0.50 to .38 | 16 to 12 | 0.48 to .37 | 0.50 to .37 | 0.47 to .35 | 0.54 to .41 |
| Marginal | 0.33 to .26 | 0.35 to .28 | 11 to 9 | 0.34 to .27 | 0.34 to .28 | 0.33 to .26 | 0.37 to .31 |
| Poor | 0.24 and below | 0.26 and below | 8 and below | 0.25 and below | 0.25 and below | 0.24 and below | 0.27 and below |

[1] Mu-Meter equipped with smooth RL 2 tires inflated to 10 lb/in$^2$.

[2] RCR values equal Tapley meter reading × 32.

[3] Surface friction tester and BV-11 skiddometer equipped with grooved aero tire inflated to 100 lb/in$^2$.

[4] Runway friction tester equipped with smooth RL 2 tire inflated to 30 lb/in$^2$.

## Appendix A

## Compilation of Boeing 737 Aircraft and Ground-Vehicle Test Data

The chronological test-run sequence for the 737 aircraft and the different ground vehicles is given in table AI for each test site. Test-runway surface conditions, temperature, and wind readings are also listed. Table AII provides a compilation by test site and run number of the 737 aircraft braking friction data. In this table, the aircraft gross weight, c.g. station, test-surface type and wetness condition, type of braking, and ground speed are given. The ground-vehicle friction data obtained on dry-runway test surfaces are listed by test site, surface type, and vehicle type in table AIII. Table AIV contains the ground-vehicle friction data obtained during wet-runway 737 aircraft braking test runs. The data are listed by vehicle type and test-surface type, with the aircraft test-run number and the elapsed time relative to the aircraft test run given for each ground-vehicle run. The average ground-vehicle friction coefficient values are listed in 10-mph increments up to 60 mph. Some supplemental ground-vehicle test runs were conducted on wet-runway test surfaces without the test aircraft. These data are compiled in table AV by test-vehicle type, date, test site, and test-surface type and wetness condition. The ground-vehicle friction measurements obtained during 737 aircraft tests at BNAS, Maine, in March 1985 are listed in table AVI by surface condition. The appropriate aircraft flight and run numbers and the ambient temperatures are also given. The surface friction tester and the runway friction tester were not available for this test series at BNAS. The empirical runway condition factors used for 737 aircraft data reduction are given in table AVII. The aerodynamic and geometric data for the 737 test aircraft are listed in table AVIII for use with aircraft equations of balance.

Table AI. Boeing 737 Aircraft and Ground-Vehicle Test-Run Sequence Data

[Temperature and wind values indicated only at times of measurement]

(a) Wallops Flight Facility

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 6-15-83 | Mu-M | 17 | 1215 | 10 | SSA | Dry | 74 | 80 |  | 0 |
|  | DBV | 11 | 1216 |  |  |  |  |  |  |  |
|  | Mu-M | 18 | 1219 |  |  |  |  |  |  |  |
|  | DBV | 12 | 1220 | ↓ | ↓ |  |  |  |  |  |
|  | Mu-M | 19 | 1230 | 22 | A, B |  |  |  |  |  |
|  |  | 20 | 1233 |  |  |  |  |  |  |  |
|  |  | 21 | 1236 |  |  |  |  |  |  |  |
|  |  | 22 | 1239 |  |  |  |  |  |  |  |
|  | ↓ | 23 | 1242 | ↓ | ↓ |  |  |  |  |  |
|  | 737 | 1 | 1331 | 10 | SSA |  | 78 | 85 |  |  |
|  |  | 2 | 1444 |  |  |  |  |  |  |  |
|  |  | 3 | 1501 |  |  |  |  |  |  |  |
|  |  | 4 | 1513 | ↓ | ↓ |  |  |  |  |  |
|  |  | 6 | 1647 | 22 | A, B |  | 80 | 95 | 160 | 6 |
|  |  | 7 | 1658 | 04 | B, A |  |  |  |  |  |
|  |  | 5 | 1715 | 10 | SSA |  |  |  |  |  |
|  |  | 8 | 1722 | 22 | A, B |  |  |  | 150 | 8 |
| ↓ | ↓ | 9 | 1739 | 04 | B, A | ↓ |  |  |  |  |
| 6-17-83 | 737 | 10 | 1309 | 10 | SSA | Dry | 77 | 86 | 110 | 6 |
|  | Mu-M | 50 | 1404 | 22 | A, B | Wet |  | 80 |  |  |
|  | DBV | 26 | 1405 |  |  |  |  |  |  |  |
|  | 737 | 11 | 1406 |  |  |  |  |  |  |  |
|  | Mu-M | 51 | 1406 |  |  |  |  |  |  |  |
|  | DBV | 27 | 1407 | ↓ | ↓ |  |  |  |  |  |
|  | Mu-M | 52 | 1422 | 04 | B, A |  |  |  |  |  |
|  | DBV | 28 | 1423 |  | B, A |  |  |  |  |  |
|  | 737 | 12 | 1424 |  | B |  |  |  |  |  |
|  | Mu-M | 53 | 1425 |  | B, A |  |  |  |  |  |
|  | DBV | 29 | 1426 | ↓ | B, A |  |  | 84 |  |  |
|  | Mu-M | 54 | 1441 | 22 | A, B |  |  |  |  |  |
|  | DBV | 30 | 1442 |  |  |  | 77 | 84 | 110 | 6 |
|  | 737 | 13 | 1443 |  |  |  |  |  |  |  |
|  | Mu-M | 55 | 1444 |  |  |  |  |  |  |  |
|  | DBV | 31 | 1444 | ↓ | ↓ |  |  |  |  |  |
|  | Mu-M | 56 | 1502 | 04 | B, A |  |  |  |  |  |
|  | DBV | 32 | 1502 |  |  |  |  |  |  |  |
|  | 737 | 14 | 1503 |  |  |  | 80 | 85 | 150 | 4 |
|  | Mu-M | 57 | 1504 |  |  |  |  |  |  |  |
|  | DBV | 33 | 1505 | ↓ | ↓ |  |  |  |  |  |
| ↓ | 737 | 19 | 1632 | 22 | B | ↓ |  |  |  |  |

Table AI. Continued

(a) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 6-17-83 | Mu-M | 58 | 1650 | 22 | A, B | Wet | | | | |
| | DBV | 34 | 1650 | | | | | | | |
| | 737 | 15 | 1651 | | | | 81 | | 130 | 6 |
| | Mu-M | 59 | 1652 | | | | | | | |
| | DBV | 35 | 1652 | | | | | | | |
| | Mu-M | 60 | 1710 | 04 | B, A | | | | | |
| | DBV | 36 | 1710 | | | | | | | |
| | 737 | 16 | 1712 | | | | | | | |
| | Mu-M | 61 | 1713 | | | | | | | |
| | DBV | 37 | 1714 | | | | | | | |
| | 737 | 17 | 2122 | 10 | SSA | Dry | | 98 | | |
| | 737 | 18 | 2134 | 10 | SSA | Dry | | | | |
| 6-21-83 | 737 | 20 | 1432 | 10 | SSA | Dry | 75 | 87 | 110 | 9 |
| | SFT | 17 | 1543 | | | Wet | | | | |
| | Mu-M | 81 | 1543 | | | | | | | |
| | BV-11 | 20 | 1543 | | | | | | | |
| | DBV | 44 | 1544 | | | | | | | |
| | 737 | 21 | 1547 | | | | 72 | | 112 | 13 |
| | SFT | 18 | 1548 | | | | | | | |
| | Mu-M | 82 | 1548 | | | | | | | |
| | BV-11 | 21 | 1548 | | | | 72 | 31(87) | 112 | 13 |
| | DBV | 45 | 1548 | | | | | | | |
| | SFT | 19 | 1600 | | | | | | | |
| | Mu-M | 83 | 1600 | | | | | | | |
| | BV-11 | 22 | 1600 | | | | | | | |
| | DBV | 46 | 1601 | | | | | | | |
| | 737 | 22 | 1604 | | | | | | 110 to 122 | 12 |
| | SFT | 20 | 1604 | | | | | | | |
| | Mu-M | 84 | 1605 | | | | | | | |
| | BV-11 | 23 | 1605 | | | | | | | |
| | DBV | 47 | 1605 | | | | | | | |
| | SFT | 21 | 1741 | 04 | C-B | Damp to flooded | | 78 | | |
| | Mu-M | 85 | 1741 | | | | | | | |
| | BV-11 | 24 | 1741 | | | | | | | |
| | DBV | 48 | 1742 | | | | | | | |
| | 737 | 23 | 1743 | | | | 73 | | 110 | 13 |
| | SFT | 22 | 1746 | | | | | | | |
| | Mu-M | 86 | 1746 | | | | | | | |
| | BV-11 | 25 | 1747 | | | | | | | |
| | DBV | 49 | 1747 | | | | | | | |
| | SFT | 23 | 1804 | | | | | | 102 | 11 |

Table AI. Continued

(a) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 6-21-83 | Mu-M | 87 | 1804 | 04 | C-B | Damp<br>to<br>flooded | | | | |
| | BV-11 | 26 | 1804 | | | | | | | |
| | DBV | 50 | 1804 | | | | | | | |
| | 737 | 24 | 1806 | | | | 74 | 80 | 108 | 16 |
| | SFT | 24 | 1806 | | | | | | | |
| | Mu-M | 88 | 1807 | | | | | | | |
| | BV-11 | 27 | 1807 | | | | | | | |
| | DBV | 51 | 1807 | | | | | | 098 | 14 |
| | SFT | 25 | 1835 | 22 | J-1, J-2 | Wet | 75 | 92 | 091 | |
| | Mu-M | 89 | 1835 | | | | | | | |
| | BV-11 | 28 | 1835 | | | | 75 | 92 | 085 | 17 |
| | DBV | 52 | 1835 | | | | | | | |
| | 737 | 28 | 1837 | | J-1 | | | | 083 | 17 |
| | SFT | 26 | 1839 | | J-1, J-2 | | | | | |
| | Mu-M | 90 | 1839 | | | | | | | |
| | BV-11 | 29 | 1839 | | | | | | | |
| | DBV | 53 | 1840 | | | | 74 | | 108 | 16 |
| | SFT | 27 | 1858 | 04 | J-2, J-1 | | 73 | | 104 | 14 |
| | Mu-M | 91 | 1858 | | | | | | | |
| | BV-11 | 30 | 1858 | | | | | | | |
| | DBV | 54 | 1859 | | | | | | | |
| | 737 | 29 | 1900 | | J-2 | | | | 102 | 17 |
| | SFT | 28 | 1901 | | J-2, J-1 | | | | | |
| | Mu-M | 92 | 1901 | | | | | | | |
| | BV-11 | 31 | 1901 | | | | | | | |
| | DBV | 55 | 1902 | | | | | | 098<br>(variable) | 12 |
| | SFT | 29 | 1919 | 22 | J-1, J-2 | | 72 | 90 | 093 | 11 |
| | Mu-M | 93 | 1919 | | | | | | | |
| | BV-11 | 32 | 1919 | | | | | | | |
| | DBV | 56 | 1919 | | | | | | | |
| | 737 | 30 | 1922 | | | | | | 097 | 9 |
| | SFT | 30 | 1923 | | | | | | | |
| | Mu-M | 94 | 1923 | | | | | | | |
| | BV-11 | 33 | 1923 | | | | | | | |
| | DBV | 57 | 1924 | | | | | | 100 | 9 |
| | SFT | 31 | 1941 | 04 | J-2, J-1 | | 74 | | | |
| | Mu-M | 95 | 1941 | | | | | | | |
| | BV-11 | 34 | 1941 | | | | | | | |
| | DBV | 58 | 1941 | | | | | | 099 to<br>107 | 15 |
| | 737 | 31 | 1943 | | | | | | 084 | 14 |

Table AI. Continued

(a) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 6-21-83 | SFT | 32 | 1944 | 04 | J-2, J-1 | Wet | 74 | 90 | 084 | 14 |
|  | Mu-M | 96 | 1944 |  |  |  |  |  |  |  |
|  | BV-11 | 35 | 1944 |  |  |  |  |  |  |  |
| ↓ | DBV | 59 | 1944 | ↓ | ↓ | ↓ |  |  |  |  |
| 6-28-83 | 737 | 20R2 | 1030 | 10 | SSA | Dry | 70 | 76 | 220 | 4 |
|  | Mu-M | 104 | 1044 | 04 | B, C | Flooded |  | 74 |  |  |
|  | DBV | 92 | 1045 |  |  |  |  |  |  |  |
|  | 737 | 32 | 1047 |  |  |  |  |  | 250 | 4 |
|  | Mu-M | 105 | 1048 |  |  |  |  |  |  |  |
|  | DBV | 93 | 1049 |  |  |  |  |  |  |  |
|  | Mu-M | 106 | 1100 | 22 |  |  |  |  |  |  |
|  | DBV | 94 | 1101 |  |  |  |  |  |  |  |
|  | 737 | 33 | 1102 |  |  |  |  |  | 270 | 8 |
|  | Mu-M | 107 | 1103 |  |  |  |  |  |  |  |
|  | DBV | 95 | 1104 |  |  |  |  |  |  |  |
|  | Mu-M | 108 | 1117 |  |  |  |  |  |  |  |
|  | DBV | 96 | 1118 |  |  |  |  |  |  |  |
|  | 737 | 34 | 1119 |  |  |  |  |  | 250 | 8 |
|  | Mu-M | 109 | 1120 |  |  |  |  |  |  |  |
|  | DBV | 97 | 1121 |  |  |  |  |  |  |  |
|  | 737 | 35 | 1133 |  |  |  |  |  | 240 | 6 |
|  | 737 | 36 | 1142 | ↓ | ↓ |  |  |  | 260 | 4 |
|  | Mu-M | 110 | 1400 | 04 | A |  | 80 | 82 | 250 | 10 |
|  | DBV | 98 | 1401 |  |  |  |  |  |  |  |
|  | 737 | 37 | 1402 |  |  |  |  |  |  |  |
|  | Mu-M | 111 | 1403 |  |  |  |  |  |  |  |
|  | DBV | 99 | 1404 | ↓ |  |  |  |  |  |  |
|  | Mu-M | 112 | 1407 | 22 |  |  |  |  |  |  |
|  | DBV | 100 | 1408 |  |  |  |  |  |  |  |
|  | 737 | 38 | 1410 |  |  |  |  |  | 260 | 10 |
|  | Mu-M | 113 | 1411 |  |  |  |  |  |  |  |
|  | DBV | 101 | 1412 |  |  |  | 80 | 82 | 260 | 10 |
|  | Mu-M | 114 | 1417 |  |  |  |  |  |  |  |
|  | DBV | 102 | 1418 |  |  |  |  |  |  |  |
|  | 737 | 39 | 1419 |  |  |  |  |  | 230 | 14 |
|  | Mu-M | 115 | 1420 |  |  |  |  |  |  |  |
|  | DBV | 103 | 1421 |  |  |  |  |  |  |  |
|  | 737 | 40 | 1424 |  |  |  |  |  | 250 | 8 |
|  | 737 | 40R1 | 1428 |  |  |  |  |  |  |  |
| ↓ | 737 | 41 | 1431 | ↓ | ↓ | ↓ |  |  | 250 | 10 |

Table AI. Continued

(a) Concluded

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 11-20-84 | 737 | 12 | 1836 | 10 | SSA | Dry | 40 |  | 350 | 10 |
|  |  | 1 | 1845 | 28 |  | Dry |  |  |  |  |
|  |  | 13 | 1849 | 10 |  | Dry |  |  |  |  |
|  |  | 2 | 1909 | 28 |  | Wet |  |  |  | 12 |
|  |  | 3 | 1914 | 10 | ↓ | Wet |  |  |  |  |
| [a]2-5-85 | DBV | 1 | 1542 | 07 | PCC | Rain wet | 35 |  | 360 | 5 |
|  | DBV | 2 | 1928 |  |  |  |  |  |  |  |
|  | 737 | 1 | 1931 |  |  |  |  |  |  |  |
|  | DBV | 3 | 1932 | ↓ | ↓ | ↓ |  |  |  |  |
| 3-22-85 | 737 | 1 | 1548 | 10 | SAA | Rain wet | 41 |  | 080 | 16 |
|  | DBV | 1 | 1627 |  |  |  |  |  |  |  |
|  | DBV | 2 | 1630 |  |  |  |  |  |  |  |
|  | 737 | 4A | 1632 |  |  |  | 42 |  |  | 18 |
|  | DBV | 3 | 1636 |  |  |  |  |  |  |  |
|  | 737 | 1A | 1639 |  |  |  |  |  |  |  |
|  | DBV | 4 | 1642 |  |  |  |  |  |  |  |
|  | 737 | 4B | 1644 |  |  |  | 43 |  | 070 | 16 |
|  | DBV | 5 | 1646 |  |  |  |  |  |  |  |
|  | DBV | 6 | 1651 |  |  |  |  |  |  |  |
|  | 737 | 4C | 1652 |  |  |  |  |  |  | 22 |
|  | DBV | 7 | 1654 |  |  |  |  |  |  |  |
|  | DBV | 8 | 1705 |  |  |  |  |  |  | 16 |
|  | 737 | 5 | 1706 |  |  |  |  |  |  |  |
|  | DBV | 9 | 1709 | ↓ | ↓ |  |  |  |  |  |
|  | DBV | 10 | 1717 | 22 | A, B |  |  |  |  |  |
|  | DBV | 11 | 1719 | 04 | B, A |  |  |  |  |  |
|  | 737 | 6 | 1724 | 22 | A, B |  |  |  |  |  |
|  | DBV | 12 | 1727 | 22 | A, B |  |  |  |  |  |
|  | DBV | 13 | 1730 | 04 | B |  |  |  |  |  |
|  | 737 | 7 | 1733 | 04 | B, A |  |  |  |  | 14 |
|  | DBV | 14 | 1737 | 04 | B |  |  |  |  |  |
|  | DBV | 15 | 1739 | 22 | A |  |  |  |  |  |
| ↓ | 737 | [a]10 | 2025 | 07 | PCC | ↓ |  |  | 060 | 20 |

[a]Langley AFB, VA.

Table AI. Continued

(b) FAA Technical Center

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 6-23-83 | DBV | 8 | 1222 | 31 | D, C, B | Wet | 65 | 88 | Variable | Light |
| | SFT | 9 | 1234 | 13 | B, C, D | | | 89 | | |
| | Mu-M | | 1234 | | | | | | | |
| | BV-11 | | 1234 | | | | | | | |
| | DBV | ↓ | 1234 | ↓ | ↓ | | | | | |
| | SFT | 10 | 1241 | 31 | D, C, B | | | 90 | | |
| | Mu-M | | 1241 | | | | | | | |
| | BV-11 | | 1241 | | | | | | | |
| | DBV | ↓ | 1242 | ↓ | ↓ | | | | | |
| | SFT | 11 | 1315 | 13 | B, C, D | | | 98 | | |
| | Mu-M | | 1315 | | | | | | | |
| | BV-11 | | 1315 | | | | | | | |
| | DBV | ↓ | 1316 | ↓ | ↓ | | | | | |
| | SFT | 12 | 1319 | 31 | D, C, B | | | 102 | | |
| | Mu-M | | 1319 | | | | | | | |
| | BV-11 | | 1320 | | | | | | | |
| | DBV | ↓ | 1320 | | | | | | | |
| | SFT | 13 | 1323 | | | | | 103 | | |
| | Mu-M | | 1323 | | | | | | | |
| | BV-11 | | 1323 | | | | | | | |
| | DBV | ↓ | 1323 | ↓ | ↓ | ↓ | | | | |
| | 737 | 1 | 1417 | 13 | B, C, D | Dry | | | | |
| | 737 | 2 | 1658 | | C | | 85 | 128 | 120 | 2 |
| | 737 | 3 | 1708 | 31 | D | | | 131 | 100 | 8 |
| ↓ | 737 | 1R1 | 1718 | 13 | B, C, D | ↓ | | | 200 | 3 |
| 6-24-83 | SFT | 14 | 1013 | 13 | C | Wet | 64 | 72 | 250 | 8 |
| | Mu-M | | 1013 | | | | | | | |
| | BV-11 | | 1014 | | | | | | | |
| | DBV | ↓ | 1015 | | | | | | | |
| ↓ | 737 | 4 | 1016 | | ↓ | | | | | |
| 6-23-83 | SFT | 1 | 1108 | | B, C, D | | 63 | 74 | 145 | 2 |
| | Mu-M | | 1108 | | | | | | | |
| | BV-11 | | 1108 | | | | | | | |
| | DBV | ↓ | 1109 | ↓ | ↓ | | | | | |
| | SFT | 2 | 1122 | 31 | D, C, B | | | 77 | | |
| | Mu-M | | 1122 | | | | | | | |
| | BV-11 | | 1122 | | | | | | | |
| | DBV | ↓ | 1123 | ↓ | ↓ | | | | Variable | Light |
| | SFT | 3 | 1128 | 13 | B, C, D | | | 75 | | |
| | Mu-M | | 1129 | | | | | | | |
| | BV-11 | | 1129 | | | | | | | |
| ↓ | DBV | ↓ | 1129 | ↓ | ↓ | ↓ | | | 320 | 3 |

Table AI. Continued

(b) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 6-23-83 | SFT | 4 | 1145 | 31 | D, C, B | Wet |  | 79 |  |  |
|  | Mu-M |  | 1145 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1146 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1146 | ↓ | ↓ |  |  |  | Variable | Light |
|  | SFT | 5 | 1151 | 13 | B, C, D |  | 64 | 80 |  |  |
|  | Mu-M |  | 1151 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1151 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1152 | ↓ | ↓ |  |  |  |  |  |
|  | SFT | 6 | 1206 | 31 | D, C, B |  |  | 82 |  |  |
|  | Mu-M |  | 1206 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1206 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1207 | ↓ | ↓ |  |  |  |  |  |
|  | SFT | 7 | 1212 | 13 | B, C, D |  |  | 85 |  |  |
|  | Mu-M |  | 1213 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1213 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1213 | ↓ | ↓ |  | 65 |  |  |  |
|  | SFT | 8 | 1221 | 31 | D, C, B |  |  | 88 |  |  |
|  | Mu-M | 8 | 1221 | 31 | D, C, B |  |  |  |  |  |
| ↓ | BV-11 | 8 | 1221 | 31 | D, C, B | ↓ |  |  |  |  |
| 6-24-83 | SFT | 15 | 1017 | 13 | C | Wet | 64 | 72 | 250 | 8 |
|  | Mu-M |  | 1017 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1017 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1018 | ↓ | ↓ |  |  |  | 250 | 11 |
|  | SFT | 16 | 1031 | 31 | D |  |  |  |  |  |
|  | Mu-M |  | 1031 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1032 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1034 |  |  |  |  |  |  |  |
|  | 737 | 5 | 1035 |  |  |  |  |  |  |  |
|  | SFT | 17 | 1036 |  |  |  |  |  | 260 | 9 |
|  | Mu-M |  | 1036 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1036 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1037 | ↓ | ↓ |  | 67 | 74 | 250 | 11 |
|  | SFT | 18 | 1104 | 13 | B |  |  |  |  |  |
|  | Mu-M |  | 1104 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1104 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1105 |  |  |  |  |  |  |  |
|  | 737 | 6 | 1107 |  |  |  |  |  |  |  |
|  | SFT | 19 | 1108 |  |  |  |  |  |  |  |
|  | Mu-M |  | 1108 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1108 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1110 | ↓ |  |  |  |  |  |  |
| ↓ | SFT | 20 | 1114 | 31 | ↓ | ↓ |  |  |  |  |

Table AI. Continued

(b) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 6-24-83 | Mu-M | 20 | 1114 | 31 | B | Wet |  |  |  |  |
|  | BV-11 | 20 | 1114 |  |  |  |  |  |  |  |
|  | DBV | 20 | 1114 |  |  |  |  |  |  |  |
|  | 737 | 7 | 1116 |  |  |  |  |  |  |  |
|  | SFT | 21 | 1117 |  |  |  |  |  |  |  |
|  | Mu-M |  | 1117 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1117 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1118 | ↓ |  |  |  |  |  |  |
|  | SFT | 22 | 1126 | 13 |  |  | 70 | 76 | 250 | 11 |
|  | Mu-M | 22 | 1126 |  |  |  |  |  |  |  |
|  | BV-11 | 22 | 1126 |  |  |  |  |  |  |  |
|  | DBV | 22 | 1127 |  |  |  |  |  | 270 | 10 |
|  | 737 | 8 | 1131 |  |  |  |  |  |  |  |
|  | SFT | 23 | 1131 |  |  |  |  |  |  |  |
|  | Mu-M | 23 | 1131 |  |  |  |  |  |  |  |
|  | BV-11 | 23 | 1132 |  |  |  |  |  |  |  |
|  | DBV | 23 | 1132 |  |  |  |  |  |  |  |
|  | SFT | 24 | 1139 |  |  |  |  |  |  |  |
|  | Mu-M | 24 | 1139 |  |  |  |  |  |  |  |
|  | BV-11 | 24 | 1139 |  |  |  |  |  |  |  |
|  | DBV | 24 | 1139 |  |  |  |  |  |  |  |
|  | 737 | 9 | 1144 |  |  |  |  |  |  |  |
|  | SFT | 25 | 1144 |  |  |  |  |  |  |  |
|  | Mu-M | 25 | 1144 |  |  |  |  |  |  |  |
|  | BV-11 | 25 | 1145 |  |  |  | 74 | 78 |  |  |
|  | DBV | 25 | 1145 | ↓ |  |  |  |  |  |  |
|  | 737 | 10 | 1158 | 31 |  |  |  |  |  |  |
|  | 737 | 11 | 1205 | 31 |  |  |  |  |  |  |
|  | 737 | 12 | 1215 | 31 | ↓ | ↓ | 75 |  |  |  |
|  | SFT | 26 | 1232 | 13 | B, C, D | Dry | 76 | 90 |  |  |
|  | Mu-M | 26 | 1233 | 13 | B, C, D |  |  |  |  |  |
|  | BV-11 | 26 | 1234 | 13 | B, C, D |  |  |  |  |  |
|  | SFT | 27 | 1238 | 31 | D, C, B |  |  |  |  |  |
|  | Mu-M | 27 | 1238 | 31 | D, C, B |  |  |  |  |  |
|  | BV-11 | 27 | 1238 | 31 | D, C, B |  |  |  |  |  |
|  | SFT | 28 | 1240 | 13 | B, C, D |  |  |  |  |  |
|  | Mu-M | 28 | 1240 | 13 | B, C, D |  |  |  |  |  |
|  | BV-11 | 28 | 1241 | 13 | B, C, D |  |  |  |  |  |
|  | SFT | 29 | 1242 | 31 | D, C, B |  |  |  |  |  |
| ↓ | Mu-M | 29 | 1242 | 31 | D, C, B | ↓ |  |  |  |  |

Table AI. Continued

(b) Concluded

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 6-24-83 | BV-11 | 29 | 1242 | 31 | D, C, B | Dry | 76 | 90 | 270 | 10 |
|  | SFT | 30 | 1243 | 13 | B, C, D |  |  |  |  |  |
|  | Mu-M | 30 | 1243 | 13 | B, C, D |  |  |  |  |  |
|  | BV-11 | 30 | 1244 | 13 | B, C, D |  |  |  |  |  |
|  | SFT | 31 | 1246 | 31 | D, C, B |  |  |  |  |  |
|  | Mu-M | 31 | 1246 | 31 | D, C, B |  |  |  |  |  |
|  | BV-11 | 31 | 1246 | 31 | D, C, B |  |  |  |  |  |
|  | SFT | 26R | 1248 | 13 | B, C, D |  |  |  | 270 | 13 |

Table AI. Continued

(c) BNAS

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-6-85 | 737 | 6 | 1816 | 01 | Asphalt | Dry, loose snow, 6 in. | 23 |  | 250 | 10 |
|  |  | 7 | 1825 | 19 |  |  |  |  | 360 |  |
|  |  | 9 | 1843 | 01 |  |  |  |  | 360 |  |
|  |  | 2 | 2141 | 01 |  |  | 28 |  | 330 |  |
|  |  | 3 | 2154 | 19 |  |  |  |  | 360 | 14 |
|  |  | 4 | 2204 | 01 |  |  |  |  | 330 | 8 |
|  | ↓ | 5 | 2213 | 19 |  |  | 27 |  | 330 | 10 |
|  | RCR | 1 | 2240 | 01 |  |  |  |  |  |  |
|  |  | 2 | 2243 | 19 |  |  |  |  |  |  |
|  |  | 3 | 2246 | 01 |  |  |  |  |  |  |
|  |  | 4 | 2250 | 19 |  |  |  |  |  |  |
| ↓ | ↓ | 5 | 2253 | 01 | ↓ | ↓ |  |  |  |  |
| 3-7-85 | RCR | 6 | 1710 | 01 | Asphalt | Dry, loose snow, 3 in. | 30 |  | 240 | 8 |
|  |  | 7 | 1715 | 19 |  |  |  |  |  |  |
|  |  | 8 | 1718 | 01 |  |  |  |  |  |  |
|  |  | 9 | 1721 | 19 |  |  |  |  |  |  |
|  | ↓ | 10 | 1725 | 01 |  |  |  |  |  |  |
|  | 737 | 7 | 1842 | 19 |  |  |  |  |  |  |
|  |  | 9 | 1849 | 01 |  |  |  |  | 230 | 10 |
|  |  | 3 | 1908 | 19 |  |  | 31 |  | 240 | 10 |
|  |  | 4 | 1921 | 01 |  | ↓ |  |  | 240 | 8 |
|  |  | [a]14 | 1935 | 19 |  | Dry |  |  | 200 | 12 |
|  |  | 5 | 1942 | 01 |  | Dry, loose snow, 3 in. |  |  |  | 14 |
|  |  | 15 | 1951 | 19 |  |  |  |  |  | 10 |
| ↓ | ↓ | 14R1 | 1954 | 19 | ↓ | Dry |  |  |  |  |
| 3-8-85 | Mu-M | 10 | 1420 | 01 | Asphalt | Wet snow, 1.5 in. | 37 |  | 220 |  |
|  | BV-11 | 10 | 1421 |  |  |  |  |  |  |  |
|  | RCR | 1 | 1422 |  |  |  |  |  |  |  |
|  | 737 | 2 | 1425 |  |  |  |  |  |  |  |
|  | Mu-M | 11 | 1428 |  |  |  |  |  |  |  |
|  | BV-11 | 11 | 1429 |  |  |  |  |  |  |  |
| ↓ | RCR | 2 | 1430 | ↓ | ↓ | ↓ |  |  |  |  |

[a] Inboard runway.

Table AI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-8-85 | 737 | 3 | 1439 | 01 | Asphalt | 1.5-in. snow | 39 |  | 240 | 10 |
|  |  | 2R1 | 1510 |  |  | 4.5 in. |  |  | 240 | 10 |
|  |  | 3R1 | 1516 |  |  | 4.5 in. |  |  | 230 | 8 |
|  | ↓ | $^{a}$14 | 1524 |  |  | Wet |  |  |  |  |
|  | Mu-M | 12 | 1530 |  |  |  |  |  |  |  |
|  | BV-11 | 12 | 1531 |  |  |  |  |  |  |  |
|  | RCR | 3 | 1532 | ↓ |  |  |  |  |  |  |
|  | Mu-M | 13 | 1535 | 19 |  |  |  |  |  |  |
|  | BV-11 | 13 | 1536 |  |  |  |  |  |  |  |
|  | RCR | 4 | 1537 | ↓ |  |  |  |  |  |  |
|  | Mu-M | 14 | 1540 | 01 |  |  |  |  |  |  |
|  | BV-11 | 14 | 1541 |  |  |  |  |  |  |  |
|  | RCR | 5 | 1542 | ↓ |  | ↓ |  |  |  |  |
|  | RCR | 6 | 1705 | 19 |  | 1-in. slush | 41 |  | 240 |  |
|  | 737 | 2RC | 1710 |  |  |  |  |  |  |  |
|  | RCR | 7 | 1712 |  |  |  |  |  |  |  |
|  | 737 | 3R2 | 1716 |  |  | ↓ |  |  |  |  |
|  |  | 9 | 1724 | ↓ |  | Wet snow, |  |  | 230 |  |
|  |  | 7 | 1728 | 01 |  | 4 in. |  |  |  | 10 |
|  |  | 3R3 | 1733 | 19 |  | 1-in. slush |  |  |  | 8 |
|  |  | 14R1 | 1745 | 19 |  | Wet |  |  | 210 | 12 |
|  |  | 13 | 1946 | 19 |  | Wet snow, | 45 |  | 240 | 12 |
|  |  | 11 | 1952 | 01 |  | 2 to 3 in. |  |  | 240 | 10 |
|  |  | 10 | 1956 | 19 |  |  | 47 |  | 220 | 8 |
|  |  | 16 | 2002 | 01 |  | Wet |  |  | 220 | 10 |
| ↓ | ↓ | 14R2 | 2017 | 19 | ↓ | Dry |  |  | 240 | 6 |
| 3-9-85 | RCR | 8 | 1100 | 19 | Asphalt | Icy | 29 |  | 0 |  |
|  | Mu-M | 21 | 1114 | 19 |  |  |  |  |  |  |
|  | BV-11 | 21 | 1115 | 19 |  |  |  |  |  |  |
|  | Mu-M | 22 | 1117 | 01 |  |  |  |  |  |  |
|  | BV-11 | 22 | 1118 | 01 |  |  |  |  |  |  |
|  | Mu-M | 23 | 1119 | 19 |  |  |  |  |  |  |
|  | BV-11 | 23 | 1120 | 19 |  |  |  |  |  |  |
| ↓ | Mu-M | 24 | 1121 | 01 | ↓ | ↓ |  |  |  |  |

$^{a}$Inboard runway.

Table AI. Concluded

(c) Concluded

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-9-85 | BV-11 | 24 | 1122 | 01 | Asphalt | Icy | 29 | | 0 | |
| | 737 | 2 | 1127 | 19 | | | | | | |
| | Mu-M | 25 | 1128 | 19 | | | | | | |
| | BV-11 | 25 | 1129 | 19 | | | | | | |
| | Mu-M | 26 | 1131 | 01 | | | | | 310 | 2 |
| | BV-11 | 26 | 1132 | 01 | | | | | | |
| | 737 | 3 | 1135 | 01 | | | | | | |
| | Mu-M | 27 | 1136 | 19 | | | | | | |
| | BV-11 | 27 | 1137 | 19 | | | | | | |
| | Mu-M | 28 | 1138 | 01 | | | | | | |
| | BV-11 | 28 | 1139 | 01 | | | | | | |
| | Mu-M | 29 | 1141 | 19 | | | 32 | 25 | 0 | |
| | BV-11 | 29 | 1142 | 19 | | | | | | |
| | Mu-M | 30 | 1143 | 01 | | | | | | |
| | BV-11 | 30 | 1144 | 01 | | | | | | |
| | 737 | 4 | 1150 | 01 | | | | | | |
| | Mu-M | 31 | 1151 | 19 | | | | | | |
| | BV-11 | 31 | 1152 | 19 | | | | | | |
| | Mu-M | 32 | 1153 | 01 | | | | | | |
| | BV-11 | 32 | 1154 | 01 | | | | | | |
| | 737 | 5 | 1156 | 19 | | | | | | |
| | Mu-M | 33 | 1157 | 19 | | | | | | |
| | BV-11 | 33 | 1158 | 19 | | | | | | |
| | Mu-M | 34 | 1159 | 01 | | | | | | |
| | BV-11 | 34 | 1200 | 01 | | | | | | |
| | Mu-M | 35 | 1204 | 19 | | | | | | |
| | BV-11 | 35 | 1205 | 19 | | | | | | |
| | Mu-M | 36 | 1206 | 01 | | | | | | |
| | BV-11 | 36 | 1207 | 01 | | | | | | |

Table AII. Compilation of Boeing 737 Braking Friction Data by Test-Surface Type and Wetness Condition

(a) Wallops Flight Facility

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface |  | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness |  |  |  |
| 2 | 409 | 10 | $83.70 \times 10^3$ | 649.4 | SSA | Dry | Manual | 25 | 0.41 |
|  |  |  |  |  |  |  |  | 30 | .42 |
|  |  |  |  |  |  |  |  | 35 | .43 |
| 3 | 409 | 10 | $82.90 \times 10^3$ | 649.9 | SSA | Dry | Manual | 25 | .43 |
|  |  |  |  |  |  |  |  | 30 | .42 |
|  |  |  |  |  |  |  |  | 35 | .42 |
|  |  |  |  |  |  |  |  | 40 | .42 |
|  |  |  |  |  |  |  |  | 45 | .42 |
|  |  |  |  |  |  |  |  | 50 | .42 |
| 18 | 410 | 10 | $77.30 \times 10^3$ | 650.9 | SSA | Dry | Manual | 30 | .47 |
|  |  |  |  |  |  |  |  | 40 | .45 |
|  |  |  |  |  |  |  |  | 50 | .43 |
|  |  |  |  |  |  |  |  | 60 | .44 |
|  |  |  |  |  |  |  |  | 70 | .43 |
|  |  |  |  |  |  |  |  | 80 | .43 |
| 17 | 410 | 10 | $78.90 \times 10^3$ | 650.4 | SSA | Dry | Automatic | 40 | .36 |
|  |  |  |  |  |  |  |  | 50 | .34 |
|  |  |  |  |  |  |  |  | 60 | .31 |
|  |  |  |  |  |  |  |  | 70 | .28 |
|  |  |  |  |  |  |  |  | 80 | .28 |
|  |  |  |  |  |  |  |  | 90 | .29 |
| 21 | 412 | 10 | $84.40 \times 10^3$ | 650.0 | SSA | Truck wet | Manual | 40 | .38 |
|  |  |  |  |  |  |  |  | 50 | .37 |
|  |  |  |  |  |  |  |  | 60 | .34 |
|  |  |  |  |  |  |  |  | 70 | .27 |
|  |  |  |  |  |  |  |  | 80 | .29 |
| 22 | 412 | 10 | $83.00 \times 10^3$ | 649.5 | SSA | Truck wet | Automatic | 55 | .28 |
|  |  |  |  |  |  |  |  | 60 | .16 |
|  |  |  |  |  |  |  |  | 65 | .14 |
|  |  |  |  |  |  |  |  | 70 | .25 |
|  |  |  |  |  |  |  |  | 75 | .20 |
|  |  |  |  |  |  |  |  | 80 | .17 |
|  |  |  |  |  |  |  |  | 85 | .21 |
|  |  |  |  |  |  |  |  | 90 | .18 |
|  |  |  |  |  |  |  |  | 95 | .13 |
| 7 | 409 | 4 | $80.60 \times 10^3$ | 650.1 | A | Dry | Manual | 30 | .51 |
|  |  |  |  |  |  |  |  | 35 | .49 |
|  |  |  |  |  |  |  |  | 40 | .47 |
|  |  |  |  |  |  |  |  | 45 | .44 |
|  |  |  |  |  |  |  |  | 50 | .44 |

Table AII. Continued

(a) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface |  | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness |  |  |  |
| 9 | 409 | 4 | $77.00 \times 10^3$ | 651.2 | A | Dry | Manual | 50 | 0.48 |
|  |  |  |  |  |  |  |  | 55 | .47 |
|  |  |  |  |  |  |  |  | 60 | .45 |
|  |  |  |  |  |  |  |  | 65 | .43 |
|  |  |  |  |  |  |  |  | 70 | .42 |
| 6 | 409 | 22 | $81.10 \times 10^3$ | 650.0 | A | Dry | Manual | 45 | .46 |
|  |  |  |  |  |  |  |  | 50 | .45 |
|  |  |  |  |  |  |  |  | 55 | .44 |
|  |  |  |  |  |  |  |  | 60 | .44 |
|  |  |  |  |  |  |  |  | 65 | .46 |
|  |  |  |  |  |  |  |  | 70 | .43 |
| 8 | 409 | 22 | $78.80 \times 10^3$ | 650.7 | A | Dry | Manual | 90 | .40 |
|  |  |  |  |  |  |  |  | 95 | .38 |
| 16 | 410 | 4 | $80.20 \times 10^3$ | 650.1 | A | Truck wet | Manual | 53 | .14 |
|  |  |  |  |  |  |  |  | 56 | .15 |
|  |  |  |  |  |  |  |  | 59 | .10 |
| 14 | 410 | 4 | $76.40 \times 10^3$ | 651.3 | A | Truck wet | Manual | 61 | .12 |
|  |  |  |  |  |  |  |  | 64 | .10 |
|  |  |  |  |  |  |  |  | 67 | .09 |
| 11 | 410 | 22 | $90.98 \times 10^3$ | 650.0 | A | Truck wet | Manual | 50 | .15 |
|  |  |  |  |  |  |  |  | 55 | .14 |
|  |  |  |  |  |  |  |  | 60 | .14 |
| 13 | 410 | 22 | $77.81 \times 10^3$ | 650.8 | A | Truck wet | Manual | 70 | .08 |
|  |  |  |  |  |  |  |  | 73 | .08 |
|  |  |  |  |  |  |  |  | 77 | .08 |
| 15 | 410 | 22 | $81.98 \times 10^3$ | 649.8 | A | Truck wet | Manual | 93 | .01 |
|  |  |  |  |  |  |  |  | 95 | .02 |
|  |  |  |  |  |  |  |  | 97 | .03 |
| 37 | 415 | 4 | $87.34 \times 10^3$ | 651.4 | A | Flooded | Manual | 48 | .12 |
|  |  |  |  |  |  |  |  | 53 | .10 |
|  |  |  |  |  |  |  |  | 58 | .08 |
| 38 | 415 | 22 | $87.09 \times 10^3$ | 651.2 | A | Flooded | Manual | 72 | .05 |
|  |  |  |  |  |  |  |  | 75 | .04 |
|  |  |  |  |  |  |  |  | 78 | .03 |

Table AII. Continued

(a) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 39 | 415 | 22 | $85.79 \times 10^3$ | 650.5 | A | Flooded | Manual | 79 | 0.05 |
| | | | | | | | | 82 | .05 |
| | | | | | | | | 85 | .03 |
| 7 | 409 | 4 | $80.56 \times 10^3$ | 650.1 | B | Dry | Manual | 47 | .45 |
| | | | | | | | | 50 | .43 |
| | | | | | | | | 53 | .45 |
| | | | | | | | | 56 | .43 |
| | | | | | | | | 59 | .44 |
| | | | | | | | | 62 | .41 |
| 9 | 409 | 4 | $77.00 \times 10^3$ | 651.2 | B | Dry | Manual | 75 | .45 |
| | | | | | | | | 78 | .45 |
| | | | | | | | | 81 | .45 |
| | | | | | | | | 84 | .44 |
| | | | | | | | | 87 | .43 |
| 6 | 409 | 22 | $81.10 \times 10^3$ | 650.0 | B | Dry | Manual | 35 | .52 |
| | | | | | | | | 37 | .50 |
| | | | | | | | | 39 | .49 |
| | | | | | | | | 41 | .48 |
| | | | | | | | | 43 | .48 |
| | | | | | | | | 45 | .46 |
| 8 | 409 | 22 | $78.80 \times 10^3$ | 650.6 | B | Dry | Manual | 65 | .44 |
| | | | | | | | | 70 | .43 |
| | | | | | | | | 75 | .42 |
| | | | | | | | | 80 | .41 |
| | | | | | | | | 85 | .40 |
| | | | | | | | | 90 | .39 |
| 12 | 410 | 4 | $79.46 \times 10^3$ | 650.3 | B | Truck wet | Manual | 25 | .45 |
| | | | | | | | | 30 | .44 |
| | | | | | | | | 35 | .42 |
| | | | | | | | | 40 | .41 |
| | | | | | | | | 45 | .39 |
| | | | | | | | | 48 | .37 |
| 16 | 410 | 4 | $80.23 \times 10^3$ | 650.1 | B | Truck wet | Manual | 62 | .37 |
| | | | | | | | | 64 | .37 |
| | | | | | | | | 66 | .36 |
| | | | | | | | | 68 | .36 |
| | | | | | | | | 70 | .34 |
| | | | | | | | | 72 | .32 |
| | | | | | | | | 74 | .30 |

Table AII. Continued

(a) Continued

| | | | | | Test surface | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Type | Wetness | Type of braking | Ground speed, knots | Effective braking friction coefficient |
| 14 | 410 | 4 | $76.36 \times 10^3$ | 651.3 | B | Truck wet | Manual | 70 | 0.37 |
| | | | | | | | | 72 | .35 |
| | | | | | | | | 74 | .34 |
| | | | | | | | | 76 | .32 |
| | | | | | | | | 78 | .32 |
| | | | | | | | | 80 | .30 |
| | | | | | | | | 82 | .30 |
| 11 | 410 | 22 | $80.98 \times 10^3$ | 650.0 | B | Truck wet | Manual | 18 | .44 |
| | | | | | | | | 20 | .44 |
| | | | | | | | | 25 | .43 |
| | | | | | | | | 30 | .41 |
| | | | | | | | | 35 | .36 |
| | | | | | | | | 40 | .32 |
| | | | | | | | | 45 | .29 |
| 19 | 410 | 22 | $83.80 \times 10^3$ | 650.0 | B | Truck wet | Manual | 32 | .39 |
| | | | | | | | | 35 | .40 |
| | | | | | | | | 40 | .39 |
| | | | | | | | | 45 | .39 |
| | | | | | | | | 50 | .38 |
| | | | | | | | | 55 | .34 |
| 13 | 410 | 22 | $77.80 \times 10^3$ | 650.8 | B | Truck wet | Manual | 57 | .34 |
| | | | | | | | | 60 | .31 |
| | | | | | | | | 63 | .27 |
| | | | | | | | | 66 | .23 |
| 15 | 410 | 22 | $81.98 \times 10^3$ | 649.8 | B | Truck wet | Manual | 84 | .21 |
| | | | | | | | | 86 | .21 |
| | | | | | | | | 88 | .19 |
| | | | | | | | | 90 | .18 |
| 32 | 415 | 4 | $83.06 \times 10^3$ | 649.6 | B | Flooded | Manual | 32 | .40 |
| | | | | | | | | 36 | .40 |
| | | | | | | | | 40 | .39 |
| | | | | | | | | 44 | .36 |
| | | | | | | | | 48 | .35 |
| | | | | | | | | 52 | .34 |
| | | | | | | | | 55 | .31 |

Table AII. Continued

(a) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 23 | 412 | 4 | $81.80 \times 10^3$ | 649.4 | C | Truck wet | Manual | 36 | 0.44 |
| | | | | | | | | 38 | .44 |
| | | | | | | | | 40 | .43 |
| | | | | | | | | 42 | .44 |
| | | | | | | | | 44 | .43 |
| | | | | | | | | 62 | .42 |
| | | | | | | | | 64 | .41 |
| | | | | | | | | 66 | .40 |
| | | | | | | | | 68 | .40 |
| 24 | 412 | 4 | $79.93 \times 10^3$ | 650.6 | B | Truck wet | Manual | 67 | .35 |
| | | | | | | | | 70 | .32 |
| | | | | | | | | 73 | .30 |
| 24 | 412 | 4 | $79.93 \times 10^3$ | 650.6 | C | Truck wet | Manual | 87 | .36 |
| | | | | | | | | 89 | .35 |
| | | | | | | | | 91 | .34 |
| 33 | 415 | 22 | $82.20 \times 10^3$ | 649.5 | B | Flooded | Manual | 62 | .32 |
| | | | | | | | | 64 | .30 |
| | | | | | | | | 66 | .30 |
| | | | | | | | | 68 | .28 |
| | | | | | | | | 70 | .28 |
| | | | | | | | | 72 | .26 |
| | | | | | | | | 74 | .26 |
| 34 | 415 | 22 | $80.00 \times 10^3$ | 649.9 | B | Flooded | Manual | 85 | .17 |
| | | | | | | | | 90 | .16 |
| | | | | | | | | 95 | .16 |
| 31 | 412 | 4 | $72.80 \times 10^3$ | 652.1 | J1 | Truck wet | Manual | 51 | .20 |
| | | | | | | | | 54 | .20 |
| | | | | | | | | 57 | .19 |
| | | | | | | | | 60 | .17 |
| | | | | | | | | 63 | .18 |
| | | | | | | | | 66 | .18 |
| | | | | | | | | 69 | .18 |
| 28 | 412 | 22 | $77.60 \times 10^3$ | 650.4 | J1 | Truck wet | Manual | 34 | .32 |
| | | | | | | | | 37 | .32 |
| | | | | | | | | 40 | .31 |
| | | | | | | | | 43 | .30 |
| | | | | | | | | 46 | .29 |
| | | | | | | | | 49 | .27 |
| | | | | | | | | 52 | .26 |
| 30 | 412 | 22 | $74.20 \times 10^3$ | 650.5 | J1 | Truck wet | Manual | 67 | .17 |
| | | | | | | | | 69 | .15 |
| | | | | | | | | 71 | .13 |
| | | | | | | | | 73 | .13 |

Table AII. Continued

(a) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 29 | 412 | 4 | $75.98 \times 10^3$ | 651.0 | J2 | Truck wet | Manual | 36 | 0.43 |
| | | | | | | | | 40 | .40 |
| | | | | | | | | 44 | .38 |
| | | | | | | | | 48 | .42 |
| | | | | | | | | 52 | .38 |
| | | | | | | | | 56 | .42 |
| | | | | | | | | 60 | .36 |
| 31 | 412 | 4 | $72.88 \times 10^3$ | 652.2 | J2 | Truck wet | Manual | 70 | .27 |
| | | | | | | | | 72 | .27 |
| | | | | | | | | 74 | .27 |
| | | | | | | | | 76 | .25 |
| | | | | | | | | 78 | .25 |
| | | | | | | | | 80 | .25 |
| | | | | | | | | 82 | .28 |
| | | | | | | | | 84 | .26 |
| | | | | | | | | 86 | .25 |
| 30 | 412 | 22 | $74.28 \times 10^3$ | 650.5 | J2 | Truck wet | Manual | 40 | .40 |
| | | | | | | | | 42 | .39 |
| | | | | | | | | 44 | .40 |
| | | | | | | | | 46 | .40 |
| | | | | | | | | 48 | .37 |
| | | | | | | | | 50 | .35 |
| | | | | | | | | 52 | .33 |
| | | | | | | | | 54 | .29 |
| | | | | | | | | 56 | .33 |
| | | | | | | | | 58 | .31 |
| | | | | | | | | 60 | .29 |
| | | | | | | | | 62 | .26 |
| | | | | | | | | 64 | .23 |
| | | | | | | | | 66 | .21 |

Table AII. Continued

(a) Concluded

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 4A | 434 | 10 | $85.60 \times 10^3$ | 651.9 | SSA | Rain wet | Manual | 10 | 0.37 |
| | | | | | | | | 15 | .34 |
| | | | | | | | | 20 | .33 |
| | | | | | | | | 25 | .34 |
| | | | | | | | | 30 | .35 |
| | | | | | | | | 35 | .38 |
| | | | | | | | | 40 | .40 |
| 4B | 434 | 10 | $84.30 \times 10^3$ | 651.6 | SSA | Rain wet | Manual | 20 | .34 |
| | | | | | | | | 25 | .37 |
| | | | | | | | | 30 | .38 |
| | | | | | | | | 35 | .40 |
| | | | | | | | | 40 | .41 |
| | | | | | | | | 45 | .42 |
| | | | | | | | | 50 | .42 |
| | | | | | | | | 55 | .42 |
| | | | | | | | | 60 | .41 |
| 4C | 434 | 10 | $83.20 \times 10^3$ | 651.5 | SSA | Rain damp | Manual | 45 | .50 |
| | | | | | | | | 50 | .49 |
| | | | | | | | | 55 | .48 |
| | | | | | | | | 60 | .46 |
| | | | | | | | | 65 | .44 |
| | | | | | | | | 70 | .44 |
| | | | | | | | | 75 | .43 |
| | | | | | | | | 80 | .42 |
| | | | | | | | | 85 | .43 |
| | | | | | | | | 90 | .42 |
| 5 | 434 | 10 | $81.70 \times 10^3$ | 651.7 | SSA | Rain damp | Automatic | 35 | .34 |
| | | | | | | | | 40 | .33 |
| | | | | | | | | 45 | .32 |
| | | | | | | | | 50 | .31 |
| | | | | | | | | 55 | .30 |
| | | | | | | | | 60 | .28 |
| | | | | | | | | 65 | .27 |
| | | | | | | | | 70 | .26 |
| | | | | | | | | 75 | .26 |
| | | | | | | | | 80 | .25 |
| | | | | | | | | 85 | .24 |
| | | | | | | | | 90 | .23 |
| | | | | | | | | 95 | .21 |
| | | | | | | | | 100 | .20 |
| 6 | 434 | 22 | $79.80 \times 10^3$ | 652.3 | A | Rain damp | Manual | 85 | .32 |
| 7 | 434 | 4 | $78.80 \times 10^3$ | 652.6 | B | Rain damp | Manual | 80 | .41 |
| | | | | | | | | 85 | .40 |

Table AII. Continued

(b) FAA Technical Center

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface |  | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness |  |  |  |
| 6 | 414 | 13 | $80.48 \times 10^3$ | 650.2 | B | Truck wet | Manual | 29 | 0.37 |
|  |  |  |  |  |  |  |  | 32 | .38 |
|  |  |  |  |  |  |  |  | 35 | .39 |
|  |  |  |  |  |  |  |  | 38 | .40 |
| 7 | 414 | 13 | $79.98 \times 10^3$ | 650.3 | B | Truck wet | Manual | 37 | .33 |
|  |  |  |  |  |  |  |  | 39 | .33 |
|  |  |  |  |  |  |  |  | 41 | .33 |
|  |  |  |  |  |  |  |  | 43 | .32 |
|  |  |  |  |  |  |  |  | 45 | .33 |
|  |  |  |  |  |  |  |  | 47 | .34 |
| 9 | 414 | 13 | $76.88 \times 10^3$ | 651.3 | B | Truck wet | Manual | 81 | .21 |
|  |  |  |  |  |  |  |  | 83 | .19 |
|  |  |  |  |  |  |  |  | 85 | .19 |
|  |  |  |  |  |  |  |  | 87 | .17 |
| 2 | 413 | 13 | $82.40 \times 10^3$ | 649.8 | C | Dry | Manual | 35 | .52 |
|  |  |  |  |  |  |  |  | 40 | .51 |
|  |  |  |  |  |  |  |  | 45 | .50 |
|  |  |  |  |  |  |  |  | 50 | .49 |
|  |  |  |  |  |  |  |  | 55 | .50 |
|  |  |  |  |  |  |  |  | 60 | .49 |
|  |  |  |  |  |  |  |  | 65 | .48 |
|  |  |  |  |  |  |  |  | 70 | .45 |
|  |  |  |  |  |  |  |  | 75 | .47 |
|  |  |  |  |  |  |  |  | 80 | .47 |
|  |  |  |  |  |  |  |  | 85 | .46 |
|  |  |  |  |  |  |  |  | 90 | .45 |
|  |  |  |  |  |  |  |  | 95 | .47 |
|  |  |  |  |  |  |  |  | 100 | .45 |

Table AII. Continued

(b) Concluded

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface |  | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness |  |  |  |
| 4 | 414 | 13 | $85.90 \times 10^3$ | 650.1 | C | Truck wet | Manual | 50 | 0.40 |
|  |  |  |  |  |  |  |  | 55 | .39 |
|  |  |  |  |  |  |  |  | 60 | .38 |
|  |  |  |  |  |  |  |  | 65 | .36 |
|  |  |  |  |  |  |  |  | 70 | .36 |
|  |  |  |  |  |  |  |  | 75 | .40 |
|  |  |  |  |  |  |  |  | 80 | .40 |
|  |  |  |  |  |  |  |  | 85 | .40 |
|  |  |  |  |  |  |  |  | 90 | .35 |
|  |  |  |  |  |  |  |  | 95 | .35 |
|  |  |  |  |  |  |  |  | 100 | .37 |
|  |  |  |  |  |  |  |  | 105 | .35 |
|  |  |  |  |  |  |  |  | 110 | .34 |
| 3 | 413 | 31 | $80.90 \times 10^3$ | 650.0 | D | Dry | Manual | 50 | .51 |
|  |  |  |  |  |  |  |  | 55 | .50 |
|  |  |  |  |  |  |  |  | 60 | .49 |
|  |  |  |  |  |  |  |  | 65 | .48 |
|  |  |  |  |  |  |  |  | 70 | .47 |
|  |  |  |  |  |  |  |  | 75 | .46 |
|  |  |  |  |  |  |  |  | 80 | .46 |
|  |  |  |  |  |  |  |  | 85 | .47 |
|  |  |  |  |  |  |  |  | 90 | .46 |
|  |  |  |  |  |  |  |  | 95 | .46 |
|  |  |  |  |  |  |  |  | 100 | .45 |
| 5 | 414 | 31 | $82.90 \times 10^3$ | 649.9 | D | Truck wet | Manual | 50 | .33 |
|  |  |  |  |  |  |  |  | 55 | .32 |
|  |  |  |  |  |  |  |  | 60 | .35 |
|  |  |  |  |  |  |  |  | 65 | .34 |
|  |  |  |  |  |  |  |  | 70 | .32 |
|  |  |  |  |  |  |  |  | 75 | .33 |
|  |  |  |  |  |  |  |  | 80 | .33 |
|  |  |  |  |  |  |  |  | 85 | .36 |
|  |  |  |  |  |  |  |  | 90 | .33 |
|  |  |  |  |  |  |  |  | 95 | .33 |
|  |  |  |  |  |  |  |  | 100 | .35 |
|  |  |  |  |  |  |  |  | 105 | .35 |
|  |  |  |  |  |  |  |  | 110 | .32 |

Table AII. Continued

(c) Brunswick Naval Air Station

| | | | | | Test surface | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Type | Wetness | Type of braking | Ground speed, knots | Effective braking friction coefficient |
| 2 | 430 | 1 | $79.70 \times 10^3$ | 653.1 | Asphalt | Dry, loose snow, 6 in. | Manual | 8 | 0.10 |
| | | | | | | | | 14 | .11 |
| | | | | | | | | 18 | .14 |
| | | | | | | | | 24 | .16 |
| | | | | | | | | 28 | .15 |
| 3 | 430 | 19 | $79.10 \times 10^3$ | 654.1 | Asphalt | Dry, loose snow, 6 in. | Manual | 20 | .13 |
| | | | | | | | | 25 | .14 |
| | | | | | | | | 30 | .16 |
| | | | | | | | | 35 | .18 |
| | | | | | | | | 40 | .20 |
| 4 | 430 | 1 | $78.70 \times 10^3$ | 653.5 | Asphalt | Dry, loose snow, 6 in. | Manual | 20 | .13 |
| | | | | | | | | 25 | .15 |
| | | | | | | | | 30 | .17 |
| | | | | | | | | 35 | .19 |
| | | | | | | | | 40 | .19 |
| | | | | | | | | 45 | .18 |
| | | | | | | | | 50 | .19 |
| | | | | | | | | 55 | .19 |
| | | | | | | | | 60 | .19 |
| 5 | 430 | 19 | $78.40 \times 10^3$ | 652.0 | Asphalt | Dry, loose snow, 6 in. | Manual | 25 | .15 |
| | | | | | | | | 30 | .17 |
| | | | | | | | | 35 | .18 |
| | | | | | | | | 40 | .19 |
| | | | | | | | | 45 | .19 |
| | | | | | | | | 50 | .19 |
| | | | | | | | | 55 | .19 |
| | | | | | | | | 60 | .20 |
| | | | | | | | | 65 | .20 |
| | | | | | | | | 70 | .20 |
| 3 | 431 | 19 | $77.10 \times 10^3$ | 652.9 | Asphalt | Dry, loose snow, 3 in. | Manual | 20 | .11 |
| | | | | | | | | 25 | .14 |
| | | | | | | | | 30 | .16 |
| | | | | | | | | 35 | .17 |
| | | | | | | | | 40 | .18 |
| | | | | | | | | 45 | .17 |
| 4 | 431 | 1 | $76.50 \times 10^3$ | 653.0 | Asphalt | Dry, loose snow, 3 in. | Manual | 25 | .14 |
| | | | | | | | | 30 | .14 |
| | | | | | | | | 35 | .16 |
| | | | | | | | | 40 | .17 |
| | | | | | | | | 45 | .16 |
| | | | | | | | | 50 | .15 |
| | | | | | | | | 55 | .15 |

Table AII. Continued

(c) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface Type | Test surface Wetness | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 431 | 1 | $75.10 \times 10^3$ | 653.6 | Asphalt | Dry, loose snow, 3 in. | Manual | 25 | 0.15 |
| | | | | | | | | 30 | .16 |
| | | | | | | | | 35 | .16 |
| | | | | | | | | 40 | .17 |
| | | | | | | | | 45 | .18 |
| | | | | | | | | 50 | .18 |
| | | | | | | | | 55 | .16 |
| | | | | | | | | 60 | .15 |
| | | | | | | | | 65 | .16 |
| | | | | | | | | 70 | .16 |
| 2 | 432 | 1 | $78.20 \times 10^3$ | 652.5 | Asphalt | New wet snow, 1.5 in. | Manual | 10 | .11 |
| | | | | | | | | 15 | .11 |
| | | | | | | | | 20 | .09 |
| | | | | | | | | 25 | .09 |
| 3 | 432 | 1 | $77.60 \times 10^3$ | 652.7 | Asphalt | New wet snow, 1.5 in. | Manual | 25 | .14 |
| | | | | | | | | 30 | .14 |
| | | | | | | | | 35 | .14 |
| | | | | | | | | 40 | .14 |
| | | | | | | | | 45 | .14 |
| | | | | | | | | 50 | .13 |
| 2R1 | 432 | 1 | $75.80 \times 10^3$ | 653.3 | Asphalt | Wet snow, 4.5 in. | Manual | 15 | .10 |
| | | | | | | | | 20 | .09 |
| | | | | | | | | 25 | .09 |
| 3R1 | 432 | 1 | $75.40 \times 10^3$ | 653.5 | Asphalt | Wet snow, 4.5 in. | Manual | 20 | .09 |
| | | | | | | | | 25 | .10 |
| | | | | | | | | 30 | .12 |
| | | | | | | | | 35 | .13 |
| | | | | | | | | 40 | .13 |
| | | | | | | | | 45 | .13 |
| | | | | | | | | 50 | .12 |
| 2R2 | 432 | 19 | $79.70 \times 10^3$ | 651.8 | Asphalt | 1-in. slush | Manual | 20 | .09 |
| | | | | | | | | 25 | .09 |
| | | | | | | | | 30 | .09 |
| 3R2 | 432 | 19 | $79.40 \times 10^3$ | 652.1 | Asphalt | 1-in. slush | Manual | 20 | .12 |
| | | | | | | | | 25 | .12 |
| | | | | | | | | 30 | .14 |
| | | | | | | | | 35 | .14 |
| | | | | | | | | 40 | .13 |
| | | | | | | | | 45 | .12 |
| | | | | | | | | 50 | .10 |

Table AII. Continued

(c) Concluded

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 3R3 | 432 | 19 | $78.50 \times 10^3$ | 652.4 | Asphalt | 1-in. slush | Manual | 25 | 0.12 |
| | | | | | | | | 30 | .12 |
| | | | | | | | | 35 | .17 |
| | | | | | | | | 40 | .15 |
| | | | | | | | | 45 | .13 |
| | | | | | | | | 50 | .10 |
| | | | | | | | | 55 | .08 |
| 2 | 433 | 19 | $81.40 \times 10^3$ | 652.6 | Asphalt | Icy | Manual | 20 | .03 |
| | | | | | | | | 25 | .04 |
| | | | | | | | | 30 | .04 |
| 3 | 433 | 1 | $80.00 \times 10^3$ | 653.0 | Asphalt | Icy | Manual | 35 | .04 |
| | | | | | | | | 40 | .02 |
| | | | | | | | | 45 | .03 |
| | | | | | | | | 50 | .03 |
| 5 | 433 | 19 | $79.50 \times 10^3$ | 653.2 | Asphalt | Icy | Manual | 45 | .01 |
| | | | | | | | | 50 | .01 |
| | | | | | | | | 55 | .00 |
| | | | | | | | | 60 | .01 |
| | | | | | | | | 65 | .01 |
| | | | | | | | | 70 | .02 |
| | | | | | | | | 80 | .01 |

Table AII. Concluded

(d) Langley Air Force Base

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface |  | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness |  |  |  |
| 10 | 434 | 7 | $87.00 \times 10^3$ | 652.9 | PCC | Rain wet, 0.02 to 0.03 in. | Manual | 50 | 0.35 |
|  |  |  |  |  |  |  |  | 55 | .34 |
|  |  |  |  |  |  |  |  | 55 | .34 |
|  |  |  |  |  |  |  |  | 60 | .33 |
|  |  |  |  |  |  |  |  | 60 | .33 |
|  |  |  |  |  |  |  |  | 65 | .29 |
|  |  |  |  |  |  |  |  | 70 | .25 |
|  |  |  |  |  |  |  |  | 75 | .23 |
|  |  |  |  |  |  |  |  | 80 | .20 |
|  |  |  |  |  |  |  |  | 85 | .19 |
|  |  |  |  |  |  |  |  | 90 | .19 |

Table AIII. Ground-Vehicle Friction Data Obtained on Dry-Runway Test Surfaces

(a) Wallops Flight Facility

| Test surface | Test vehicle | Run | Speed, mph | Average friction coefficient |
|---|---|---|---|---|
| SSA | DBV | 11 | 60 | 0.88 |
| | | | 50 | .88 |
| | | | 40 | .90 |
| | | | 30 | .88 |
| | | | 20 | .88 |
| | | | 10 | .93 |
| | | | 2 | .93 |
| | | 12 | 60 | .88 |
| | | | 50 | .90 |
| | | | 40 | .93 |
| | | | 30 | .88 |
| | | | 20 | |
| | | | 10 | |
| | | | 2 | |
| | Mu-M | 17 | 20 | .89 |
| | | | 30 | .88 |
| | | | 40 | .87 |
| | | | 50 | .86 |
| | | | 60 | |
| | | 18 | 20 | |
| | | | 30 | |
| | | | 40 | |
| | | | 50 | |
| | | | 60 | |
| | | 79 | 20 | .87 |
| | | | 30 | .88 |
| | | | 40 | .89 |
| | | | 50 | .89 |
| | | | 58 | .88 |
| | | 80 | 20 | .86 |
| | | | 30 | .87 |
| | | | 40 | .88 |
| | | | 50 | .89 |
| | | | 60 | .89 |
| | | 78 | 1 | .82 |
| | BV-11 | 17 | 1 | 1.10 |
| | | 18 | 20 | 1.13 |
| | | | 30 | 1.12 |
| | | | 40 | 1.10 |
| | | | 50 | 1.07 |
| | | | 60 | 1.00 |
| | | 19 | 20 | 1.11 |
| | | 19 | 30 | 1.11 |
| | | 19 | 40 | 1.10 |

Table AIII. Continued

(a) Continued

| Test surface | Test vehicle | Run | Speed, mph | Average friction coefficient |
|---|---|---|---|---|
| SSA | BV-11 | 19 | 50 | 1.07 |
| | BV-11 | 19 | 60 | 1.02 |
| | SFT | 15 | 20 | .98 |
| | | | 30 | .96 |
| | | | 40 | .94 |
| | | | 50 | .91 |
| | | | 60 | .87 |
| | | 16 | 20 | .96 |
| | | | 30 | .95 |
| | | | 40 | .92 |
| | | | 50 | .89 |
| | | | 60 | .86 |
| A | DBV | 38 | 60 | 0.87 |
| | | | 50 | .95 |
| | | | 40 | .92 |
| | | | 30 | .87 |
| | | | 20 | .78 |
| | | | 10 | .81 |
| | | | 2 | 1.00 |
| | Mu-M | 19 | 60 | .91 |
| | | 20 | 50 | .89 |
| | | 21 | 40 | .89 |
| | | 22 | 30 | .88 |
| | | 23 | 20 | .87 |
| | | 62 | 1 | .81 |
| | | 64 | 20 | .89 |
| | | 65 | 20 | .89 |
| | | 66 | 40 | .91 |
| | | 67 | 40 | .91 |
| | | 68 | 60 | .90 |
| | | 69 | 60 | .90 |
| | BV-11 | 1 | 1 | 1.10 |
| | | 3 | 20 | 1.08 |
| | | 4 | 20 | 1.07 |
| | | 5 | 40 | 1.01 |
| | | 6 | 40 | 1.02 |
| | | 7 | 60 | .94 |
| | | 8 | 60 | .97 |
| | SFT | 1 | 20 | .99 |
| | | 2 | 20 | .99 |
| | | 3 | 40 | .98 |
| | | 4 | 40 | .98 |
| | | 5 | 60 | .97 |
| | | 6 | 60 | .96 |

Table AIII. Continued

(a) Continued

| Test surface | Test vehicle | Run | Speed, mph | Average friction coefficient |
|---|---|---|---|---|
| B, C | DBV | 39 | 60 | 0.84 |
| | | | 50 | .86 |
| | | | 40 | .84 |
| | | | 30 | .77 |
| | | | 20 | .73 |
| | | | 10 | .80 |
| | | | 2 | .98 |
| | Mu-M | 19 | 60 | .89 |
| | | 20 | 50 | .88 |
| | | 21 | 40 | .88 |
| | | 22 | 30 | .87 |
| | | 23 | 20 | .86 |
| | | 63 | 1 | .79 |
| | | 64 | 20 | .89 |
| | | 65 | 20 | .88 |
| | | 66 | 40 | .91 |
| | | 67 | 40 | .90 |
| | | 68 | 60 | .92 |
| | | 69 | 60 | .90 |
| | BV-11 | 2 | 1 | 1.11 |
| | | 3 | 20 | 1.09 |
| | | 4 | 20 | 1.08 |
| | | 5 | 40 | 1.04 |
| | | 6 | 40 | 1.04 |
| | | 7 | 60 | .98 |
| | | 8 | 60 | .99 |
| | SFT | 1 | 20 | .99 |
| | | 2 | 20 | .99 |
| | | 3 | 40 | .98 |
| | | 4 | 40 | .99 |
| | | 5 | 60 | .98 |
| | | 6 | 60 | .98 |
| J-1 | Mu-M | 40 | 20 | 0.85 |
| | | 41 | 20 | .84 |
| | | 42 | 30 | .85 |
| | | 43 | 30 | .85 |
| | | 44 | 40 | .87 |
| | | 45 | 40 | .86 |
| | | 46 | 50 | .87 |
| | | 47 | 50 | .86 |
| | | 48 | 60 | .88 |
| | | 49 | 60 | .87 |
| | | 97 | 20 | .86 |
| | | 98 | 40 | .87 |
| | | 99 | 60 | .89 |

Table AIII. Continued

(a) Concluded

| Test surface | Test vehicle | Run | Speed, mph | Average friction coefficient |
|---|---|---|---|---|
| J-1 | BV-11 | 36 | 20 | 1.10 |
| | BV-11 | 37 | 40 | |
| | BV-11 | 38 | 60 | 1.00 |
| | SFT | 33 | 20 | .98 |
| | SFT | 34 | 40 | .90 |
| | SFT | 35 | 60 | .87 |
| J-2 | Mu-M | 40 | 20 | 0.88 |
| | | 41 | 20 | .88 |
| | | 42 | 30 | .89 |
| | | 43 | 30 | .89 |
| | | 44 | 40 | .90 |
| | | 45 | 40 | .88 |
| | | 46 | 50 | .91 |
| | | 47 | 50 | .89 |
| | | 48 | 60 | .91 |
| | | 49 | 60 | .90 |
| | BV-11 | 36 | 20 | 1.07 |
| | BV-11 | 37 | 40 | 1.01 |
| | BV-11 | 38 | 60 | .98 |
| | SFT | 33 | 20 | .95 |
| | SFT | 34 | 40 | .89 |
| | SFT | 35 | 60 | .84 |

Table AIII. Continued

(b) FAA Technical Center

| Test surface | Test vehicle | Run | Speed, mph | Average friction coefficient |
|---|---|---|---|---|
| B | DBV | 77 | 60 | 0.86 |
| | | | 50 | .86 |
| | | | 40 | .71 |
| | | | 30 | .65 |
| | | | 20 | .76 |
| | | | 10 | .96 |
| | | | 2 | 1.05 |
| | Mu-M | 26 | 20 | .88 |
| | | 27 | 20 | .87 |
| | | 28 | 40 | .90 |
| | | 29 | 40 | .89 |
| | | 30 | 60 | .90 |
| | | 31 | 60 | .91 |
| | BV-11 | 26 | 20 | 1.01 |
| | | 27 | 20 | .93 |
| | | 28 | 40 | .93 |
| | | 29 | 40 | .99 |
| | | 30 | 60 | .92 |
| | | 31 | 60 | .95 |
| | SFT | 26 | 20 | .98 |
| | | 27 | 20 | .99 |
| | | 28 | 40 | .92 |
| | | 29 | 40 | .90 |
| | | 30 | 60 | .88 |
| | | 31 | 60 | .86 |
| C | DBV | 78 | 60 | 0.83 |
| | | | 50 | .83 |
| | | | 40 | .74 |
| | | | 30 | .71 |
| | | | 20 | .71 |
| | | | 10 | .81 |
| | | | 2 | .86 |
| | Mu-M | 26 | 20 | .87 |
| | | 27 | 20 | .87 |
| | | 28 | 40 | .89 |
| | | 29 | 40 | .89 |
| | | 30 | 60 | .90 |
| | | 31 | 60 | .91 |
| | BV-11 | 26 | 20 | 1.03 |
| | | 27 | 20 | .97 |
| | | 28 | 40 | 1.00 |
| | | 29 | 40 | 1.02 |
| | | 30 | 60 | .98 |
| | | 31 | 60 | .99 |

Table AIII. Concluded

(b) Concluded

| Test surface | Test vehicle | Run | Speed, mph | Average friction coefficient |
|---|---|---|---|---|
| C | SFT | 26R | 20 | 0.99 |
| | | 27 | 20 | .99 |
| | | 28 | 40 | .95 |
| | | 29 | 40 | .93 |
| | | 30 | 60 | .90 |
| | | 31 | 60 | .90 |
| D | DBV | 79 | 60 | 0.74 |
| | | | 50 | .83 |
| | | | 40 | .83 |
| | | | 30 | .83 |
| | | | 20 | .83 |
| | | | 10 | .94 |
| | | | 2 | .98 |
| | Mu-M | 26 | 20 | .87 |
| | | 27 | 20 | .88 |
| | | 28 | 40 | .89 |
| | | 29 | 40 | .89 |
| | | 30 | 60 | .90 |
| | | 31 | 60 | .91 |
| | BV-11 | 26 | 20 | .98 |
| | | 27 | 20 | .98 |
| | | 28 | 40 | .98 |
| | | 29 | 40 | 1.00 |
| | | 30 | 60 | .96 |
| | | 31 | 60 | .95 |
| | SFT | 26 | 20 | .99 |
| | | 27 | 20 | .99 |
| | | 28 | 40 | .93 |
| | | 29 | 40 | .93 |
| | | 30 | 60 | .88 |
| | | 31 | 60 | .88 |

Table AIV. Ground-Vehicle Friction Data Obtained During Wet-Runway Aircraft Braking Test Runs

(a) Diagonal-braked vehicle

| Test site | Test surface | A/C run | Vehicle run | | Average friction coefficient at test speed, mph, of— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number | Time from A/C run, min[a] | 10 | 20 | 30 | 40 | 50 | 60 |
| Wallops Flight Facility | SSA | 21 | 44 | −3 | 0.85 | 0.66 | 0.51 | 0.44 | 0.36 | 0.33 |
| | | | 45 | +1 | | .73 | .58 | .51 | .46 | .39 |
| | | 22 | 46 | −3 | 0.85 | 0.64 | 0.49 | 0.39 | 0.34 | 0.29 |
| | | | 47 | +1 | .85 | .66 | .51 | .44 | .39 | .34 |
| | A | 11 | 26 | −1 | | | | | 0.15 | 0.07 |
| | B, C | | | −1 | 0.64 | 0.58 | 0.56 | 0.53 | | |
| | A | | 27 | +2 | | | | | 0.17 | 0.10 |
| | B, C | | | +2 | 0.67 | 0.63 | 0.55 | 0.51 | | |
| | B, C | 12 | 28 | −1 | | | 0.51 | 0.47 | 0.41 | 0.39 |
| | A | | | −1 | 0.55 | 0.36 | | | | |
| | B, C | | 29 | +2 | | | 0.61 | 0.55 | 0.51 | 0.49 |
| | A | | | +2 | 0.58 | 0.41 | | | | |
| | A | 13 | 30 | −2 | | | | | 0.15 | 0.10 |
| | B, C | | | −2 | 0.70 | 0.63 | 0.58 | 0.51 | | |
| | A | | 31 | +1 | | | | | 0.12 | 0.07 |
| | B, C | | | +1 | 0.67 | 0.58 | 0.58 | 0.53 | | |
| | B, C | 14 | 32 | −1 | | | | 0.51 | 0.49 | 0.46 |
| | A | | | −1 | 0.61 | 0.44 | 0.24 | | | |
| | B, C | | 33 | +2 | | | | 0.53 | 0.51 | 0.45 |
| | A | | | +2 | 0.53 | 0.39 | 0.24 | | | |
| | A | 15 | 34 | −1 | | | | | 0.17 | 0.12 |
| | B, C | | | −1 | 0.70 | 0.63 | 0.59 | 0.56 | | |
| | A | | 35 | +2 | | | | | 0.17 | 0.12 |
| | B, C | | | +2 | 0.66 | 0.58 | 0.51 | 0.48 | | |
| | B, C | 16 | 36 | −2 | | | | 0.51 | 0.49 | 0.51 |
| | A | | | −2 | 0.58 | 0.36 | 0.24 | | | |
| | B, C | | 37 | +2 | | | | 0.51 | 0.47 | 0.46 |
| | A | | | +2 | 0.52 | 0.44 | 0.24 | | | |
| | | 37 | [b]98 | −1 | | | | | 0.17 | 0.12 |
| | | | [b]99 | +2 | | | | | .15 | .10 |
| | | 38 | [b]100 | −2 | | | | | 0.17 | 0.10 |
| | | | [b]101 | +2 | | | | | .16 | .12 |
| | | 39 | [b]102 | −1 | | | | | 0.18 | 0.12 |
| | | | [b]103 | +2 | | | | | .15 | .10 |
| | B, C | 23 | 48 | −2 | 0.72 | 0.66 | 0.61 | 0.56 | 0.51 | 0.49 |
| | | | 49 | +2 | .68 | .63 | .61 | .53 | .51 | .51 |
| | | 24 | 50 | −1 | 0.73 | 0.64 | 0.58 | 0.50 | 0.51 | 0.49 |
| | | | 51 | +2 | .73 | .63 | .61 | .55 | .53 | .51 |
| | | 32 | [b]92 | −2 | | | | 0.42 | 0.37 | 0.29 |
| | | | [b]93 | +2 | | | | .42 | .33 | .29 |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.
[b] Flooded condition.

Table AIV. Continued

(a) Continued

| Test site | Test surface | A/C run | Vehicle run | | Average friction coefficient at test speed, mph, of— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number | Time from A/C run, min[a] | 10 | 20 | 30 | 40 | 50 | 60 |
| Wallops Flight Facility | B, C | 33 | [b]94 | −1 | | | | 0.53 | 0.42 | 0.32 |
| | | | [b]95 | +2 | | | | .51 | .39 | .29 |
| | | 34 | [b]96 | −1 | | | | 0.49 | 0.37 | 0.29 |
| | | | [b]97 | +2 | | | | .50 | .40 | .29 |
| | J-1 | 28 | 52 | −2 | | | | | 0.39 | 0.24 |
| | J-2 | | | −2 | 1.00 | 0.85 | 0.66 | 0.58 | | |
| | J-1 | | 53 | +3 | | | | | 0.36 | 0.24 |
| | J-2 | | | +3 | 0.97 | 0.85 | 0.73 | 0.63 | | |
| | J-2 | 29 | 54 | −1 | | | | 0.36 | 0.36 | 0.29 |
| | J-1 | | | −1 | 0.73 | 0.56 | 0.49 | | | |
| | J-2 | | 55 | +2 | | | | | 0.41 | 0.32 |
| | J-1 | | | +2 | 0.75 | 0.63 | 0.63 | 0.61 | | |
| | J-1 | 30 | 56 | −3 | | | | | 0.27 | 0.12 |
| | J-2 | | | −3 | 1.09 | 0.94 | 0.69 | 0.53 | | |
| | J-1 | | 57 | +2 | | | | | 0.36 | 0.12 |
| | J-2 | | | +2 | 1.00 | 0.83 | 0.66 | 0.53 | | |
| | J-2 | 31 | 58 | −1 | | | | | 0.36 | 0.29 |
| | J-1 | | | −1 | 0.73 | 0.55 | 0.34 | 0.49 | | |
| | J-2 | | 59 | +2 | | | | 0.56 | 0.49 | 0.36 |
| | J-1 | | | +2 | 0.75 | 0.61 | 0.51 | | | |
| FAA Technical Center | C | 4 | 80 | −1 | 0.73 | 0.68 | 0.63 | 0.53 | 0.45 | 0.38 |
| | C | | 81 | +2 | .76 | .66 | .56 | .48 | .41 | .38 |
| | D | 5 | 82 | −2 | 0.89 | 0.76 | 0.68 | 0.63 | 0.58 | 0.51 |
| | D | | 83 | +2 | .81 | .73 | .71 | .66 | .56 | .51 |
| | B | 6 | 84 | −2 | 0.80 | 0.61 | 0.48 | | | |
| | | | 85 | +3 | .76 | .63 | .51 | | | |
| | | 7 | 86 | −2 | 0.76 | 0.67 | 0.51 | 0.32 | | |
| | | | 87 | | | | | | | |
| | | 8 | 88 | | | | | | | |
| | | | 89 | +2 | | | | | 0.25 | |
| | | 9 | 90 | −4 | | | | | | 0.10 |
| | | | 91 | +1 | | | | | | .17 |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

[b] Flooded condition.

Table AIV. Continued

(a) Concluded

| | | | Vehicle run | | Average friction coefficient at test speed, mph, of | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test site | Test surface | A/C run | Number | Time from A/C run, min[a] | 10 | 20 | 30 | 40 | 50 | 60 |
| Wallops Flight Facility | [c]SSA | 4A | 1 | −3 | 0.90 | 0.80 | 0.70 | 0.63 | 0.53 | 0.45 |
| | | | 3 | +6 | .88 | .80 | .70 | .65 | .55 | .45 |
| | | 4B | 4 | −1 | 0.90 | 0.80 | 0.72 | 0.62 | 0.52 | 0.42 |
| | | | 5 | +3 | .86 | .80 | .75 | .63 | .53 | .45 |
| | | 4C | 6 | −1 | 0.88 | 0.82 | 0.73 | 0.63 | 0.56 | 0.45 |
| | | | 7 | +2 | .88 | .78 | .70 | .65 | .55 | .45 |
| | | 5 | 8 | −2 | 0.90 | 0.80 | 0.72 | 0.62 | 0.53 | 0.42 |
| | | | 9 | +3 | .92 | .80 | .70 | .60 | .53 | .45 |
| | [c]A | 6 | 10 | −7 | | | | | 0.25 | 0.15 |
| | | | 11 | −5 | 0.58 | 0.42 | | | | |
| | | | 12 | +3 | | | 0.40 | 0.28 | | |
| | | 7 | 15 | +6 | 0.60 | 0.42 | 0.32 | 0.22 | | |
| | [c]B | 6 | 10 | −7 | 0.65 | 0.60 | 0.55 | 0.50 | | |
| | | | 11 | −5 | | | .62 | .58 | 0.50 | 0.43 |
| | | | 12 | +3 | .76 | .68 | | | | |
| | | 7 | 13 | −3 | 0.66 | 0.62 | 0.56 | 0.56 | 0.50 | |
| | | | 14 | +4 | .66 | .64 | .56 | .54 | .50 | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

[c] Rain-wet condition.

Table AIV. Continued

(b) Mu-Meter

| | | | Vehicle run | | Average friction coefficient at test speed, mph, of | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test site | Test surface | A/C run | Number | Time from A/C run, min[a] | 10 | 20 | 30 | 40 | 50 | 60 |
| Wallops Flight Facility | SSA | 21 | 81 | −3 | | 0.86 | 0.84 | 0.74 | 0.68 | 0.54 |
| | | | 82 | +1 | | .86 | .86 | .84 | .80 | .70 |
| | | 22 | 83 | −4 | | 0.86 | 0.78 | 0.73 | 0.75 | 0.60 |
| | ↓ | | 84 | +1 | | .86 | .85 | .83 | .83 | |
| | A | 11 | 50 | −1 | | | | 0.26 | | |
| | B/C | | | −1 | | | | .86 | | |
| | A | | 51 | +1 | | | | 0.23 | | |
| | B/C | | | +1 | | | | .76 | | |
| | B/C | 12 | 52 | −2 | | | | 0.77 | | |
| | A | | | −2 | | | | .26 | | |
| | B/C | | 53 | +2 | | | | 0.77 | | |
| | A | | | +2 | | | | .22 | | |
| | A | 13 | 54 | −2 | | | | 0.25 | | |
| | B/C | | | −2 | | | | .54 | | |
| | A | | 55 | +1 | | | | 0.23 | | |
| | B/C | | | +1 | | | | .74 | | |
| | B/C | 14 | 56 | −1 | | | | 0.75 | | |
| | A | | | −1 | | | | .26 | | |
| | B/C | | 57 | +2 | | | | 0.75 | | |
| | A | | | +2 | | | | .28 | | |
| | A | 15 | 58 | −1 | | | | 0.41 | | |
| | B/C | | | −1 | | | | .77 | | |
| | A | | 59 | +1 | | | | 0.35 | | |
| | B, C | | | +1 | | | | .74 | | |
| | B, C | 16 | 60 | −2 | | | | 0.76 | | |
| | A | | | −2 | | | | .25 | | |
| | B, C | | 61 | +1 | | | | 0.74 | | |
| | A | | | +1 | | | | .24 | | |
| | A | 37 | [b]110 | −2 | | | | 0.07 | | |
| | | | [b]111 | +1 | | | | .07 | | |
| | | 38 | [b]112 | −3 | | | | 0.08 | | |
| | | | [b]113 | +1 | | | | .12 | | |
| | | 39 | [b]114 | −2 | | | | 0.16 | | |
| ↓ | ↓ | | [b]115 | +1 | | | | .22 | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.
[b] Flooded condition.

Table AIV. Continued

(b) Concluded

| | | | Vehicle run | | Average friction coefficient at test speed, mph, of – | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test site | Test surface | A/C run | Number | Time wideheadfrom A/C run, min[a] | 10 | 20 | 30 | 40 | 50 | 60 |
| Wallops Flight Facility | B, C | 23 | 85 | −2 | | | | 0.81 | | |
| | | | 86 | +3 | | | | .83 | | |
| | | 24 | 87 | −2 | | | | 0.81 | | |
| | | | 88 | +1 | | | | .81 | | |
| | | 32 | [b]104 | −2 | | | | 0.60 | | |
| | | | [b]105 | +1 | | | | .61 | | |
| | | 33 | [b]106 | −2 | | | | 0.80 | | |
| | | | [b]107 | +1 | | | | .81 | | |
| | | 34 | [b]108 | −2 | | | | 0.78 | | |
| | ↓ | | [b]109 | +1 | | | | .77 | | |
| | J-1 | 28 | 89 | −3 | | | | 0.65 | | |
| | J-2 | | | −3 | | | | .94 | | |
| | J-1 | | 90 | +1 | | | | 0.74 | | |
| | J-2 | | | +1 | | | | .94 | | |
| | J-2 | 29 | 91 | −2 | | | | 0.91 | | |
| | J-1 | | | −2 | | | | .32 | | |
| | J-2 | | 92 | +1 | | | | 0.93 | | |
| | J-1 | | | +1 | | | | .30 | | |
| | J-1 | 30 | 93 | −3 | | | | 0.50 | | |
| | J-2 | | | −3 | | | | .95 | | |
| | J-1 | | 94 | +1 | | | | 0.60 | | |
| | J-2 | | | +1 | | | | .96 | | |
| | J-2 | 31 | 95 | −2 | | | | 0.89 | | |
| | J-1 | | | −2 | | | | .30 | | |
| | J-2 | | 96 | +1 | | | | 0.95 | | |
| ↓ | J-1 | | | +1 | | | | .25 | | |
| FAA Technical Center | C | 4 | 14 | −2 | | 0.82 | 0.81 | 0.82 | 0.82 | 0.82 |
| | | | 15 | +1 | | .79 | .80 | .80 | .81 | |
| | D | 5 | 16 | −4 | | 0.84 | 0.80 | 0.80 | 0.82 | 0.80 |
| | | | 17 | +1 | | .84 | .81 | .81 | .81 | .80 |
| | B | 6 | 18 | −3 | | | | 0.62 | | |
| | | | 19 | +1 | | | | .64 | | |
| | | 7 | 20 | −2 | | | | 0.62 | | |
| | | | 21 | +1 | | | | .58 | | |
| | | 8 | 22 | −5 | | | | 0.60 | | |
| | | | 23 | +1 | | | | .62 | | |
| | | 9 | 24 | −5 | | | | 0.62 | | |
| ↓ | ↓ | | 25 | +1 | | | | .64 | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.
[b] Flooded condition.

Table AIV. Continued

(c) Surface friction tester

| Test site | Test surface | A/C run | Vehicle run |  | Average friction coefficient at test speed, mph, of— |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Number | Time from A/C run, min[a] | 10 | 20 | 30 | 40 | 50 | 60 |
| Wallops Flight Facility | SSA | 21 | 17 | −4 |  | 0.92 | 0.83 | 0.68 | 0.58 | 0.40 |
|  |  |  | 18 | +1 |  | .94 | .89 | .83 | .68 |  |
|  |  | 22 | 19 | −4 |  | 0.90 | 0.75 | 0.65 | 0.55 | 0.45 |
|  |  |  | 20 | +1 |  | .93 | .87 | .81 | .71 | .55 |
|  | B, C | 23 | 21 | −3 |  |  |  | 0.90 |  |  |
|  |  |  | 22 | +2 |  |  |  | .89 |  |  |
|  |  | 24 | 23 | −2 |  |  |  | 0.90 |  |  |
|  |  |  | 24 | +1 |  |  |  | .88 |  |  |
|  | J-1 | 28 | 25 | −3 |  |  |  | 0.64 |  |  |
|  | J-2 |  |  | −3 |  |  |  | .89 |  |  |
|  | J-1 |  | 26 | +1 |  |  |  | 0.75 |  |  |
|  | J-2 |  |  | +1 |  |  |  | .93 |  |  |
|  | J-2 | 29 | 27 | −2 |  |  |  | 0.90 |  |  |
|  | J-1 |  |  | −2 |  |  |  | .60 |  |  |
|  | J-2 |  | 28 | +1 |  |  |  | 0.93 |  |  |
|  | J-1 |  |  | +1 |  |  |  | .60 |  |  |
|  | J-1 | 30 | 29 | −3 |  |  |  | 0.62 |  |  |
|  | J-2 |  |  | −3 |  |  |  | .87 |  |  |
|  | J-1 |  | 30 | +1 |  |  |  | 0.65 |  |  |
|  | J-2 |  |  | +1 |  |  |  | .90 |  |  |
|  | J-2 | 31 | 31 | −2 |  |  |  | 0.90 |  |  |
|  | J-1 |  |  | −2 |  |  |  | .60 |  |  |
|  | J-2 |  | 32 | +1 |  |  |  | 0.92 |  |  |
|  | J-1 |  |  | +1 |  |  |  | .60 |  |  |
| FAA Technical Center | C | 4 | 14 | −3 |  |  | 0.93 | 0.91 | 0.90 | 0.89 |
|  |  |  | 15 | +1 |  | 0.95 | .91 | .90 | .89 | .88 |
|  | D | 5 | 16 | −4 |  | 0.97 | 0.94 | 0.92 | 0.90 | 0.87 |
|  |  |  | 17 | +1 |  | .95 | .93 | .91 | .89 | .84 |
|  | B | 6 | 18a | −3 |  |  |  | 0.60 |  |  |
|  |  |  | 19 | +1 |  |  |  | .63 |  |  |
|  |  | 7 | 20 | −2 |  |  |  | 0.50 |  |  |
|  |  |  | 21 | +1 |  |  |  | .68 |  |  |
|  |  | 8 | 22 | −5 |  |  |  | 0.50 |  |  |
|  |  |  | 23 | +1 |  |  |  | .67 |  |  |
|  |  | 9 | 24 | −5 |  |  |  | 0.45 |  |  |
|  |  |  | 25 | +1 |  |  |  | .68 |  |  |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

Table AIV. Concluded

(d) BV-11 skiddometer

| | | | Vehicle run | | Average friction coefficient at test speed, mph, of | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test site | Test surface | A/C run | Number | Time from A/C run, min[a] | 10 | 20 | 30 | 40 | 50 | 60 |
| Wallops Flight Facility | SSA | 21 | 20 | −3 | | 0.97 | 0.81 | 0.78 | 0.66 | 0.49 |
| | | | 21 | +1 | | .98 | .81 | .72 | .67 | .52 |
| | | 22 | 22 | −3 | | 0.95 | 0.77 | 0.75 | 0.66 | 0.43 |
| | | | 23 | +1 | | .95 | .81 | .78 | .75 | .57 |
| | B, C | 23 | 24 | −2 | | | | 0.92 | | |
| | | | 25 | +3 | | | | .94 | | |
| | | 24 | 26 | −2 | | | | 0.90 | | |
| | | | 27 | +1 | | | | .91 | | |
| | J-1 | 28 | 28 | −2 | | | | 0.66 | | |
| | J-2 | | | −2 | | | | .95 | | |
| | J-1 | | 29 | +2 | | | | 0.68 | | |
| | J-2 | | | +2 | | | | 1.00 | | |
| | J-2 | 29 | 30 | −1 | | | | 0.91 | | |
| | J-1 | | | −1 | | | | .45 | | |
| | J-2 | | 31 | +2 | | | | 0.90 | | |
| | J-1 | | | +2 | | | | .43 | | |
| | J-1 | 30 | 32 | −3 | | | | 0.51 | | |
| | J-2 | | | −3 | | | | .96 | | |
| | J-1 | | 33 | +1 | | | | 0.57 | | |
| | J-2 | | | +1 | | | | .95 | | |
| | J-2 | 31 | 34 | −2 | | | | 0.86 | | |
| | J-1 | | | −2 | | | | .43 | | |
| | J-2 | | 35 | +1 | | | | 0.94 | | |
| | J-1 | | | +1 | | | | .46 | | |
| FAA Technical Center | C | 4 | 14 | −2 | | 0.90 | 0.86 | 0.97 | 0.96 | 0.98 |
| | | | 15 | +1 | | .80 | .82 | .88 | .94 | .93 |
| | D | 5 | 16 | −3 | | 0.88 | 0.87 | 0.87 | 0.91 | 0.89 |
| | | | 17 | +1 | | .93 | .90 | .91 | .91 | .88 |
| | B | 6 | 18 | −3 | | | | 0.55 | | |
| | | | 19 | +1 | | | | .67 | | |
| | | 7 | 20 | −2 | | | | 0.40 | | |
| | | | 21 | +1 | | | | .49 | | |
| | | 8 | 22 | −4 | | | | 0.46 | | |
| | | | 23 | +1 | | | | .46 | | |
| | | 9 | 24 | −5 | | | | 0.34 | | |
| | | | 25 | +1 | | | | .41 | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

Table AV. Supplemental Ground-Vehicle Friction Data Obtained on Wet-Runway Test Surfaces

(a) Diagonal-braked vehicle

| Date | Test site | Run | Test surface | | Average friction coefficient at test speed, mph, of— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Type | Wetness condition | 10 | 20 | 30 | 40 | 50 | 60 |
| 6-14-83 | Wallops Flight Facility | 1 | SSA | Wet | 0.71 | 0.52 | 0.49 | 0.39 | 0.31 | 0.24 |
| | | 2 | | Wet | .69 | .49 | .39 | .31 | .27 | .24 |
| | | 3 | | Wet | .71 | .52 | .42 | .32 | .29 | .27 |
| | | 4 | | Damp | .74 | .62 | .49 | .44 | .37 | |
| | | 5 | | Damp | .74 | .55 | .49 | .42 | .39 | .37 |
| | | 6 | | Damp | .74 | .59 | .52 | .44 | .42 | |
| 6-20-83 | | 41 | | Rain | .86 | .70 | .61 | .51 | .41 | .29 |
| 6-20-83 | | 42 | | Rain | .86 | .77 | .60 | .56 | .53 | .44 |
| 6-20-83 | | 43 | | Rain | .84 | .70 | .61 | .56 | .51 | .44 |
| 6-14-83 | Wallops Flight Facility | 7 | A | Wet | 0.56 | 0.53 | 0.51 | | | |
| | | 8 | B, C | | | | | 0.46 | 0.53 | 0.61 |
| | | 8 | A | | .56 | .41 | .28 | | | |
| | | 9 | A | | | | .51 | .46 | .41 | |
| | | 9 | B, C | | .63 | .58 | | | | |
| | | 10 | B, C | | | | | .56 | .53 | .43 |
| | | 10 | A | | .53 | .36 | .24 | | | |
| 6-20-83 | | 40 | | | | | | .19 | .15 | .12 |
| 6-30-83 | | 104 | | | | | | .18 | | |
| | | 106 | | | .73 | .34 | .29 | | | |
| | | 108 | | | | .39 | .29 | | | |
| | | 110 | | | .69 | .51 | .24 | | | |
| | | 112 | | | .56 | .46 | | | | |
| | | 113 | | | | | | .19 | | |
| | | 114 | | | | | | | .12 | |
| | | 115 | | | | | | | | .10 |
| 6-16-83 | | 13 | J-1 | | | | | | .36 | .24 |
| | | 13 | J-2 | | 1.08 | .87 | .70 | .56 | | |
| | | 14 | J-2 | | | | | .53 | .44 | .36 |
| | | 14 | J-1 | | .75 | .58 | .53 | | | |
| | | 15 | J-1 | | | | | | .24 | .12 |
| | | 15 | J-2 | | 1.04 | .87 | .67 | .53 | | |
| | | 16 | J-2 | | | | | | .36 | .30 |
| | | 16 | J-1 | | .70 | .51 | .41 | .41 | | |
| | | 17 | J-1 | | | | | .41 | .28 | .18 |
| | | 17 | J-2 | | 1.08 | .90 | .67 | | | |
| | | 18 | J-2 | | | | | | .36 | .24 |
| | | 18 | J-1 | | .61 | .49 | .34 | .36 | | |
| | | 19 | J-1 | | | | | | .24 | .15 |
| | | 19 | J-2 | | .95 | .75 | .61 | .53 | | |
| | | 20 | J-2 | | | | | | .36 | .24 |
| | | 20 | J-1 | | .66 | .46 | .41 | .36 | | |
| | | 21 | J-1 | | | | | | .17 | .12 |
| | | 21 | J-2 | | .92 | .73 | .58 | .53 | | |
| | | 22 | J-2 | | | | | | .49 | .36 |
| | | 22 | J-1 | | .70 | .57 | .49 | .46 | | |

Table AV. Continued

(a) Concluded

| | | | Test surface | | Average friction coefficient at test speed, mph, of— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Test site | Run | Type | Wetness condition | 10 | 20 | 30 | 40 | 50 | 60 |
| 6-22-83 | Wallops Flight Facility | 60 | J-1 | Wet | | | | | | 0.17 |
| | | 61 | J-2 | | | | | | | .22 |
| | | 62 | J-1 | | | | | | | .15 |
| | | 63 | J-2 | | 0.94 | 0.78 | 0.70 | 0.61 | | |
| 6-23-83 | FAA Technical Center | 66 | B | Wet | 0.78 | 0.60 | 0.34 | | | |
| | | 67 | | | | .55 | .43 | 0.31 | | |
| | | 68 | | | | | | | 0.15 | |
| | | 69 | | | | | | | | 0.12 |
| | | 70 | | | | | | | .18 | |
| | | 71 | | | | | | .15 | | |
| | | 72 | | | | .29 | .39 | .22 | | |
| | | 73 | | | | .54 | .41 | .31 | | |
| | | 74 | | | .86 | .77 | .65 | .39 | .31 | .25 |
| | | 75 | | | .88 | .74 | .51 | .47 | .39 | .18 |
| | | 76 | | | .96 | .76 | .66 | .55 | .25 | .18 |
| | | 64 | C | | .76 | .70 | .66 | .61 | .58 | .47 |
| | | 65 | D | | .76 | .66 | .61 | .59 | .54 | .49 |
| 8-11-83 | Wallops Flight Facility | 4 | A | Flooded | 0.45 | 0.38 | 0.29 | 0.24 | | |
| | | 10 | A | Flooded | | | | .20 | 0.15 | 0.06 |

Table AV. Continued

(b) Mu-Meter

| Date | Test site | Run | Test surface | | Average friction coefficient at test speed, mph, of— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Type | Wetness condition | 10 | 20 | 30 | 40 | 50 | 60 |
| 6-14-83 | Wallops Flight Facility | 1 | SSA | Wet | | 0.80 | 0.78 | 0.74 | 0.74 | |
| | | 2 | | Wet | | .82 | .78 | .74 | .70 | |
| | | 3 | | Wet | | .83 | .76 | .74 | .70 | 0.55 |
| | | 4 | | Damp | | .79 | .75 | .80 | .80 | .75 |
| | | 5 | | Damp | | .83 | .77 | .77 | .82 | .74 |
| | | 6 | | Damp | | .81 | .76 | .81 | .80 | .76 |
| 6-21-83 | | 75 | | Rain | | .84 | .86 | .88 | .83 | |
| | | 76 | | Rain | | .83 | .84 | .86 | .86 | |
| | | 77 | | Rain | | .83 | .83 | .86 | .85 | |
| | | 81 | | Wet | | .86 | .84 | .74 | .68 | .54 |
| | | 82 | | | | .86 | .86 | .84 | .80 | .70 |
| | | 83 | | | | .86 | .78 | .73 | .75 | .60 |
| | | 84 | | | | .86 | .85 | .83 | .82 | |
| 6-14-83 | Wallops Flight Facility | 12 | A | Wet | | 0.73 | | | | |
| | | 12 | B, C | | | .75 | | | | |
| | | 13 | A | | | .72 | | | | |
| | | 13 | B, C | | | .75 | | | | |
| | | 14 | B, C | | | .82 | | | | |
| | | 14 | A | | | .79 | | | | |
| | | 15 | A | | | | 0.54 | | | |
| | | 15 | B, C | | | | .76 | | | |
| | | 16 | B, C | | | | .80 | | | |
| | | 16 | A | | | | .68 | | | |
| 6-16-83 | | 34 | A | | | | | 0.46 | | |
| | | 34 | B, C | | | | | .75 | | |
| | | 35 | B, C | | | | | .84 | | |
| | | 35 | A | | | | | .54 | | |
| | | 36 | A | | | | | | 0.44 | |
| | | 36 | B, C | | | | | | .81 | |
| | | 37 | B, C | | | | | | .80 | |
| | | 37 | A | | | | | | .50 | |
| | | 38 | A | | | | | | | 0.30 |
| | | 38 | B, C | | | | | | | .80 |
| | | 39 | A | | | | | | | .79 |
| | | 39 | B, C | | | | | | | .48 |
| 6-20-83 | | 70 | A | | | .70 | | | | |
| | | 70 | B, C | | | .77 | | | | |
| | | 71 | B, C | | | | .83 | | | |
| | | 71 | A | | | | .66 | | | |
| | | 72 | A | | | | | .25 | | |
| | | 72 | B, C | | | | | .76 | | |
| | | 73 | B, C | | | | | | .84 | |
| | | 73 | A | | | | | | .25 | |
| | | 74 | A | | | | | | | .07 |
| | | 74 | B, C | | | | | | | .60 |

Table AV. Continued

(b) Continued

| | | | Test surface | | Average friction coefficient at test speed, mph, of— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Test site | Run | Type | Wetness condition | 10 | 20 | 30 | 40 | 50 | 60 |
| 6-30-83 | Wallops Flight Facility | 116 | A | Wet | | 0.82 | | | | |
| | | 116 | B, C | | | .81 | | | | |
| | | 117 | B, C | | | | 0.85 | | | |
| | | 117 | A | | | | .58 | | | |
| | | 118 | A | | | | | 0.39 | | |
| | | 118 | B, C | | | | | .83 | | |
| | | 119 | B, C | | | | | | 0.83 | |
| | | 119 | A | | | | | | .24 | |
| | | 120 | A | | | | | | | 0.17 |
| | | 120 | B, C | | | | | | | .78 |
| | | [a]121 | A | | | .88 | | | | |
| | | [a]121 | B, C | | | .88 | | | | |
| | | [a]122 | B, C | | | | .89 | | | |
| | | [a]122 | A | | | | .66 | | | |
| | | [a]123 | A | | | | | .48 | | |
| | | [a]123 | B, C | | | | | .86 | | |
| | | [a]124 | B, C | | | | | | .89 | |
| | | [a]124 | A | | | | | | .30 | |
| | | [a]125 | A | | | | | | | .28 |
| | | [a]125 | B, C | | | | | | | .83 |
| | | [a]126 | B, C | | | | | | | .84 |
| | | [a]126 | A | | | | | | | .21 |
| 6-16-83 | | 24 | J-1 | | | .75 | | | | |
| | | 24 | J-2 | | | .88 | | | | |
| | | 25 | J-2 | | | .89 | | | | |
| | | 25 | J-1 | | | .75 | | | | |
| | | 26 | J-1 | | | | .66 | | | |
| | | 26 | J-2 | | | | .89 | | | |
| | | 27 | J-2 | | | | .92 | | | |
| | | 27 | J-1 | | | | .68 | | | |
| | | 28 | J-1 | | | | | .52 | | |
| | | 28 | J-2 | | | | | .90 | | |
| | | 29 | J-2 | | | | | .91 | | |
| | | 29 | J-1 | | | | | .50 | | |
| | | 30 | J-1 | | | | | | .34 | |
| | | 30 | J-2 | | | | | | .83 | |
| | | 31 | J-2 | | | | | | .84 | |
| | | 31 | J-1 | | | | | | .46 | |
| | | 32 | J-1 | | | | | | | .30 |
| | | 32 | J-2 | | | | | | | .86 |
| | | 33 | J-2 | | | | | | | .86 |
| | | 33 | J-1 | | | | | | | .34 |

[a] Tire inflation pressure = 30 lb/in$^2$.

Table AV. Continued

(b) Concluded

| Date | Test site | Run | Test surface |  | Average friction coefficient at test speed, mph, of— |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Type | Wetness condition | 10 | 20 | 30 | 40 | 50 | 60 |
| 6-22-83 | Wallops Flight Facility | 100 | J-1 | Wet |  | 0.76 |  |  |  |  |
| ↓ | ↓ | 100 | J-2 | ↓ |  | .90 |  |  |  |  |
|  |  | 101 | J-2 |  |  |  | 0.87 |  |  |  |
|  |  | 101 | J-1 |  |  |  | .64 |  |  |  |
|  |  | 102 | J-1 |  |  |  |  |  | 0.32 |  |
|  |  | 102 | J-2 |  |  |  |  |  | .87 |  |
|  |  | 103 | J-2 |  |  |  |  |  |  | 0.75 |
|  |  | 103 | J-1 |  |  |  |  |  |  | .10 |
| 6-23-83 | FAA Technical Center | 1 | B | Wet |  | 0.77 |  |  |  |  |
| ↓ | ↓ | 1 | C | ↓ |  | .80 |  |  |  |  |
|  |  | 1 | D |  |  | .80 |  |  |  |  |
|  |  | 2 | D |  |  | .81 |  |  |  |  |
|  |  | 2 | C |  |  | .80 |  |  |  |  |
|  |  | 2 | B |  |  | .78 |  |  |  |  |
|  |  | 3 | B |  |  |  | 0.64 |  |  |  |
|  |  | 3 | C |  |  |  | .80 |  |  |  |
|  |  | 3 | D |  |  |  | .80 |  |  |  |
|  |  | 4 | D |  |  |  | .81 |  |  |  |
|  |  | 4 | C |  |  |  | .81 |  |  |  |
|  |  | 4 | B |  |  |  | .70 |  |  |  |
|  |  | 5 | B |  |  |  |  | 0.40 |  |  |
|  |  | 5 | C |  |  |  |  | .80 |  |  |
|  |  | 5 | D |  |  |  |  | .80 |  |  |
|  |  | 6 | D |  |  |  |  | .82 |  |  |
|  |  | 6 | C |  |  |  |  | .80 |  |  |
|  |  | 6 | B |  |  |  |  | .58 |  |  |
|  |  | 7 | B |  |  |  |  |  | 0.26 |  |
|  |  | 7 | C |  |  |  |  |  | .80 |  |
|  |  | 7 | D |  |  |  |  |  | .82 |  |
|  |  | 8 | D |  |  |  |  |  | .82 |  |
|  |  | 8 | C |  |  |  |  |  | .80 |  |
|  |  | 8 | B |  |  |  |  |  | .30 |  |
|  |  | 9 | B |  |  |  |  |  |  | 0.15 |
|  |  | 9 | C |  |  |  |  |  |  | .80 |
|  |  | 9 | D |  |  |  |  |  |  | .82 |
|  |  | 11 | B |  |  | .77 |  |  |  |  |
|  |  | 12 | B |  |  |  |  | .47 |  |  |
|  |  | 13 | B |  |  |  |  |  |  | .24 |
| 8-11-83 | Wallops Flight Facility | 1 | A | Flooded |  | 0.65 |  |  |  |  |
| ↓ |  | 2 | A | ↓ |  |  | 0.32 |  |  |  |
|  |  | 3 | A |  |  |  |  | 0.13 |  |  |
|  |  | 4 | A |  |  |  |  |  | 0.05 |  |

Table AV. Continued

(c) Surface friction tester

| | | | Test surface | | Average friction coefficient at test speed, mph, of— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Test site | Run | Type | Wetness condition | 10 | 20 | 30 | 40 | 50 | 60 |
| 6-20-83 | Wallops Flight Facility | 12 | SSA | Rain | | 0.98 | 0.97 | 0.96 | 0.90 | 0.80 |
| | | 13 | SSA | Rain | | .98 | .92 | .90 | .87 | .70 |
| | | 14 | SSA | Rain | | .92 | .88 | .86 | .78 | .65 |
| | | 7 | A | Wet | | .72 | | | | |
| | | 7 | B, C | | | .88 | | | | |
| | | 8 | B, C | | | | .94 | | | |
| | | 8 | A | | | | .59 | | | |
| | | 9 | A | | | | | .29 | | |
| | | 9 | B, C | | | | | .83 | | |
| | | 10 | B, C | | | | | | .89 | |
| | | 10 | A | | | | | | .30 | |
| | | 11 | A | | | | | | | .07 |
| | | 11 | B, C | | | | | | | .62 |
| 6-22-83 | Wallops Flight Facility | 36 | J-1 | Wet | | 0.83 | | | | |
| | | 36 | J-2 | | | .97 | | | | |
| | | 37 | J-2 | | | | 0.95 | | | |
| | | 37 | J-1 | | | | .75 | | | |
| | | 38 | J-1 | | | | | | 0.55 | |
| | | 38 | J-2 | | | | | | .83 | |
| | | 39 | J-2 | | | | | | | 0.63 |
| | | 39 | J-1 | | | | | | | .30 |
| 6-23-83 | FAA Technical Center | 1 | B | Wet | | 0.78 | | | | |
| | | 1 | C | | | .95 | | | | |
| | | 1 | D | | | .93 | | | | |
| | | 2 | D | | | .93 | | | | |
| | | 2 | C | | | .96 | | | | |
| | | 2 | B | | | .82 | | | | |
| | | 3 | B | | | | 0.60 | | | |
| | | 3 | C | | | | .93 | | | |
| | | 3 | D | | | | .90 | | | |
| | | 4 | D | | | | .91 | | | |
| | | 4 | C | | | | .93 | | | |
| | | 4 | B | | | | .65 | | | |
| | | 5 | B | | | | | 0.45 | | |
| | | 5 | C | | | | | .92 | | |
| | | 5 | D | | | | | .89 | | |
| | | 6 | D | | | | | .93 | | |
| | | 6 | C | | | | | .93 | | |
| | | 6 | B | | | | | .50 | | |
| | | 7 | B | | | | | | 0.20 | |

Table AV. Continued

(c) Concluded

| Date | Test site | Run | Test surface |  | Average friction coefficient at test speed, mph, of— |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Type | Wetness condition | 10 | 20 | 30 | 40 | 50 | 60 |
| 6-23-83 | FAA | 7 | C | Wet |  |  |  |  | 0.90 |  |
| ↓ | Technical | 7 | D | ↓ |  |  |  |  | .88 |  |
| ↓ | Center | 8 | D | ↓ |  |  |  |  | .90 |  |
| ↓ | ↓ | 8 | C | ↓ |  |  |  |  | .91 |  |
| ↓ | ↓ | 8 | B | ↓ |  |  |  |  | .30 |  |
| ↓ | ↓ | 9 | B | ↓ |  |  |  |  |  | 0.22 |
| ↓ | ↓ | 9 | C | ↓ |  |  |  |  |  | .88 |
| ↓ | ↓ | 9 | D | ↓ |  |  |  |  |  | .86 |
| ↓ | ↓ | 10 | D | ↓ |  |  |  |  |  | .87 |
| ↓ | ↓ | 10 | C | ↓ |  |  |  |  |  | .88 |
| ↓ | ↓ | 10 | B | ↓ |  |  |  |  |  | .26 |
| ↓ | ↓ | 11 | ↓ | ↓ |  | 0.85 |  |  |  |  |
| ↓ | ↓ | 12 | ↓ | ↓ |  |  |  | 0.55 |  |  |
| ↓ | ↓ | 13 | ↓ | ↓ |  |  |  |  |  | .35 |
| 8-11-83 | Wallops | 1 | A | Flooded |  | 0.80 |  |  |  |  |
| ↓ | Flight | 2 | ↓ | ↓ |  |  | 0.60 |  |  |  |
| ↓ | Facility | 4 | ↓ | ↓ |  |  |  | 0.30 |  |  |
| ↓ | ↓ | 5 | ↓ | ↓ |  |  |  |  | 0.12 |  |
| ↓ | ↓ | 6 | ↓ | ↓ |  |  |  |  |  | 0.02 |
| ↓ | ↓ | 7 | ↓ | ↓ |  |  |  |  |  | .04 |

Table AV. Continued

(d) BV-11 skiddometer

| Date | Test site | Run | Test surface |  | Average friction coefficient at test speed, mph, of— |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Type | Wetness condition | 10 | 20 | 30 | 40 | 50 | 60 |
| 6-20-83 | Wallops Flight Facility | 14 | SSA | Rain |  | 0.95 | 0.97 | 1.03 | 0.96 | 0.95 |
|  |  | 15 | SSA | Rain |  | .95 | .93 | 1.04 | .99 | .83 |
|  |  | 16 | SSA | Rain |  | .90 | .91 | .95 | .97 | .75 |
|  |  | 9 | A | Wet |  | .83 |  |  |  |  |
|  |  | 9 | B, C |  |  | 1.01 |  |  |  |  |
|  |  | 10 | B, C |  |  |  | 1.00 |  |  |  |
|  |  | 10 | A |  |  |  | .65 |  |  |  |
|  |  | 11 | A |  |  |  |  | .33 |  |  |
|  |  | 11 | B, C |  |  |  |  | .86 |  |  |
|  |  | 12 | B, C |  |  |  |  |  | .92 |  |
|  |  | 12 | A |  |  |  |  |  | .27 |  |
|  |  | 13 | A |  |  |  |  |  |  | .18 |
| ↓ | ↓ | 13 | B, C | ↓ |  |  |  |  |  | .60 |
| 6-22-83 | FAA Technical Center | 39 | J-1 | Wet |  | 0.82 |  |  |  |  |
|  |  | 39 | J-2 |  |  | 1.05 |  |  |  |  |
|  |  | 40 | J-2 |  |  |  | 0.98 |  |  |  |
|  |  | 40 | J-1 |  |  |  | .65 |  |  |  |
|  |  | 41 | J-1 |  |  |  |  |  | 0.36 |  |
|  |  | 41 | J-2 |  |  |  |  |  | .83 |  |
|  |  | 42 | J-2 |  |  |  |  |  |  | 0.69 |
| ↓ | ↓ | 42 | J-1 | ↓ |  |  |  |  |  | .30 |
| 6-23-83 | FAA Technical Center | 1 | B | Wet |  | 0.85 |  |  |  |  |
|  |  | 1 | C |  |  | 1.00 |  |  |  |  |
|  |  | 1 | D |  |  | .99 |  |  |  |  |
|  |  | 2 | D |  |  | .97 |  |  |  |  |
|  |  | 2 | C |  |  | .99 |  |  |  |  |
|  |  | 2 | B |  |  | .85 |  |  |  |  |
|  |  | 3 | B |  |  |  | 0.58 |  |  |  |
|  |  | 3 | C |  |  |  | .95 |  |  |  |
|  |  | 3 | D |  |  |  | .94 |  |  |  |
|  |  | 4 | D |  |  |  | .92 |  |  |  |
|  |  | 4 | C |  |  |  | .95 |  |  |  |
|  |  | 4 | B |  |  |  | .63 |  |  |  |
|  |  | 5 | B |  |  |  |  | 0.29 |  |  |
|  |  | 5 | C |  |  |  |  | .93 |  |  |
|  |  | 5 | D |  |  |  |  | .94 |  |  |
|  |  | 6 | D |  |  |  |  | .93 |  |  |
|  |  | 6 | C |  |  |  |  | .96 |  |  |
|  |  | 6 | B |  |  |  |  | .36 |  |  |
|  |  | 7 | B |  |  |  |  |  | 0.15 |  |
|  |  | 7 | C |  |  |  |  |  | .92 |  |
| ↓ | ↓ | 7 | D | ↓ |  |  |  |  | .90 |  |

Table AV. Concluded

(d) Concluded

| Date | Test site | Run | Test surface |  | Average friction coefficient at test speed, mph, of— |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Type | Wetness condition | 10 | 20 | 30 | 40 | 50 | 60 |
| 6-23-83 | FAA Technical Center | 8 | D | Wet |  |  |  |  | 0.90 |  |
|  |  | 8 | C |  |  |  |  |  | .91 |  |
|  |  | 8 | B |  |  |  |  |  | .17 |  |
|  |  | 9 | B |  |  |  |  |  |  | 0.06 |
|  |  | 9 | C |  |  |  |  |  |  | .88 |
|  |  | 9 | D |  |  |  |  |  |  | .89 |
|  |  | 10 | D |  |  |  |  |  |  | .89 |
|  |  | 10 | C |  |  |  |  |  |  | .92 |
|  |  | 10 | B |  |  |  |  |  |  | .16 |
|  |  | 11 |  |  |  | 0.88 |  |  |  |  |
|  |  | 12 |  |  |  |  |  | 0.52 |  |  |
|  |  | 13 |  |  |  |  |  |  |  | .16 |
| 8-11-83 | Wallops Flight Facility | 1 | A | Flooded |  |  |  | 0.34 |  |  |
|  |  | 2 |  |  |  |  |  |  | 0.07 |  |
|  |  | 3 |  |  |  |  |  |  |  | 0.01 |
|  |  | 4 |  |  |  |  |  | .36 |  |  |

Table AVI. Ground-Vehicle Friction Data Obtained During Boeing 737 Tests at BNAS, March 1985

| Surface condition | Run | Flt | Ambient temperature, °F | Speed, mph | Average friction coefficient for— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Mu-Meter | RCR | Tapley | BV-11 | SFT | RFT |
| Loose, dry snow, 6 in. | 2 to 5 | 430 | 23 | 20 | Not usable | 18 | 0.57 | Not usable | Not available | Not available |
| | | | | 30 | | 10 | .33 | | | |
| | | | | 40 | ↓ | 7 | .21 | ↓ | ↓ | ↓ |
| | | | | 50 | ↓ | 2 | .06 | ↓ | ↓ | ↓ |
| | | | | 60 | ↓ | 0 | 0 | ↓ | ↓ | ↓ |
| Loose, dry snow, 3 in. | 3 to 5 | 431 | 30 | 20 | Not usable | 16 | 0.51 | Not usable | Not available | Not available |
| | | | | 30 | | 23 | .72 | | | |
| | | | | 40 | ↓ | 14 | .45 | ↓ | ↓ | ↓ |
| | | | | 50 | ↓ | 26 | .84 | ↓ | ↓ | ↓ |
| | | | | 60 | ↓ | 30 | .96 | ↓ | ↓ | ↓ |
| New, wet snow, 1.5 in. | 2, 3 | 432 | 38 | 20 | 0.11 | 16 | 0.51 | 0.19 | Not available | Not available |
| | | | | 40 | .04 | 23 | .75 | .19 | | |
| Wet | None | None | 41 | 20 | 0.80 | | | 0.82 | Not available | Not available |
| | | | | 25 | | 22 | 0.69 | | | |
| | | | | 40 | .75 | | | .84 | ↓ | ↓ |
| | | | | 60 | .65 | | | .84 | ↓ | ↓ |
| 1-in. slush | 2R2,<br>3R2,<br>3R3 | 432 | 41 | 20 | | 28 | 0.90 | | Not available | Not available |
| | | | | 40 | | 22 | .69 | | | |
| Glare ice | 2 to 5 | 433 | 30 | 20 | 0.18 | 0 | 0 | 0.21 | Not available | Not available |
| | | | | 30 | .17 | ↓ | ↓ | .17 | | |
| | | | | 40 | .17 | ↓ | ↓ | .17 | ↓ | ↓ |
| | | | | 50 | .16 | ↓ | ↓ | .15 | ↓ | ↓ |

Table AVII. Empirical Runway Condition Factors for Boeing 737 Data

| Wetness condition | Type or amount of wetness | Factor |
|---|---|---|
| Dry | None | 0 |
| Ice | 0.25 in. | 0.05 |
| Wet | Rain | 0.05 |
| Wet | Truck | .05 |
| Slush | ≤1 in. | 1.2 |
| Snow | 1.5 in., wet | 1.5 |
| | 1 to 3 in., wet | 2.5 |
| | 1 to 3 in., dry | 3.0 |
| | 4 in., wet | 4.5 |
| | 4.5 in., wet | 5.0 |
| ↓ | 6 in., loose | 3.5 |

C - 2

Table AVIII. Aerodynamic and Geometric Data for Boeing 737 Brake Performance Data Reduction

| Symbol | Description | Value |
|---|---|---|
| $S$ | Aerodynamic reference area | 980 $\text{ft}^2$ |
| $C_L$ | Lift coefficient, flaps 40°, spoilers up | 0.242 |
| $C_D$ | Drag coefficient, flaps 40°, spoilers up | 0.285 |
| $T_o$ | Idle thrust at Velocity = 0 | 2800 lb |
| $DT/DV$ | Gradient of thrust versus velocity | −8 lb/knot |
| $MUR$ | Rolling resistance coefficient | 0.015 |
| $CBAR$ | Reference mean aerodynamic chord | 134.46 in. |
| $(WL)_{cg}$ | Center-of-gravity water line | 206 in. |
| $(WL)_g$ | Ground water line | 106 in. |
| $(WL)_t$ | Thrust-application water line | 156 in. |
| $(BS)_{ng}$ | Nose-gear balance station | 286 in. |
| $(BS)_{mg}$ | Main-gear balance station | 698 in. |
| $C_m$ | Pitching-moment coefficient | 0.305 |
| $W$ | Weight (varies with condition) | ≈80 000 lb |
| $(BS)_{cg}$ | Center-of-gravity balance station (varies) | ≈650 lb |
| $(BS)_{0.25c}$ | Quarter-chord balance station | 659.22 in. |
| $K$ | Average percent of gross weight carried by main gear | 89 |

# Appendix B

## Compilation of Boeing 727 Aircraft and Ground-Vehicle Test Data

The chronological test-run sequence for the 727 aircraft and the different ground vehicles is given in table BI for each test site. Test-runway surface conditions, temperature, and wind readings are also listed. Table BII provides a compilation by test site and run number of the 727 aircraft braking friction data. In this table, the aircraft gross weight, c.g. station, test-surface type and wetness condition, type of braking, and ground speed are given. The ground-vehicle friction data obtained on dry-runway test surfaces is listed by test site, surface type, and vehicle type in table BIII. Table BIV contains the ground-vehicle friction data obtained during wet-runway 727 aircraft braking test runs. The data are listed by vehicle type and test-surface type, with the aircraft test-run number and the elapsed time relative to the aircraft test run given for each ground-vehicle run. The average ground-vehicle friction coefficient values are listed in 10-mph increments up to 60 mph. Some supplemental ground-vehicle test runs were conducted on wet runway test surfaces without the test aircraft. These data are compiled in table BV by test-vehicle type, date, test site, and test-surface type and wetness condition. The ground-vehicle friction measurements obtained during 727 aircraft tests at BNAS and Pease AFB in March 1985 and January to March 1986 are listed in table BVI by surface condition. The appropriate aircraft flight and run numbers and the ambient temperatures are also given. The empirical runway condition factors used for 727 aircraft data reduction are given in table BVII. The aerodynamic and geometric data for the 727 test aircraft are listed in table BVIII for use with aircraft equations of balance.

Table BI. Boeing 727 Aircraft and Ground-Vehicle Test-Run Sequence Data

(a) Wallops Flight Facility

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-22-85 | DBV | 16 | 1825 | 10 | SSA | Rain wet | 42 |  | 070 | 20 |
|  | 727 | 4A | 1828 |  |  |  |  |  |  |  |
|  | DBV | 17 | 1831 |  |  |  |  |  |  |  |
|  | DBV | 18 | 1834 |  |  |  |  |  |  |  |
|  | 727 | 4B | 1835 | ↓ | ↓ | ↓ |  |  | 060 | 18 |
|  | DBV | 19 | 1838 | 10 | SSA | Rain wet |  |  |  |  |
|  | 727 | 1 | 1844 |  |  |  |  |  | 070 | 74 |
|  | DBV | 20 | 1848 |  |  |  |  |  |  |  |
|  | 727 | 4C | 1850 |  |  |  |  |  | 060 | 18 |
|  | DBV | 21 | 1853 | ↓ | ↓ | ↓ |  |  |  |  |
|  | DBV | 22 | 1857 | 10 | SSA | Rain wet |  |  |  |  |
|  | 727 | 5 | 1902 | 10 | SSA | Rain wet | 43 |  |  | 20 |
|  | DBV | 23 | 1904 | 10 | SSA | Rain wet |  |  |  |  |
|  | DBV | 24 | 1910 | 22 | A, B | Rain wet |  |  |  |  |
|  | DBV | 25 | 1913 | 04 | A |  |  |  |  |  |
|  | DBV | 26 | 1916 | 04 | B, A |  |  |  |  |  |
|  | 727 | 6 | 1917 | 22 | A, B |  |  |  |  | 16 |
|  | DBV | 27 | 1919 | 22 | A, B | ↓ |  |  |  |  |
|  | DBV | 28 | 1923 | 04 | B, A | Rain wet |  |  |  |  |
|  | 727 | 7 | 1926 |  | B, A |  |  |  | 070 | 18 |
|  | DBV | 29 | 1930 |  | A |  |  |  |  |  |
| ↓ | DBV | 30 | 1932 | ↓ | B | ↓ |  |  |  |  |
| 4-18-85 | Mu-M | 1 | 2040 | 10 | SSA | Wet | 60 |  | 270 | 25 |
|  | BV-11 | 1 | 2041 |  |  |  |  |  |  |  |
|  | SFT | 1 | 2042 |  |  |  |  |  |  |  |
|  | DBV | 1 | 2044 |  |  |  |  |  |  |  |
|  | 727 | 1 | 2048 |  |  |  |  |  |  |  |
|  | Mu-M | 2 | 2049 |  |  |  |  |  |  |  |
|  | BV-11 | 2 | 2050 |  |  |  |  |  |  |  |
|  | SFT | 2 | 2051 |  |  |  |  |  |  |  |
| ↓ | DBV | 2 | 2052 | ↓ | ↓ | ↓ |  |  |  |  |
| 8-12-85 | 727 | 9 | 1434 | 10 | SSA | Dry | 87 |  | 050 | 8 |
|  | 727 | 10 | 1445 |  |  | Dry | 83 |  | 070 | 6 |
|  | 727 | 11 | 1459 |  |  | Dry |  |  | 090 | 10 |
|  | Mu-M | 1 | 1533 |  |  | Wet |  |  | 080 |  |
|  | BV-11 |  | 1533 |  |  |  |  |  |  |  |
|  | SFT |  | 1534 |  |  |  |  |  |  |  |
|  | RFT |  | 1534 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1534 |  |  |  |  |  |  |  |
| ↓ | 727 | 12 | 1536 | ↓ | ↓ | ↓ |  |  |  |  |

Table BI. Continued

(a) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 8-12-85 | Mu-M | 2 | 1538 | 10 | SSA | Wet |  |  | 080 |  |
|  | BV-11 |  | 1538 |  |  |  |  |  |  |  |
|  | SFT |  | 1538 |  |  |  |  |  |  |  |
|  | RFT |  | 1538 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1539 | ↓ | ↓ | ↓ |  |  |  |  |
|  | Mu-M | 3 | 1551 | 10 | SSA | Wet | 81 |  | 110 | 8 |
|  | BV-11 |  | 1551 |  |  |  |  |  |  |  |
|  | SFT |  | 1552 |  |  |  |  |  |  |  |
|  | RFT |  | 1552 |  |  |  |  |  |  |  |
|  | DBV | ↓ | 1552 |  |  |  |  |  |  |  |
|  | 727 | 13 | 1555 |  |  |  |  |  |  |  |
|  | Mu-M | 4 | 1557 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1557 |  |  |  |  |  |  |  |
|  | SFT |  | 1558 |  |  |  |  |  |  |  |
|  | RFT |  | 1558 |  |  |  |  |  |  |  |
| ↓ | DBV | ↓ | 1558 | ↓ | ↓ | ↓ |  |  |  |  |
| 8-13-85 | 727 | 1 | 0930 | 22 | A | Dry | 76 |  | 150 | 6 |
|  |  | 2 | 0949 | 04 | I |  | 79 |  | 150 | 4 |
|  |  | 3 | 1003 | 22 | B, C |  | 81 |  | 140 | 4 |
|  |  | R3 | 1026 | 22 | B, C |  | 81 |  | 150 | 6 |
|  |  | 4 | 1039 | 04 | H |  | 80 |  | 190 | 8 |
|  |  | 5 | 1052 | 22 | A, B |  | 80 |  | 170 | 8 |
|  |  | 6 | 1100 | 04 | B, A |  | 81 |  | 180 | 6 |
|  |  | 7 | 1107 | 22 | A, B |  |  |  | 190 | 6 |
|  |  | 8 | 1118 | 04 | B, A |  |  |  | 170 | 8 |
|  | ↓ | 20 | 1128 | 22 | A, B | ↓ |  |  |  | 4 |
|  | Mu-M | 8 | 1313 | 04 | B, A | Wet | 82 |  |  | 10 |
|  | BV-11 |  | 1313 |  |  |  |  |  |  |  |
|  | SFT |  | 1313 |  |  |  |  |  |  |  |
|  | RFT | ↓ | 1313 |  |  |  |  |  |  |  |
|  | DBV | 5 | 1315 |  |  |  |  |  |  |  |
|  | 727 | 15 | 1316 |  |  |  |  |  |  |  |
|  | Mu-M | 9 | 1317 |  |  |  |  |  |  |  |
|  | BV-11 |  | 1317 |  |  |  |  |  |  |  |
|  | SFT |  | 1318 |  |  |  |  |  |  |  |
|  | RFT | ↓ | 1318 | ↓ | ↓ | ↓ |  |  |  |  |
|  | Mu-M | 10 | 1330 | 04 | B, A | Wet | 82 |  | 180 | 8 |
|  | BV-11 | 10 | 1330 | 04 | B, A | Wet |  |  |  |  |
| ↓ | SFT | 10 | 1330 | 04 | B, A | Wet |  |  |  |  |

Table BI. Continued

(a) Concluded

| | | | | | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Type | Wetness | Ambient | Surface | Deg | Knots |
| 8-13-85 | RFT | 10 | 1330 | 04 | B, A | Wet | 82 | | 180 | 8 |
| | DBV | 7 | 1331 | | | | | | | |
| | 727 | 17 | 1332 | | | | | | | |
| | Mu-M | 11 | 1333 | | | | | | | |
| | BV-11 | | 1333 | | | | | | | |
| | SFT | | 1334 | | | | | | | |
| | RFT | | 1334 | | | | | | | |
| | DBV | 8 | 1134 | | | | | | | |
| | Mu-M | 12 | 1343 | 22 | A | Wet | | | | 12 |
| | BV-11 | | 1343 | | | | | | | |
| | SFT | | 1343 | | | | | | | |
| | RFT | | 1343 | | | | | | | |
| | DBV | 9 | 1343 | | | | | | | |
| | 727 | 18 | 1345 | | | | | | | |
| | Mu-M | 13 | 1347 | | | | | | | |
| | BV-11 | | 1347 | | | | | | | |
| | SFT | | 1347 | | | | | | | |
| | RFT | | 1347 | | | | | | | |
| | DBV | 10 | 1347 | | | | | | | |

Table BI. Continued

(b) FAA Technical Center

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 8-15-85 | Mu-M | 14 | 0738 | 13 | C | Wet | 80 | | 240 | 6 |
| | DBV | 11 | 0738 | | | | | | | |
| | 727 | 27 | 0740 | | | | | | | |
| | Mu-M | 15 | 0742 | | | | | | | |
| ↓ | DBV | 12 | 0742 | ↓ | ↓ | ↓ | | | | |
| 8-21-85 | Mu-M | 31 | 0723 | 13 | C | Wet | | | | |
| | SFT | 31 | 0724 | | | | | | | |
| | 727 | R27 | 0725 | | | | | | | |
| | Mu-M | 32 | 0726 | | | | | | | |
| | SFT | 32 | 0728 | ↓ | ↓ | ↓ | | | | |
| | Mu-M | 33 | 0735 | 31 | D | Wet | | | | 8 |
| | SFT | 33 | 0737 | | | | | | | |
| | 727 | 28 | 0738 | | | | | | | |
| | Mu-M | 34 | 0739 | | | | | | | |
| | SFT | 34 | 0740 | ↓ | ↓ | ↓ | | | | |
| | Mu-M | 35 | 0743 | 31 | D | Wet | | | 040 | 6 |
| | SFT | 35 | 0746 | | | | | | | |
| | 727 | R28 | 0751 | | | | | | | |
| | Mu-M | 36 | 0752 | | | | | | | |
| | SFT | 36 | 0752 | ↓ | ↓ | ↓ | | | | |
| | Mu-M | 37 | 0800 | 31 | B | Wet | | | | 9 |
| | BV-11 | 37 | 0800 | | | | | | | |
| | SFT | 37 | 0801 | | | | | | | |
| | 727 | 33 | 0809 | | | | | | | |
| | Mu-M | 38 | 0810 | | | | 70 | | 040 | 9 |
| | BV-11 | 38 | 0810 | | | | | | | |
| | SFT | 38 | 0811 | ↓ | ↓ | ↓ | | | | |
| | Mu-M | 39 | 0829 | 13 | B | Wet | | | 020 | 6 |
| | SFT | 39 | 0830 | | | | | | | |
| | 727 | 32 | 0831 | | | | | | | |
| | Mu-M | 40 | 0833 | | | | | | | |
| ↓ | SFT | 40 | 0834 | ↓ | ↓ | ↓ | | | | |

Table BI. Continued

(b) Concluded

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 8-21-85 | Mu-M | 41 | 0840 | 13 | B | Wet | | | 030 | 5 |
| | BV-11 | 41 | 0840 | | | | | | | |
| | SFT | 41 | 0840 | | | | | | | |
| | 727 | 31 | 0842 | | | | | | | |
| | Mu-M | 42 | 0843 | | | | | | | |
| | BV-11 | 42 | 0843 | | | | | | | |
| | SFT | 42 | 0844 | ↓ | ↓ | ↓ | | | | |
| | Mu-M | 43 | 0844 | 31 | B | Wet | | | 010 | 8 |
| | BV-11 | 43 | 0846 | | | | | | | |
| | SFT | 43 | 0846 | | | | | | | |
| | 727 | 30 | 0847 | | | | | | | |
| | BV-11 | 44 | 0848 | | | | | | | |
| | SFT | 44 | 0848 | | | | | | | |
| | Mu-M | 44 | 0849 | ↓ | | | | | | |
| | BV-11 | 45 | 0854 | 13 | | | 68 | | 040 | 8 |
| | Mu-M | 45 | 0855 | | | | | | | |
| | SFT | 45 | 0857 | | | | | | | |
| | 727 | 29 | 0858 | | | | | | | |
| | BV-11 | 46 | 0859 | | | | | | | |
| | Mu-M | 46 | 0859 | | | | | | | |
| ↓ | SFT | 46 | 0901 | ↓ | ↓ | ↓ | ↓ | | | |
| 8-22-85 | 727 | 21, 26 | 0858 | 13 | C | Dry | 64 | | 350 | 7 |
| | | 22, 26 | 0919 | 31 | D | | | | 330 | 9 |
| | | 23 | 0943 | 13 | C | | | | 020 | 10 |
| | | 24 | 0954 | 31 | D | | | | 360 | 7 |
| ↓ | ↓ | 25 | 1010 | 31 | D | ↓ | ↓ | | 360 | 10 |

Table BI. Continued

(c) Brunswick Naval Air Station

| | | | | | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-27-85 | Mu-M | 1 | 1052 | 190 | Asphalt | Slush | 33 | | 0 | |
| | Mu-M | 2 | 1054 | 010 | | | | | | |
| | Mu-M | 2A | 1057 | 010 | | | | | | |
| | BV-11 | 1 | 1059 | 190 | | | | | | |
| | BV-11 | 2 | 1101 | 010 | | | | | | |
| | 727 | [a]1 | 1102 | 190 | | | | | | |
| | Mu-M | 3 | 1104 | 190 | | | | | | |
| | BV-11 | 3 | 1105 | 190 | | | | | | |
| | Mu-M | [a]4 | 1106 | 010 | | | | | | |
| | BV-11 | 4 | 1107 | 010 | ↓ | ↓ | | | | |
| | 727 | 2 | 1109 | 010 | Asphalt | Slush | | | | |
| | Mu-M | 5 | 1111 | 190 | | | | | | |
| | BV-11 | 5 | 1112 | 190 | | | | | | |
| | Mu-M | 6 | 1116 | 010 | | | | | | |
| | BV-11 | 6 | 1118 | 010 | | | | | | |
| | Mu-M | 4A | 1120 | 010 | ↓ | ↓ | | | | |
| | 727 | [b]3 | 1121 | 010 | Asphalt | Dry | 34 | | | |
| | 727 | 4 | 1126 | 190 | | Damp | | | | |
| | Mu-M | 7 | 1128 | 190 | | | | | | |
| | BV-11 | 7 | 1129 | 190 | | | | | | |
| | Mu-M | 8 | 1131 | 010 | | | | | | |
| | BV-11 | 8 | 1132 | 010 | | | | | | |
| | Mu-M | 9 | 1134 | 190 | | | | | | |
| | BV-11 | 9 | 1135 | 190 | | | | | | |
| | 727 | [b]5 | 1136 | 010 | ↓ | ↓ | | | | |
| | Mu-M | 10 | 1137 | 010 | Asphalt | Damp | | | | |
| | BV-11 | 10 | 1138 | 010 | | | | | | |
| | 727 | 6 | 1146 | 190 | | | | | | |
| | Mu-M | 11 | 1147 | 190 | | | | | | |
| | BV-11 | 11 | 1148 | 190 | | | | | | |
| | Mu-M | 12 | 1149 | 010 | | | | | | |
| | BV-11 | 12 | 1150 | 010 | | | | | | |
| ↓ | 727 | 7 | 1154 | 190 | ↓ | ↓ | | | | |

[a] No data recorded.
[b] Inboard runway.

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-27-85 | Mu-M | 13 | 1535 | 010 | Asphalt | Wet, 0.01 in. | 44 |  | 240 | 4 |
| ↓ | BV-11 | 13 | 1536 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 14 | 1538 | 190 | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 14 | 1539 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | B-727 | 8 | 1542 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 15 | 1543 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 15 | 1544 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 16 | 1545 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 16 | 1546 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 17 | 1604 | 010 | Asphalt | Wet, 0.01 in. |  |  | 230 |  |
| ↓ | BV-11 | 17 | 1605 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | 727 | 9 | 1613 | 190 | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 18 | 1614 | 190 | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 18 | 1615 | 190 | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 19 | 1617 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 19 | 1618 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 20 | 1632 | 010 | Asphalt | Wet, 0.01 in. | 48 |  | 240 | 8 |
| ↓ | BV-11 | 20 | 1633 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | 727 | 8R1 | 1638 | 190 | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 21 | 1639 | 190 | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 21 | 1640 | 190 | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 22 | 1641 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 22 | 1642 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | 727 | 10 | 1655 | 190 | Asphalt | Damp |  |  | 250 | 6 |
| 3-28-85 | 727 | 11 | 1540 | 190 | Asphalt | Dry | 55 |  | 310 | 6 |
| ↓ | 727 | 12 | 1554 | 010 | Asphalt | Dry | 58 |  | 300 | 12 |
| ↓ | 727 | 13 | 1604 | 010 | Asphalt | Dry | 62 |  | 310 | 7 |
| 4-10-85 | [c]727 | 1 | 1602 | 070 | PCC | Dry | 40 |  | 270 | 6 |
|  | 727 | 2 | 1613 | 070 | PCC | Dry | 40 |  | 270 | 6 |
| 1-28-86 | 727 | 1 | 1523 | 010 | Asphalt | Wet snow, 1.5 in. | 31 | 16 | 340 | 4 |
| ↓ | 727 | 2 | 1536 | ↓ | ↓ | ↓ |  |  | 020 | 4 |
| ↓ | BV-11 | 1 | 1543 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | RFT | 1 | 1544 | ↓ | ↓ | ↓ |  |  |  |  |

[c] Langley Air Force Base.

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 1-28-86 | SFT | 1 | 1545 | 010 | Asphalt | Wet snow, 1.5 in. | 31 | 14 | 020 | 4 |
|  | RCR | 1 | 1546 |  |  |  |  |  |  |  |
|  | 727 | 3 | 1549 |  |  |  |  |  |  |  |
|  | BV-11 | 2 | 1552 |  |  |  |  |  |  |  |
|  | RFT | 2 | 1553 |  |  |  |  |  |  |  |
|  | SFT | 2 | 1555 |  |  |  |  |  |  |  |
|  | RCR | 2 | 1556 | ↓ | ↓ | ↓ |  |  |  |  |
|  | BV-11 | 3 | 1557 | 190 | Asphalt | Wet snow, 1.5 in. |  |  |  |  |
|  | RFT | 3 | 1558 |  |  |  |  |  |  |  |
|  | SFT | 3 | 1601 |  |  |  |  |  |  |  |
|  | 727 | 4 | 1604 |  |  |  | 28 | 12 | 340 | 8 |
|  | BV-11 | 4 | 1606 |  |  |  |  |  |  |  |
|  | RFT | 4 | 1608 |  |  |  |  |  |  |  |
|  | SFT | 4 | 1610 |  |  |  |  |  |  |  |
|  | RCR | 3 | 1610 | ↓ | ↓ | ↓ |  |  |  |  |
|  | BV-11 | 5 | 1611 | 010 | Asphalt | Wet snow, 1.5 in. |  |  |  |  |
|  | RFT | 5 | 1612 |  |  |  |  |  |  |  |
|  | SFT | 5 | 1613 |  |  |  |  |  |  |  |
|  | RCR | 4 | 1613 | ↓ |  |  |  |  |  |  |
|  | RCR | 5 | 1615 | 190 |  |  |  |  |  |  |
|  | RCR | 6 | 1617 | 010 |  |  |  |  |  |  |
|  | Mu-M | 1 | 1621 | 190 |  |  |  |  |  |  |
|  | RCR | 7 | 1629 | 010 |  |  |  |  |  |  |
|  | Mu-M | 2 | 1630 |  |  |  |  |  |  |  |
|  | BV-11 | 6 | 1630 |  |  |  |  |  |  |  |
|  | RFT | 6 | 1631 |  |  |  |  |  |  |  |
|  | SFT | 6 | 1632 |  |  |  |  |  |  |  |
|  | RCR | 8 | 1633 | ↓ | ↓ | ↓ |  |  |  |  |
|  | 727 | 3A | 1638 | 010 | Asphalt | Wet snow, 1.5 in. | 28 | 12 | 330 | 8 |
|  | Mu-M | 3 | 1639 |  |  |  |  |  |  |  |
|  | BV-11 | 7 | 1640 |  |  |  |  |  |  |  |
|  | RFT | 7 | 1641 |  |  |  |  |  |  |  |
|  | SFT | 7 | 1644 | ↓ |  |  |  |  |  |  |
|  | Mu-M | 4 | 1645 | 190 | ↓ | ↓ |  |  |  |  |
|  | SFT | 8 | 1957 | 190 | Asphalt | Packed snow | 15 |  |  |  |
|  | RFT | 8 | 2000 | 190 |  |  |  |  |  |  |
|  | RCR | 9 | 2001 | 190 |  |  |  |  |  |  |
|  | SFT | 9 | 2003 | 010 |  |  |  |  |  |  |
|  | RCR | 10 | 2004 | 010 |  |  |  |  |  |  |
|  | RCR | 11 | 2013 | 010 |  |  |  |  |  |  |
|  | Mu-M | 5 | 2014 | 190 |  |  |  |  |  |  |
| ↓ | SFT | 10 | 2015 | 190 | ↓ | ↓ |  |  |  |  |

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 1-28-86 | Mu-M | 6 | 2018 | 010 | Asphalt | Packed snow | | | | |
| | RCR | 12 | 2019 | 010 | | | | | | |
| | SFT | 11 | 2019 | 010 | | | | | | |
| | Mu-M | 7 | 2022 | 190 | | | | | | |
| | SFT | 12 | 2023 | 190 | | | | | | |
| | RCR | 13 | 2023 | 190 | | | | | | |
| | Mu-M | 8 | 2026 | 010 | | | | | | |
| | SFT | 13 | 2027 | 010 | | | | | | |
| | RCR | 14 | 2027 | 010 | ↓ | ↓ | | | | |
| | Mu-M | 9 | 2033 | 190 | Asphalt | Packed snow | | | | |
| | Mu-M | 10 | 2037 | 010 | | | | | | |
| | RFT | 9 | 2043 | 010 | | | | | | |
| | RFT | 10 | 2045 | 190 | | | | | | |
| | RFT | 11 | 2051 | 190 | | | | | | |
| ↓ | RFT | 12 | 2053 | 010 | ↓ | ↓ | | | | |
| 1-29-86 | BV-11 | 9 | 1415 | 190 | Asphalt | Dry snow on ice | 13 | 10 | 270 | 8 |
| | Mu-M | 11 | 1419 | | | | | | | |
| | SFT | 14 | 1420 | | | | | | | |
| | RCR | 11 | 1424 | ↓ | | | | | | |
| | RCR | 12 | 1426 | 010 | | | | | | |
| | 727 | 3 | 1430 | 190 | | | | | | |
| | BV-11 | 10 | 1436 | | | | | | | |
| | Mu-M | 12 | 1437 | | | | | | | |
| | SFT | 15 | 1437 | | | | | | | |
| | RCR | 13 | 1437 | ↓ | ↓ | ↓ | | | | |
| | BV-11 | 11 | 1439 | 010 | Asphalt | Dry snow on ice | | | 260 | 4 |
| | Mu-M | 13 | 1441 | | | | | | | |
| | SFT | 16 | 1442 | | | | | | | |
| | RCR | 14 | 1443 | | | | | | | |
| | 727 | 4 | 1444 | | | | | | | |
| | BV-11 | 12 | 1450 | | | | | | | |
| | Mu-M | 14 | 1451 | | | | | | | |
| | SFT | 17 | 1452 | | | | | | | |
| ↓ | RCR | 15 | 1452 | ↓ | ↓ | ↓ | | | | |

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 1-29-86 | Mu-M | 15 | 1454 | 190 | Asphalt | Dry snow |  |  | 250 |  |
|  | BV-11 | 13 | 1455 |  |  | on ice |  |  |  |  |
|  | RCR | 16 | 1455 |  |  |  |  |  |  |  |
|  | SFT | 18 | 1456 |  |  |  |  |  |  |  |
|  | 727 | 5 | 1500 |  |  |  |  |  |  |  |
|  | BV-11 | 14 | 1503 |  |  |  |  |  |  |  |
|  | Mu-M | 16 | 1505 |  |  |  |  |  |  |  |
|  | RCR | 17 | 1506 |  |  |  |  |  |  |  |
|  | SFT | 19 | 1509 | ↓ | ↓ | ↓ |  |  |  |  |
|  | 727 | 6 | 1513 | 190 | Asphalt | Dry snow |  |  | 260 | 5 |
|  | BV-11 | 15 | 1515 |  |  | on ice |  |  | 260 | 5 |
|  | Mu-M | 17 | 1519 |  |  |  | 13 | 10 | 260 | 5 |
|  | RCR | 18 | 1519 |  |  |  |  |  |  |  |
|  | SFT | 20 | 1520 | ↓ | ↓ | ↓ |  |  |  |  |
|  | BV-11 | 16 | 1521 | 010 | Asphalt | Dry snow |  |  | 0 |  |
|  | Mu-M | 18 | 1522 |  |  | on ice |  |  |  |  |
|  | RCR | 19 | 1522 |  |  |  |  |  |  |  |
|  | SFT | 21 | 1522 | ↓ |  |  |  |  |  |  |
|  | 727 | 6R1 | 1523 | 190 |  |  |  |  |  |  |
|  | BV-11 | 17 | 1526 |  |  |  |  |  |  |  |
|  | Mu-M | 19 | 1527 |  |  |  |  |  |  |  |
|  | RCR | 20 | 1527 |  |  |  |  |  |  |  |
|  | SFT | 22 | 1528 | ↓ | ↓ | ↓ |  |  |  |  |
|  | BV-11 | 18 | 1529 | 010 | Asphalt | Dry snow |  |  |  |  |
|  | Mu-M | 20 | 1530 |  |  | on ice |  |  |  |  |
|  | RCR | 21 | 1531 |  |  |  |  |  |  |  |
|  | SFT | 23 | 1532 |  |  |  |  |  |  |  |
|  | 727 | 6R2 | 1533 | ↓ | ↓ | ↓ |  |  |  |  |
|  | RCR | 22 | 1538 | 190 | Asphalt | Dry snow |  |  |  |  |
|  | 727 | 5R | 1540 | 190 | Asphalt | on ice |  |  |  |  |
| ↓ | 727 | 7 | 1554 | 190 | Asphalt |  |  |  | 300 | 5 |
| 1-30-86 | BV-11 | 19 | 1412 | 190 | Asphalt | Dry snow | 19 | 12 | 020 | 8 |
|  | Mu-M | 21 | 1413 |  |  | on ice |  |  |  |  |
|  | RCR | 23 | 1415 |  |  |  |  |  |  |  |
|  | SFT | 24 | 1416 | ↓ |  |  |  |  |  |  |
|  | RCR | 24 | 1420 | 010 |  |  |  |  |  |  |
|  | SFT | 25 | 1420 |  |  |  |  |  |  |  |
|  | Mu-M | 22 | 1422 |  |  |  |  |  |  |  |
|  | BV-11 | 20 | 1424 | ↓ |  |  |  |  |  |  |
|  | BV-11 | 21 | 1425 | 190 |  |  |  |  |  |  |
|  | Mu-M | 23 | 1425 | 190 |  |  |  |  |  |  |
| ↓ | RCR | 25 | 1426 | 196 | ↓ | ↓ |  |  |  |  |

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 1-30-86 | SFT | 26 | 1426 | 190 | Asphalt | Dry snow | 19 | 12 | 020 | 8 |
| ↓ | BV-11 | 22 | 1458 | 010 | Asphalt | Urea on snow | | | | |
| ↓ | Mu-M | 24 | 1500 | ↓ | ↓ | ↓ | | | | |
| ↓ | SFT | 27 | 1501 | ↓ | ↓ | ↓ | | | | |
| ↓ | RCR | 26 | 1502 | ↓ | ↓ | ↓ | | | | |
| ↓ | BV-11 | 23 | 1503 | 190 | Asphalt | Urea on snow | | | | |
| ↓ | Mu-M | 25 | 1504 | ↓ | ↓ | ↓ | | | | |
| ↓ | SFT | 23 | 1506 | ↓ | ↓ | ↓ | | | | |
| ↓ | RCR | 27 | 1508 | ↓ | ↓ | ↓ | | | | |
| ↓ | BV-11 | 24 | 1509 | 010 | Asphalt | Urea on snow | | | | |
| ↓ | Mu-M | 26 | 1511 | ↓ | ↓ | ↓ | | | | |
| ↓ | SFT | 29 | 1513 | ↓ | ↓ | ↓ | | | | |
| ↓ | RCR | 28 | 1513 | ↓ | ↓ | ↓ | | | | |
| ↓ | 727 | 1 | 1517 | ↓ | ↓ | ↓ | | | | |
| ↓ | 727 | 2 | 1532 | 010 | Asphalt | Urea on snow | | | 060 | 10 |
| ↓ | 727 | 2R | 1545 | 010 | Asphalt | | | | 030 | 8 |
| ↓ | 727 | 2R2 | 1557 | 010 | Asphalt | | | | 060 | 10 |
| ↓ | 727 | 4 | 1608 | 010 | Asphalt | Urea on snow | | | 020 | 8 |
| ↓ | BV-11 | 25 | 1610 | 190 | ↓ | ↓ | | | | |
| ↓ | Mu-M | 27 | 1612 | ↓ | ↓ | ↓ | | | | |
| ↓ | SFT | 30 | 1614 | ↓ | ↓ | ↓ | | | | |
| ↓ | RCR | 29 | 1615 | ↓ | ↓ | ↓ | | | | |
| ↓ | BV-11 | 26 | 1616 | 010 | Asphalt | Urea on snow | | | | |
| ↓ | Mu-M | 28 | 1618 | ↓ | ↓ | ↓ | | | | |
| ↓ | SFT | 31 | 1620 | ↓ | ↓ | ↓ | | | | |
| ↓ | RCR | 30 | 1620 | ↓ | ↓ | ↓ | | | | |
| ↓ | BV-11 | 27 | 1621 | 190 | Asphalt | Urea on snow | | | | |
| ↓ | Mu-M | 29 | 1622 | ↓ | ↓ | ↓ | | | | |
| ↓ | SFT | 32 | 1624 | ↓ | ↓ | ↓ | | | | |
| ↓ | RCR | 31 | 1624 | ↓ | ↓ | ↓ | | | | |
| 2-18-86 | 727 | 1 | 1935 | 010 | Asphalt | Loose snow, 4.5 in. | 27 | | 050 | 6 |
| ↓ | ↓ | 1R | 1939 | 190 | ↓ | | | | 050 | 6 |
| ↓ | ↓ | 2 | 1943 | 010 | ↓ | ↓ | | | 040 | 6 |
| ↓ | ↓ | 3 | 1948 | 190 | ↓ | ↓ | | | | 5 |
| ↓ | ↓ | 4 | 1955 | 010 | ↓ | ↓ | | | | 5 |
| ↓ | ↓ | 5 | 2020 | ↓ | ↓ | ↓ | | | | 5 |
| ↓ | ↓ | 6 | 2054 | ↓ | ↓ | ↓ | 28 | | 050 | 6 |
| ↓ | ↓ | 7 | 2105 | ↓ | ↓ | ↓ | 28 | | 040 | 5 |

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 2-18-86 | BV-11 | 1 | 2058 | 010 | Asphalt | Loose snow, |  |  |  |  |
| ↓ | Mu-M | ↓ | 2102 | ↓ | ↓ | 4.5 in. |  |  |  |  |
| ↓ | SFT | ↓ | 2103 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | RCR | ↓ | 2104 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 2 | 2105 | 190 | Asphalt | Loose snow, |  |  |  |  |
| ↓ | Mu-M | ↓ | 2108 | ↓ | ↓ | 4.5 in. |  |  |  |  |
| ↓ | SFT | ↓ | 2112 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | RCR | ↓ | 2113 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 3 | 2115 | 010 | Asphalt | Loose snow, |  |  |  |  |
| ↓ | SFT | 3 | 2118 | 010 | Asphalt | 4.5 in. |  |  |  |  |
| ↓ | RCR | 3 | 2119 | 010 | Asphalt |  |  |  |  |  |
| ↓ | Mu-M | 4 | 2121 | 190 | Asphalt | Loose snow, |  |  |  |  |
| ↓ | SFT | 4 | 2124 | 190 | Asphalt | 4.5 in. |  |  |  |  |
| ↓ | RCR | 4 | 2125 | 190 | Asphalt |  |  |  |  |  |
| ↓ | Mu-M | 5 | 2126 | 010 | Asphalt | Loose snow, |  |  |  |  |
| ↓ | SFT | 5 | 2129 | 010 | Asphalt | 4.5 in. |  |  |  |  |
| ↓ | RCR | 5 | 2130 | 010 | Asphalt |  |  |  |  |  |
| ↓ | SFT | 6 | 2133 | 190 | Asphalt | Loose snow, |  |  |  |  |
| ↓ | RCR | 6 | 2134 | 190 | Asphalt | 4.5 in. |  |  |  |  |
| 2-19-86 | BV-11 | 4 | 1519 | 190 | Asphalt | Loose snow, |  | 17 | 020 | 8 |
| ↓ | SFT | 7 | 1523 | ↓ | ↓ | 1.0 to 3.0 in. |  |  |  |  |
| ↓ | RCR | 7 | 1524 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 5 | 1539 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | SFT | 8 | 1543 | ↓ | ↓ | ↓ | 28 | 17 | 020 | 8 |
| ↓ | RCR | 8 | 1544 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 6 | 1546 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | SFT | 9 | 1549 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | RCR | 9 | 1550 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | 727 | 3 | 1554 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | 727 | 4 | 1600 | 190 | Asphalt | Loose snow, |  |  | 030 |  |
| ↓ | ↓ | 5 | 1614 | 010 | ↓ | 1.0 to 3.0 in. |  |  | 020 |  |
| ↓ | ↓ | 2 | 1620 | 190 | ↓ | ↓ |  |  | 030 |  |
| ↓ | ↓ | 1 | 1625 | 010 | ↓ | ↓ |  |  | 030 |  |
| ↓ | ↓ | 1R1 | 1629 | 190 | ↓ | ↓ |  |  | 030 |  |
| ↓ | ↓ | 1R2 | 1632 | 010 | ↓ | ↓ |  |  | 020 |  |
| ↓ | SFT | 10 | 1641 | 190 | Asphalt | Loose snow, | 30 |  |  |  |
| ↓ | BV-11 | 7 | 1642 | 190 | ↓ | 1.0 to 3.0 in. |  |  |  |  |
| ↓ | RCR | 10 | 1643 | 190 | ↓ | ↓ |  |  |  |  |
| ↓ | SFT | 11 | 1645 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 8 | 1646 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | RCR | 11 | 1647 | 010 | ↓ | ↓ |  |  |  |  |

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 2-19-86 | SFT | 12 | 1648 | 190 | Asphalt | Loose snow, |  |  |  |  |
|  | BV-11 | 9 | 1651 | 190 |  | 1.0 to 3.0 in. |  |  |  |  |
|  | SFT | 13 | 1652 | 010 |  |  |  |  |  |  |
|  | BV-11 | 10 | 1653 | 010 | ↓ | ↓ |  |  |  |  |
|  | SFT | 14 | 1915 | 190 | Asphalt | Loose snow, | 33 |  | 360 | 6 |
|  | BV-11 | 11 | 1917 | 190 |  | 1 in. |  |  |  |  |
|  | RCR | 12 | 1919 | 190 |  |  |  |  |  |  |
|  | SFT | 15 | 1920 | 010 |  |  |  |  |  |  |
|  | BV-11 | 12 | 1921 | 010 |  |  |  |  |  |  |
|  | RCR | 13 | 1922 | 010 |  |  |  |  |  |  |
|  | SFT | 16 | 1924 | 190 |  |  |  |  |  |  |
|  | BV-11 | 13 | 1925 | 190 |  |  |  |  |  |  |
|  | RCR | 14 | 1927 | 190 |  |  |  |  |  |  |
|  | SFT | 17 | 1928 | 010 |  |  |  |  |  |  |
|  | BV-11 | 14 | 1929 |  |  |  |  |  |  |  |
|  | RCR | 15 | 1930 |  |  |  |  |  |  |  |
|  | SFT | 17R | 1930 | ↓ |  |  | 33 |  | 360 | 6 |
|  | SFT | 18 | 1934 | 190 |  |  |  |  |  |  |
|  | BV-11 | 15 | 1935 | 190 |  |  |  |  |  |  |
|  | RCR | 16 | 1936 | 190 |  |  |  |  |  |  |
|  | SFT | 19 | 1939 | 010 |  |  |  |  |  |  |
|  | BV-11 | 16 | 1940 | 010 |  |  |  |  |  |  |
|  | RCR | 17 | 1941 | 010 |  |  |  |  |  |  |
|  | SFT | 20 | 2053 | 190 |  |  |  |  |  |  |
|  | BV-11 | 17 | 2054 | 190 |  |  |  |  |  |  |
|  | RCR | 18 | 2055 | 190 | ↓ | ↓ |  |  |  |  |
|  | SFT | 21 | 2057 | 010 | Asphalt | Loose snow, |  |  |  |  |
|  | BV-11 | 18 | 2058 | 010 |  | 1 in. |  |  |  |  |
|  | RCR | 19 | 2059 | 010 |  |  |  |  |  |  |
|  | SFT | 22 | 2100 | 190 |  |  |  |  |  |  |
|  | BV-11 | 19 | 2101 | 190 |  |  |  |  |  |  |
|  | RCR | 20 | 2102 | 190 |  |  |  |  |  |  |
|  | SFT | 23 | 1603 | 010 |  |  |  |  |  |  |
|  | BV-11 | 20 | 1605 | 010 |  |  |  |  |  |  |
|  | RCR | 21 | 1606 | 010 |  |  |  |  |  |  |
|  | SFT | 24 | 1607 | 190 |  |  |  |  |  |  |
|  | BV-11 | 21 | 1608 | 190 |  |  |  |  |  |  |
|  | RCR | 22 | 1609 | 190 |  |  |  |  |  |  |
|  | SFT | 25 | 1610 | 010 |  |  |  |  |  |  |
|  | BV-11 | 22 | 1611 | 010 |  |  |  |  |  |  |
| ↓ | RCR | 23 | 1613 | 010 | ↓ | ↓ |  |  |  |  |

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 2-20-86 | RFT | 1 | 1340 | 190 | Asphalt | Packed | 28 | | 050 | 4 |
| | RCR | 24 | 1341 | 190 | | snow on ice | | | | |
| | RFT | 2 | 1344 | 010 | | | | | | |
| | RCR | 25 | 1345 | 010 | | | | | | |
| | 727 | 3 | 1357 | 010 | | | | | | |
| | 727 | 4 | 1402 | 190 | | | | | | |
| | 727 | 5 | 1413 | 010 | | | | | 060 | 5 |
| | BF-11 | 23 | 1420 | 190 | | | 30 | | 060 | 5 |
| | RFT | 1R | 1421 | | | | | | | |
| | SFT | 24 | 1422 | | | | | | | |
| | RCR | 26 | 1423 | ↓ | | | | | | |
| | BV-11 | 24 | 1424 | 010 | | | | | | |
| | RFT | 2R | 1425 | | | | | | | |
| | SFT | 25 | 1426 | | | | | | | |
| | RCR | 27 | 1427 | ↓ | ↓ | ↓ | | | | |
| | BV-11 | 25 | 1428 | 190 | Asphalt | Packed | | | | |
| | RFT | 3 | 1429 | | | snow on ice | | | | |
| | SFT | 26 | 1430 | | | | | | | |
| | RCR | 28 | 1431 | ↓ | | | | | | |
| | BV-11 | 26 | 1432 | 010 | | | | | | |
| | RFT | 4 | 1433 | | | | | | | |
| | SFT | 27 | 1434 | | | | | | | |
| | RCR | 29 | 1435 | ↓ | ↓ | ↓ | | | | |
| | BV-11 | 27 | 1436 | 190 | Asphalt | Packed | 33 | | | |
| | RFT | 5 | 1437 | | | snow on ice | | | | |
| | SFT | 28 | 1438 | | | | | | | |
| | RCR | 30 | 1439 | ↓ | | | | | | |
| | BV-11 | 28 | 1440 | 010 | | | | | | |
| | RFT | 6 | 1441 | | | | | | | |
| | SFT | 29 | 1442 | | | | | | | |
| | RCR | 31 | 1443 | ↓ | ↓ | ↓ | | | | |
| | BV-11 | 29 | 1543 | 190 | Asphalt | UCAR | 40 | | 120 | 6 |
| | RFT | 7 | 1544 | | | applied | | | | |
| | SFT | 30 | 1545 | | | | | | | |
| | RCR | 32 | 1546 | ↓ | | | | | | |
| | BV-11 | 30 | 1547 | 010 | | | | | | |
| | RFT | 8 | 1548 | | | | | | | |
| | SFT | 31 | 1549 | | | | | | | |
| ↓ | RCR | 33 | 1550 | ↓ | ↓ | ↓ | | | | |

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 2-20-86 | BV-11 | 31 | 1601 | 190 | Asphalt | UCAR | 40 | | 120 | 6 |
| | RFT | 9 | 1602 | | | applied | | | | |
| | SFT | 32 | 1603 | | | | | | | |
| | RCR | 34 | 1604 | ↓ | | | 40 | | 120 | 6 |
| | BV-11 | 32 | 1605 | 010 | | | | | | |
| | RFT | 10 | 1605 | | | | | | | |
| | SFT | 33 | 1606 | | | | | | | |
| | RCR | 35 | 1606 | ↓ | ↓ | ↓ | | | | |
| | BV-11 | 33 | 1617 | 190 | Asphalt | 2nd UCAR | | | | |
| | RFT | 11 | 1617 | | | application | | | | |
| | SFT | 34 | 1618 | | | | | | | |
| | RCR | 36 | 1618 | ↓ | | | | | | |
| | BV-11 | 34 | 1620 | 010 | | | | | | |
| | RFT | 12 | 1621 | | | | | | | |
| | SFT | 35 | 1623 | | | | | | | |
| | RCR | 37 | 1624 | ↓ | ↓ | ↓ | | | | |
| | 727 | 5R | 1632 | 190 | Asphalt | 2nd UCAR | | | | |
| | 727 | 5R2 | 1649 | 010 | | application | | | 160 | 5 |
| | BV-11 | 35 | 1653 | 190 | | | | | | |
| | RFT | 13 | 1654 | | | | | | | |
| | SFT | 36 | 1655 | | | | | | | |
| | RCR | 38 | 1655 | ↓ | | | | | | |
| | BV-11 | 36 | 1656 | 010 | | | | | | |
| | RFT | 14 | 1657 | | | | | | | |
| | SFT | 37 | 1658 | | | | | | | |
| | RCR | 39 | 1658 | ↓ | ↓ | ↓ | | | | |
| | BV-11 | 37 | 1700 | 190 | Asphalt | 2nd UCAR | | | | |
| | RFT | 15 | 1701 | | | application | | | | |
| | SFT | 38 | 1702 | | | | | | | |
| | RCR | 40 | 1702 | ↓ | | | | | | |
| | BV-11 | 38 | 1703 | 010 | | | | | | |
| | RFT | 16 | 1704 | | | | | | | |
| | SFT | 39 | 1705 | | | | | | | |
| | RCR | 41 | 1705 | ↓ | ↓ | ↓ | | | | |
| | BV-11 | 39 | 1708 | 190 | Asphalt | 2nd UCAR | | | | |
| | RFT | 17 | 1709 | | | application | | | | |
| | SFT | 40 | 1710 | | | | | | | |
| ↓ | RCR | 42 | 1710 | ↓ | ↓ | ↓ | | | | |

Table BI. Continued

(c) Continued

| | | | | | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Type | Wetness | Ambient | Surface | Deg | Knots |
| 2-20-86 | BV-11 | 40 | 1711 | 010 | Asphalt | 2nd UCAR application | 40 | | 160 | 5 |
| | RFT | 18 | 1712 | | | | | | | |
| | SFT | 41 | 1713 | | | | | | | |
| | RCR | 43 | 1715 | ↓ | ↓ | ↓ | | | | |
| | BV-11 | 41 | 1910 | 010 | Asphalt | UCAR on bare asphalt | 42 | | | |
| | RFT | 19 | 1911 | | | | | | | |
| | SFT | 42 | 1912 | | | | | | | |
| | RCR | 44 | 1913 | | | | | | | |
| | BV-11 | 42 | 1914 | | | | | | | |
| | RFT | 20 | 1915 | | | | | | | |
| | SFT | 43 | 1916 | | | | | | | |
| | RCR | 45 | 1917 | ↓ | ↓ | ↓ | | | | |
| | BV-11 | 43 | 1918 | 010 | Asphalt | UCAR on bare asphalt | | | | |
| | RFT | 21 | 1918 | | | | | | | |
| | SFT | 44 | 1919 | | | | | | | |
| | RCR | 46 | 1919 | | | | | | | |
| | BV-11 | 44 | 1925 | | | | | | | |
| | RFT | 22 | 1925 | | | | | | | |
| | SFT | 45 | 1926 | | | | | | | |
| | RCR | 47 | 1926 | ↓ | ↓ | ↓ | | | | |
| | RFT | 23 | 1928 | 010 | Asphalt | UCAR on bare asphalt | | | | |
| | SFT | 46 | 1929 | | | | | | | |
| | RCR | 48 | 1929 | | | | | | | |
| | SFT | 47 | 1932 | | | | | | | |
| ↓ | RCR | 49 | 1933 | ↓ | ↓ | ↓ | | | | |
| 3-19-86 | SFT | 1 | 1411 | 190 | Asphalt | Rain wet | | | 180 | 16 |
| | [d]RFT | 1 | 1411 | | | | | | | |
| | Mu-M | 1 | 1412 | | | | | | | |
| | RCR | 1 | 1412 | ↓ | | | | | | |
| | SFT | 2 | 1415 | 010 | | | | | | |
| | [d]RFT | 2 | 1415 | | | | | | | |
| | Mu-M | 2 | 1416 | | | | | | | |
| | RCR | 2 | 1416 | ↓ | | | | | | |
| | SFT | 3 | 1420 | 190 | | | 42 | | 180 | 16 |
| | RFT | | 1420 | | | | | | | |
| | Mu-M | | 1421 | | | | | | | |
| ↓ | [d]RCR | ↓ | 1421 | ↓ | ↓ | ↓ | | | | |

[d] Tapley and Bowmonk meter readings.

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface: Type | Test surface: Wetness | Temperature, °F: Ambient | Temperature, °F: Surface | Wind: Deg | Wind: Knots |
|---|---|---|---|---|---|---|---|---|---|---|
| 3-19-86 | SFT | 4 | 1423 | 010 | Asphalt | Rain | 42 | | 180 | 16 |
| | RFT | | 1423 | | | wet | | | | |
| | Mu-M | | 1424 | | | | | | | |
| | [d]RCR | ↓ | 1424 | ↓ | ↓ | ↓ | | | | |
| | SFT | 5 | 1427 | 190 | Asphalt | Rain | | | | |
| | RFT | | 1427 | | | wet | | | | |
| | Mu-M | | 1428 | | | | | | | |
| | [d]RCR | ↓ | 1428 | ↓ | | | | | | |
| | SFT | 6 | 1431 | 010 | | | | | | |
| | RFT | | 1431 | | | | | | | |
| | Mu-M | | 1432 | | | | | | | |
| | [d]RCR | ↓ | 1432 | ↓ | ↓ | ↓ | | | | |
| | 727 | 1 | 1440 | 190 | Asphalt | Rain | 43 | | | |
| | SFT | 7 | 1449 | | | wet | | | | |
| | RFT | 7 | 1449 | | | | | | | |
| | Mu-M | 7 | 1450 | | | | | | | |
| | BV-11 | 1 | 1450 | | | | | | | |
| | [d]RCR | 7 | 1450 | ↓ | | | | | | |
| | SFT | 8 | 1452 | 010 | | | | | | |
| | RFT | 8 | 1452 | | | | | | | |
| | Mu-M | 8 | 1453 | | | | | | | |
| | BV-11 | 2 | 1453 | | | | | | | |
| | [d]RCR | 8 | 1454 | ↓ | ↓ | ↓ | | | | |
| | 727 | 2 | 1458 | 190 | Asphalt | Rain | 44 | | | 20 |
| | SFT | 9 | 1512 | | | wet | | | | |
| | RFT | 9 | 1512 | | | | | | | |
| | Mu-M | 9 | 1513 | | | | | | | |
| | BV-11 | 3 | 1513 | | | | | | | |
| | [d]RCR | 9 | 1514 | ↓ | | | | | | |
| | SFT | 10 | 1515 | 010 | | | | | | |
| | RFT | 10 | 1515 | | | | | | | |
| | Mu-M | 10 | 1516 | | | | 44 | | 180 | 20 |
| | BV-11 | 4 | 1516 | | | | | | | |
| | [d]RCR | 10 | 1517 | ↓ | | | | | | |
| | BV-11 | 5 | 1518 | 190 | | | | | | |
| ↓ | BV-11 | 6 | 1519 | 010 | ↓ | ↓ | | | | |

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[d] Tapley and Bowmonk meter readings.

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-19-86 | 727 | 3 | 1520 | 190 | Asphalt | Rain wet |  |  | 190 | 16 |
| ↓ | 727 | 3R | 1530 | 190 | ↓ | ↓ |  |  |  | 20 |
| ↓ | BV-11 | 7 | 1531 | 190 | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | 8 | 1532 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | 727 | [b]L1 | 2245 | 190 | Asphalt | Damp | 46 |  |  | 16 |
| 3-21-86 | Mu-M | 11 | 1100 | 190 | Asphalt | Ice | 4 | 10 | 350 | 10 |
| ↓ | BV-11 | ↓ | 1100 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | SFT | ↓ | 1101 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | RFT | ↓ | 1101 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | [d]RCR | ↓ | 1101 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 12 | 1104 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | ↓ | 1104 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | SFT | ↓ | 1105 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | RFT | ↓ | 1105 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | [d]RCR | ↓ | 1106 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 13 | 1107 | 190 | Asphalt | Ice |  |  |  |  |
| ↓ | BV-11 | ↓ | 1107 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | SFT | ↓ | 1107 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | RFT | ↓ | 1108 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | [d]RCR | ↓ | 1108 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 14 | 1109 | 010 | ↓ | ↓ |  |  |  |  |
| ↓ | BV-11 | ↓ | 1109 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | SFT | ↓ | 1110 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | RFT | ↓ | 1110 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | [d]RCR | ↓ | 1111 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 15 | 1112 | 190 | Asphalt | Ice |  |  |  |  |
| ↓ | BV-11 | ↓ | 1112 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | SFT | ↓ | 1113 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | RFT | ↓ | 1113 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | [d]RCR | ↓ | 1114 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | Mu-M | 16 | 1115 | 010 | ↓ | ↓ | 4 | 10 | 350 | 10 |
| ↓ | BV-11 | ↓ | 1115 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | SFT | ↓ | 1116 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | RFT | ↓ | 1116 | ↓ | ↓ | ↓ |  |  |  |  |
| ↓ | [d]RCR | ↓ | 1116 | ↓ | ↓ | ↓ |  |  |  |  |

[b] Inboard runway.
[d] Tapley and Bowmonk meter readings.

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-21-86 | Mu-M | 17 | 1119 | 190 | Asphalt | Ice |  |  |  |  |
|  | BV-11 |  | 1119 |  |  |  |  |  |  |  |
|  | SFT |  | 1120 |  |  |  |  |  |  |  |
|  | RFT |  | 1120 |  |  |  |  |  |  |  |
|  | [d]RCR | ↓ | 1121 | ↓ |  |  |  |  |  |  |
|  | Mu-M | 18 | 1122 | 010 |  |  |  |  |  |  |
|  | BV-11 |  | 1122 |  |  |  |  |  |  |  |
|  | SFT |  | 1123 |  |  |  |  |  |  |  |
|  | RFT |  | 1123 |  |  |  |  |  |  |  |
|  | [d]RCR | ↓ | 1123 | ↓ | ↓ | ↓ |  |  |  |  |
|  | 727 | 1 | 1127 | 010 | Asphalt | Ice | 5 | 15 |  |  |
|  | 727 | 2 | 1133 | 190 |  |  |  |  | 360 | 12 |
|  | 727 | 3 | 1136 | 010 |  |  |  |  | 350 | 10 |
|  | 727 | 4 | 1143 | 010 | ↓ | ↓ |  |  |  | 8 |
|  | Mu-M | 19 | 1149 | 190 | Asphalt | Ice | 6 |  |  |  |
|  | BV-11 |  | 1149 |  |  |  |  |  |  |  |
|  | SFT |  | 1150 |  |  |  |  |  |  |  |
|  | RFT |  | 1150 |  |  |  |  |  |  |  |
|  | [d]RCR | ↓ | 1151 | ↓ |  |  |  |  |  |  |
|  | Mu-M | 20 | 1152 | 010 |  |  |  |  |  |  |
|  | BV-11 |  | 1152 |  |  |  |  |  |  |  |
|  | SFT |  | 1153 |  |  |  |  |  |  |  |
|  | RFT |  | 1153 |  |  |  |  |  |  |  |
|  | [d]RCR | ↓ | 1153 | ↓ | ↓ | ↓ |  |  |  |  |
|  | Mu-M | 21 | 1154 | 190 | Asphalt | Ice | 7 | 20 | 340 | 10 |
|  | BV-11 |  | 1154 |  |  |  |  |  |  |  |
|  | SFT |  | 1155 |  |  |  |  |  |  |  |
|  | RFT |  | 1155 |  |  |  |  |  |  |  |
|  | [d]RCR | ↓ | 1156 | ↓ |  |  |  |  |  |  |
|  | 727 | 5 | 1200 | 010 |  |  |  |  |  |  |
|  | Mu-M | 22 | 1202 |  |  |  | 7 | 20 | 340 | 10 |
|  | BV-11 |  | 1202 |  |  |  |  |  |  |  |
|  | SFT |  | 1203 |  |  |  |  |  |  |  |
|  | RFT |  | 1203 |  |  |  |  |  |  |  |
| ↓ | [d]RCR | ↓ | 1204 | ↓ | ↓ | ↓ |  |  |  |  |

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[d] Tapley and Bowmonk meter readings.

Table BI. Continued

(c) Continued

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-21-86 | Mu-M | 23 | 1207 | 190 | Asphalt | Ice | | | | |
| | BV-11 | | 1207 | | | | | | | |
| | SFT | | 1208 | | | | | | | |
| | RFT | | 1208 | | | | | | | |
| | [d]RCR | ↓ | 1209 | ↓ | | | | | | |
| | Mu-M | 24 | 1214 | 010 | | | | | | |
| | BV-11 | | 1214 | | | | | | | |
| | SFT | | 1215 | | | | | | | |
| | RFT | | 1215 | | | | | | | |
| | [d]RCR | ↓ | 1216 | ↓ | ↓ | ↓ | | | | |
| | Mu-M | 25 | 1503 | 190 | Asphalt | Slush | 12 | 42 | | 8 |
| | BV-11 | | 1503 | | | | | | | |
| | SFT | | 1504 | | | | | | | |
| | RFT | | 1504 | | | | | | | |
| | [d]RCR | ↓ | 1505 | ↓ | | | | | | |
| | Mu-M | 26 | 1506 | 010 | | | | | | |
| | BV-11 | | 1506 | | | | | | | |
| | SFT | | 1507 | | | | | | | |
| | RFT | | 1507 | | | | | | | |
| | [d]RCR | ↓ | 1508 | ↓ | ↓ | ↓ | | | | |
| | Mu-M | 27 | 1520 | 190 | Asphalt | UCAR application | 15 | 48 | | |
| | BV-11 | | 1520 | | | | | | | |
| | SFT | | 1521 | | | | | | | |
| | RFT | | 1521 | | | | | | | |
| | [d]RCR | ↓ | 1522 | ↓ | | | | | | |
| | Mu-M | 28 | 1523 | 010 | | | | | | |
| | BV-11 | | 1523 | | | | | | | |
| | SFT | | 1524 | | | | | | | |
| | RFT | | 1524 | | | | | | | |
| ↓ | [d]RCR | ↓ | 1525 | ↓ | ↓ | ↓ | | | | |

[d] Tapley and Bowmonk meter readings.

Table BI. Continued

(c) Concluded

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-21-86 | Mu-M | 29 | 1534 | 190 | Asphalt | UCAR application | 15 | 48 | 340 | 8 |
|  | BV-11 |  | 1534 |  |  |  |  |  |  |  |
|  | SFT |  | 1535 |  |  |  |  |  |  |  |
|  | RFT |  | 1535 |  |  |  |  |  |  |  |
|  | [d]RCR |  | 1536 |  |  |  |  |  |  |  |
|  | Mu-M | 30 | 1537 | 010 |  |  |  |  |  |  |
|  | BV-11 |  | 1537 |  |  |  |  |  |  |  |
|  | SFT |  | 1538 |  |  |  |  |  |  |  |
|  | RFT |  | 1538 |  |  |  |  |  |  |  |
|  | [d]RCR |  | 1534 |  |  |  |  |  |  |  |
|  | 727 | 4 | 1546 |  |  |  |  |  | 010 | 6 |
|  | BV-11 | 31 | 1549 | 190 | Asphalt | UCAR application | 19 | 59 |  |  |
|  | SFT |  | 1549 |  |  |  |  |  |  |  |
|  | RFT |  | 1550 |  |  |  |  |  |  |  |
|  | [d]RCR |  | 1550 |  |  |  |  |  |  |  |
|  | BV-11 | 32 | 1552 | 010 |  |  |  |  |  |  |
|  | SFT |  | 1553 |  |  |  |  |  |  |  |
|  | RFT |  | 1553 |  |  |  |  |  |  |  |
|  | [d]RCR |  | 1554 |  |  |  |  |  |  |  |

[d] Tapley and Bowmonk meter readings.

Table BI. Continued

(d) Pease Air Force Base

| | | | | | Test surface | | Temperature, °F | | Wind | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-19-86 | 727 | $^{e}$P1 | 1719 | 110 | PFC | Rain | 44 | | 190 | 16 |
| | 727 | 2 | 1753 | 160 | PFC | wet | 57 | | 230 | 19 |
| | Mu-M | 1 | 2007 | 160 | PFC | Rain | 58 | | 240 | 18 |
| | BV-11 | | 2007 | | | wet | | | | |
| | SFT | | 2008 | | | | | | | |
| | RFT | | 2008 | | | | | | | |
| | $^{d}$RCR | ↓ | 2008 | ↓ | ↓ | ↓ | | | | |
| | Mu-M | 2 | 2009 | 340 | PFC | Rain | | | | |
| | BV-11 | | 2009 | | | wet | | | | |
| | SFT | | 2010 | | | | | | | |
| | RFT | | 2010 | | | | | | | |
| | $^{d}$RCR | ↓ | 2010 | ↓ | | | | | | |
| | 727 | 1 | 2011 | 160 | | | | | | |
| | Mu-M | 3 | 2016 | | | | | | | |
| | BV-11 | | 2016 | | | | | | | |
| | SFT | | 2017 | | | | | | | |
| | RFT | | 2017 | | | | | | | |
| | $^{d}$RCR | ↓ | 2018 | ↓ | ↓ | ↓ | | | | |
| | Mu-M | 4 | 2019 | 340 | PFC | Rain | | | | 12 |
| | BV-11 | | 2019 | | | wet | | | | |
| | SFT | | 2020 | | | | | | | |
| | RFT | | 2021 | | | | | | | |
| | $^{d}$RCR | ↓ | 2022 | ↓ | | | | | | |
| | 727 | 2R | 2033 | 160 | | | | | | |
| | Mu-M | 5 | 2039 | | | | | | | |
| | BV-11 | | 2039 | | | | | | | |
| | SFT | | 2040 | | | | | | | |
| | RFT | | 2040 | | | | | | | |
| | $^{d}$RCR | ↓ | 2041 | ↓ | ↓ | ↓ | | | | |
| | Mu-M | 6 | 2043 | 340 | PFC | Rain | | | | 15 |
| | BV-11 | | 2043 | | | wet | | | | |
| | RFT | | 2044 | | | | | | | |
| | $^{d}$RCR | ↓ | 2045 | ↓ | | | | | | |
| | 727 | 3 | 2057 | 160 | | | | | | |
| | Mu-M | 7 | 2107 | | | | 58 | | 240 | 12 |
| | BV-11 | | 2107 | | | | | | | |
| | RFT | | 2108 | | | | | | | |
| ↓ | $^{d}$RCR | ↓ | 2109 | ↓ | ↓ | ↓ | | | | |

$^{d}$Tapley and Bowmonk meter readings.
$^{e}$Portland International Jetport.

Table BI. Concluded

(d) Concluded

| Date | Test vehicle | Run | Time of day, GMT | Test R/W | Test surface |  | Temperature, °F |  | Wind |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness | Ambient | Surface | Deg | Knots |
| 3-19-86 | Mu-M | 8 | 2110 | 340 | PFC | Rain |  |  |  |  |
|  | BV-11 |  | 2110 |  |  | wet |  |  |  |  |
|  | RFT |  | 2111 |  |  |  |  |  |  |  |
|  | $^{d}$RCR | ↓ | 2112 | ↓ | ↓ | ↓ |  |  |  |  |
|  | Mu-M | 9 | 2113 | 160 | Asphalt | Rain |  |  |  |  |
|  | BV-11 |  | 2113 |  | shoulder | wet |  |  |  |  |
|  | RFT |  | 2114 |  |  |  |  |  |  |  |
|  | $^{d}$RCR | ↓ | 2114 | ↓ |  |  |  |  |  |  |
|  | Mu-M | 10 | 2116 | 340 |  |  |  |  |  |  |
|  | BV-11 |  | 2116 |  |  |  |  |  |  |  |
|  | RFT |  | 2117 |  |  |  |  |  |  |  |
|  | $^{d}$RCR | ↓ | 2117 | ↓ | ↓ | ↓ |  |  |  |  |
|  | SFT | 6 | 2117 | 160 | PFC | Rain |  |  |  |  |
|  | SFT | 7 | 2125 | 340 |  | wet |  |  |  |  |
|  | SFT | 8 | 2126 | 160 |  |  |  |  |  |  |
|  | SFT | 9 | 2129 | 340 | ↓ |  |  |  |  |  |
|  | SFT | 10 | 2130 | 160 | Asphalt |  |  |  |  |  |
| ↓ | SFT | 11 | 2132 | 340 | shoulder | ↓ |  |  |  |  |

$^{d}$Tapley and Bowmonk meter readings.

Table BII. Compilation of Boeing 727 Braking Friction Data by Test-Surface Type and Wetness Condition

(a) Wallops Flight Facility

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface |  | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness |  |  |  |
| 4A | 3 | 10 | $132.5 \times 10^3$ | 892.0 | SSA | Rain damp | Main | 5 | 0.55 |
|  |  |  |  |  |  |  |  | 10 | .56 |
|  |  |  |  |  |  |  |  | 15 | .57 |
|  |  |  |  |  |  |  |  | 20 | .51 |
|  |  |  |  |  |  |  |  | 25 | .52 |
|  |  |  |  |  |  |  |  | 30 | .52 |
|  |  |  |  |  |  |  |  | 35 | .53 |
|  |  |  |  |  |  |  |  | 40 | .52 |
|  |  |  |  |  |  |  |  | 45 | .47 |
| 4B | 3 | 10 | $131.6 \times 10^3$ | 891.6 | SSA | Rain damp | Main | 20 | .44 |
|  |  |  |  |  |  |  |  | 25 | .52 |
|  |  |  |  |  |  |  |  | 30 | .48 |
|  |  |  |  |  |  |  |  | 35 | .44 |
|  |  |  |  |  |  |  |  | 40 | .44 |
|  |  |  |  |  |  |  |  | 45 | .53 |
|  |  |  |  |  |  |  |  | 50 | .49 |
|  |  |  |  |  |  |  |  | 55 | .45 |
|  |  |  |  |  |  |  |  | 60 | .48 |
|  |  |  |  |  |  |  |  | 65 | .49 |
|  |  |  |  |  |  |  |  | 70 | .39 |
|  |  |  |  |  |  |  |  | 75 | .35 |
| 4C | 3 | 10 | $129.5 \times 10^3$ | 891.4 | SSA | Rain damp | Main | 20 | .51 |
|  |  |  |  |  |  |  |  | 25 | .47 |
|  |  |  |  |  |  |  |  | 30 | .41 |
|  |  |  |  |  |  |  |  | 35 | .55 |
|  |  |  |  |  |  |  |  | 40 | .54 |
|  |  |  |  |  |  |  |  | 45 | .51 |
|  |  |  |  |  |  |  |  | 50 | .46 |
|  |  |  |  |  |  |  |  | 55 | .41 |
|  |  |  |  |  |  |  |  | 60 | .39 |
|  |  |  |  |  |  |  |  | 65 | .44 |
|  |  |  |  |  |  |  |  | 70 | .46 |
|  |  |  |  |  |  |  |  | 75 | .44 |
|  |  |  |  |  |  |  |  | 80 | .46 |

Table BII. Continued

(a) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 5 | 3 | 10 | $126.5 \times 10^3$ | 892.8 | SSA | Rain damp | Main and nose | 15 | 0.52 |
| | | | | | | | | 20 | .51 |
| | | | | | | | | 25 | .50 |
| | | | | | | | | 30 | .48 |
| | | | | | | | | 35 | .45 |
| | | | | | | | | 40 | .42 |
| | | | | | | | | 45 | .45 |
| | | | | | | | | 50 | .49 |
| | | | | | | | | 55 | .49 |
| | | | | | | | | 60 | .49 |
| | | | | | | | | 65 | .49 |
| | | | | | | | | 70 | .47 |
| | | | | | | | | 75 | .44 |
| 1 | 8 | 10 | $128.4 \times 10^3$ | 891.4 | SSA | Truck wet | Main | 15 | .45 |
| | | | | | | | | 20 | .53 |
| | | | | | | | | 25 | .46 |
| | | | | | | | | 30 | .46 |
| | | | | | | | | 35 | .41 |
| | | | | | | | | 40 | .48 |
| | | | | | | | | 45 | .40 |
| | | | | | | | | 50 | .39 |
| | | | | | | | | 55 | .42 |
| | | | | | | | | 60 | .41 |
| | | | | | | | | 65 | .37 |
| | | | | | | | | 70 | .34 |
| | | | | | | | | 75 | .36 |
| | | | | | | | | 80 | .38 |
| | | | | | | | | 85 | .33 |
| | | | | | | | | 90 | .33 |

Table BII. Continued

(a) Continued

| | | | | | Test surface | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Type | Wetness | Type of braking | Ground speed, knots | Effective braking friction coefficient |
| 12 | 11 | 10 | $130.5 \times 10^3$ | 891.1 | SSA | Truck wet | Main | 25 | 0.44 |
| | | | | | | | | 30 | .44 |
| | | | | | | | | 35 | .53 |
| | | | | | | | | 40 | .50 |
| | | | | | | | | 45 | .49 |
| | | | | | | | | 50 | .45 |
| | | | | | | | | 55 | .44 |
| | | | | | | | | 60 | .43 |
| | | | | | | | | 65 | .40 |
| | | | | | | | | 70 | .42 |
| | | | | | | | | 75 | .41 |
| | | | | | | | | 80 | .44 |
| | | | | | | | | 85 | .43 |
| | | | | | | | | 90 | .36 |
| | | | | | | | | 95 | .35 |
| 13 | 11 | 10 | $127.1 \times 10^3$ | 891.7 | SSA | Truck wet | Main and nose | 25 | .48 |
| | | | | | | | | 30 | .47 |
| | | | | | | | | 35 | .49 |
| | | | | | | | | 40 | .49 |
| | | | | | | | | 45 | .47 |
| | | | | | | | | 50 | .48 |
| | | | | | | | | 55 | .48 |
| | | | | | | | | 60 | .45 |
| | | | | | | | | 65 | .44 |
| | | | | | | | | 70 | .38 |
| | | | | | | | | 75 | .35 |
| | | | | | | | | 80 | .37 |
| | | | | | | | | 85 | .39 |
| | | | | | | | | 90 | .35 |

Table BII. Continued

(a) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface |  | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness |  |  |  |
| 9 | 11 | 10 | $139.3 \times 10^3$ | 890.6 | SSA | Dry | Main | 25 | 0.41 |
|  |  |  |  |  |  |  |  | 30 | .47 |
|  |  |  |  |  |  |  |  | 35 | .48 |
|  |  |  |  |  |  |  |  | 40 | .45 |
|  |  |  |  |  |  |  |  | 45 | .48 |
|  |  |  |  |  |  |  |  | 50 | .46 |
|  |  |  |  |  |  |  |  | 55 | .41 |
|  |  |  |  |  |  |  |  | 60 | .38 |
|  |  |  |  |  |  |  |  | 65 | .48 |
|  |  |  |  |  |  |  |  | 70 | .47 |
|  |  |  |  |  |  |  |  | 75 | .48 |
|  |  |  |  |  |  |  |  | 80 | .46 |
|  |  |  |  |  |  |  |  | 85 | .42 |
|  |  |  |  |  |  |  |  | 90 | .42 |
|  |  |  |  |  |  |  |  | 95 | .36 |
|  |  |  |  |  |  |  |  | 100 | .35 |
| 10 | 11 | 10 | $136.2 \times 10^3$ | 891.5 | SSA | Dry | Main and nose | 30 | .43 |
|  |  |  |  |  |  |  |  | 35 | .46 |
|  |  |  |  |  |  |  |  | 40 | .45 |
|  |  |  |  |  |  |  |  | 45 | .42 |
|  |  |  |  |  |  |  |  | 50 | .44 |
|  |  |  |  |  |  |  |  | 55 | .47 |
|  |  |  |  |  |  |  |  | 60 | .46 |
|  |  |  |  |  |  |  |  | 65 | .45 |
|  |  |  |  |  |  |  |  | 70 | .43 |
|  |  |  |  |  |  |  |  | 75 | .43 |
|  |  |  |  |  |  |  |  | 80 | .42 |
|  |  |  |  |  |  |  |  | 85 | .39 |
|  |  |  |  |  |  |  |  | 90 | .38 |
|  |  |  |  |  |  |  |  | 95 | .40 |
|  |  |  |  |  |  |  |  | 100 | .36 |

Table BII. Continued

(a) Continued

| | | | | | Test surface | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Type | Wetness | Type of braking | Ground speed, knots | Effective braking friction coefficient |
| 5 | 12 | 22 | $113.5 \times 10^3$ | 895.6 | A | Dry | Main | 45 | 0.53 |
| | | | | | | | | 50 | .52 |
| | | | | | | | | 55 | .55 |
| | | | | | | | | 60 | .55 |
| | | | | | | | | 65 | .54 |
| 6 | 12 | 4 | $113.3 \times 10^3$ | 895.7 | A | Dry | Main | 30 | .49 |
| | | | | | | | | 35 | .50 |
| | | | | | | | | 40 | .47 |
| | | | | | | | | 45 | .49 |
| 7 | 12 | 22 | $111.8 \times 10^3$ | 895.9 | A | Dry | Main and nose | 75 | .51 |
| | | | | | | | | 80 | .50 |
| | | | | | | | | 85 | .52 |
| | | | | | | | | 90 | .45 |
| | | | | | | | | 95 | .50 |
| 8 | 12 | 4 | $109.8 \times 10^3$ | 896.0 | A | Dry | Main and nose | 25 | .45 |
| | | | | | | | | 30 | .47 |
| | | | | | | | | 35 | .47 |
| | | | | | | | | 40 | .43 |
| | | | | | | | | 45 | .44 |
| | | | | | | | | 50 | .42 |
| | | | | | | | | 55 | .41 |
| | | | | | | | | 60 | .39 |
| 7 | 3 | 4 | $122.9 \times 10^3$ | 892.2 | A | Rain damp | Main | 70 | .45 |
| | | | | | | | | 75 | .42 |
| 6 | 3 | 22 | $124.7 \times 10^3$ | 891.8 | A | Rain damp | Main | 95 | .19 |
| | | | | | | | | 100 | .21 |
| | | | | | | | | 105 | .17 |
| 17 | 12 | 4 | $131.9 \times 10^3$ | 891.2 | A | Truck wet | Main | 30 | .25 |
| | | | | | | | | 35 | .24 |
| | | | | | | | | 40 | .23 |
| | | | | | | | | 45 | .23 |
| | | | | | | | | 50 | .22 |
| | | | | | | | | 55 | .21 |
| | | | | | | | | 60 | .15 |
| | | | | | | | | 65 | .12 |
| | | | | | | | | 70 | .11 |
| | | | | | | | | 75 | .10 |

Table BII. Continued

(a) Concluded

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 5 | 12 | 22 | $113.5 \times 10^3$ | 895.5 | B | Dry | Main | 25 | 0.60 |
| | | | | | | | | 30 | .57 |
| | | | | | | | | 35 | .56 |
| | | | | | | | | 40 | .57 |
| 6 | 12 | 4 | $113.3 \times 10^3$ | 895.6 | B | Dry | Main | 50 | .45 |
| | | | | | | | | 55 | .44 |
| | | | | | | | | 60 | .46 |
| | | | | | | | | 65 | .42 |
| 7 | 12 | 22 | $111.8 \times 10^3$ | 895.9 | B | Dry | Main and nose | 50 | .43 |
| | | | | | | | | 55 | .45 |
| | | | | | | | | 60 | .47 |
| | | | | | | | | 65 | .46 |
| | | | | | | | | 70 | .48 |
| 8 | 12 | 4 | $109.8 \times 10^3$ | 896.0 | B | Dry | Main and nose | 65 | .53 |
| | | | | | | | | 70 | .53 |
| | | | | | | | | 75 | .52 |
| | | | | | | | | 80 | .47 |
| | | | | | | | | 85 | .47 |
| 7 | 3 | 4 | $122.7 \times 10^3$ | 892.2 | B | Rain wet | Main | 80 | .50 |
| | | | | | | | | 85 | .49 |
| | | | | | | | | 90 | .48 |
| 6 | 3 | 22 | $124.9 \times 10^3$ | 891.8 | B | Rain wet | Main | 85 | .35 |
| | | | | | | | | 90 | .29 |
| 15 | 12 | 4 | $134.8 \times 10^3$ | 891.8 | B | Truck wet | Main | 25 | .43 |
| | | | | | | | | 30 | .46 |
| | | | | | | | | 35 | .40 |
| | | | | | | | | 40 | .43 |
| | | | | | | | | 45 | .41 |
| | | | | | | | | 50 | .38 |
| | | | | | | | | 55 | .34 |
| 18 | 12 | 22 | $129.5 \times 10^3$ | 891.4 | B | Truck wet | Main | 50 | .41 |
| | | | | | | | | 55 | .40 |
| | | | | | | | | 60 | .39 |
| | | | | | | | | 65 | .38 |
| | | | | | | | | 70 | .36 |
| | | | | | | | | 75 | .30 |
| | | | | | | | | 80 | .30 |
| | | | | | | | | 85 | .30 |
| | | | | | | | | 90 | .29 |
| | | | | | | | | 95 | .24 |

Table BII. Continued

(b) FAA Technical Center

| | | | | | Test surface | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Type | Wetness | Type of braking | Ground speed, knots | Effective braking friction coefficient |
| 29 | 14 | 13 | $118.9 \times 10^3$ | 892.9 | B | Truck wet | Main | 26 | 0.30 |
| | | | | | | | | 31 | .29 |
| | | | | | | | | 36 | .29 |
| | | | | | | | | 41 | .28 |
| 30 | 14 | 31 | $118.9 \times 10^3$ | 892.9 | B | Truck wet | Main | 45 | .27 |
| | | | | | | | | 50 | .27 |
| 31 | 14 | 13 | $119.9 \times 10^3$ | 892.7 | B | Truck wet | Main | 70 | .27 |
| | | | | | | | | 75 | .20 |
| 32 | 14 | 13 | $122.0 \times 10^3$ | 892.3 | B | Truck wet | Main | 75 | .29 |
| 31 | 14 | 13 | $119.9 \times 10^3$ | 892.7 | C | Dry | Main | 80 | .42 |
| 32 | 14 | 13 | $122.0 \times 10^3$ | 892.3 | C | Dry | Main | 80 | .45 |
| 23 | 15 | 13 | $124.1 \times 10^3$ | 893.2 | C | Dry | Main | 20 | .41 |
| | | | | | | | | 25 | .45 |
| | | | | | | | | 30 | .44 |
| | | | | | | | | 35 | .50 |
| | | | | | | | | 40 | .51 |
| | | | | | | | | 45 | .48 |
| | | | | | | | | 50 | .49 |
| | | | | | | | | 55 | .47 |
| | | | | | | | | 60 | .47 |
| | | | | | | | | 65 | .47 |
| | | | | | | | | 70 | .46 |
| | | | | | | | | 75 | .50 |
| | | | | | | | | 80 | .49 |
| | | | | | | | | 85 | .46 |
| | | | | | | | | 90 | .45 |
| 27R | 14 | 13 | $130.9 \times 10^3$ | 892.2 | C | Truck wet | Main | 55 | .43 |
| | | | | | | | | 60 | .42 |
| | | | | | | | | 65 | .43 |
| | | | | | | | | 70 | .41 |
| | | | | | | | | 75 | .44 |
| | | | | | | | | 80 | .41 |
| | | | | | | | | 85 | .37 |
| | | | | | | | | 90 | .36 |
| | | | | | | | | 95 | .35 |
| | | | | | | | | 100 | .37 |

Table BII. Continued

(b) Concluded

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 24R | 15 | 31 | $122.3 \times 10^3$ | 893.4 | D | Dry | Main | 30 | 0.49 |
| | | | | | | | | 35 | .50 |
| | | | | | | | | 40 | .48 |
| | | | | | | | | 45 | .45 |
| | | | | | | | | 50 | .43 |
| | | | | | | | | 55 | .41 |
| | | | | | | | | 60 | .48 |
| | | | | | | | | 65 | .47 |
| | | | | | | | | 70 | .46 |
| | | | | | | | | 75 | .45 |
| | | | | | | | | 80 | .44 |
| | | | | | | | | 85 | .43 |
| 25 | 15 | 31 | $120.6 \times 10^3$ | 897.2 | D | Dry | Main and nose | 20 | .49 |
| | | | | | | | | 25 | .53 |
| | | | | | | | | 30 | .56 |
| | | | | | | | | 35 | .53 |
| | | | | | | | | 40 | .51 |
| | | | | | | | | 45 | .50 |
| | | | | | | | | 50 | .49 |
| | | | | | | | | 55 | .49 |
| | | | | | | | | 60 | .48 |
| | | | | | | | | 65 | .46 |
| | | | | | | | | 70 | .46 |
| | | | | | | | | 75 | .46 |
| | | | | | | | | 80 | .45 |
| | | | | | | | | 85 | .44 |
| | | | | | | | | 90 | .41 |
| 28 | 14 | 31 | $128.6 \times 10^3$ | 891.4 | D | Truck wet | Main | 95 | .27 |
| | | | | | | | | 100 | .26 |
| | | | | | | | | 105 | .25 |
| 28R | 14 | 31 | $126.3 \times 10^3$ | 892.8 | D | Truck wet | Main | 35 | .43 |
| | | | | | | | | 40 | .42 |
| | | | | | | | | 45 | .46 |
| | | | | | | | | 50 | .43 |
| | | | | | | | | 55 | .41 |
| | | | | | | | | 60 | .42 |
| | | | | | | | | 65 | .47 |
| | | | | | | | | 70 | .40 |
| | | | | | | | | 75 | .42 |
| | | | | | | | | 80 | .41 |
| | | | | | | | | 85 | .43 |
| | | | | | | | | 90 | .37 |
| | | | | | | | | 95 | .36 |

Table BII. Continued

(c) Brunswick Naval Air Station

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface |  | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness |  |  |  |
| 2 | 4 | 1 | $126.3 \times 10^3$ | 892.8 | Asphalt | Slush | Main | 25 | 0.37 |
|  |  |  |  |  |  |  |  | 30 | .25 |
|  |  |  |  |  |  |  |  | 35 | .35 |
|  |  |  |  |  |  |  |  | 40 | .45 |
|  |  |  |  |  |  |  |  | 45 | .36 |
|  |  |  |  |  |  |  |  | 50 | .30 |
|  |  |  |  |  |  |  |  | 55 | .32 |
| 4 | 4 | 19 | $123.0 \times 10^3$ | 892.0 | Asphalt | Damp | Main | 35 | .38 |
|  |  |  |  |  |  |  |  | 40 | .31 |
|  |  |  |  |  |  |  |  | 45 | .16 |
|  |  |  |  |  |  |  |  | 50 | .22 |
|  |  |  |  |  |  |  |  | 55 | .22 |
|  |  |  |  |  |  |  |  | 60 | .26 |
| 6 | 4 | 19 | $122.3 \times 10^3$ | 893.4 | Asphalt | Damp | Main | 30 | .42 |
|  |  |  |  |  |  |  |  | 35 | .38 |
|  |  |  |  |  |  |  |  | 40 | .41 |
|  |  |  |  |  |  |  |  | 45 | .40 |
|  |  |  |  |  |  |  |  | 50 | .36 |
|  |  |  |  |  |  |  |  | 55 | .34 |
|  |  |  |  |  |  |  |  | 60 | .31 |
|  |  |  |  |  |  |  |  | 65 | .36 |
|  |  |  |  |  |  |  |  | 70 | .34 |
|  |  |  |  |  |  |  |  | 75 | .29 |
|  |  |  |  |  |  |  |  | 80 | .24 |
|  |  |  |  |  |  |  |  | 85 | .29 |
| 8 | 5 | 19 | $129.5 \times 10^3$ | 891.7 | Asphalt | Truck wet | Main | 35 | .36 |
|  |  |  |  |  |  |  |  | 40 | .36 |
|  |  |  |  |  |  |  |  | 45 | .35 |
|  |  |  |  |  |  |  |  | 50 | .34 |
|  |  |  |  |  |  |  |  | 55 | .33 |
|  |  |  |  |  |  |  |  | 60 | .35 |
|  |  |  |  |  |  |  |  | 65 | .35 |
|  |  |  |  |  |  |  |  | 70 | .30 |
|  |  |  |  |  |  |  |  | 75 | .31 |
|  |  |  |  |  |  |  |  | 80 | .29 |
|  |  |  |  |  |  |  |  | 85 | .32 |
|  |  |  |  |  |  |  |  | 90 | .31 |
|  |  |  |  |  |  |  |  | 95 | .26 |

Table BII. Continued

(c) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 9 | 5 | 19 | $124.8 \times 10^3$ | 892.0 | Asphalt | Truck wet | Main and nose | 25 | 0.38 |
| | | | | | | | | 30 | .38 |
| | | | | | | | | 35 | .36 |
| | | | | | | | | 40 | .37 |
| | | | | | | | | 45 | .35 |
| | | | | | | | | 50 | .32 |
| | | | | | | | | 55 | .34 |
| | | | | | | | | 60 | .42 |
| | | | | | | | | 65 | .41 |
| | | | | | | | | 70 | .39 |
| | | | | | | | | 75 | .36 |
| | | | | | | | | 80 | .35 |
| | | | | | | | | 85 | .29 |
| | | | | | | | | 90 | .41 |
| | | | | | | | | 95 | .40 |
| 8R1 | 5 | 19 | $121.1 \times 10^3$ | 892.6 | Asphalt | Truck wet | Main | 20 | .40 |
| | | | | | | | | 25 | .42 |
| | | | | | | | | 30 | .40 |
| | | | | | | | | 35 | .43 |
| | | | | | | | | 40 | .41 |
| | | | | | | | | 45 | .38 |
| | | | | | | | | 50 | .36 |
| | | | | | | | | 55 | .39 |
| | | | | | | | | 60 | .36 |
| | | | | | | | | 65 | .42 |
| | | | | | | | | 70 | .38 |
| | | | | | | | | 75 | .34 |
| | | | | | | | | 80 | .32 |
| | | | | | | | | 85 | .32 |
| 11 | 6 | 19 | $134.9 \times 10^3$ | 891.9 | Asphalt | Dry | Main | 20 | .45 |
| | | | | | | | | 25 | .42 |
| | | | | | | | | 30 | .40 |
| | | | | | | | | 35 | .49 |
| | | | | | | | | 40 | .48 |
| | | | | | | | | 45 | .44 |
| | | | | | | | | 50 | .40 |
| | | | | | | | | 55 | .36 |
| | | | | | | | | 60 | .47 |
| | | | | | | | | 65 | .43 |
| | | | | | | | | 70 | .42 |
| | | | | | | | | 75 | .52 |
| | | | | | | | | 80 | .51 |
| | | | | | | | | 85 | .43 |
| | | | | | | | | 90 | .42 |

Table BII. Continued

(c) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 12 | 6 | 1 | $131.6 \times 10^3$ | 892.2 | Asphalt | Dry | Main and nose | 35 | 0.51 |
| | | | | | | | | 40 | .49 |
| | | | | | | | | 45 | .45 |
| | | | | | | | | 50 | .42 |
| | | | | | | | | 55 | .43 |
| | | | | | | | | 60 | .52 |
| | | | | | | | | 65 | .50 |
| | | | | | | | | 70 | .47 |
| | | | | | | | | 75 | .47 |
| | | | | | | | | 80 | .44 |
| | | | | | | | | 85 | .41 |
| | | | | | | | | 90 | .38 |
| 3 | 19 | 1 | $128.2 \times 10^3$ | 891.5 | Asphalt | Wet snow, 1.5 in. | Main | 25 | .07 |
| | | | | | | | | 30 | .07 |
| | | | | | | | | 35 | .07 |
| | | | | | | | | 40 | .07 |
| | | | | | | | | 45 | .08 |
| | | | | | | | | 50 | .09 |
| | | | | | | | | 55 | .09 |
| | | | | | | | | 60 | .09 |
| 4 | 19 | 19 | $127.7 \times 10^3$ | 891.6 | Asphalt | Wet snow, 1.5 in. | Main | 30 | .11 |
| | | | | | | | | 35 | .11 |
| | | | | | | | | 40 | .12 |
| | | | | | | | | 45 | .10 |
| | | | | | | | | 50 | .10 |
| | | | | | | | | 55 | .10 |
| | | | | | | | | 60 | .10 |
| | | | | | | | | 65 | .10 |
| 3R1 | 19 | 1 | $123.6 \times 10^3$ | 892.2 | Asphalt | Wet snow, 1.5 in. | Main | 30 | .08 |
| | | | | | | | | 35 | .08 |
| | | | | | | | | 40 | .09 |
| | | | | | | | | 45 | .10 |
| | | | | | | | | 50 | .11 |
| | | | | | | | | 55 | .10 |
| 3 | 20 | 19 | $129.1 \times 10^3$ | 891.5 | Asphalt | Dry snow on ice | Main | 28 | .14 |
| | | | | | | | | 33 | .14 |
| | | | | | | | | 38 | .13 |
| | | | | | | | | 43 | .15 |

Table BII. Continued

(c) Continued

| | | | | | Test surface | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Type | Wetness | Type of braking | Ground speed, knots | Effective braking friction coefficient |
| 4 | 20 | 1 | $128.2 \times 10^3$ | 891.4 | Asphalt | Dry snow on ice | Main | 27 | 0.13 |
| | | | | | | | | 32 | .12 |
| | | | | | | | | 37 | .13 |
| | | | | | | | | 42 | .14 |
| | | | | | | | | 47 | .14 |
| | | | | | | | | 52 | .14 |
| | | | | | | | | 57 | .13 |
| | | | | | | | | 62 | .14 |
| 5 | 20 | 19 | $125.2 \times 10^3$ | 891.8 | Asphalt | Dry snow on ice | Main | 30 | .13 |
| | | | | | | | | 35 | .13 |
| | | | | | | | | 40 | .15 |
| | | | | | | | | 45 | .14 |
| | | | | | | | | 50 | .15 |
| | | | | | | | | 55 | .11 |
| | | | | | | | | 60 | .14 |
| | | | | | | | | 65 | .15 |
| | | | | | | | | 70 | .16 |
| | | | | | | | | 75 | .18 |
| | | | | | | | | 80 | .16 |
| | | | | | | | | 85 | .12 |
| | | | | | | | | 90 | .16 |
| 5R1 | 20 | 19 | $121.9 \times 10^3$ | 892.3 | Asphalt | Dry snow on ice | Main | 30 | .12 |
| | | | | | | | | 35 | .14 |
| | | | | | | | | 40 | .13 |
| | | | | | | | | 45 | .13 |
| | | | | | | | | 50 | .13 |
| | | | | | | | | 55 | .12 |
| | | | | | | | | 60 | .12 |
| | | | | | | | | 65 | .13 |
| | | | | | | | | 70 | .16 |
| | | | | | | | | 75 | .14 |
| | | | | | | | | 80 | .17 |
| | | | | | | | | 85 | .15 |
| | | | | | | | | 90 | .15 |
| 1 | 21 | 1 | $129.3 \times 10^3$ | 891.7 | Asphalt | Urea on ice | Main | 30 | .06 |
| | | | | | | | | 35 | .07 |
| | | | | | | | | 40 | .07 |
| | | | | | | | | 45 | .08 |
| | | | | | | | | 50 | .11 |
| | | | | | | | | 55 | .13 |
| | | | | | | | | 60 | .10 |

Table BII. Continued

(c) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface |  | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness |  |  |  |
| 2 | 21 | 1 | $127.1 \times 10^3$ | 892.1 | Asphalt | Urea on ice | Main | 55 | 0.15 |
|  |  |  |  |  |  |  |  | 60 | .12 |
|  |  |  |  |  |  |  |  | 65 | .10 |
|  |  |  |  |  |  |  |  | 70 | .07 |
|  |  |  |  |  |  |  |  | 75 | .03 |
|  |  |  |  |  |  |  |  | 80 | .04 |
|  |  |  |  |  |  |  |  | 85 | .03 |
|  |  |  |  |  |  |  |  | 90 | .01 |
|  |  |  |  |  |  |  |  | 95 | .01 |
| 2R2 | 21 | 1 | $123.4 \times 10^3$ | 892.0 | Asphalt | Urea on ice | Main | 35 | .10 |
|  |  |  |  |  |  |  |  | 40 | .11 |
|  |  |  |  |  |  |  |  | 45 | .13 |
|  |  |  |  |  |  |  |  | 50 | .13 |
|  |  |  |  |  |  |  |  | 55 | .12 |
|  |  |  |  |  |  |  |  | 60 | .11 |
|  |  |  |  |  |  |  |  | 65 | .12 |
|  |  |  |  |  |  |  |  | 70 | .13 |
|  |  |  |  |  |  |  |  | 75 | .12 |
|  |  |  |  |  |  |  |  | 80 | .09 |
|  |  |  |  |  |  |  |  | 85 | .09 |
|  |  |  |  |  |  |  |  | 90 | .12 |
| 4 | 21 | 1 | $121.5 \times 10^3$ | 892.6 | Asphalt | Urea on ice | Main | 40 | .14 |
|  |  |  |  |  |  |  |  | 45 | .12 |
|  |  |  |  |  |  |  |  | 50 | .11 |
|  |  |  |  |  |  |  |  | 55 | .10 |
|  |  |  |  |  |  |  |  | 60 | .12 |
|  |  |  |  |  |  |  |  | 65 | .14 |
|  |  |  |  |  |  |  |  | 70 | .13 |
|  |  |  |  |  |  |  |  | 75 | .12 |
|  |  |  |  |  |  |  |  | 80 | .13 |
|  |  |  |  |  |  |  |  | 85 | .11 |
| 3 | 22 | 19 | $121.9 \times 10^3$ | 983.5 | Asphalt | Loose snow, 4.5 in. | Main | 30 | .11 |
|  |  |  |  |  |  |  |  | 35 | .11 |
|  |  |  |  |  |  |  |  | 40 | .10 |
|  |  |  |  |  |  |  |  | 45 | .11 |
|  |  |  |  |  |  |  |  | 50 | .12 |
|  |  |  |  |  |  |  |  | 55 | .11 |

Table BII. Continued

(c) Continued

| | | | | | Test surface | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Type | Wetness | Type of braking | Ground speed, knots | Effective braking friction coefficient |
| 4 | 22 | 1 | $121.6 \times 10^3$ | 984.1 | Asphalt | Loose snow, 4.5 in. | Main | 25 | 0.11 |
| | | | | | | | | 30 | .12 |
| | | | | | | | | 35 | .13 |
| | | | | | | | | 40 | .14 |
| | | | | | | | | 45 | .15 |
| | | | | | | | | 50 | .15 |
| | | | | | | | | 55 | .14 |
| | | | | | | | | 60 | .13 |
| 5 | 22 | 1 | $117.5 \times 10^3$ | 894.9 | Asphalt | Loose snow, 4.5 in. | Main | 25 | .12 |
| | | | | | | | | 30 | .14 |
| | | | | | | | | 35 | .15 |
| | | | | | | | | 40 | .15 |
| | | | | | | | | 45 | .15 |
| | | | | | | | | 50 | .15 |
| | | | | | | | | 55 | .15 |
| | | | | | | | | 60 | .16 |
| | | | | | | | | 65 | .16 |
| | | | | | | | | 70 | .16 |
| | | | | | | | | 75 | .16 |
| | | | | | | | | 80 | .15 |
| | | | | | | | | 85 | .15 |
| 3 | 23 | 1 | $133.7 \times 10^3$ | 891.8 | Asphalt | Loose snow, 1.0 to 3.0 in. | Main | 25 | .08 |
| | | | | | | | | 30 | .09 |
| | | | | | | | | 35 | .10 |
| | | | | | | | | 40 | .12 |
| | | | | | | | | 45 | .13 |
| | | | | | | | | 50 | .12 |
| | | | | | | | | 55 | .11 |
| 4 | 23 | 19 | $133.0 \times 10^3$ | 892.1 | Asphalt | Loose snow, 1.0 to 3.0 in. | Main | 30 | .10 |
| | | | | | | | | 35 | .10 |
| | | | | | | | | 40 | .11 |
| | | | | | | | | 45 | .11 |
| | | | | | | | | 50 | .11 |
| | | | | | | | | 55 | .11 |
| | | | | | | | | 60 | .11 |
| | | | | | | | | 65 | .10 |

Table BII. Continued

(c) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 5 | 23 | 1 | $130.5 \times 10^3$ | 891.9 | Asphalt | Loose snow, 1.0 to 3.0 in. | Main | 35 | 0.08 |
| | | | | | | | | 40 | .11 |
| | | | | | | | | 45 | .13 |
| | | | | | | | | 50 | .12 |
| | | | | | | | | 55 | .11 |
| | | | | | | | | 60 | .11 |
| | | | | | | | | 65 | .12 |
| | | | | | | | | 70 | .13 |
| | | | | | | | | 75 | .14 |
| | | | | | | | | 80 | .15 |
| | | | | | | | | 85 | .14 |
| 3 | 24 | 1 | $127.2 \times 10^3$ | 892.3 | Asphalt | Loose snow, 1 in. | Main | 30 | .14 |
| | | | | | | | | 35 | .15 |
| | | | | | | | | 40 | .15 |
| | | | | | | | | 45 | .16 |
| | | | | | | | | 50 | .16 |
| 4 | 24 | 19 | $126.8 \times 10^3$ | 892.7 | Asphalt | Loose snow, 1 in. | Main | 25 | .13 |
| | | | | | | | | 30 | .14 |
| | | | | | | | | 35 | .14 |
| | | | | | | | | 40 | .14 |
| | | | | | | | | 45 | .14 |
| | | | | | | | | 50 | .13 |
| | | | | | | | | 55 | .14 |
| | | | | | | | | 60 | .14 |
| 5 | 24 | 1 | $124.9 \times 10^3$ | 893.6 | Asphalt | Loose snow, 1 in. | Main | 50 | .18 |
| | | | | | | | | 55 | .16 |
| | | | | | | | | 60 | .16 |
| | | | | | | | | 65 | .13 |
| | | | | | | | | 70 | .18 |
| | | | | | | | | 75 | .20 |
| | | | | | | | | 80 | .18 |
| 3 | 25 | 1 | $135.3 \times 10^3$ | 891.1 | Asphalt | Packed snow on ice | Main | 30 | .14 |
| | | | | | | | | 35 | .15 |
| | | | | | | | | 40 | .18 |
| | | | | | | | | 45 | .20 |
| | | | | | | | | 50 | .21 |
| | | | | | | | | 55 | .19 |

Table BII. Continued

(c) Continued

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface |  | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Type | Wetness |  |  |  |
| 4 | 25 | 19 | $134.8 \times 10^3$ | 891.9 | Asphalt | Packed snow on ice | Main | 25 | 0.16 |
|  |  |  |  |  |  |  |  | 30 | .17 |
|  |  |  |  |  |  |  |  | 35 | .19 |
|  |  |  |  |  |  |  |  | 40 | .19 |
|  |  |  |  |  |  |  |  | 45 | .19 |
|  |  |  |  |  |  |  |  | 50 | .18 |
|  |  |  |  |  |  |  |  | 55 | .18 |
|  |  |  |  |  |  |  |  | 60 | .18 |
| 5 | 25 | 1 | $133.2 \times 10^3$ | 891.8 | Asphalt | Packed snow on ice | Main | 30 | .16 |
|  |  |  |  |  |  |  |  | 35 | .17 |
|  |  |  |  |  |  |  |  | 40 | .19 |
|  |  |  |  |  |  |  |  | 45 | .19 |
|  |  |  |  |  |  |  |  | 50 | .19 |
|  |  |  |  |  |  |  |  | 55 | .19 |
|  |  |  |  |  |  |  |  | 60 | .19 |
|  |  |  |  |  |  |  |  | 65 | .20 |
|  |  |  |  |  |  |  |  | 70 | .20 |
|  |  |  |  |  |  |  |  | 75 | .19 |
|  |  |  |  |  |  |  |  | 80 | .19 |
|  |  |  |  |  |  |  |  | 85 | .19 |
|  |  |  |  |  |  |  |  | 90 | .18 |
|  |  |  |  |  |  |  |  | 95 | .17 |
| 5R1 | 25 | 19 | $131.3 \times 10^3$ | 892.2 | Asphalt | UCAR on snow/ice | Main | 25 | .14 |
|  |  |  |  |  |  |  |  | 30 | .16 |
|  |  |  |  |  |  |  |  | 35 | .18 |
|  |  |  |  |  |  |  |  | 40 | .18 |
|  |  |  |  |  |  |  |  | 45 | .19 |
|  |  |  |  |  |  |  |  | 50 | .19 |
|  |  |  |  |  |  |  |  | 55 | .19 |
|  |  |  |  |  |  |  |  | 60 | .18 |
|  |  |  |  |  |  |  |  | 65 | .18 |
|  |  |  |  |  |  |  |  | 70 | .17 |
| 5R2 | 25 | 1 | $128.3 \times 10^3$ | 892.0 | Asphalt | UCAR on snow/ice | Main | 50 | .17 |
|  |  |  |  |  |  |  |  | 55 | .14 |
|  |  |  |  |  |  |  |  | 60 | .19 |
|  |  |  |  |  |  |  |  | 65 | .18 |
|  |  |  |  |  |  |  |  | 70 | .15 |
|  |  |  |  |  |  |  |  | 75 | .12 |
|  |  |  |  |  |  |  |  | 80 | .10 |
|  |  |  |  |  |  |  |  | 85 | .12 |

Table BII. Continued

(c) Continued

| | | | | | Test surface | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Type | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
| 1 | 26 | 19 | $132.7 \times 10^3$ | 893.6 | Asphalt | Rain wet | Main | 40 | 0.42 |
| | | | | | | | | 45 | .39 |
| | | | | | | | | 50 | .34 |
| | | | | | | | | 55 | .32 |
| | | | | | | | | 60 | .33 |
| | | | | | | | | 65 | .34 |
| | | | | | | | | 70 | .31 |
| | | | | | | | | 75 | .28 |
| | | | | | | | | 80 | .29 |
| 2 | 26 | 19 | $129.4 \times 10^3$ | 984.7 | Asphalt | Rain wet | Main | 40 | .26 |
| | | | | | | | | 45 | .28 |
| | | | | | | | | 50 | .29 |
| | | | | | | | | 55 | .30 |
| | | | | | | | | 60 | .30 |
| L1 | 27 | 19 | $115.0 \times 10^3$ | 895.1 | Asphalt | Rain wet | Main and nose with reverse | 25 | .04 |
| | | | | | | | | 30 | .04 |
| | | | | | | | | 35 | .04 |
| | | | | | | | | 40 | .04 |
| | | | | | | | | 45 | .05 |
| | | | | | | | | 50 | .08 |
| | | | | | | | | 55 | .10 |
| | | | | | | | | 60 | .12 |
| | | | | | | | | 65 | .13 |
| | | | | | | | | 70 | .14 |
| | | | | | | | | 75 | .10 |
| | | | | | | | | 80 | .06 |
| | | | | | | | | 85 | .03 |
| | | | | | | | | 90 | .00 |
| | | | | | | | | 95 | .01 |
| | | | | | | | | 100 | .04 |
| | | | | | | | | 105 | .09 |
| 1 | 28 | 1 | $131.6 \times 10^3$ | 895.2 | Asphalt | Ice | Main and nose | 15 | .06 |

Table BII. Continued

(c) Concluded

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 2 | 28 | 19 | $131.2 \times 10^3$ | 895.3 | Asphalt | Ice | Main | 40 | 0.06 |
| | | | | | | | | 45 | .05 |
| | | | | | | | | 50 | .04 |
| | | | | | | | | 55 | .03 |
| | | | | | | | | 60 | .00 |
| 3 | 28 | 1 | $130.7 \times 10^3$ | 894.4 | Asphalt | Ice | Main | 55 | .02 |
| | | | | | | | | 60 | .01 |
| | | | | | | | | 65 | .02 |
| | | | | | | | | 70 | .04 |
| | | | | | | | | 75 | .02 |
| 4 | 28 | 1 | $130.1 \times 10^3$ | 895.5 | Asphalt | Ice | Main | 65 | .02 |
| | | | | | | | | 70 | .02 |
| | | | | | | | | 75 | .03 |
| | | | | | | | | 80 | .05 |
| | | | | | | | | 85 | .05 |
| 1 | 29 | 19 | $126.4 \times 10^3$ | 896.0 | Asphalt | UCAR on ice | Main and nose | 15 | .07 |
| | | | | | | | | 20 | .07 |
| 4 | 29 | 1 | $125.9 \times 10^3$ | 896.0 | Asphalt | UCAR on ice | Main | 25 | .33 |
| | | | | | | | | 30 | .32 |
| | | | | | | | | 35 | .32 |
| | | | | | | | | 40 | .36 |
| | | | | | | | | 45 | .32 |
| | | | | | | | | 50 | .34 |
| | | | | | | | | 55 | .27 |
| | | | | | | | | 60 | .33 |
| | | | | | | | | 65 | .29 |
| | | | | | | | | 70 | .26 |
| | | | | | | | | 75 | .27 |
| | | | | | | | | 80 | .29 |
| | | | | | | | | 85 | .27 |

Table BII. Continued

(d) Langley Air Force Base

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 1 | 7 | 7 | $125.6 \times 10^3$ | 896.0 | PCC | Dry | Main | 20 | 0.47 |
| | | | | | | | | 25 | .46 |
| | | | | | | | | 30 | .15 |
| | | | | | | | | 35 | .44 |
| | | | | | | | | 40 | .55 |
| | | | | | | | | 45 | .48 |
| | | | | | | | | 50 | .50 |
| | | | | | | | | 55 | .46 |
| | | | | | | | | 60 | .48 |
| | | | | | | | | 65 | .45 |
| | | | | | | | | 70 | .46 |
| | | | | | | | | 75 | .43 |
| | | | | | | | | 80 | .42 |

(e) Portland International Jetport

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| P1 | 27 | 11 | $135.3 \times 10^3$ | 896.2 | PFC | Rain wet | Main | 35 | 0.36 |
| | | | | | | | | 40 | .40 |
| | | | | | | | | 45 | .39 |
| | | | | | | | | 50 | .33 |
| | | | | | | | | 55 | .33 |
| | | | | | | | | 60 | .33 |
| | | | | | | | | 65 | .36 |
| | | | | | | | | 70 | .32 |
| | | | | | | | | 75 | .33 |
| | | | | | | | | 80 | .32 |
| | | | | | | | | 85 | .29 |
| | | | | | | | | 90 | .34 |
| | | | | | | | | 95 | .31 |
| | | | | | | | | 100 | .22 |

Table BII. Concluded

(f) Pease Air Force Base

| Run | Flt | Test R/W | A/C gross weight, lb | A/C c.g. station | Test surface | | Type of braking | Ground speed, knots | Effective braking friction coefficient |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Type | Wetness | | | |
| 2 | 27 | 16 | $130.0 \times 10^3$ | 894.0 | PFC | Rain wet | Main | 40 | 0.45 |
| | | | | | | | | 45 | .42 |
| | | | | | | | | 50 | .43 |
| | | | | | | | | 55 | .43 |
| | | | | | | | | 60 | .39 |
| | | | | | | | | 65 | .41 |
| | | | | | | | | 70 | .44 |
| | | | | | | | | 75 | .42 |
| | | | | | | | | 80 | .41 |
| | | | | | | | | 85 | .42 |
| | | | | | | | | 90 | .41 |
| | | | | | | | | 95 | .40 |
| | | | | | | | | 100 | .39 |
| 1 | 27 | 16 | $128.6 \times 10^3$ | 894.4 | PFC | Rain wet | Main | 25 | .43 |
| | | | | | | | | 30 | .43 |
| | | | | | | | | 35 | .42 |
| | | | | | | | | 40 | .46 |
| | | | | | | | | 45 | .41 |
| | | | | | | | | 50 | .41 |
| | | | | | | | | 55 | .37 |
| | | | | | | | | 60 | .40 |
| | | | | | | | | 65 | .43 |
| | | | | | | | | 70 | .40 |
| | | | | | | | | 75 | .40 |
| | | | | | | | | 80 | .37 |
| | | | | | | | | 85 | .34 |
| 2R1 | 27 | 16 | $125.4 \times 10^3$ | 895.9 | PFC | Rain wet | Main | 40 | .43 |
| | | | | | | | | 45 | .43 |
| | | | | | | | | 50 | .43 |
| | | | | | | | | 55 | .41 |
| | | | | | | | | 60 | .38 |
| | | | | | | | | 65 | .42 |
| | | | | | | | | 70 | .44 |
| | | | | | | | | 75 | .43 |
| | | | | | | | | 80 | .42 |
| | | | | | | | | 85 | .41 |
| | | | | | | | | 90 | .40 |
| | | | | | | | | 95 | .39 |

Table BIII. Ground-Vehicle Dry-Surface Friction Data Obtained at Wallops Flight Facility and FAA Technical Center

[Includes friction data obtained during previous tests]

| Test site | Test surface | Speed, mph | Average friction coefficient | | | | |
|---|---|---|---|---|---|---|---|
| | | | Mu-Meter | BV-11 | SFT | RFT | DBV |
| Wallops | SSA | 10 | | | | | 0.67 |
| | | 20 | | | | 0.87 | .54 |
| | | 30 | | | | | .59 |
| | | 40 | 0.81 | 0.90 | | .78 | .72 |
| | | 50 | | | | | .76 |
| | | 60 | .81 | | | .74 | .76 |
| Wallops | A | 10 | 0.81 | | | | 0.81 |
| | | 20 | .88 | 1.08 | 0.99 | 0.90 | .78 |
| | | 30 | .88 | | | | .87 |
| | | 40 | .90 | 1.01 | .98 | .83 | .92 |
| | | 50 | .89 | | | | .95 |
| | | 60 | .90 | .96 | .96 | .80 | .87 |
| Wallops | B | 10 | | | | | 0.80 |
| | | 20 | 0.87 | 1.08 | 0.99 | 0.96 | .73 |
| | | 30 | .87 | | | | .77 |
| | | 40 | .89 | 1.04 | .98 | .87 | .84 |
| | | 50 | .88 | | | | .86 |
| | | 60 | .91 | .98 | .98 | .83 | .84 |
| FAATC | B | 10 | | | | | 0.78 |
| | | 20 | 0.78 | 0.98 | 0.98 | 0.85 | .60 |
| | | 30 | | | | | .60 |
| | | 40 | .78 | .99 | .88 | .78 | .66 |
| | | 50 | | | | | .76 |
| | | 60 | .77 | .98 | .82 | .73 | .78 |
| FAATC | C | 10 | | | | | 0.80 |
| | | 20 | 0.84 | 0.99 | 0.99 | 0.97 | .74 |
| | | 30 | | | | | .74 |
| | | 40 | .85 | .98 | .99 | .90 | .72 |
| | | 50 | | | | | .83 |
| | | 60 | .86 | .97 | .96 | .86 | .83 |
| FAATC | D | 10 | | | | | 0.94 |
| | | 20 | 0.88 | 0.98 | 0.99 | | .83 |
| | | 30 | | | | | .83 |
| | | 40 | .89 | .99 | .93 | | .83 |
| | | 50 | | | | | .83 |
| | | 60 | .90 | .96 | .88 | | .74 |

## Table BIV. Ground-Vehicle Friction Data Obtained During Wet-Surface Boeing 727 Test Runs at Wallops Flight Facility and FAA Technical Center

### (a) Diagonal-braked vehicle

| | | | | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wallops | | | FAA Technical Center | | |
| A/C run | Vehicle run | Time from A/C run, min[a] | Test speed, mph | SSA[b] | A[b] | B[b] | B | C | D |
| 4A | 16 | −3 | 10 | 0.90 | | | | | |
| | | | 20 | .80 | | | | | |
| | | | 30 | .76 | | | | | |
| | | | 40 | .68 | | | | | |
| | | | 50 | .58 | | | | | |
| | | | 60 | .46 | | | | | |
| | 17 | +3 | 10 | .92 | | | | | |
| | | | 20 | .82 | | | | | |
| | | | 30 | .70 | | | | | |
| | | | 40 | .58 | | | | | |
| | | | 50 | .48 | | | | | |
| | | | 60 | .44 | | | | | |
| 4B | 18 | −1 | 10 | .94 | | | | | |
| | | | 20 | .82 | | | | | |
| | | | 30 | .72 | | | | | |
| | | | 40 | .62 | | | | | |
| | | | 50 | .54 | | | | | |
| | | | 60 | .42 | | | | | |
| | 19 | +3 | 10 | .86 | | | | | |
| | | | 20 | .78 | | | | | |
| | | | 30 | .70 | | | | | |
| | | | 40 | .60 | | | | | |
| | | | 50 | .48 | | | | | |
| | | | 60 | .42 | | | | | |
| 4C | 20 | −2 | 10 | .90 | | | | | |
| | | | 20 | .80 | | | | | |
| | | | 30 | .72 | | | | | |
| | | | 40 | .64 | | | | | |
| | | | 50 | .58 | | | | | |
| | | | 60 | .44 | | | | | |
| | 21 | +3 | 10 | .92 | | | | | |
| | | | 20 | .84 | | | | | |
| | | | 30 | .76 | | | | | |
| | | | 40 | .60 | | | | | |
| | | | 50 | .52 | | | | | |
| | | | 60 | .44 | | | | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.
[b] Rain-damp data.

Table BIV. Continued

(a) Continued

| | | | | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wallops | | | FAA Technical Center | | |
| A/C run | Vehicle run | Time from A/C run, min[a] | Test speed, mph | SSA[b] | A[b] | B[b] | B | C | D |
| 5 | 22 | −3 | 10 | 0.92 | | | | | |
| | | | 20 | .84 | | | | | |
| | | | 30 | .72 | | | | | |
| | | | 40 | .60 | | | | | |
| | | | 50 | .52 | | | | | |
| | | | 60 | .44 | | | | | |
| | 23 | +2 | 10 | .90 | | | | | |
| | | | 20 | .80 | | | | | |
| | | | 30 | .70 | | | | | |
| | | | 40 | .62 | | | | | |
| | | | 50 | .56 | | | | | |
| | | | 60 | .44 | | | | | |
| 6 | 24 | −7 | 10 | | | 0.68 | | | |
| | | | 20 | | | .60 | | | |
| | | | 30 | | | .54 | | | |
| | | | 40 | | 0.24 | | | | |
| | | | 50 | | .20 | | | | |
| | 26 | −1 | 10 | | .54 | | | | |
| | | | 20 | | .38 | | | | |
| | | | 30 | | .30 | | | | |
| | | | 40 | | | .48 | | | |
| | | | 50 | | | .44 | | | |
| | | | 60 | | | .44 | | | |
| | 27 | +2 | 10 | | | .68 | | | |
| | | | 20 | | | .58 | | | |
| | | | 30 | | .38 | | | | |
| | | | 40 | | .30 | | | | |
| | | | 50 | | .20 | | | | |
| 7 | 28 | −3 | 10 | | | .64 | | | |
| | | | 20 | | | .60 | | | |
| | | | 30 | | | .58 | | | |
| | | | 40 | | | .54 | | | |
| | | | 50 | | | .48 | | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.
[b] Rain-damp data.

Table BIV. Continued

(a) Continued

| A/C run | Vehicle run | Time from A/C run, min[a] | Test speed, mph | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wallops | | | FAA Technical Center | | |
| | | | | SSA | A | B | B | C | D |
| 7 | 29 | +4 | 10 | | [b]0.58 | | | | |
| | | | 20 | | .40 | | | | |
| | | | 30 | | .34 | | | | |
| | ↓ | ↓ | 40 | | .30 | | | | |
| | 30 | +6 | 10 | | | [b]0.68 | | | |
| | | | 20 | | | .58 | | | |
| | | | 30 | | | .56 | | | |
| ↓ | ↓ | ↓ | 40 | | | .54 | | | |
| 18 | 9 | −2 | 50 | | .10 | | | | |
| | 9 | −2 | 55 | | .08 | | | | |
| | 9 | −2 | 60 | | .10 | | | | |
| | 10 | +2 | 55 | | .10 | | | | |
| ↓ | 10 | +2 | 50 | | .12 | | | | |
| 27 | 11 | −2 | 10 | | | | | 0.76 | |
| | | | 20 | | | | | .66 | |
| | | | 30 | | | | | .58 | |
| | | | 40 | | | | | .46 | |
| | | | 50 | | | | | .46 | |
| | ↓ | ↓ | 60 | | | | | .42 | |
| | 12 | +2 | 10 | | | | | .76 | |
| | | | 20 | | | | | .68 | |
| | | | 30 | | | | | .62 | |
| | | | 40 | | | | | .56 | |
| | | | 50 | | | | | .50 | |
| ↓ | ↓ | ↓ | 60 | | | | | .48 | |
| 12 | 1 | −2 | 10 | 0.84 | | | | | |
| | | | 20 | .78 | | | | | |
| | | | 30 | .66 | | | | | |
| | | | 40 | .58 | | | | | |
| | | | 50 | .50 | | | | | |
| | ↓ | ↓ | 60 | .34 | | | | | |
| | 2 | +3 | 10 | .84 | | | | | |
| | | | 20 | .76 | | | | | |
| | | | 30 | .70 | | | | | |
| | | | 40 | .60 | | | | | |
| | | | 50 | .50 | | | | | |
| ↓ | ↓ | ↓ | 60 | .44 | | | | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.
[b] Rain-damp data.

Table BIV. Continued

(a) Concluded

| A/C run | Vehicle run | Time from A/C run, min[a] | Test speed, mph | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wallops | | | FAA Technical Center | | |
| | | | | SSA | A | B | B | C | D |
| 13 | 3 | −3 | 10 | 0.88 | | | | | |
| | | | 20 | .80 | | | | | |
| | | | 30 | .72 | | | | | |
| | | | 40 | .56 | | | | | |
| | | | 50 | .42 | | | | | |
| | | | 60 | .36 | | | | | |
| | 4 | +3 | 10 | .90 | | | | | |
| | | | 20 | .80 | | | | | |
| | | | 30 | .72 | | | | | |
| | | | 40 | .64 | | | | | |
| | | | 50 | .54 | | | | | |
| | | | 60 | .50 | | | | | |
| 15 | 5 | −1 | 30 | | | 0.48 | | | |
| | | | 35 | | | .46 | | | |
| | | | 40 | | | .42 | | | |
| | | | 45 | | | .40 | | | |
| | | | 50 | | | .42 | | | |
| | | | 55 | | | .40 | | | |
| | | | 60 | | | .38 | | | |
| 17 | 7 | −1 | 40 | | | .40 | | | |
| | | | 45 | | | .38 | | | |
| | | | 50 | | | .36 | | | |
| | | | 55 | | | .40 | | | |
| | | | 60 | | | .40 | | | |
| | 8 | +2 | 30 | | | .52 | | | |
| | | | 35 | | | .46 | | | |
| | | | 40 | | | .42 | | | |
| | | | 45 | | | .40 | | | |
| | | | 50 | | | .38 | | | |
| | | | 55 | | | .40 | | | |
| | | | 60 | | | .36 | | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

Table BIV. Continued

(b) Mu-Meter

| A/C run | Vehicle run | Time from A/C run, min[a] | Test speed, mph | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wallops | | | FAA Technical Center | | |
| | | | | SSA | A | B | B | C | D |
| 12 | 1 | −3 | 20 | 0.72 | | | | | |
| | | | 30 | .71 | | | | | |
| | | | 40 | .63 | | | | | |
| | | | 50 | .57 | | | | | |
| | ↓ | ↓ | 60 | .42 | | | | | |
| | 2 | +2 | 20 | .70 | | | | | |
| | | | 30 | .70 | | | | | |
| | | | 40 | .68 | | | | | |
| | | | 50 | .65 | | | | | |
| ↓ | ↓ | ↓ | 60 | .60 | | | | | |
| 13 | 3 | −4 | 20 | .73 | | | | | |
| | | | 30 | .71 | | | | | |
| | | | 40 | .65 | | | | | |
| | | | 50 | .56 | | | | | |
| | ↓ | ↓ | 60 | .38 | | | | | |
| | 4 | +2 | 20 | .68 | | | | | |
| | | | 30 | .69 | | | | | |
| | | | 40 | .66 | | | | | |
| | | | 50 | .68 | | | | | |
| ↓ | ↓ | ↓ | 60 | .63 | | | | | |
| 15 | 8 | −3 | 40 | | 0.35 | 0.65 | | | |
| 15 | 9 | +1 | | | .38 | .65 | | | |
| 17 | 10 | −2 | | | .35 | .65 | | | |
| 17 | 11 | +1 | | | .35 | .66 | | | |
| 18 | 12 | −2 | | | .29 | | | | |
| 18 | 13 | +2 | | | .33 | | | | |
| 27 | 14 | −2 | | | | | | 0.69 | |
| 27 | 15 | +2 | | | | | | .69 | |
| R27 | 31 | −2 | | | | | | .75 | |
| R27 | 32 | +1 | | | | | | .74 | |
| 28 | 33 | −3 | | | | | | | 0.75 |
| 28 | 34 | +1 | | | | | | | .75 |
| R28 | 35 | −8 | | | | | | | .74 |
| R28 | 36 | +1 | | | | | | | .75 |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

Table BIV. Continued

(b) Concluded

| A/C run | Vehicle run | Time from A/C run, min[a] | Test speed, mph | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wallops | | | FAA Technical Center | | |
| | | | | SSA | A | B | B | C | D |
| 33 | 37 | −9 | | | | | 0.68 | | |
| 33 | 38 | +1 | | | | | .73 | | |
| 32 | 39 | −2 | | | | | .65 | | |
| 32 | 40 | +2 | | | | | .63 | | |
| 31 | 41 | −2 | | | | | .63 | | |
| 31 | 42 | +1 | | | | | .61 | | |
| 30 | 43 | −3 | | | | | .70 | | |
| 30 | 44 | +2 | | | | | .74 | | |
| 29 | 45 | −3 | | | | | .61 | | |
| 29 | 46 | +1 | | | | | .57 | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

Table BIV. Continued

(c) Surface friction tester

| A/C run | Vehicle run | Time from A/C run, min[a] | Test speed, mph | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wallops | | | FAA Technical Center | | |
| | | | | SSA | A | B | B | C | D |
| 12 | 1 | −2 | 20 | 0.98 | | | | | |
| | | | 30 | .93 | | | | | |
| | | | 40 | .86 | | | | | |
| | | | 50 | .78 | | | | | |
| | | | 60 | .73 | | | | | |
| | 2 | +2 | 20 | .98 | | | | | |
| | | | 30 | .94 | | | | | |
| | | | 40 | .88 | | | | | |
| | | | 50 | .85 | | | | | |
| | | | 60 | .83 | | | | | |
| 13 | 3 | −3 | 20 | .98 | | | | | |
| | | | 30 | .92 | | | | | |
| | | | 40 | .88 | | | | | |
| | | | 50 | .82 | | | | | |
| | | | 60 | .72 | | | | | |
| | 4 | +3 | 20 | .97 | | | | | |
| | | | 30 | .94 | | | | | |
| | | | 40 | .94 | | | | | |
| | | | 50 | .90 | | | | | |
| 15 | 8 | −3 | 40 | | 0.42 | 0.76 | | | |
| 15 | 9 | +2 | | | .47 | .81 | | | |
| 17 | 10 | −2 | | | .52 | .83 | | | |
| 17 | 11 | +2 | | | .42 | .80 | | | |
| 18 | 12 | −2 | | | .63 | .90 | | | |
| 18 | 13 | +2 | | | .62 | .86 | | | |
| R27 | 31 | −1 | | | | | | 0.95 | |
| R27 | 32 | +3 | | | | | | .97 | |
| 28 | 33 | −1 | | | | | | | 0.98 |
| 28 | 34 | +2 | | | | | | | .96 |
| R28 | 35 | −5 | | | | | | | .97 |
| R28 | 36 | +1 | | | | | | | .98 |
| 33 | 37 | −8 | | | | | 0.85 | | |
| 33 | 38 | +2 | | | | | .93 | | |
| 32 | 39 | −1 | | | | | .86 | | |
| 32 | 40 | +3 | | | | | .88 | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

Table BIV. Continued

(c) Concluded

| | | | | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wallops | | | FAA Technical Center | | |
| A/C run | Vehicle run | Time from A/C run, min[a] | Test speed, mph | SSA | A | B | B | C | D |
| 31 | 41 | −2 | | | | | 0.83 | | |
| 31 | 42 | +2 | | | | | .88 | | |
| 30 | 43 | −1 | | | | | .90 | | |
| 30 | 44 | +1 | | | | | .93 | | |
| 29 | 45 | −1 | | | | | .87 | | |
| 29 | 46 | +3 | | | | | .93 | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

Table BIV. Continued

(d) BV-11 skiddometer

| A/C run | Vehicle run | Time from A/C run, min[a] | Test speed, mph | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wallops | | | FAA Technical Center | | |
| | | | | SSA | A | B | B | C | D |
| 12 | 1 | −3 | 20 | 0.98 | | | | | |
| | | | 30 | .97 | | | | | |
| | | | 40 | .95 | | | | | |
| | | | 50 | .84 | | | | | |
| | ↓ | ↓ | 60 | .83 | | | | | |
| | 2 | +2 | 20 | .98 | | | | | |
| | | | 30 | .97 | | | | | |
| | | | 40 | .97 | | | | | |
| | | | 50 | .95 | | | | | |
| ↓ | ↓ | ↓ | 60 | .95 | | | | | |
| 13 | 3 | −4 | 20 | .98 | | | | | |
| | | | 30 | .95 | | | | | |
| | | | 40 | .86 | | | | | |
| | | | 50 | .83 | | | | | |
| | ↓ | ↓ | 60 | .86 | | | | | |
| | 4 | +2 | 20 | .98 | | | | | |
| | | | 30 | .97 | | | | | |
| | | | 40 | .94 | | | | | |
| | | | 50 | .92 | | | | | |
| ↓ | ↓ | ↓ | 60 | .88 | | | | | |
| 15 | 8 | −3 | 40 | | 0.57 | 0.88 | | | |
| 15 | 9 | +1 | | | .62 | .84 | | | |
| 17 | 10 | −2 | | | .55 | .87 | | | |
| 17 | 11 | +1 | | | .65 | .88 | | | |
| 18 | 12 | −2 | | | .51 | | | | |
| 18 | 13 | +2 | | | .61 | | | | |
| 33 | 37 | −9 | | | | | 0.62 | | |
| 33 | 38 | +1 | | | | | .75 | | |
| 31 | 41 | −2 | | | | | .52 | | |
| 31 | 42 | +1 | | | | | .58 | | |
| 30 | 43 | −1 | | | | | .57 | | |
| 30 | 44 | +1 | | | | | .61 | | |
| 29 | 45 | −4 | | | | | .53 | | |
| 29 | 46 | +1 | | | | | .50 | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

Table BIV. Concluded

(e) Runway friction tester

| A/C run | Vehicle run | Time from A/C run, min[a] | Test speed, mph | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wallops | | | FAA Technical Center | | |
| | | | | SSA | A | B | B | C | D |
| 12 | 1 | −2 | 20 | 0.83 | | | | | |
| | | | 30 | .76 | | | | | |
| | | | 40 | .70 | | | | | |
| | | | 50 | .67 | | | | | |
| | ↓ | ↓ | 60 | .55 | | | | | |
| | 2 | +2 | 20 | .84 | | | | | |
| | | | 30 | .82 | | | | | |
| | | | 40 | .78 | | | | | |
| | | | 50 | .74 | | | | | |
| ↓ | ↓ | ↓ | 60 | .62 | | | | | |
| 13 | 3 | −3 | 20 | .79 | | | | | |
| | 3 | −3 | 30 | .74 | | | | | |
| | 3 | −3 | 40 | .68 | | | | | |
| | 4 | +3 | 20 | .83 | | | | | |
| | | | 30 | .82 | | | | | |
| | | | 40 | .77 | | | | | |
| ↓ | ↓ | ↓ | 50 | .75 | | | | | |
| 15 | 8 | −3 | 40 | | 0.48 | 0.72 | | | |
| 15 | 9 | +2 | | | .49 | .74 | | | |
| 17 | 10 | −2 | | | .57 | .74 | | | |
| 17 | 11 | +2 | | | .48 | .74 | | | |
| 18 | 12 | −2 | | | .42 | | | | |
| 18 | 13 | +2 | | | .42 | | | | |

[a] Minus sign denotes time before A/C run; plus sign denotes time after A/C run.

Table BV. Supplemental Ground-Vehicle Friction Data Obtained on Different Test Surfaces Under Truck-Wet Conditions

| Test vehicle | Test speed, mph | Average friction coefficient | | | | | |
|---|---|---|---|---|---|---|---|
| | | Wallops | | | FAA Technical Center | | |
| | | SSA | A | B | B | C | D |
| Mu-Meter | 10 | | | | | | |
| | 20 | 0.72 | 0.72 | 0.80 | 0.73 | 0.69 | 0.72 |
| | 30 | .70 | .60 | .78 | | | |
| | 40 | .68 | .26 | .76 | .70 | .69 | .71 |
| | 50 | .63 | .25 | .73 | | | |
| ↓ | 60 | .58 | .13 | .70 | .62 | .69 | .68 |
| BV-11 | 10 | | | | | | |
| | 20 | 0.94 | 0.83 | 1.01 | 0.89 | 0.98 | 0.97 |
| | 30 | .82 | .65 | 1.00 | | | |
| | 40 | .76 | .33 | .89 | .47 | .97 | .93 |
| | 50 | .72 | .27 | .92 | | | |
| ↓ | 60 | .65 | .18 | .60 | .20 | .93 | .91 |
| SFT | 10 | | | | | | |
| | 20 | 0.96 | 0.72 | 0.88 | 0.94 | 0.98 | 0.93 |
| | 30 | .93 | .59 | .94 | | | |
| | 40 | .88 | .49 | .90 | .70 | .90 | .85 |
| | 50 | .80 | .30 | .89 | | | |
| ↓ | 60 | .70 | .07 | .62 | .45 | .88 | .80 |
| RFT | 20 | | | | 0.79 | 0.91 | 0.85 |
| RFT | 40 | 0.69 | | | .56 | .84 | .80 |
| RFT | 60 | .59 | | | .35 | .76 | |
| DBV | 10 | 0.84 | 0.56 | 0.72 | 0.78 | 0.81 | 0.80 |
| | 20 | .77 | .47 | .64 | .70 | .78 | .70 |
| | 30 | .69 | .40 | .60 | .52 | .63 | .65 |
| | 40 | .58 | .30 | .52 | .32 | .54 | .60 |
| | 50 | .45 | .15 | .48 | .22 | .50 | .53 |
| ↓ | 60 | .35 | .12 | .46 | .13 | .43 | .50 |

Table BVI. Ground-Vehicle Friction Data Obtained During Boeing 727 Tests at BNAS and Pease AFB, March 1985 and January to March 1986

| Surface condition | Run | Flt | Ambient temperature, °F | Speed, mph | Average friction coefficient for — | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Mu-Meter | RCR | Tapley | BV-11 | SFT | RFT |
| Wet snow, 1.5 in. | 3, 4 | 19 | 31 | 20 | 0.23 | 10 | 0.33 | 0.24 | 0.23 | 0.33 |
| | | | | 40 | .17 | 11 | .36 | .22 | .24 | .30 |
| | | | | 54 | .17 | 12 | .39 | | | |
| | | | | 60 | | 14 | .45 | .26 | .24 | .27 |
| Packed snow on ice | None | None | 28 | 20 | 0.22 | 7 | 0.21 | Not available | 0.25 | 0.33 |
| | | | | 40 | .16 | 7 | .22 | | .24 | .28 |
| | | | | 60 | .15 | 8 | .24 | | .24 | .29 |
| Dry snow on ice | 3, 4, 5, 5R1 | 20 | 13 | 20 | 0.23 | 8 | 0.24 | 0.29 | 0.31 | Not available |
| | | | | 30 | .23 | 8 | .24 | .31 | .29 | |
| | | | | 40 | .22 | 8 | .24 | .30 | .32 | |
| | | | | 50 | .21 | 9 | .30 | .30 | .30 | |
| | | | | 60 | .19 | 11 | .36 | .32 | .31 | |
| Dry snow on ice | None | None | 18 | 20 | 0.20 | 6 | 0.18 | 0.14 | 0.04 | Not available |
| | | | | 40 | .17 | 5 | .15 | .18 | .09 | |
| | | | | 60 | .19 | 5 | .15 | .22 | .15 | |
| Urea on ice, 15 min | None | None | 19 | 20 | 0.18 | 8 | 0.27 | 0.15 | 0.11 | Not available |
| | | | | 40 | .18 | 8 | .24 | .18 | .11 | |
| | | | | 50 | | | | .22 | .12 | |
| | | | | 60 | .18 | 7 | .21 | | .13 | |
| Urea on ice, 90 min | 1, 2, 2R2, 4 | 21 | 19 | 20 | 0.27 | 9 | 0.30 | 0.21 | 0.17 | Not available |
| | | | | 40 | .22 | 7 | .21 | .25 | .21 | |
| | | | | 50 | .26 | | | .35 | | |
| | | | | 60 | | 8 | .24 | | .18 | |
| Urea on ice, 60 min | None | None | 28 | 20 | Not available | 22 | 0.36 | 0.29 | 0.13 | Not available |
| | | | | 40 | | 15 | .48 | .09 | .10 | |
| | | | | 60 | | 18 | .57 | | .10 | |

Table BVI. Continued

| Surface condition | Run | Flt | Ambient temperature, °F | Speed, mph | Average friction coefficient for -- | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Mu-Meter | RCR | Tapley | BV-11 | SFT | RFT |
| Loose dry, snow, 2 in. | 3, 4, 5 | 23 | 33 | 20 | 0.09 | 13 | 0.39 | 0.12 | 0.13 | Not available |
| | | | | 40 | .07 | 16 | .48 | .14 | .10 | |
| | | | | 60 | .06 | 19 | .57 | .15 | .10 | |
| Packed snow on ice | 3, 4, 5 | 25 | 28 | 20 | Not available | 15 | 0.45 | 0.20 | 0.23 | 0.31 |
| | | | | 40 | | 16 | .48 | .25 | .25 | .29 |
| | | | | 60 | | 17 | .51 | .26 | .23 | .26 |
| UCAR on ice, 60 min | 5R1, 5R2 | 25 | 41 | 20 | Not available | 14 | 0.42 | 0.24 | 0.21 | 0.27 |
| | | | | 40 | | 16 | .48 | .27 | .23 | .26 |
| | | | | 60 | | 17 | .51 | .25 | .20 | .24 |
| UCAR on asphalt | None | None | 42 | 20 | Not available | 21 | 0.63 | Not available | 0.20 | 0.65 |
| | | | | 30 | | 28 | .84 | | .30 | .66 |
| | | | | 40 | | 29 | .87 | | .25 | .69 |
| | | | | 50 | | 30 | .90 | | .62 | .69 |
| | | | | 60 | | | | | .60 | .64 |
| Dry asphalt | 11, 12 | 6 | 42 | 20 | Not available | 28 | 0.84 | Not available | 0.70 | 1.08 |
| | | | | 30 | | 29 | .87 | | .75 | 1.03 |
| | | | | 40 | | 32 | .96 | | .75 | .98 |
| | | | | 50 | | 32 | .96 | | .78 | .95 |
| | | | | 60 | | | | | .75 | .93 |
| Rain wet, 0.04 to 0.06 in., Rate = 0.06 in/hr | 1, 2, L1 | 26 | 42 | 20 | 0.78 | 23 | 0.69 | 0.83 | 0.91 | 0.85 |
| | | | | 40 | .73 | 20 | .60 | .75 | .88 | .80 |
| | | | | 60 | .69 | 25 | .75 | .61 | .75 | .70 |
| Rain damp PFC at Peace AFB | 1, 2, 2R1 | 27 | 58 | 20 | 0.77 | 29 | 0.87 | 0.99 | 0.94 | 0.85 |
| | | | | 40 | .72 | 25 | .75 | .92 | | .80 |
| | | | | 60 | .72 | 25 | .75 | .85 | .81 | .70 |
| Rain damp shoulder at Pease AFB | None | None | 58 | 40 | 0.65 | 31 | 0.93 | 0.88 | 0.88 | 0.68 |

Table BVI. Concluded

| Surface condition | Run | Flt | Ambient temperature, °F | Speed, mph | Average friction coefficient for— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Mu-Meter | RCR | Tapley | BV-11 | SFT | RFT |
| Solid ice | 1 to 4 | 28 | 5 | 5 | 0.14 | 4 | 0.12 | 0.16 | 0.18 | 0.11 |
| | | | | 20 | .19 | 4 | .12 | .20 | .18 | .15 |
| | | | | 30 | .19 | 5 | .15 | .18 | .17 | .15 |
| | | | | 40 | .17 | 6 | .18 | .15 | .17 | .14 |
| | | | | 50 | .19 | 7 | .21 | .17 | .17 | .13 |
| | | | | 60 | .18 | 8 | .24 | .13 | .15 | .14 |
| UCAR on ice, 30 min | 1, 4 | 29 | 15 | 40 | 0.29 | 13 | 0.42 | 0.34 | 0.42 | 0.39 |
| 0.25-in. slush | 1, 2 | 4 | 33 | 20 | 0.66 | Not available | Not available | 0.70 | Not available | Not available |
| | | | | 40 | .41 | | | .41 | | |
| | | | | 60 | .50 | | | .39 | | |
| Truck wet | 8, 9 | 5 | 44 | 40 | 0.80 | Not available | Not available | 0.83 | Not available | Not available |
| Dry asphalt | 11, 12 | 6 | 60 | 20 | 0.84 | Not available | Not available | 0.95 | Not available | Not available |
| | | | | 40 | .85 | | | .89 | | |
| | | | | 60 | .84 | | | .84 | | |

Table BVII. Empirical Runway Condition Factors for Boeing 727 Data

| Wetness condition | Type or amount of wetness | Factor |
|---|---|---|
| Dry | None | 0 |
| Ice | 0.25 in. | 0 |
| Ice | UCAR | 0 |
| Ice | Urea | 0 |
| Wet | Rain | 0.05 |
| Wet | Truck | .05 |
| Damp | ≤0.01 in. | 0.1 |
| Slush | ≤1 in. | 0.5 |
| Snow | Packed/ice | 0.5 |
| ↓ | 1 in., loose | 3.0 |
|  | 1.5 in., wet | 1.0 |
|  | 1.5 in., loose | 2.0 |
|  | 1 to 3 in., dry | 4.5 |
|  | 4.5 in., dry | 4.0 |

Table BVIII. Aerodynamic and Geometric Data for Boeing 727 Brake Performance Data Reduction

| Symbol | Description | Value |
|---|---|---|
| $S$ | Aerodynamic reference area | 1560 ft$^2$ |
| $C_L$ | Lift coefficient, flaps 30°, spoilers up | 0.140 |
| $C_D$ | Drag coefficient, flaps 30°, spoilers up | 0.253 |
| $T_o$ | Idle thrust at Velocity = 0 | 2400 lb |
| $DT/DV$ | Gradient of thrust versus velocity | $-10.5$ lb/knot |
| $MUR$ | Rolling resistance coefficient | 0.015 |
| $CBAR$ | Reference mean aerodynamic chord | 180 in. |
| $(WL)_{cg}$ | Center-of-gravity water line | 209 in. |
| $(WL)_g$ | Ground water line | 89 in. |
| $(WL)_t$ | Thrust-application water line | 237 in. |
| $(BS)_{ng}$ | Nose-gear balance station | 311 in. |
| $(BS)_{mg}$ | Main-gear balance station | 951 in. |
| $C_m$ | Pitching-moment coefficient | Assume 0 |
| $W$ | Weight (varies with condition) | $\approx$130 000 lb |
| $(BS)_{cg}$ | Center-of-gravity balance station (varies) | $\approx$893 in. |
| $(BS)_{0.25c}$ | Quarter-chord balance station | 905.20 in. |
| $C_L$ | Lift coefficient, flaps 15°, spoilers down | 0.440 |
| $C_D$ | Drag coefficient, flaps 15°, spoilers down | 0.109 |
| $K$ | Average percent of gross weight carried by main gear | 91 |

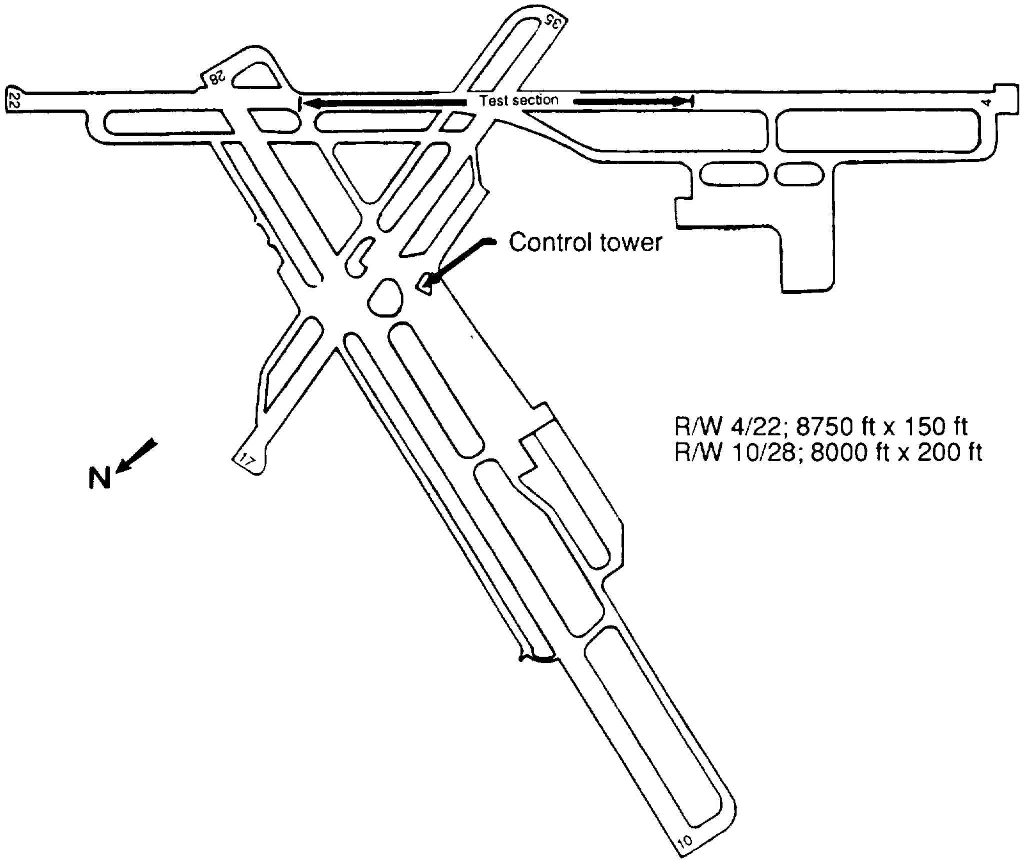
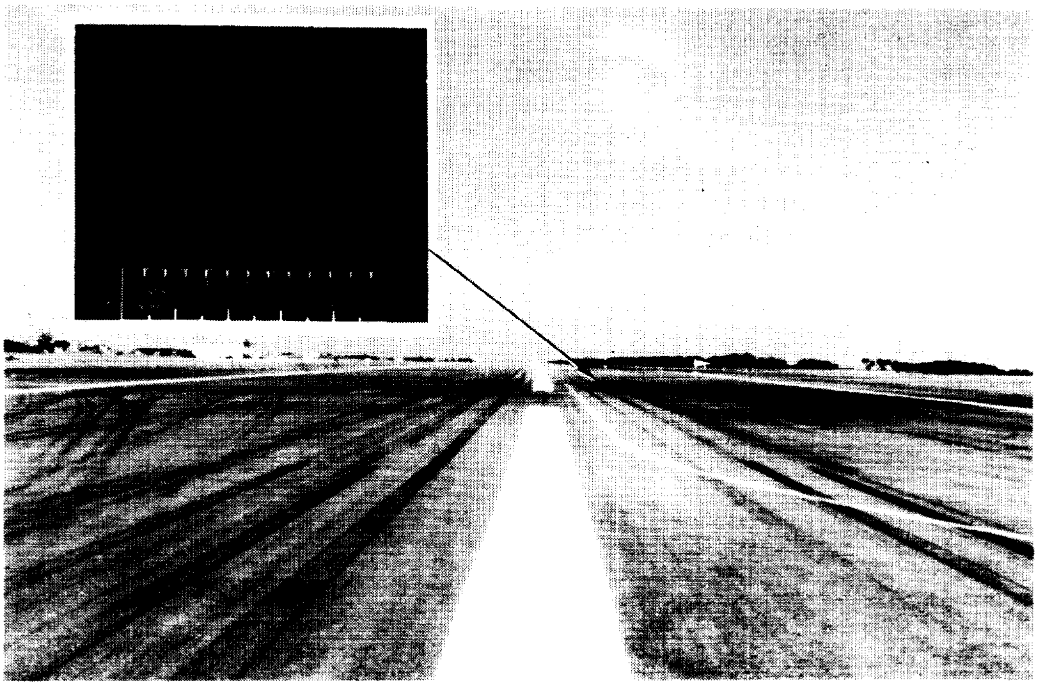


Figure 1. Schematic of runways at Wallops Flight Facility.



L-89-57

Figure 2. Runway 10/28 at Wallops Flight Facility.

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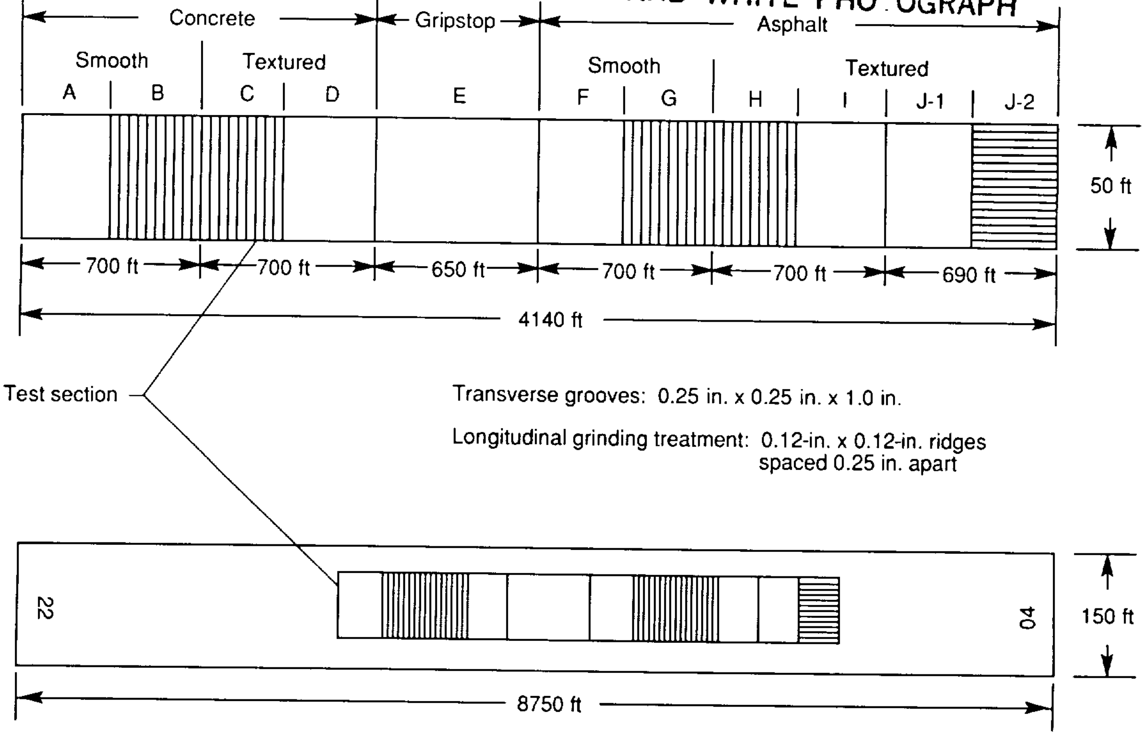
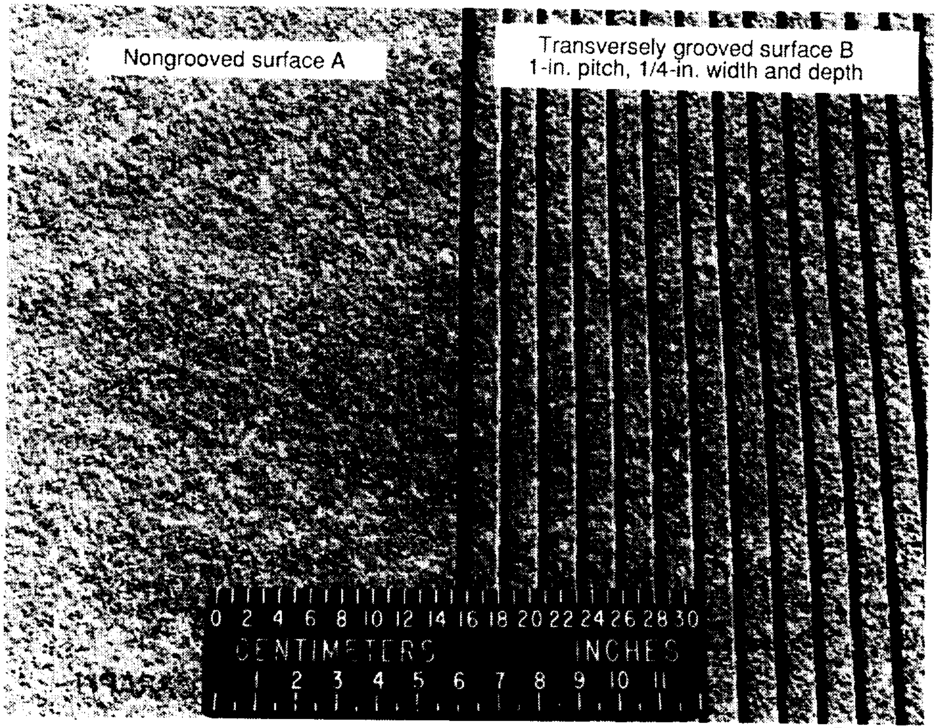


Figure 3. Schematic of runway 4/22 test surfaces at Wallops Flight Facility.



L-89-58

Figure 4. Close-up photographs of concrete test surfaces A (nongrooved) and B (transversely grooved, 1 in. × 0.25 in. × 0.25 in.) on runway 4/22 at Wallops Flight Facility.

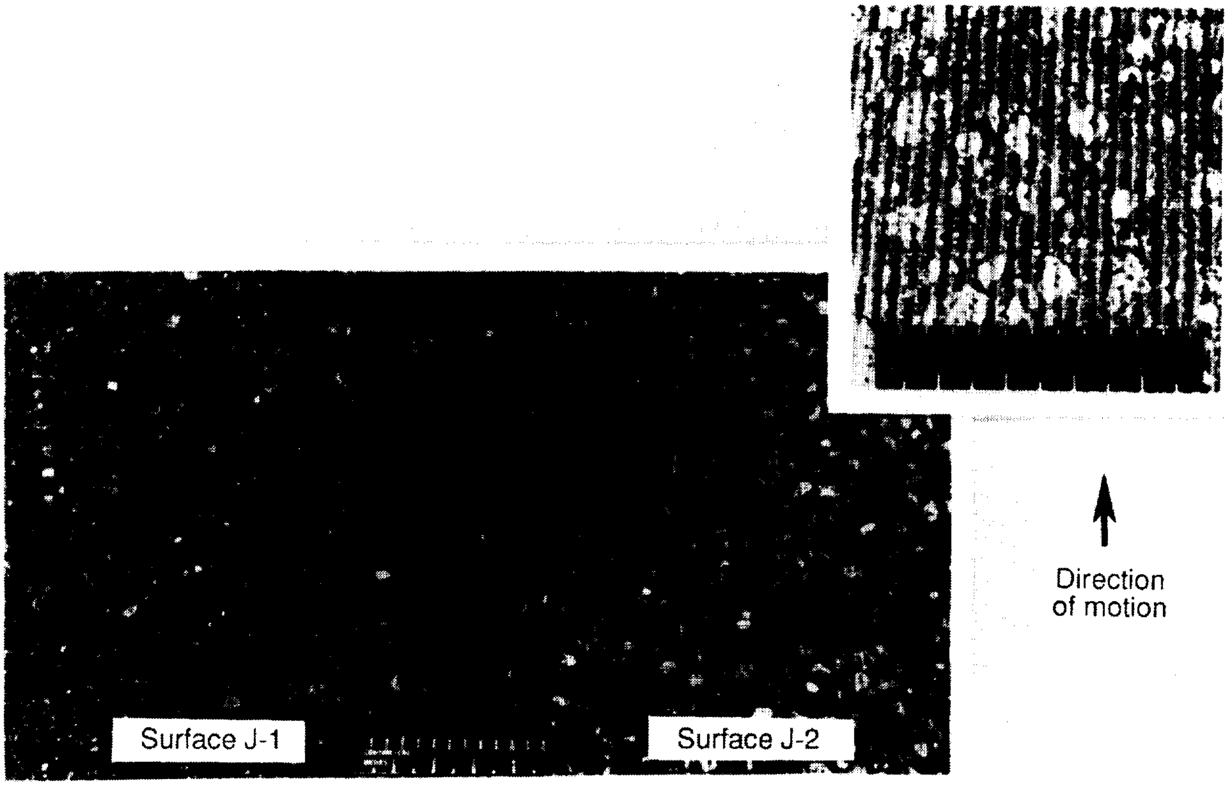


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Figure 5. New asphalt test surfaces J-1 and J-2 on runway 4/22.

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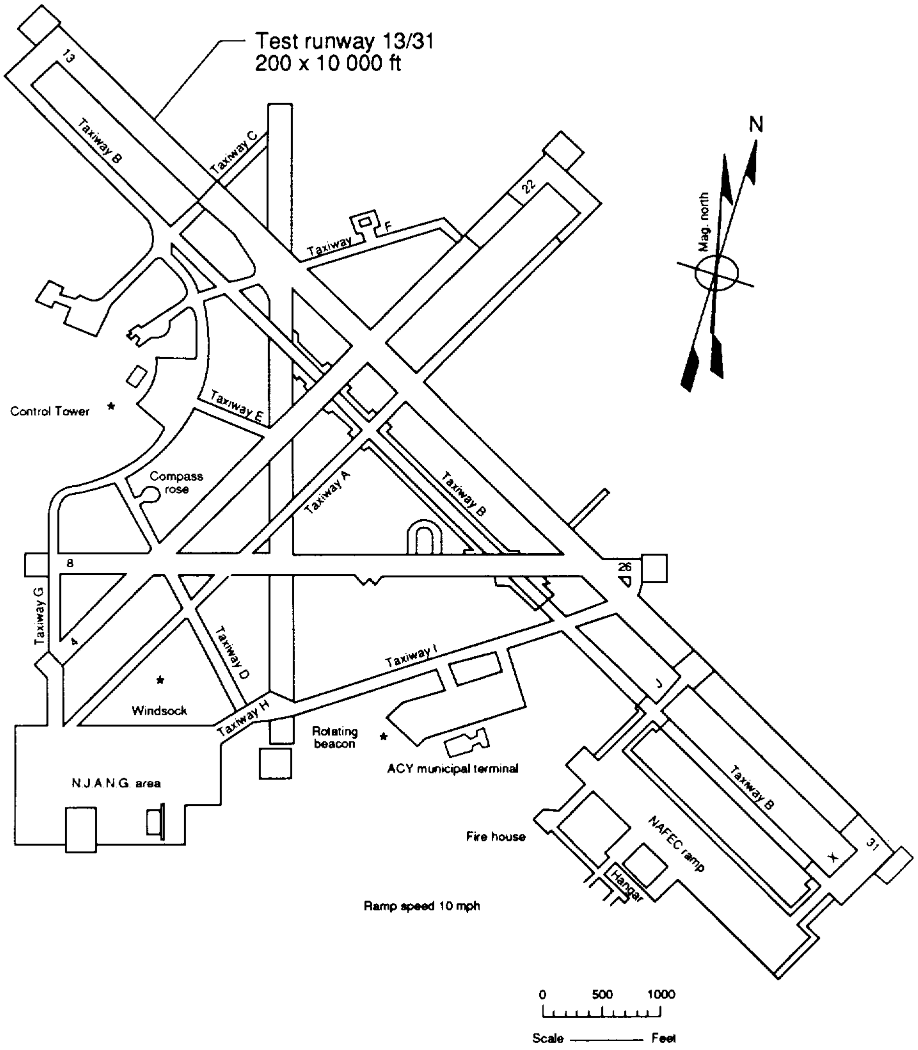


Figure 6. Runway layout at FAA Technical Center airport.

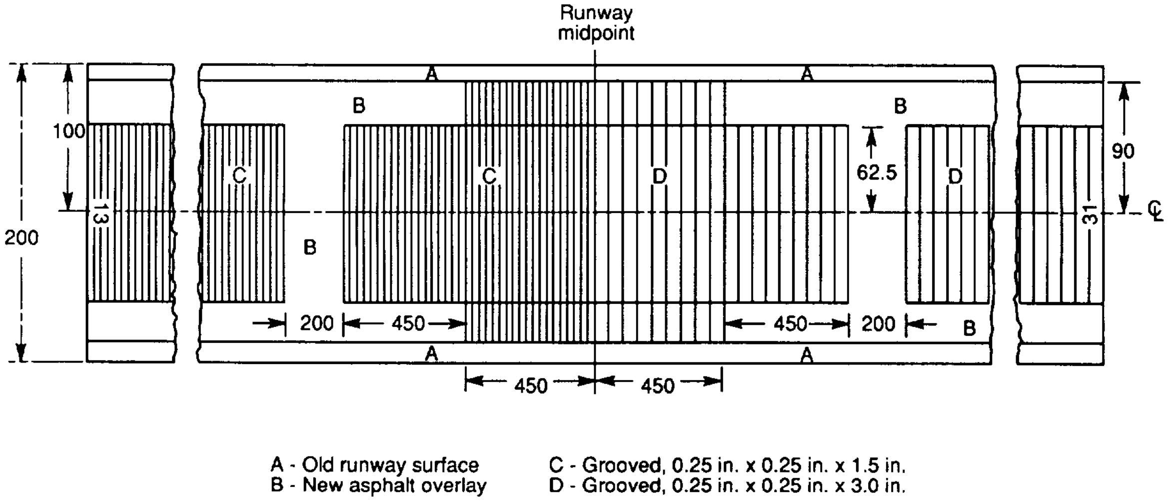
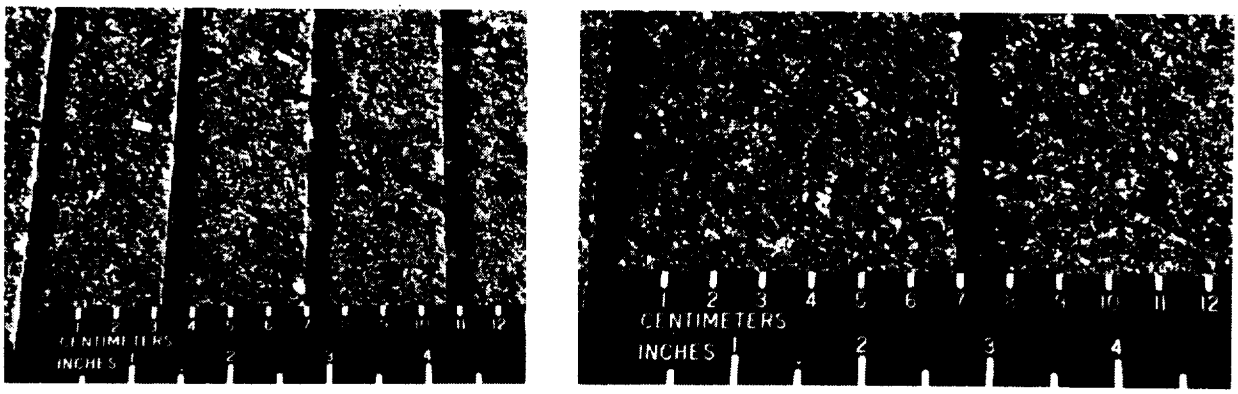


Figure 7. FAA Technical Center airport runway 13/31 test surfaces. All dimensions are in ft; drawing not to scale; surfaces C and D extend approximately 3900 ft to each end of runway.



TEST SURFACE C

TEST SURFACE D

L-89-60

Figure 8. Close-up photographs of grooved test surfaces C and D on runway 13/31 at FAA Technical Center airport.

L-89-61

Figure 9. Aerial view of Brunswick Naval Air Station. Test runway 19R/11.

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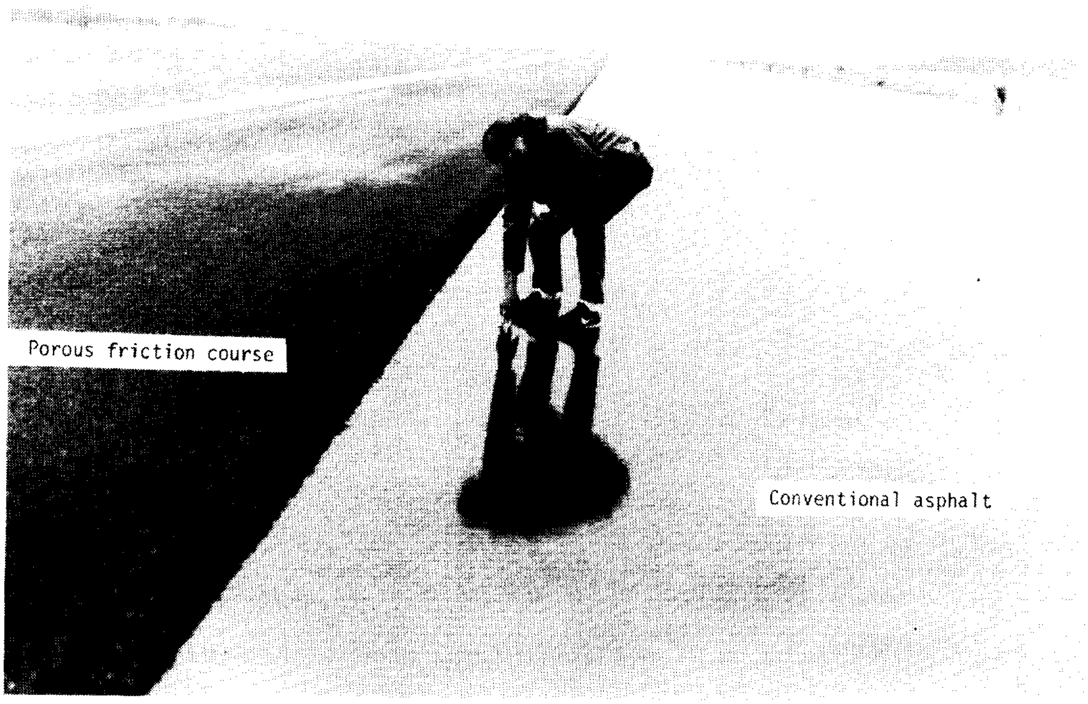
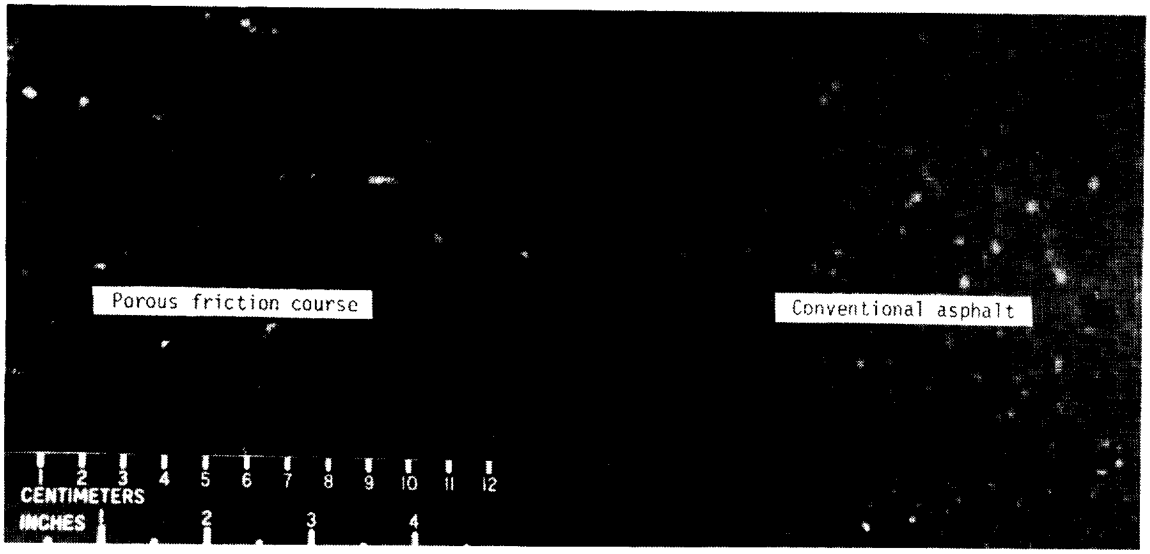


L-89-62

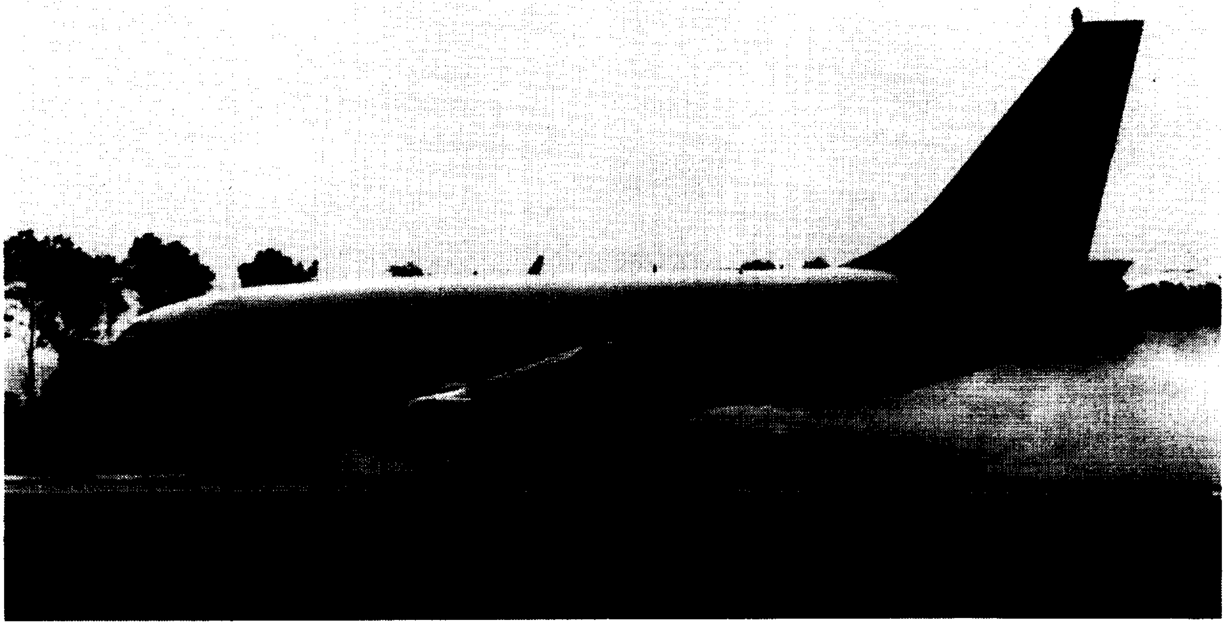
(a) Overview.



L-89-63

(b) Close-up view.

Figure 10. Porous friction course runway surface at Pease AFB under rain-wet conditions.



L-89-64

Figure 11. NASA Boeing 737 test aircraft during flooded-runway test.

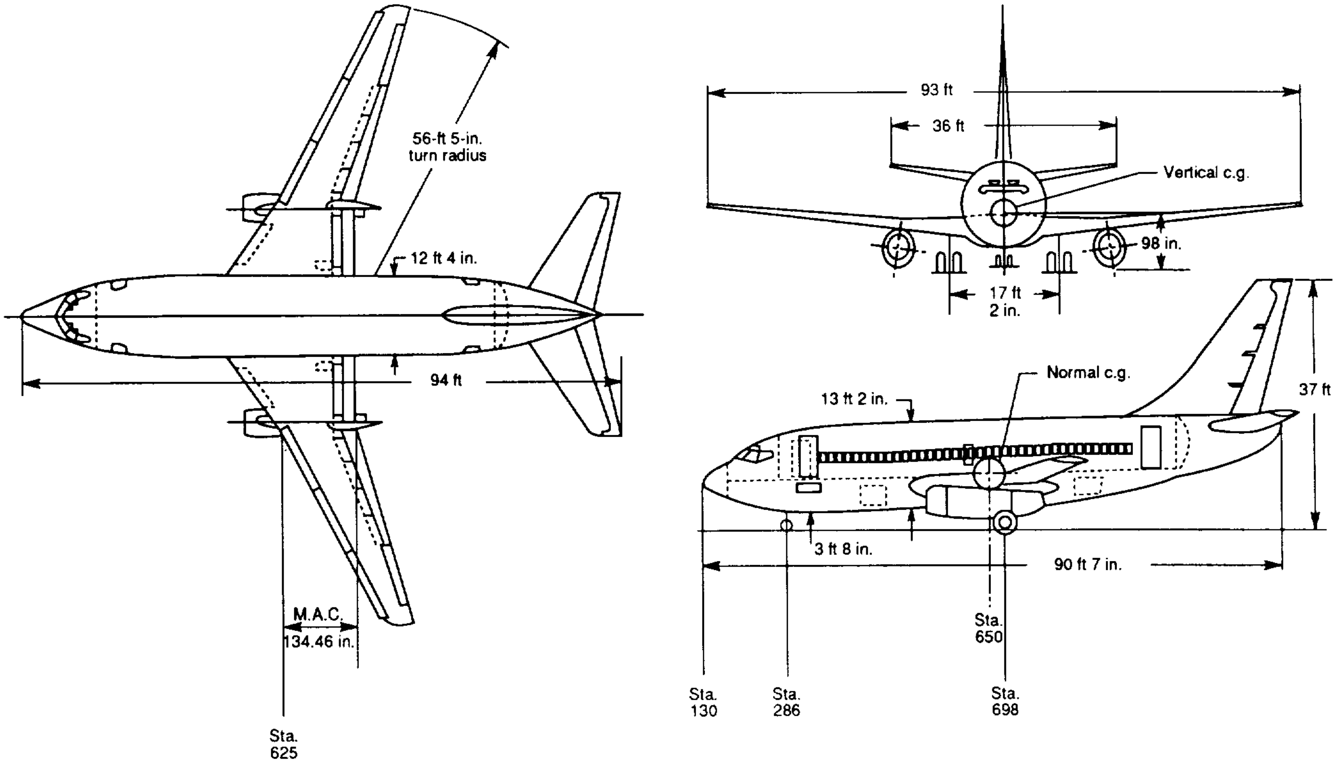


Figure 12. Schematics of NASA Boeing 737 aircraft geometry.

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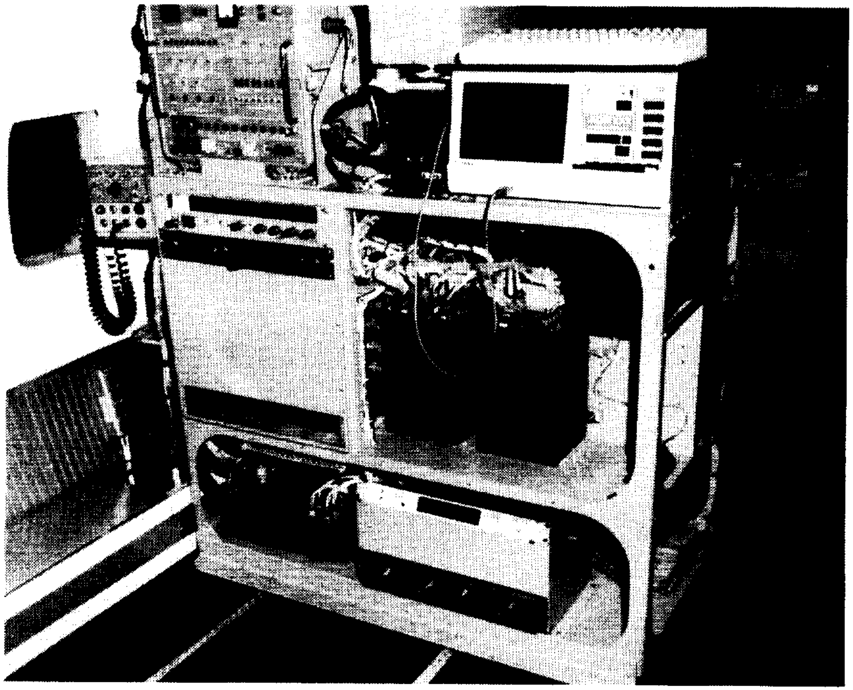
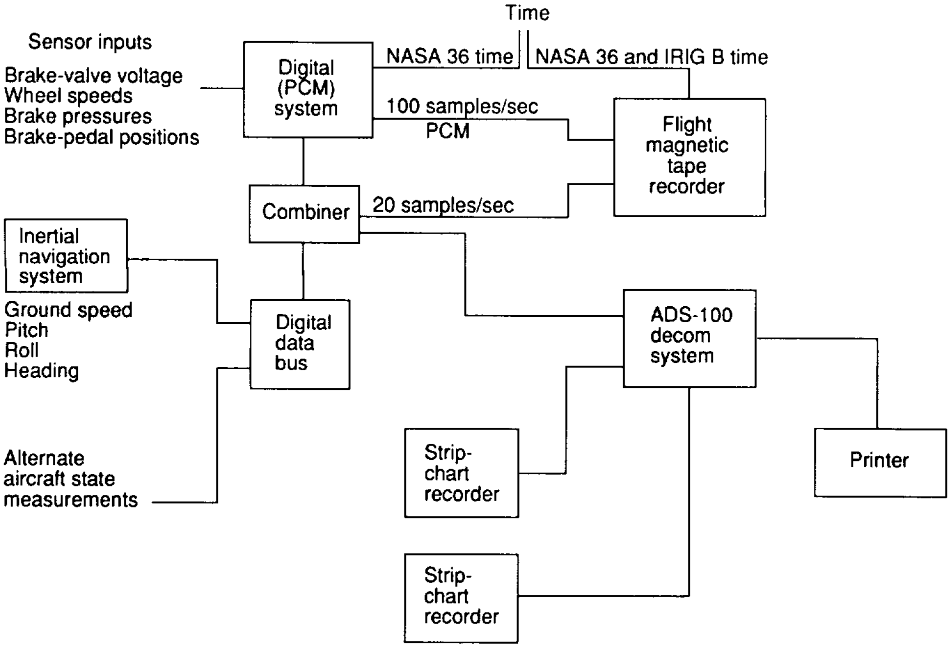
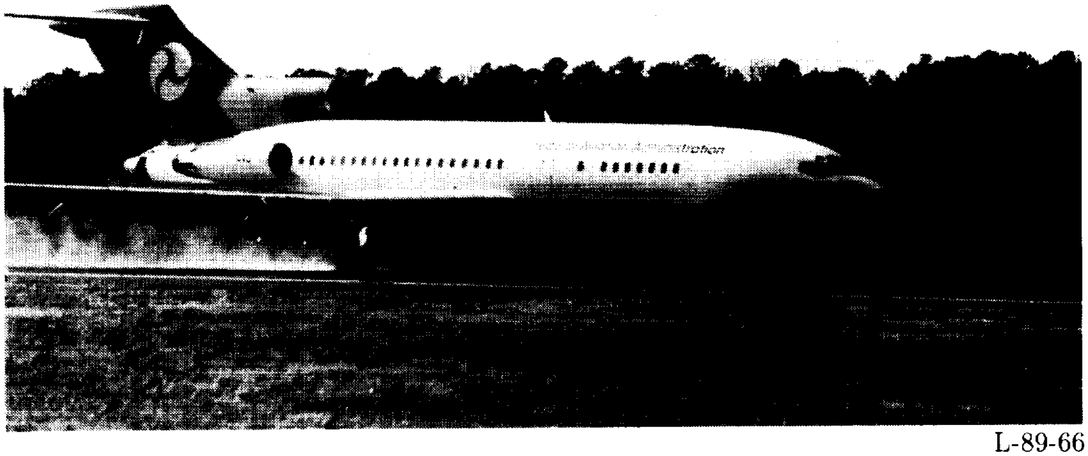

L-89-65

(a) Primary instrumentation pallet.



(b) Data-acquisition flow chart.

Figure 13. NASA Boeing 737 data-acquisition system.



L-89-66

Figure 14. FAA Boeing 727 test aircraft during wet-runway test.

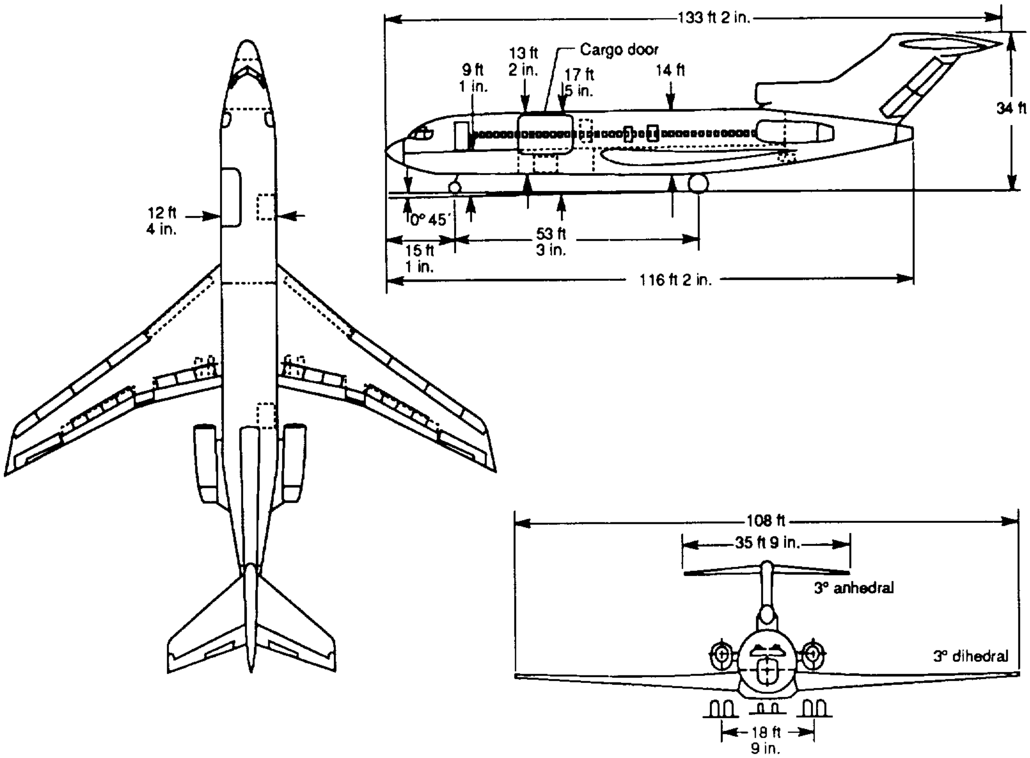


Figure 15. Schematics of FAA Boeing 727 aircraft geometry.

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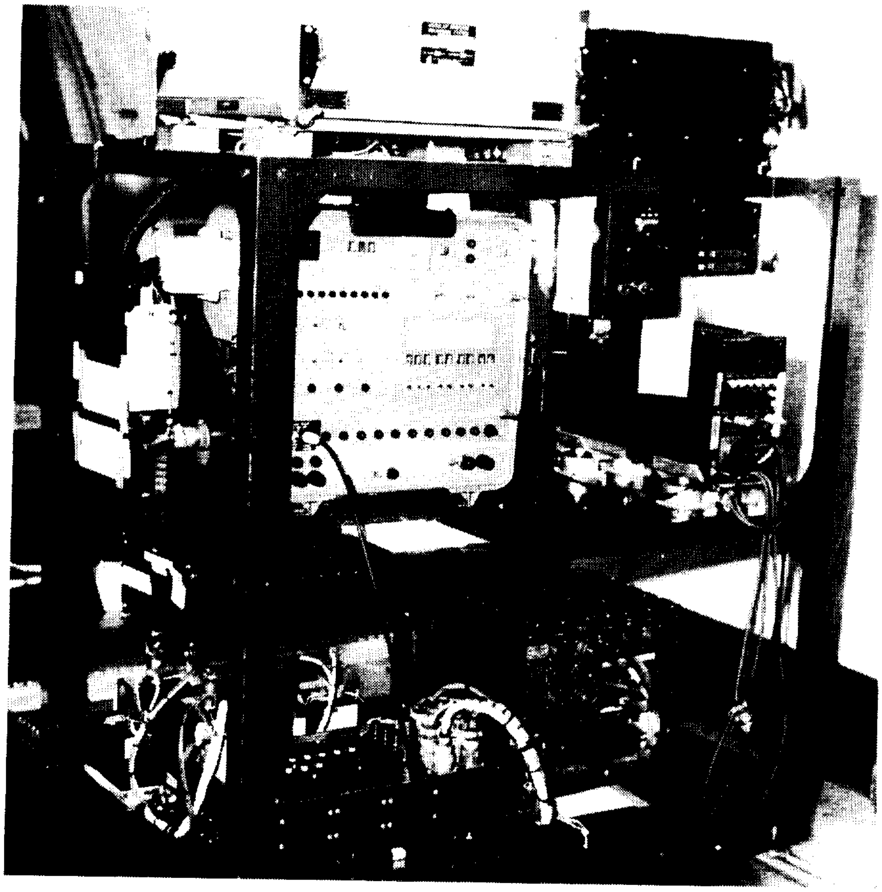
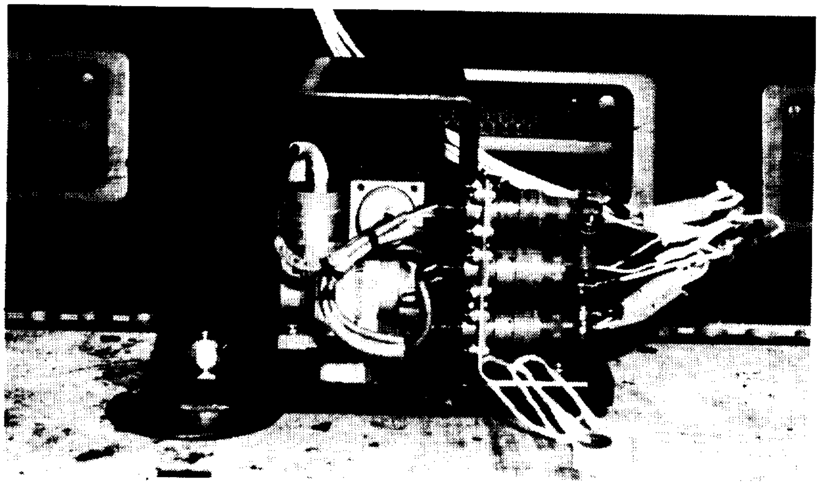


L-89-67

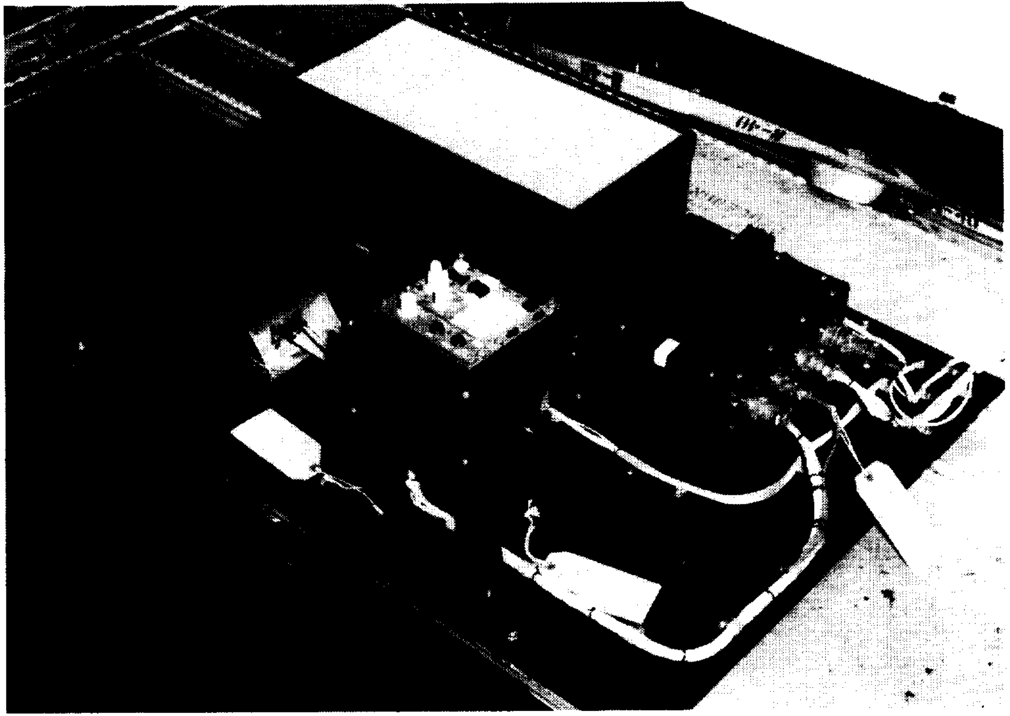
(a) Primary instrumentation pallet.



L-89-68

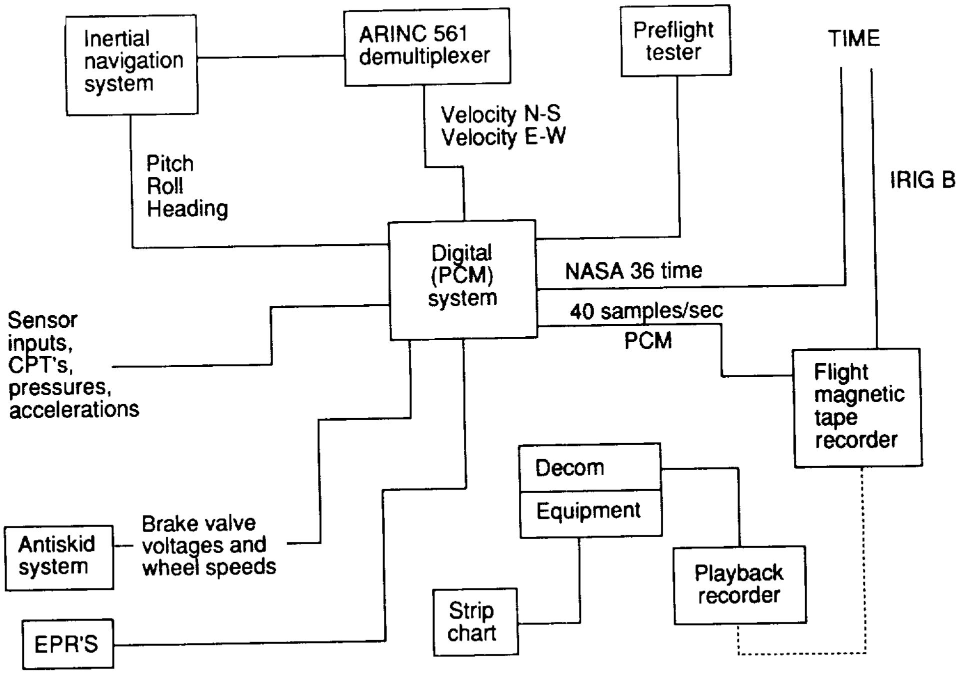
(b) Primary three-axis accelerometer package.

Figure 16. FAA Boeing 727 aircraft data-acquisition system.



L-89-69

(c) Inertial navigation system hookup with data-acquisition system.



(d) Data-acquisition flow chart.

Figure 16. Concluded.

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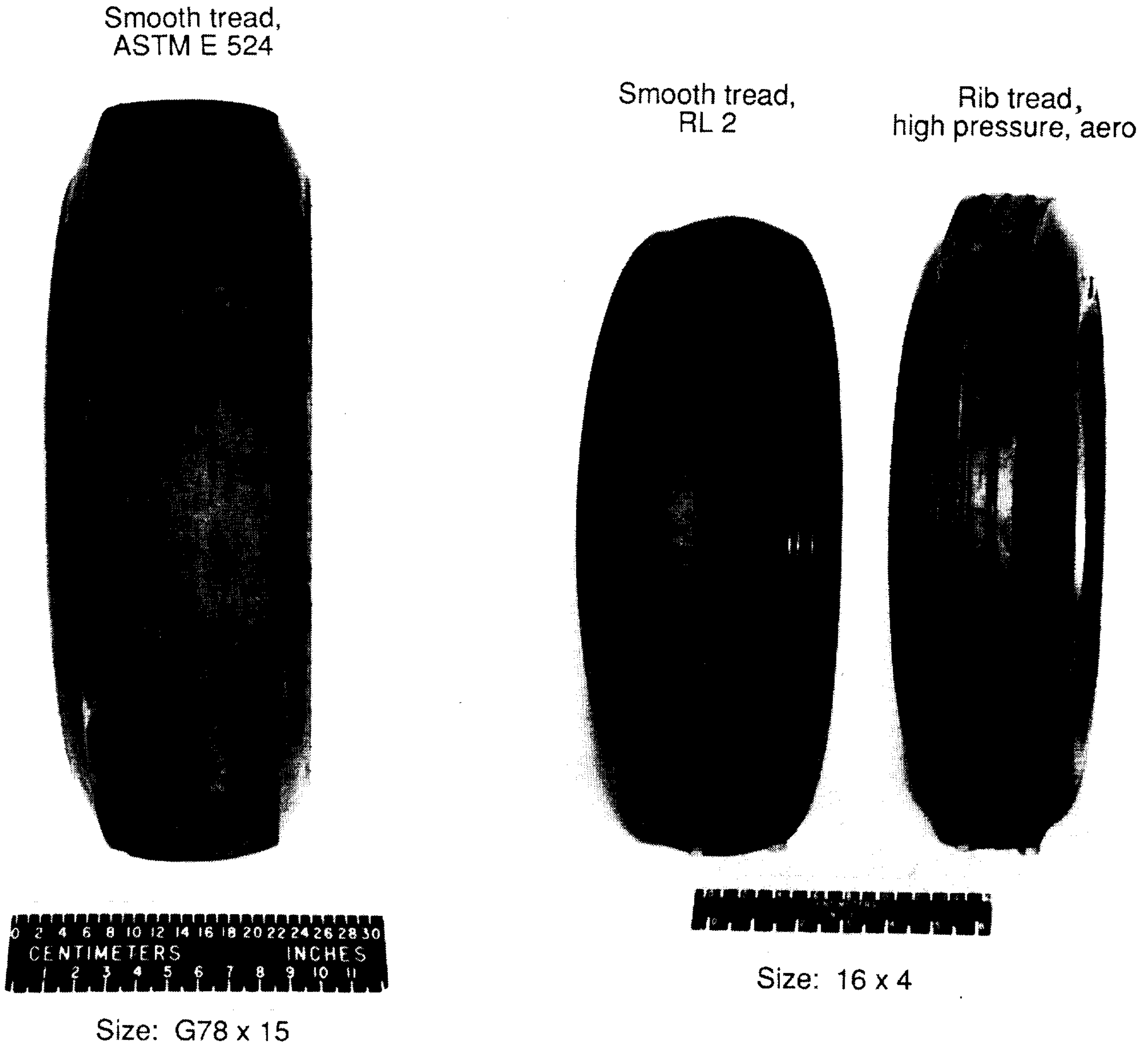
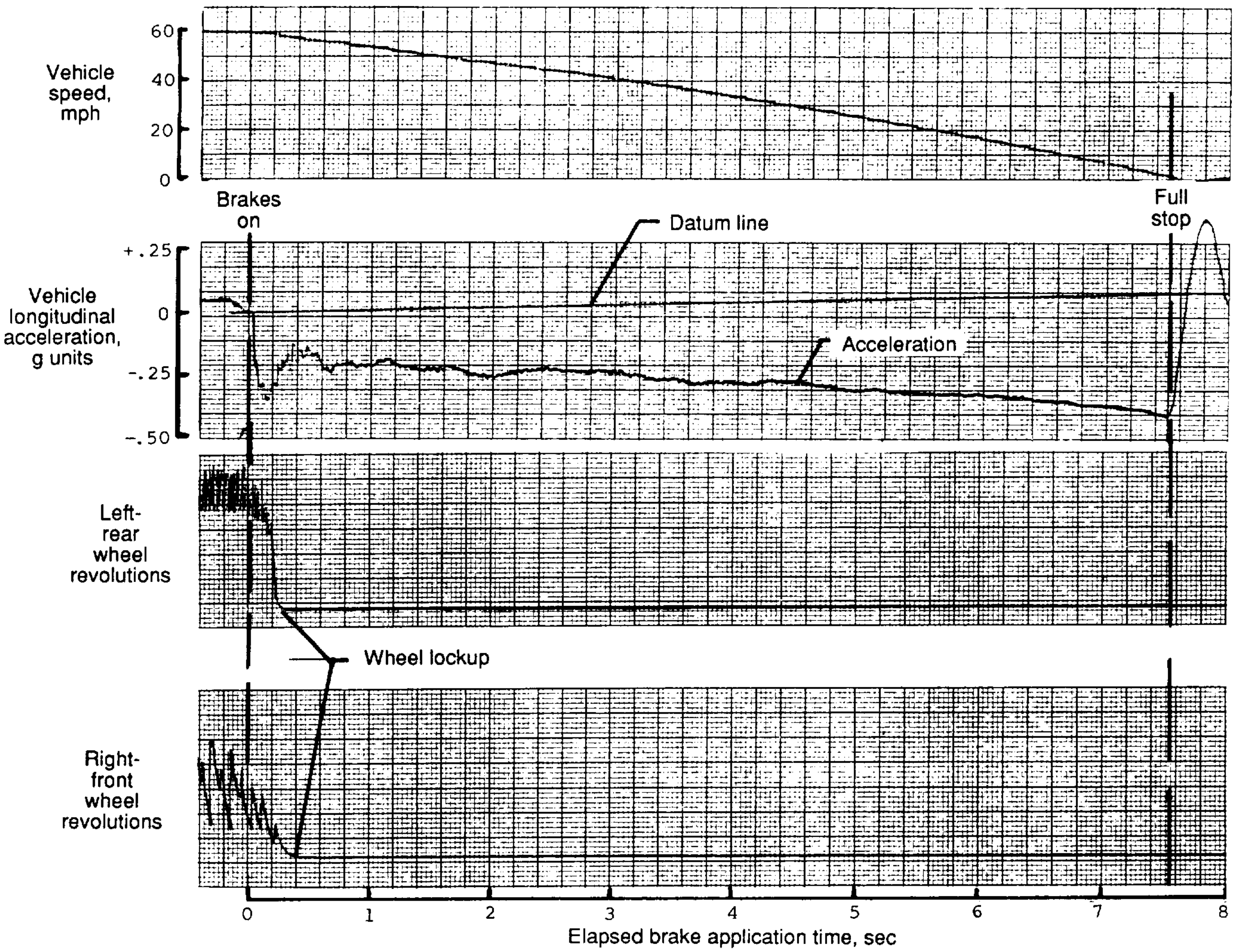


L-89-70

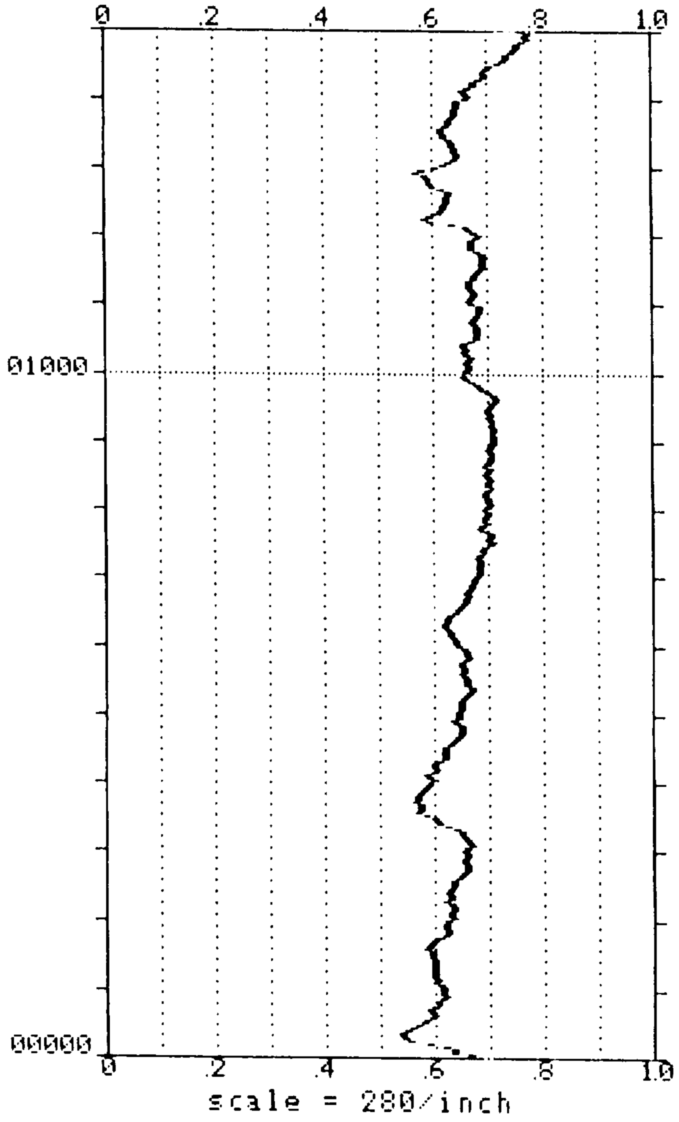
Figure 17. Test tires on friction-measuring vehicle.



(a) Diagonal-braked vehicle.

Figure 18. Samples of ground-vehicle test-run records.

```
AIRPORT WALLOPS          RUNWAY 10/28
          12 AUG 1985   1610
```



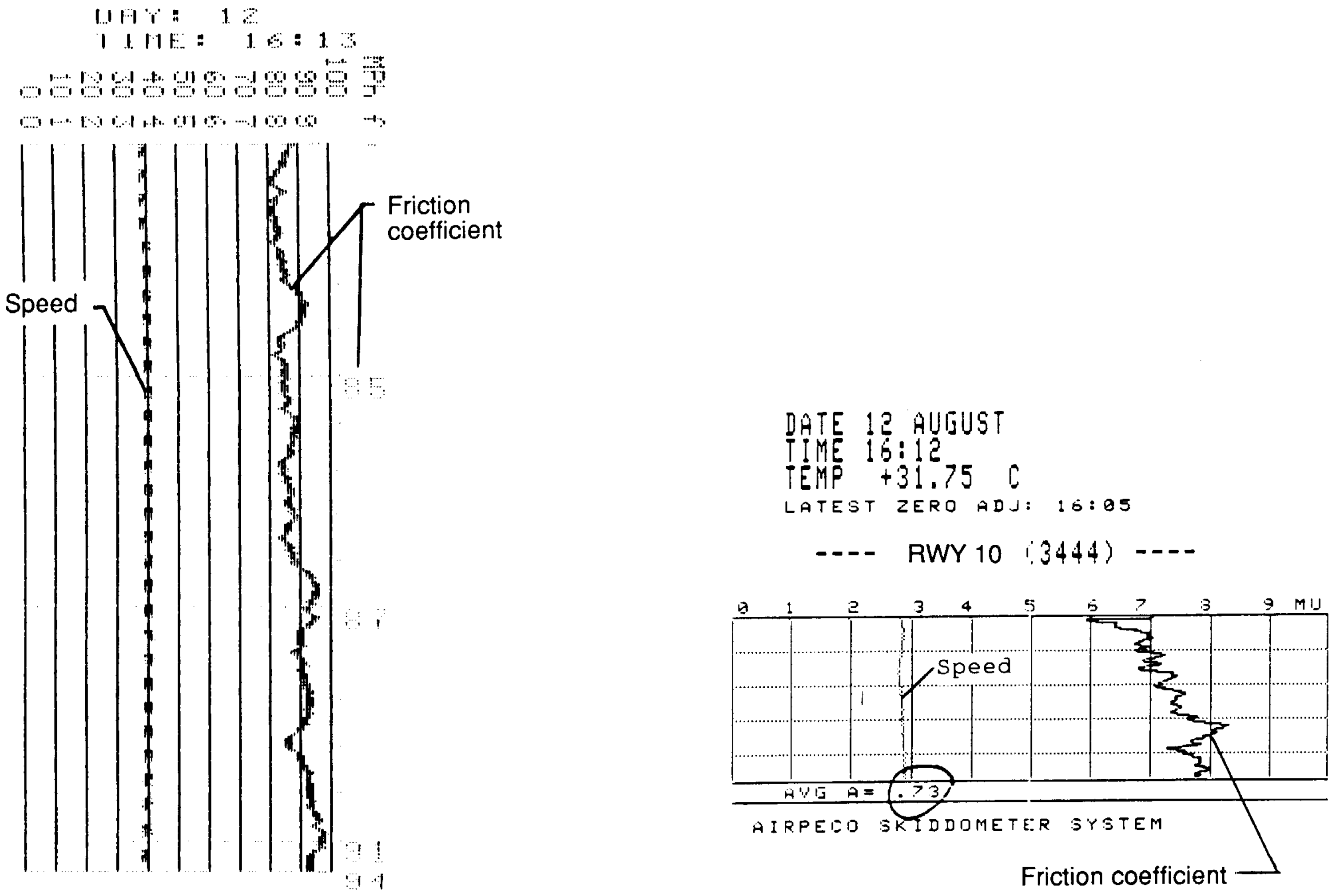
```
00000ft to 01500ft         AVERAGE Mu=.65

00000ft to 01500ft TOTAL PRINT Av.Mu=.65

AIRPORT WALLOPS          RUNWAY 10/28
          12 AUG 1985   1610
B 727, TRUCK WET
RUN 5 40 MPH
```

(b) Mu-Meter.

Figure 18. Continued.



(c) Surface friction tester.

(d) BV-11 skiddometer.

Figure 18. Continued.

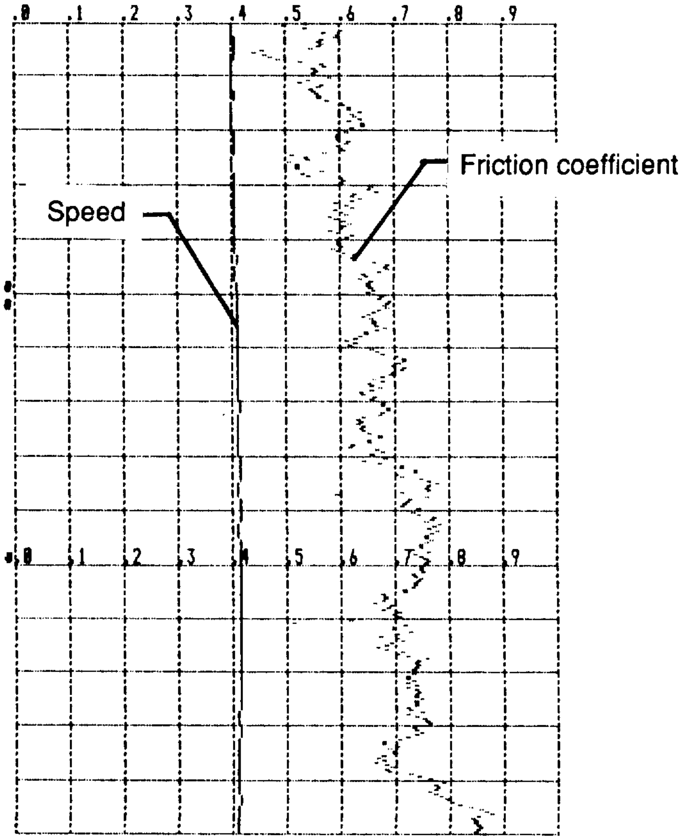
TIME: 16:11:54
DATE: 8/12/85

M6800 RUNWAY FRICTION TESTER

RUN NUMBER = 5
AIRPORT NAME: WALLOPS RUNWAY #10 OPERATOR: DJH

SCALE- 1 in = 300 ft

| COEFF. | SPEED (MPH) | FLOW (GPM) | LENGTH (FT) | V |
|---|---|---|---|---|
| 0.590 | 40.4 (MPH) | 0.0 (GPM) | 500. (FT) | |
| 0.690 | 41.1 (MPH) | 0.0 (GPM) | 1000. (FT) | |
| 0.730 | 41.1 (MPH) | 0.0 (GPM) | 1500. (FT) | |



AVERAGE FRICTION (mu) 0.675
AVERAGE SPEED (mph) 40.9
AVERAGE FLOW RATE (gpm) 0.0

COMMENTS

***END OF RUN***

(e) Runway friction tester.

Figure 18. Concluded.

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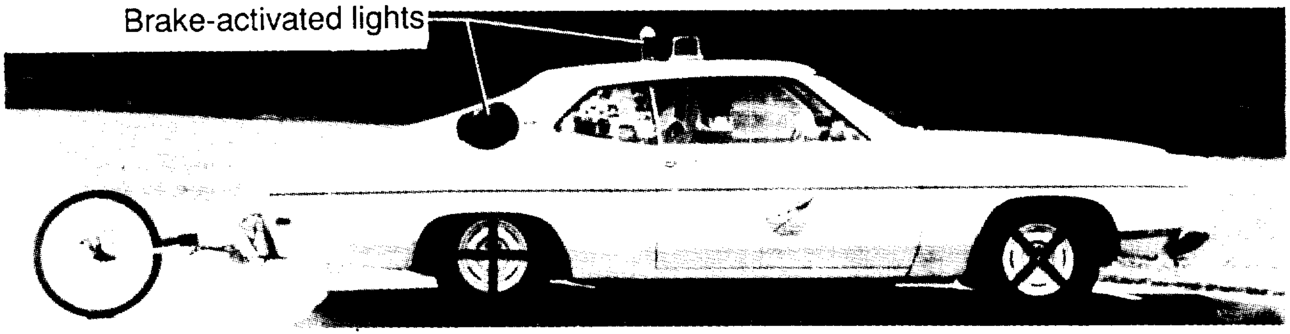
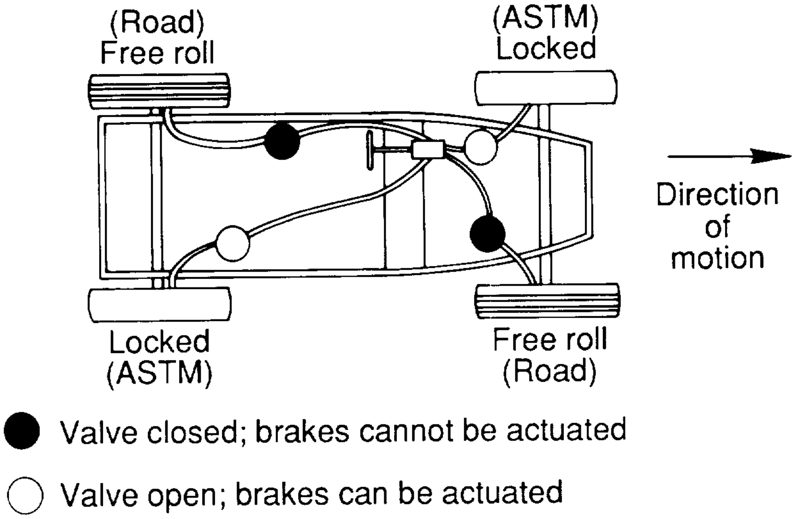


L-89-71

(a) NASA diagonal-braked vehicle.



(b) Schematic of diagonal-braked system.

Figure 19. NASA diagonal-braked vehicle system.

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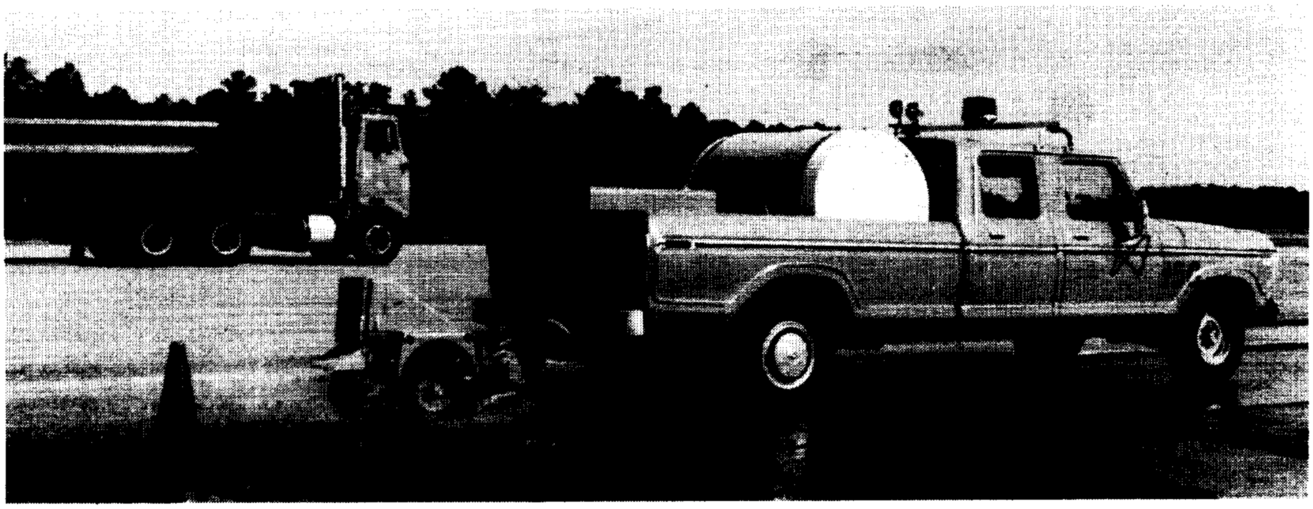
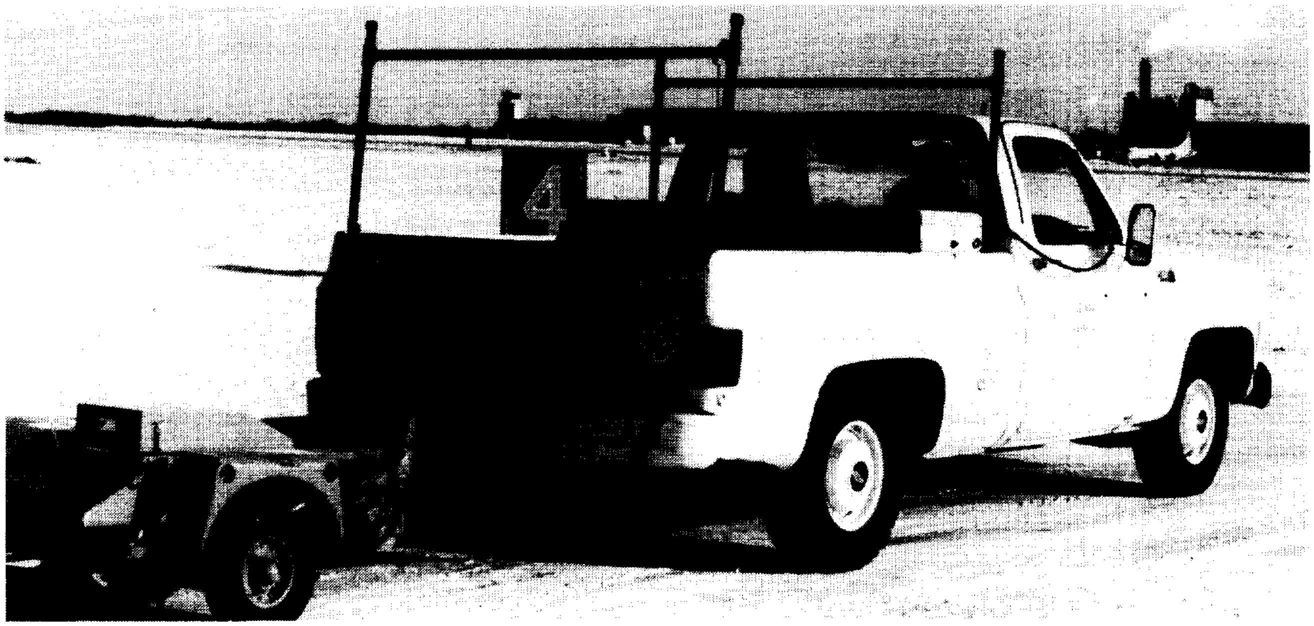


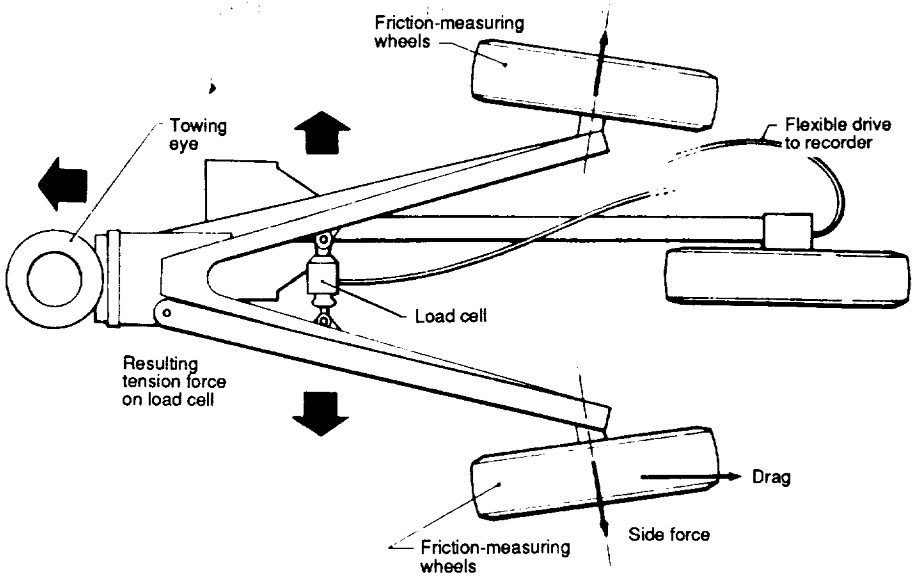
(a) Mark III unit at Wallops Flight Facility.



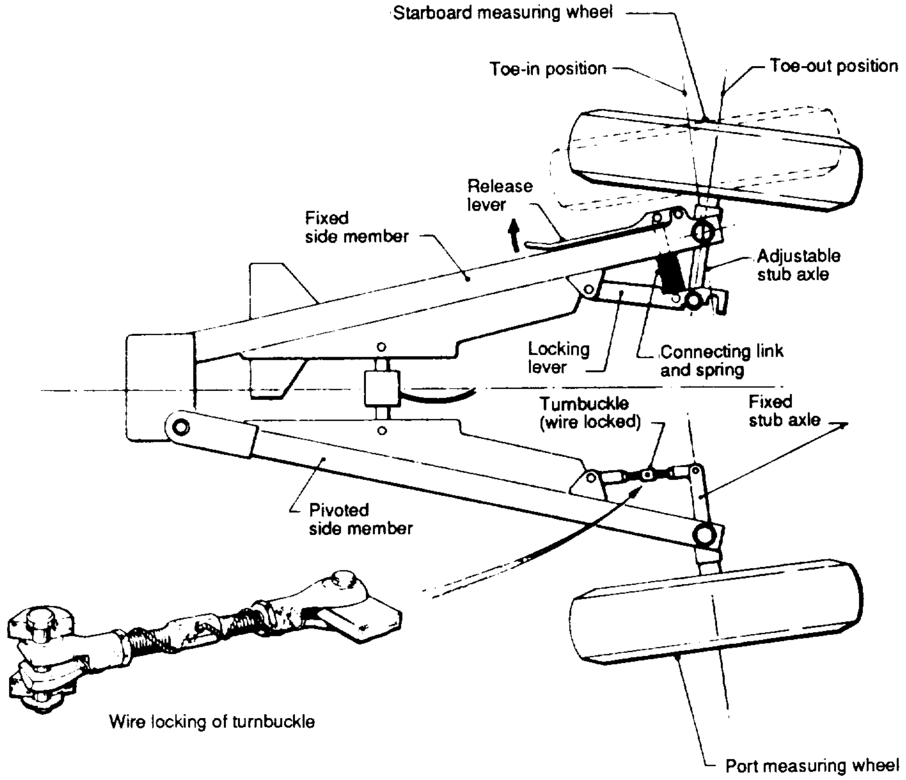
(b) Mark IV unit at BNAS.

L-89-72

Figure 20. Mu-Meter trailers with towing vehicle.



(a) Plan view without top frame.



(b) Measuring-wheel settings.

Figure 21. Features of Mu-Meter measurement system.

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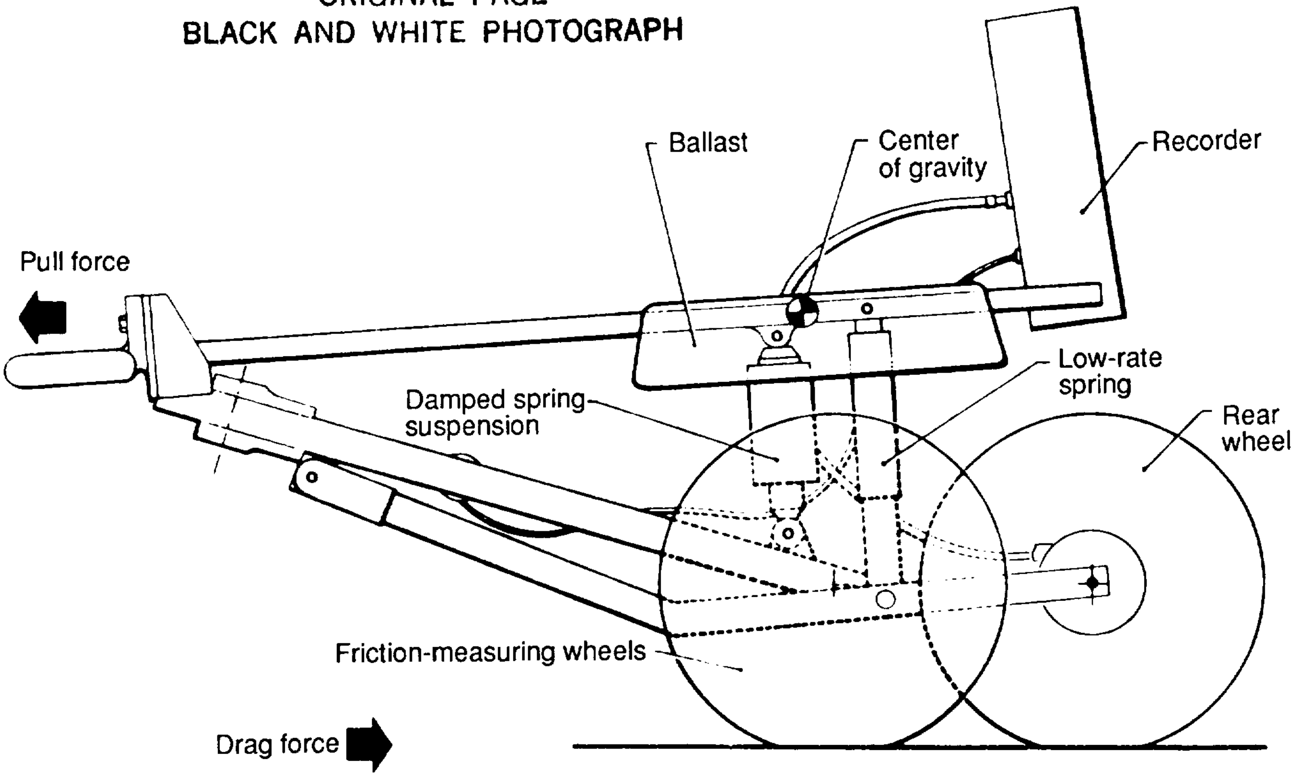
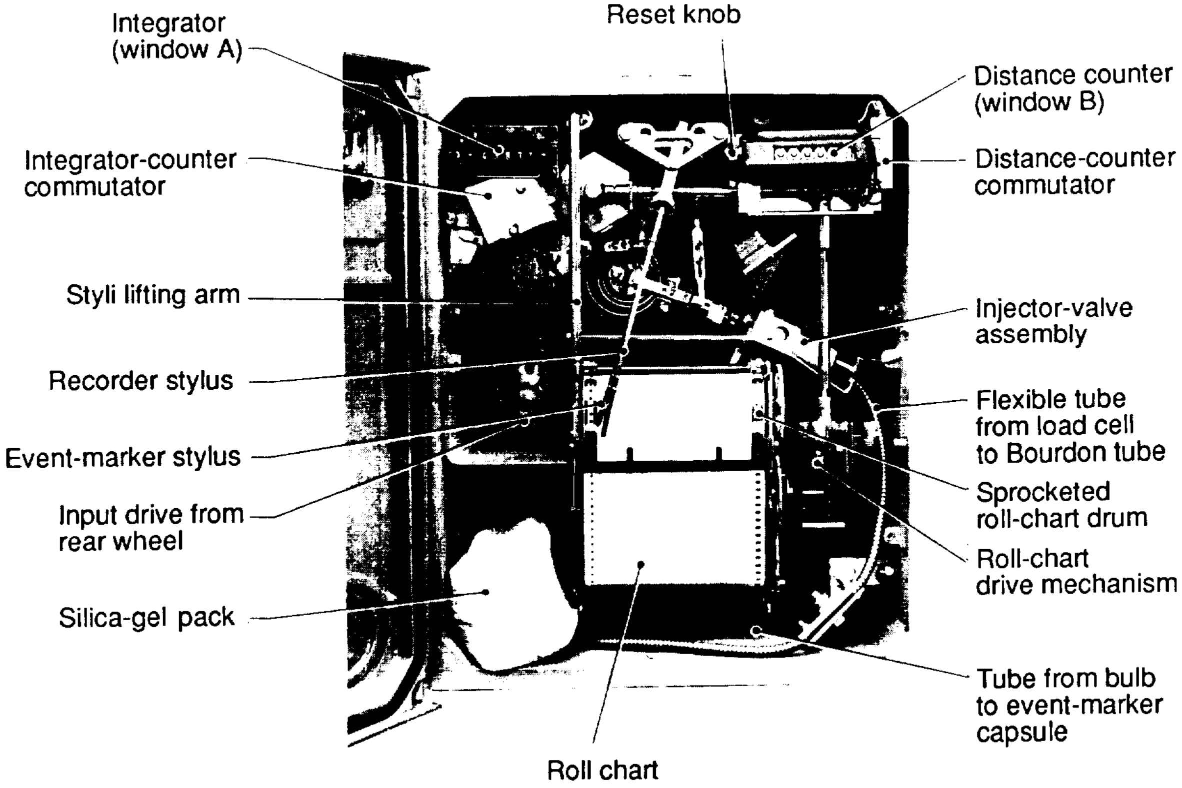


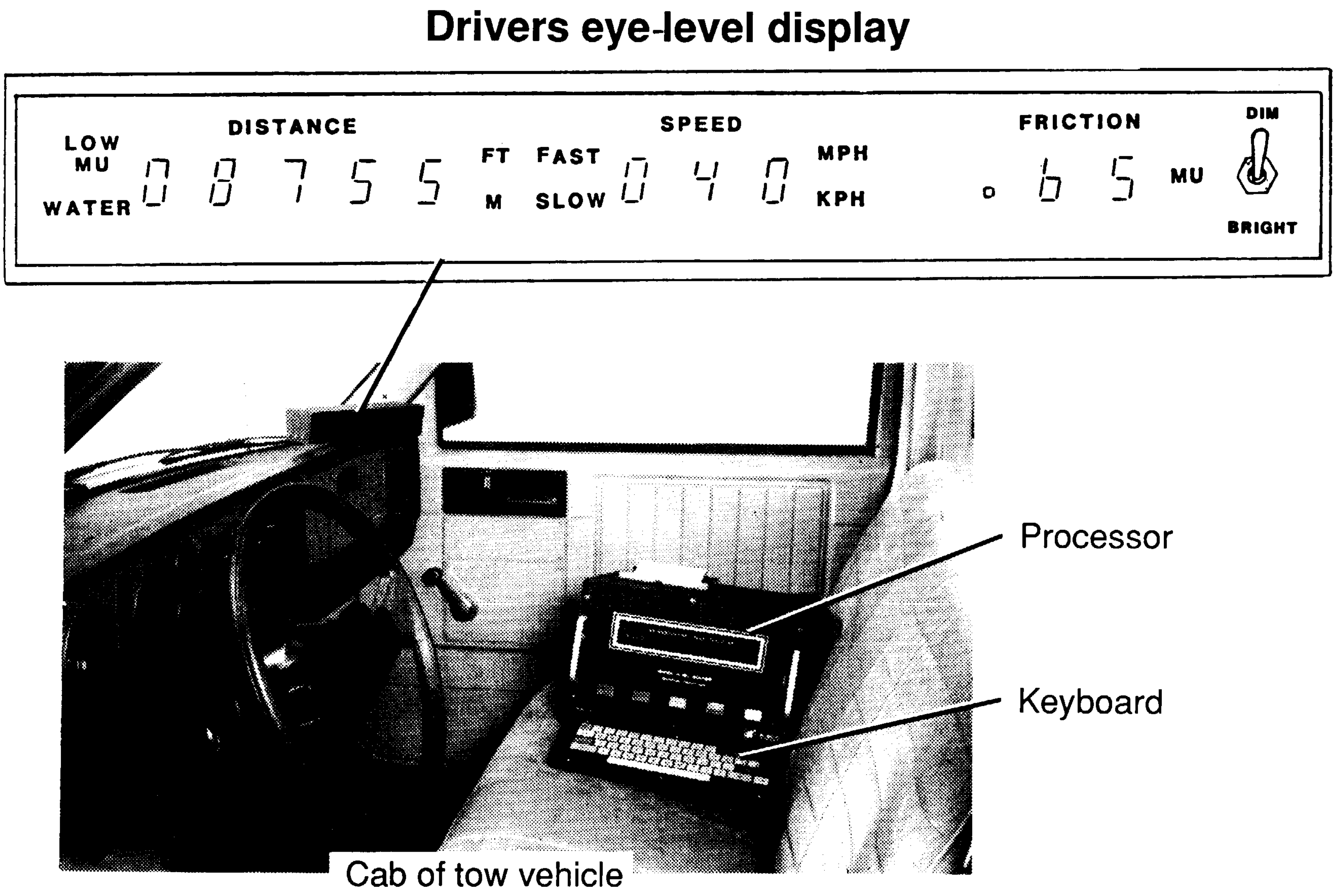
(c) Side view without top frame.



L-89-73

(d) Mark III recorder features.

Figure 21. Continued.



L-89-74

(e) Features of new Mark IV Mu-Meter unit.

Figure 21. Concluded.

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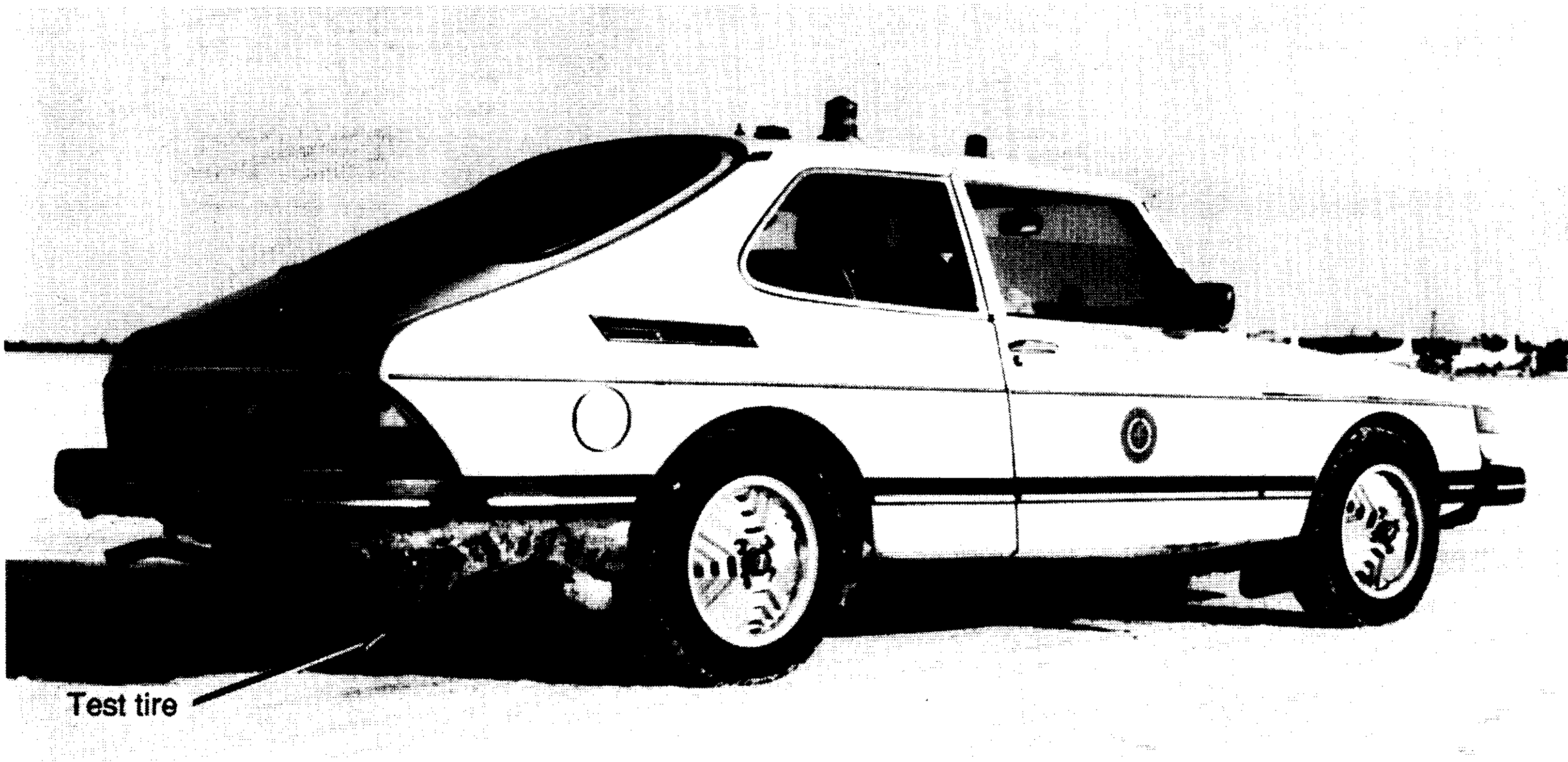
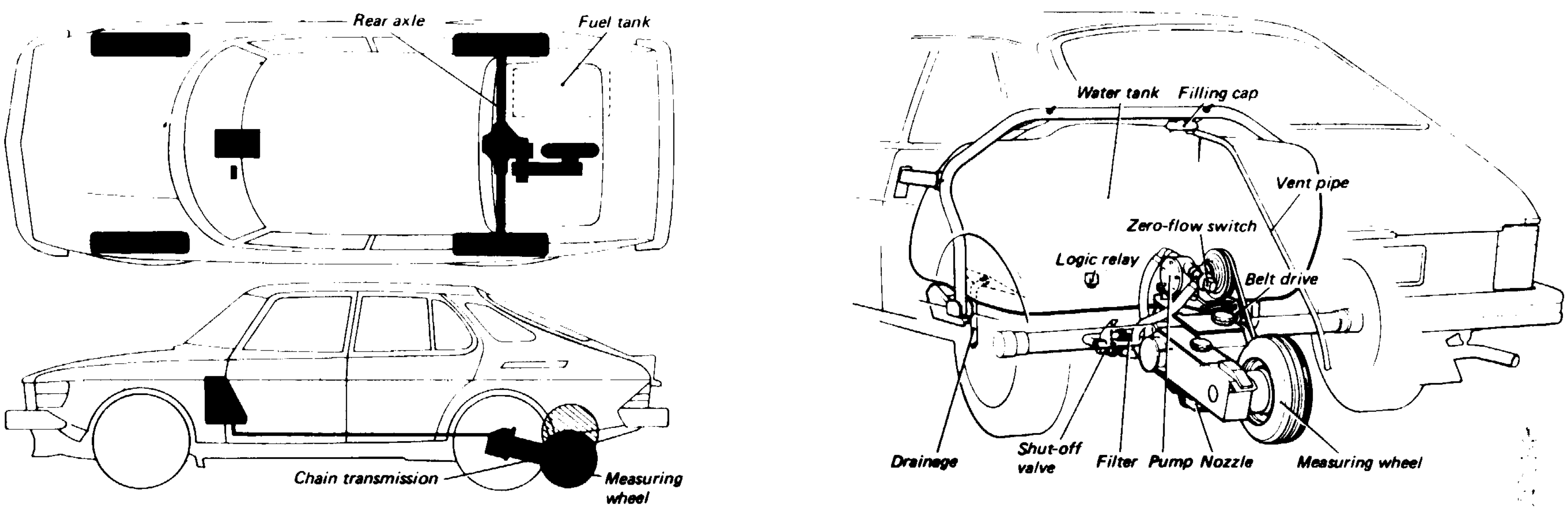


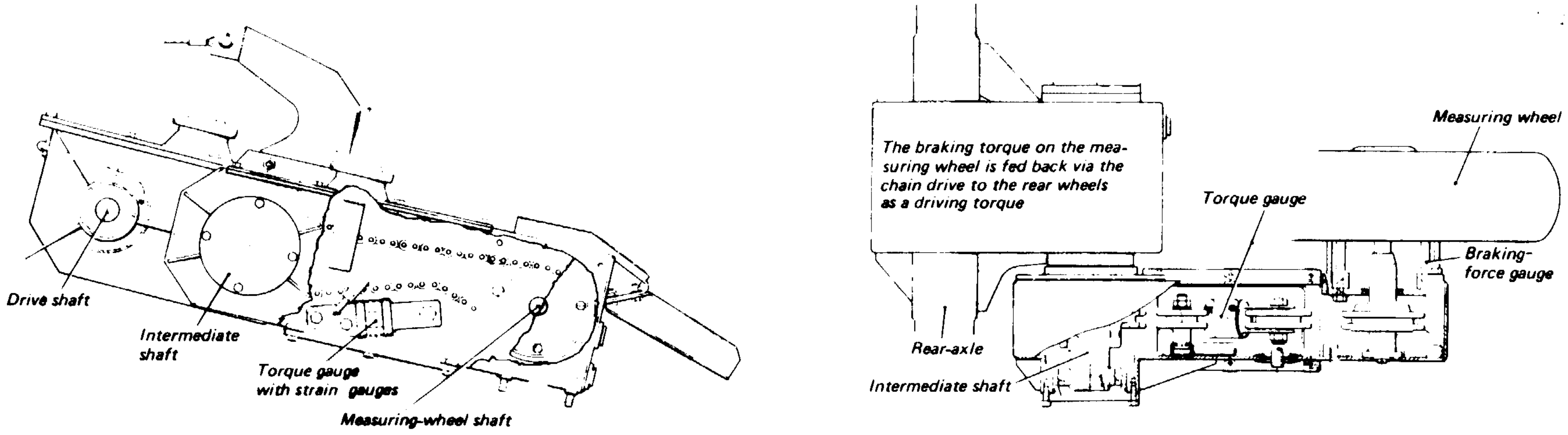
L-89-75

Figure 22. Surface friction tester.



(a) Overall vehicle configuration.

(b) Self-wetting system.



(c) Cutaway side view of measuring-wheel arm with chain drive.

(d) Cutaway plan view of measuring-wheel arm.

Figure 23. Schematics of surface friction tester vehicle with details on self-wetting system and measuring-wheel arm.

L-89-76

Figure 24. BV-11 skiddometer trailer and tow vehicle.

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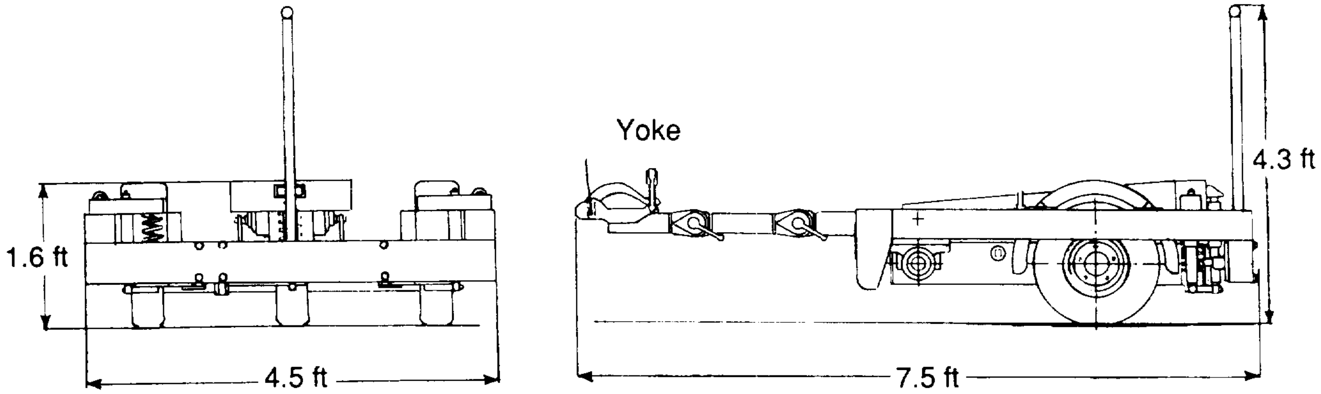
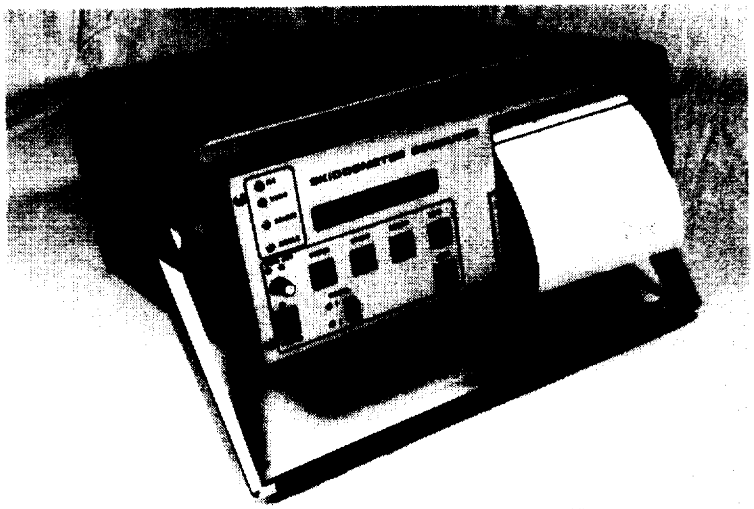


(a) Schematic.



L-89-77

(b) Portable computer and recorder.

Figure 25. Trailer schematic and portable computer and recorder used with BV-11 skiddometer.

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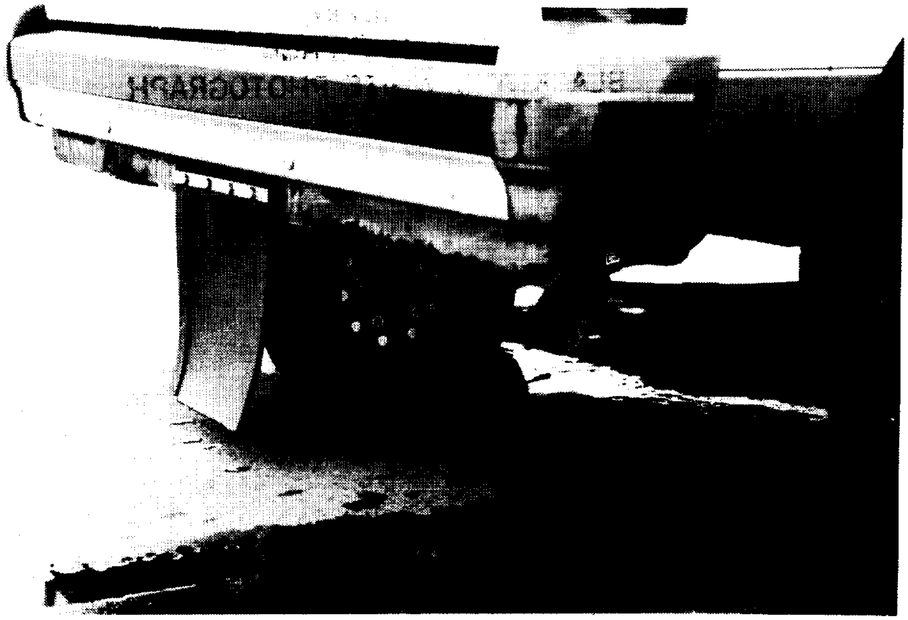
L-89-78

Figure 26. Runway friction tester during test run on compacted snow.



L-89-79

(a) Close-up view of test tire.

L-89-80

(b) Operator cab compartment.

Figure 27. Test tire and operator cab compartment on runway friction tester.

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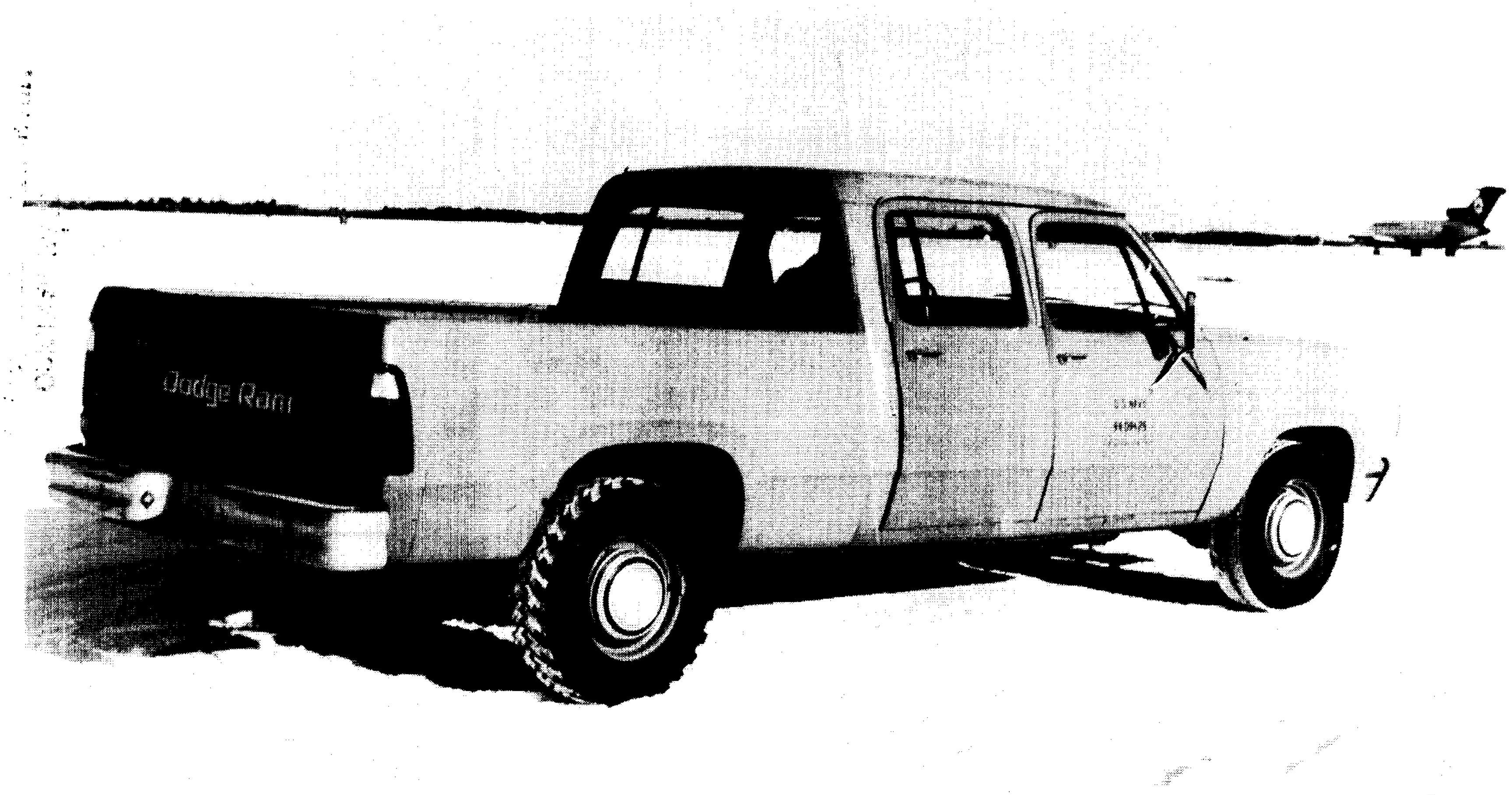

L-89-81

Figure 28. Navy runway condition reading (RCR) test vehicle.

L-89-82

(a) Mechanical Tapley meter used in runway condition reading vehicle.

Figure 29. Portable Tapley meter units.

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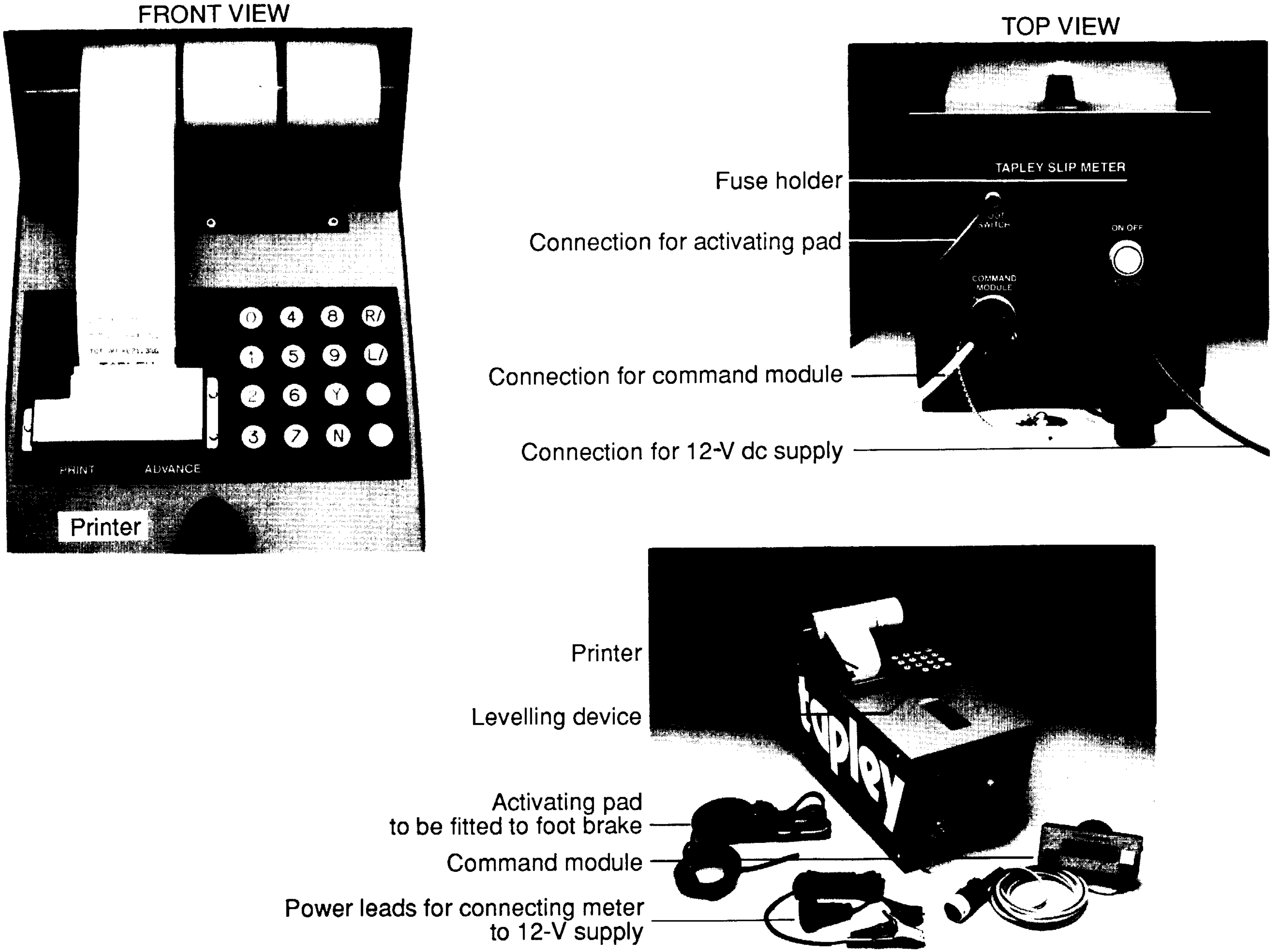


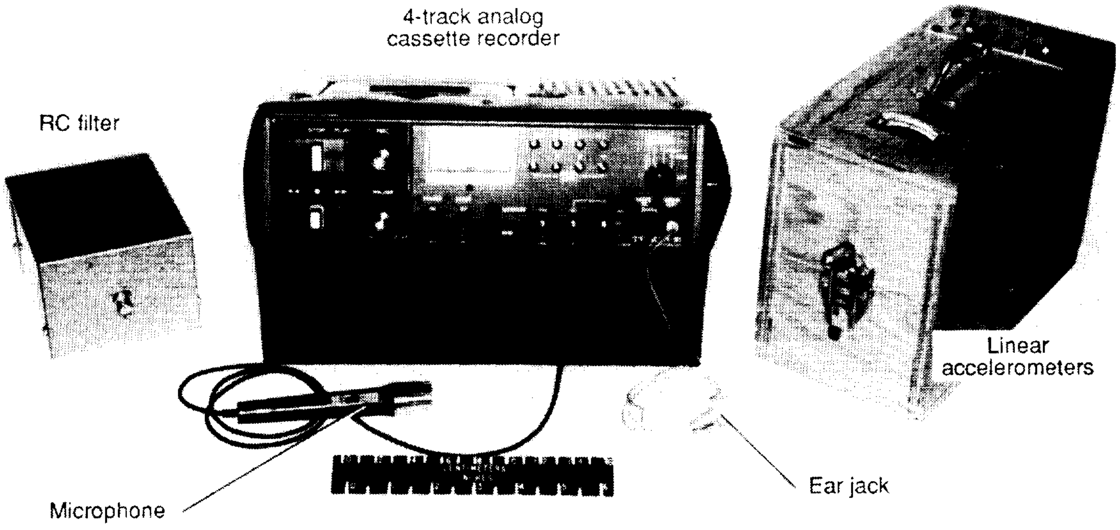
L-89-83

(b) Electronic Tapley meter.

Figure 29. Concluded.

L-89-84

Figure 30. Bowmonk brakemeter unit used in runway condition reading test vehicle.



L-89-85

Figure 31. Portable three-axis accelerometer packaged used on test aircraft as backup instrumentation system.

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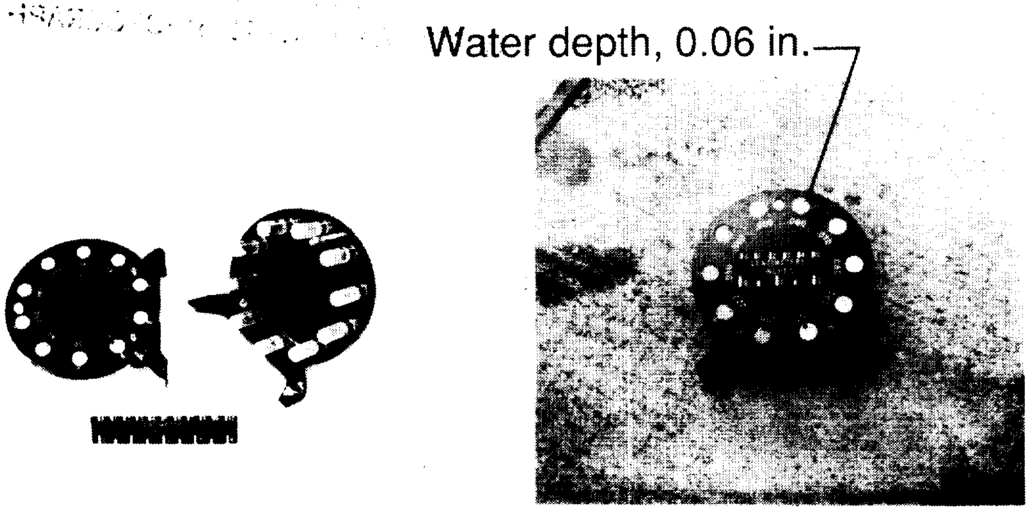
L-89-86

Figure 32. Surface temperature gauge.

L-89-87

Figure 33. Portable wind anemometer used for measurements at runway test-section site.

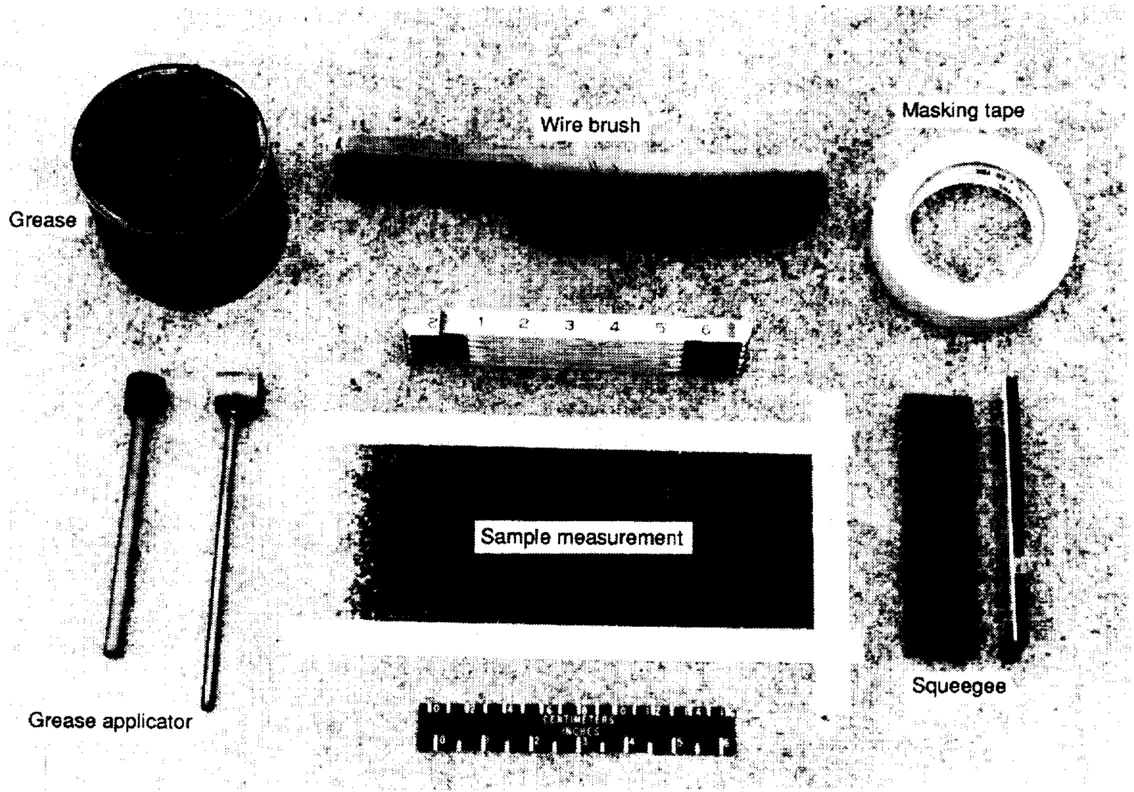


Top and bottom views of gauge

Water-depth gauge on wet pavement

L-89-88

Figure 34. Different views of NASA portable water-depth gauge.



L-89-89

Figure 35. Equipment for taking surface macrotexture-depth measurement using NASA grease-sample method.

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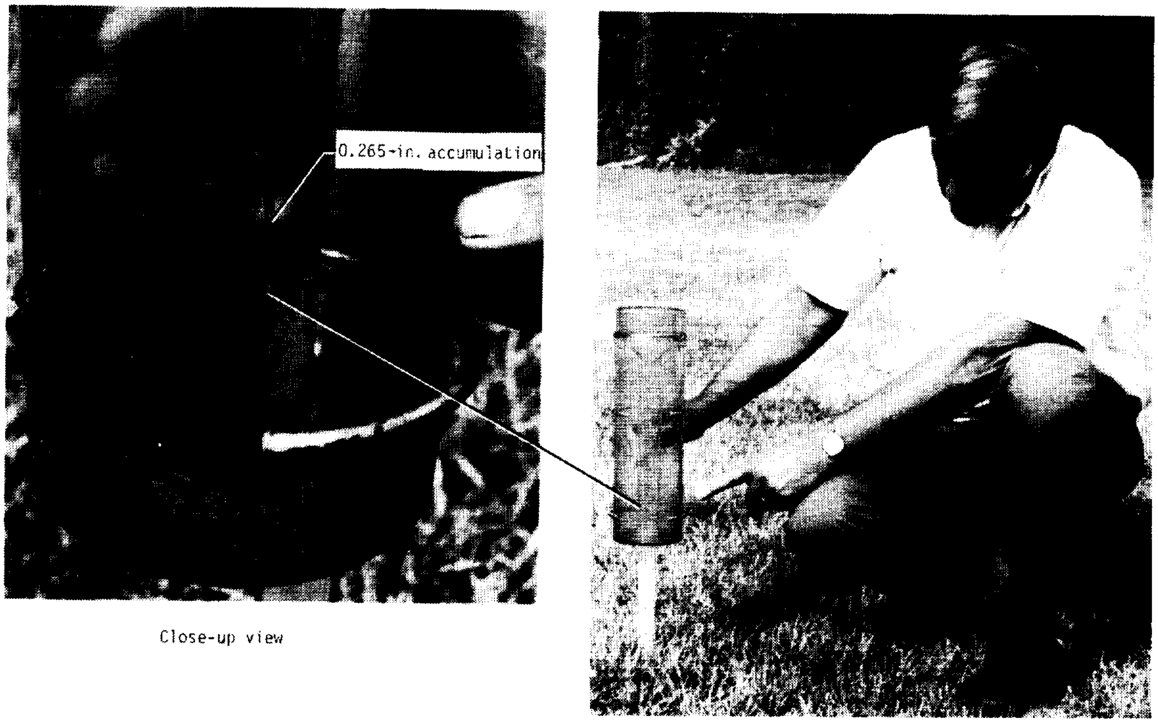
L-89-90

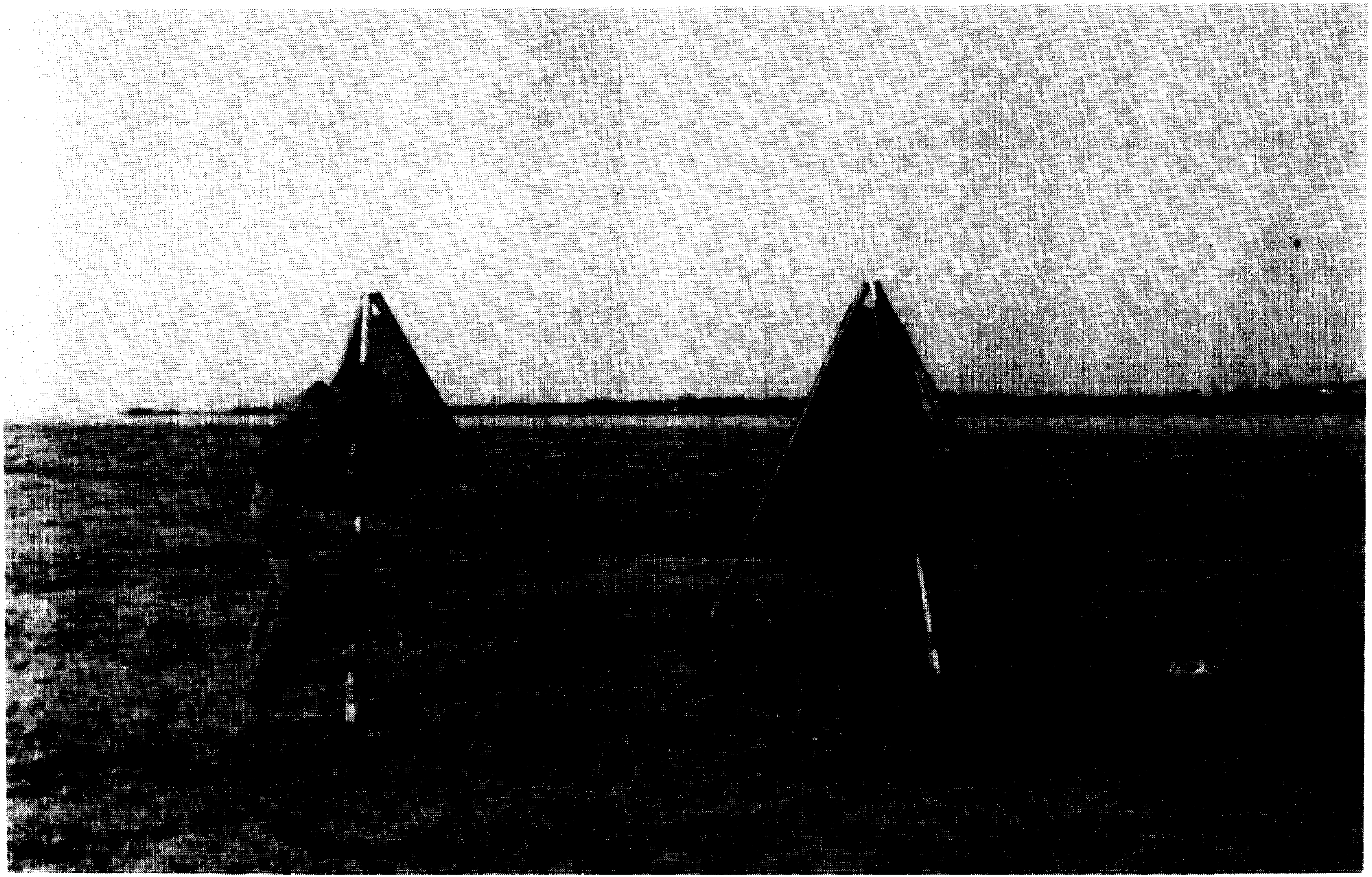
Figure 36. Collection of snow sample for density measurement.



Close-up view

L-89-91

Figure 37. Portable rain gauge.



L-89-92

Figure 38. Portable tripod runway markers.

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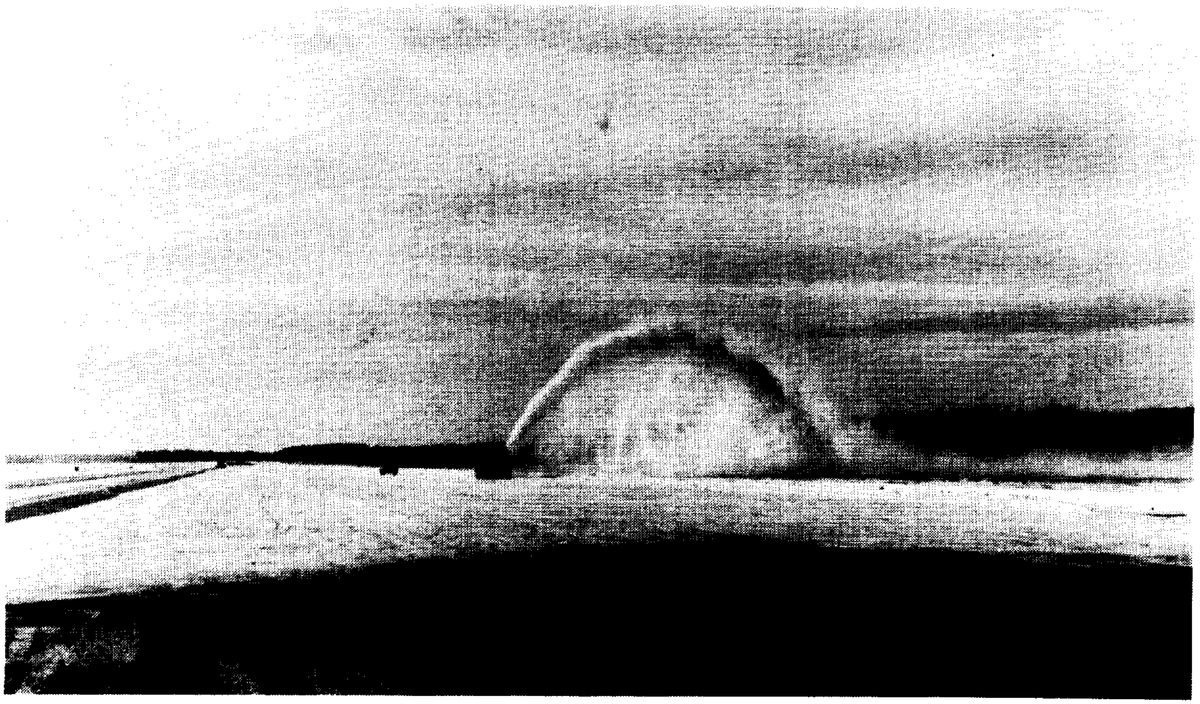
L-89-93

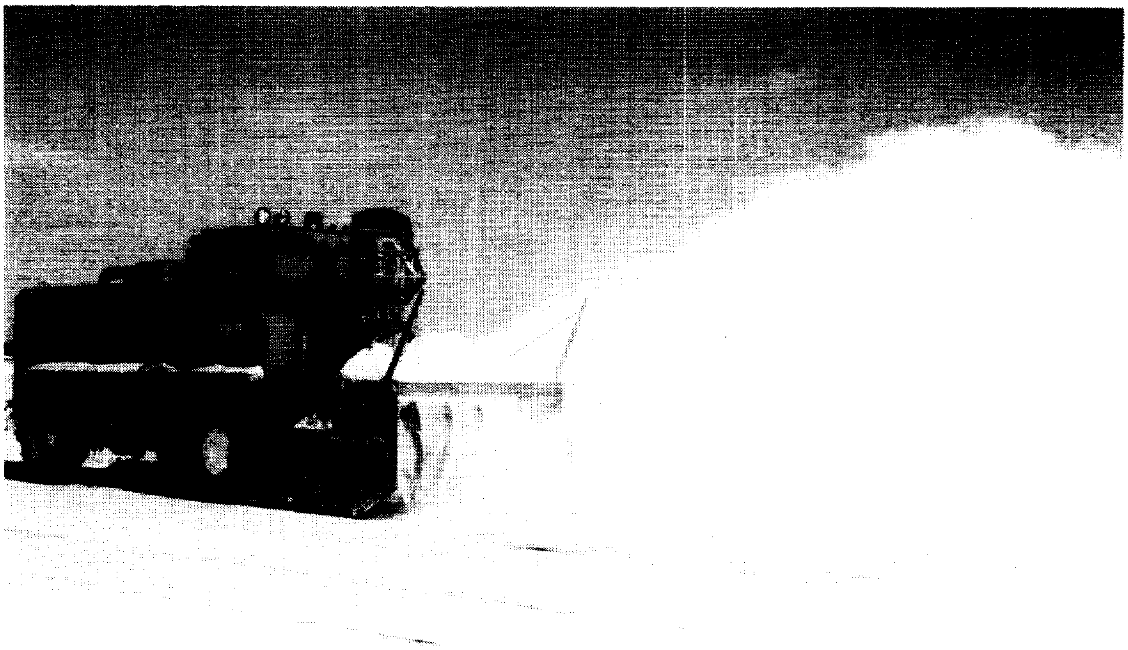
(a) Runway snow removal equipment with Boeing 737 test aircraft.



L-89-94

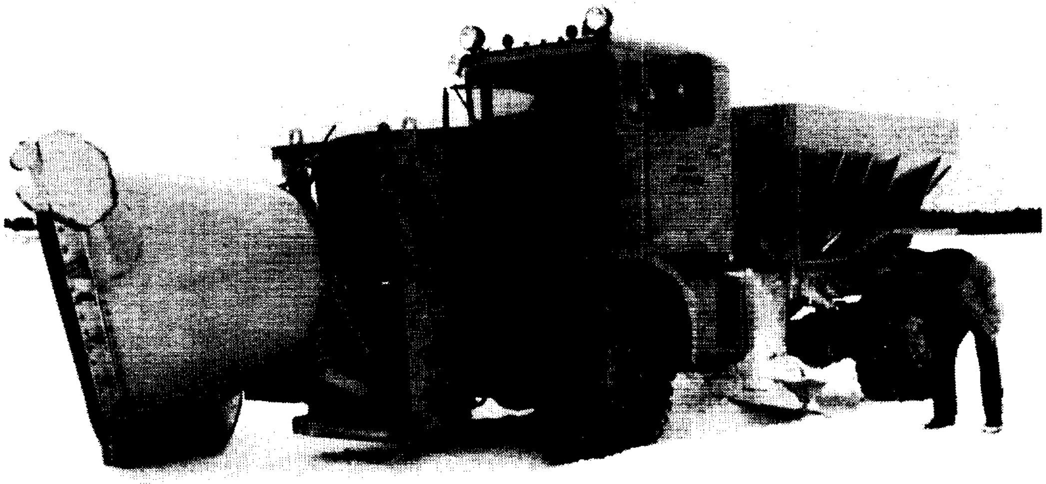
(b) Overview of snow blower in operation.

Figure 39. Snow removal equipment used at BNAS.



L-89-95

(c) Close-up view of snow blower in operation.



L-89-96

(d) Snow plow.

Figure 39. Concluded.

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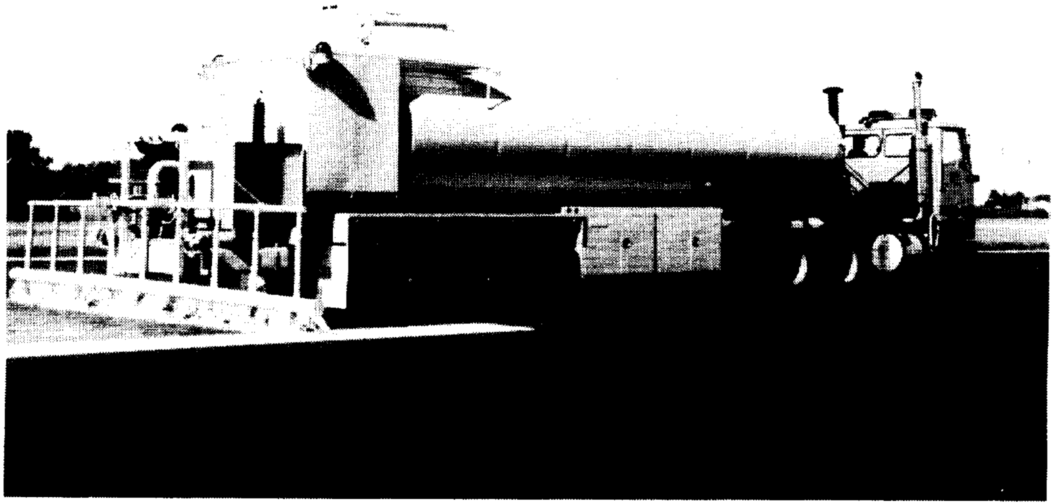
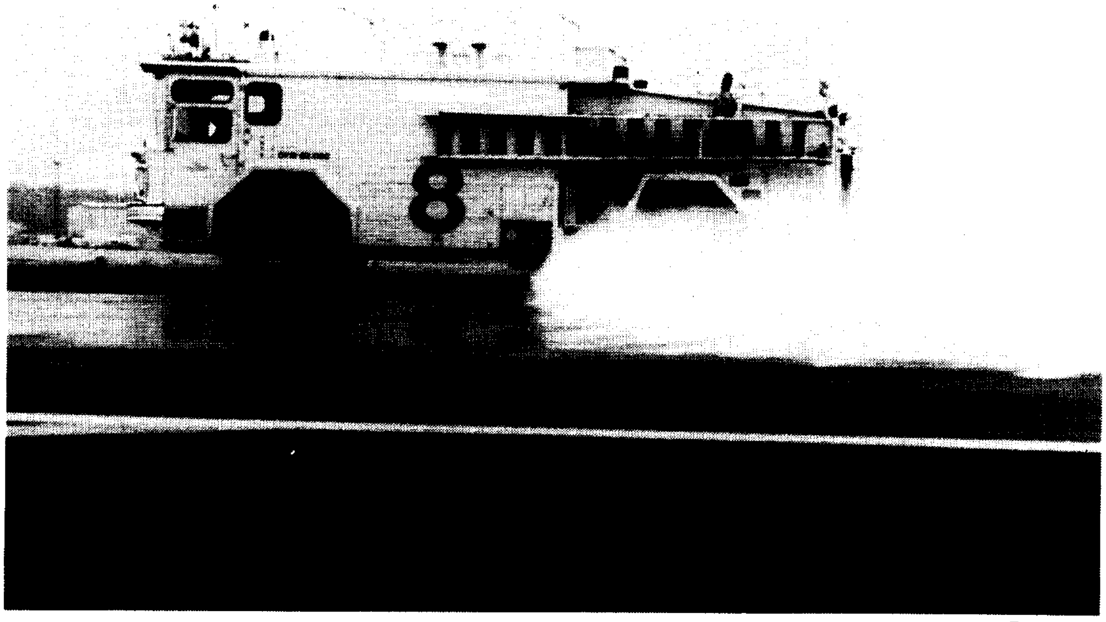


L-89-97

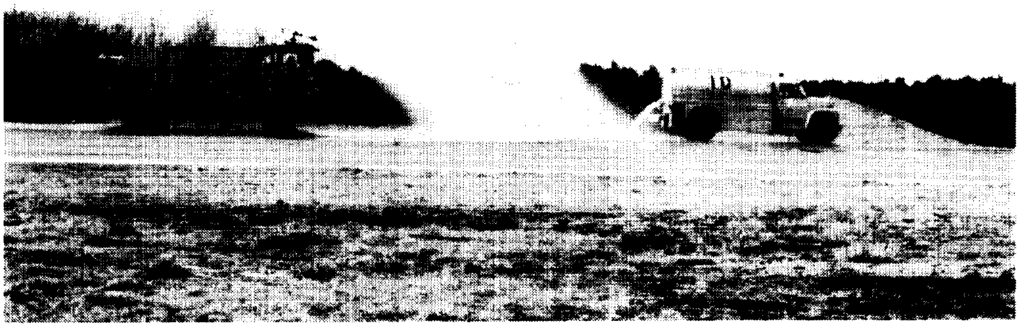
(a) Truck used at Wallops Flight Facility.



L-89-98

(b) Truck used at FAA Technical Center.

Figure 40. Trucks used to wet test surfaces.



L-89-99

(c) Trucks used at BNAS.

Figure 40. Concluded.

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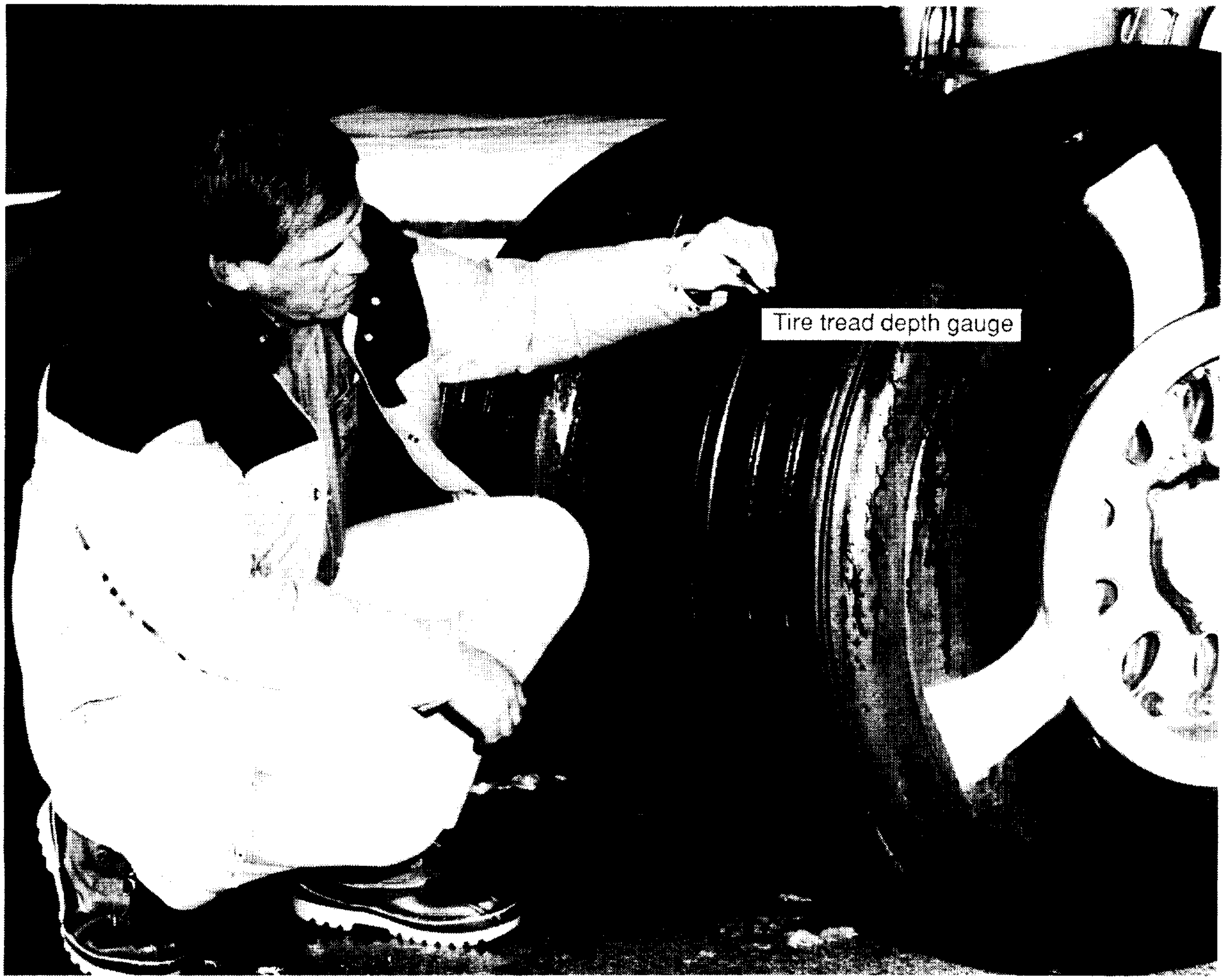
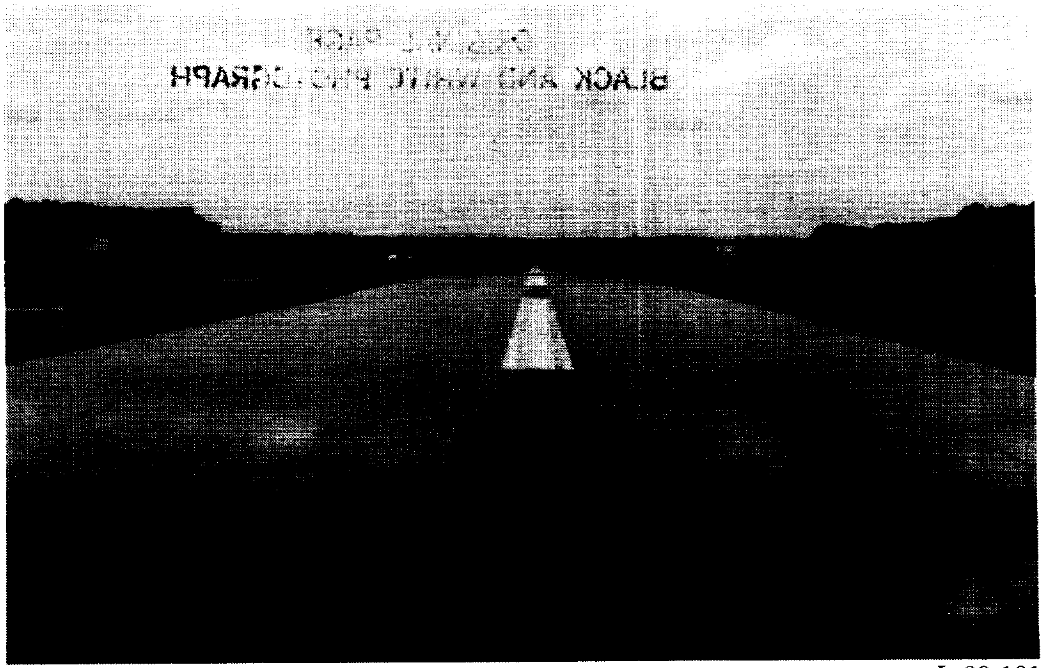


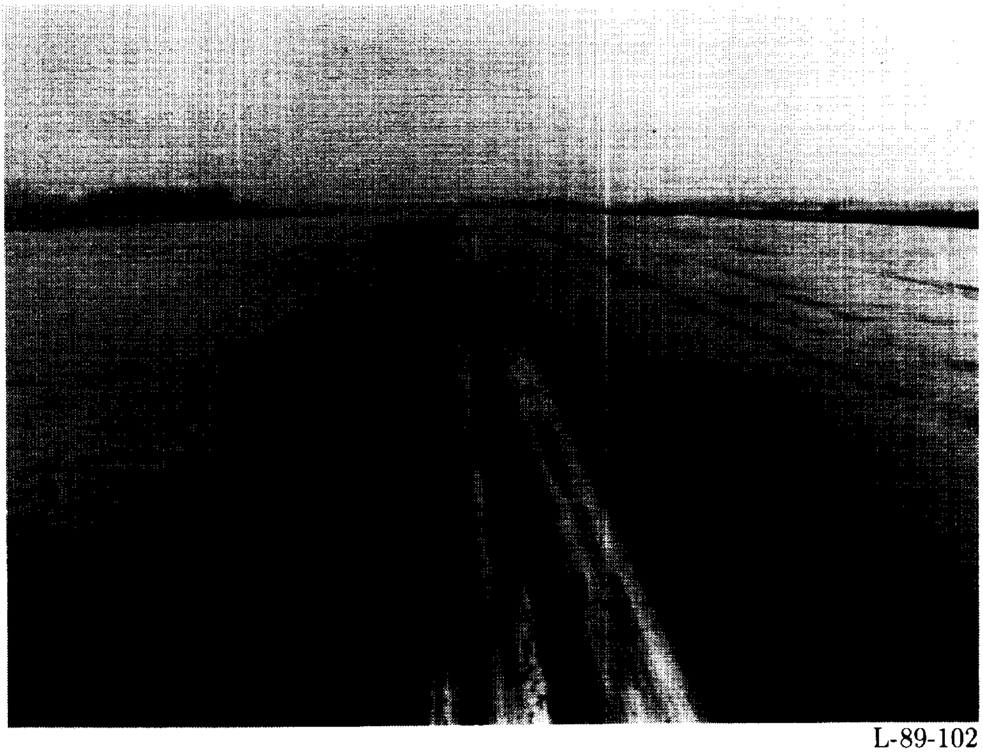
L-89-100

Figure 41. Measurement of aircraft tire tread groove depth.



L-89-101

(a) Truck-wet runway surface.



L-89-102

(b) Rain-wet runway surface.

Figure 42. Contaminated runway test-surface conditions.

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L-89-103

(c) Compacted snow-covered runway surface.

L-89-104

(d) Slush-covered runway surface.

Figure 42. Continued.

L-89-105

(e) Ice-covered runway surface.

Figure 42. Concluded.

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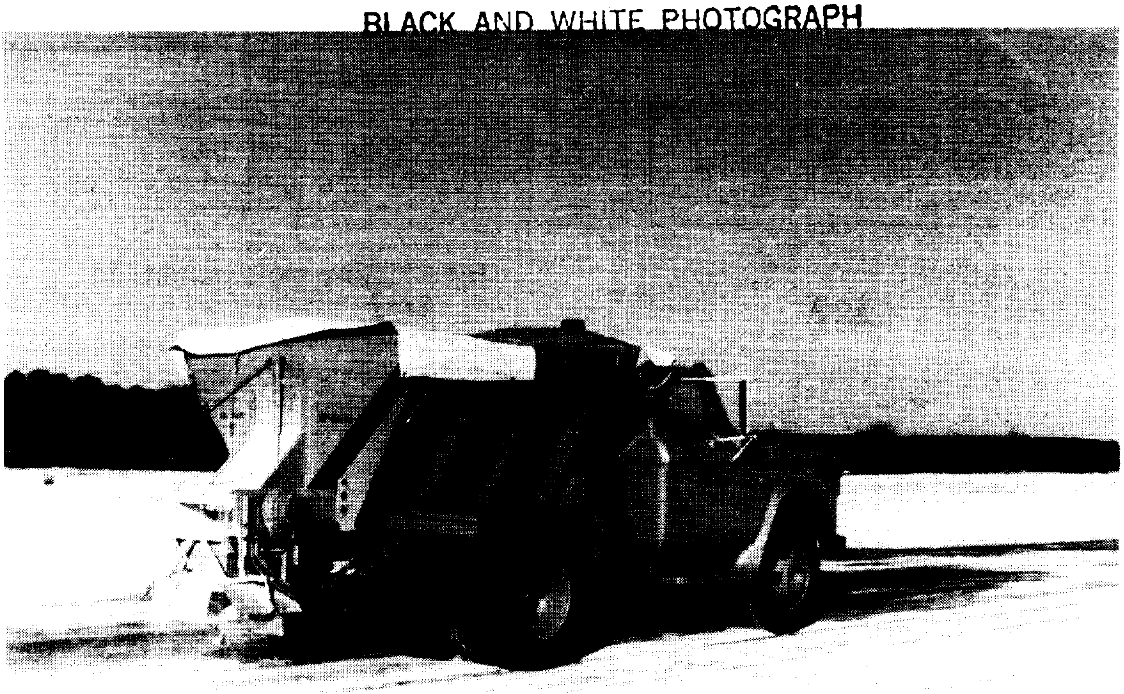
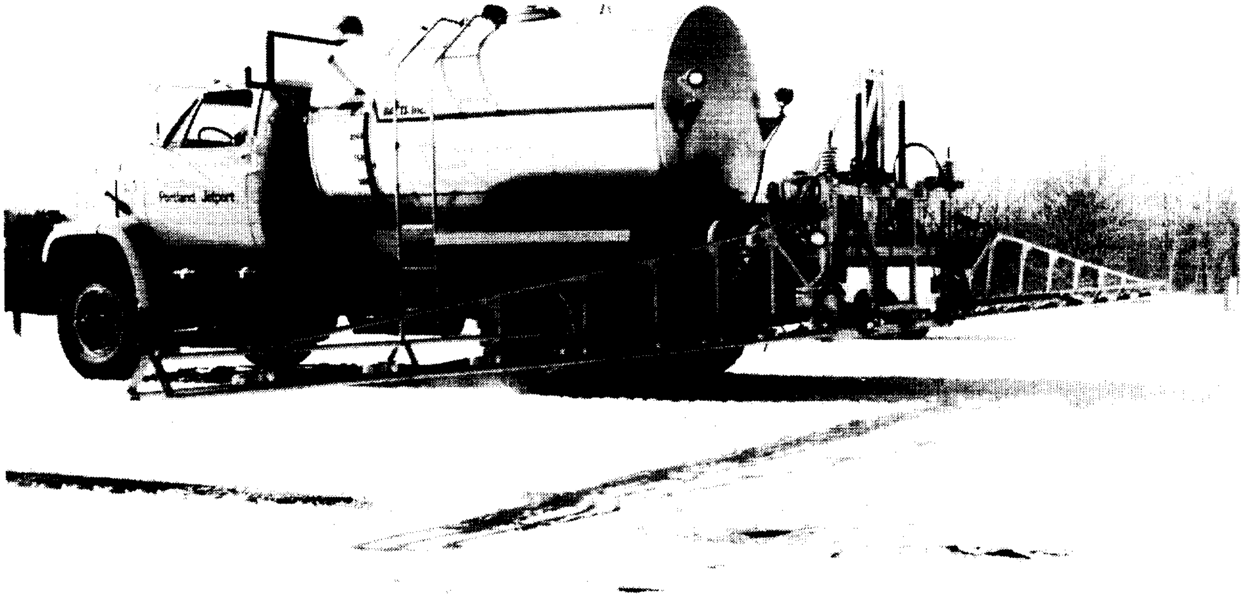


L-86-1279

(a) Dry urea.



L-86-2503

(b) Liquid UCAR.

Figure 43. Chemical distribution trucks used at BNAS.

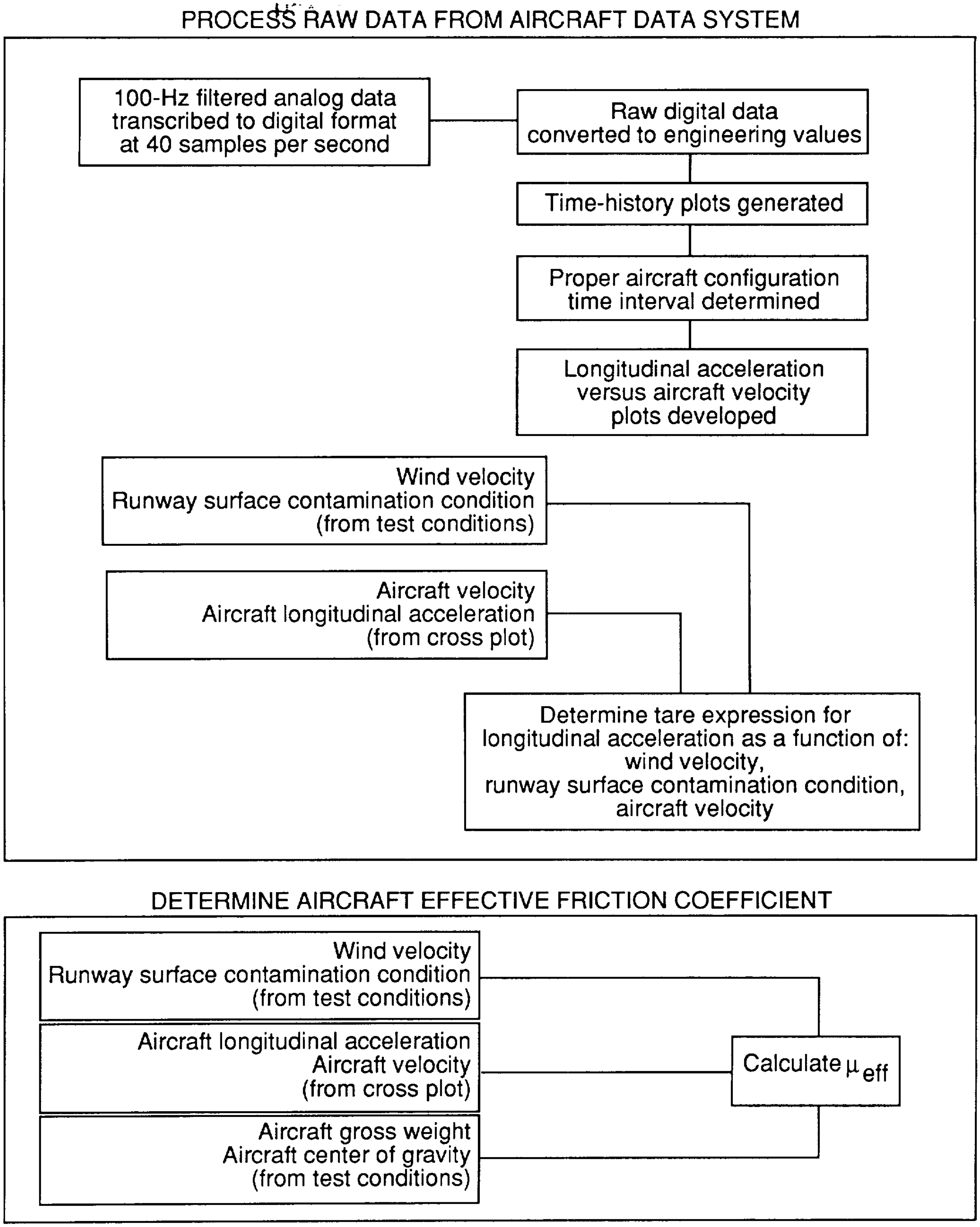
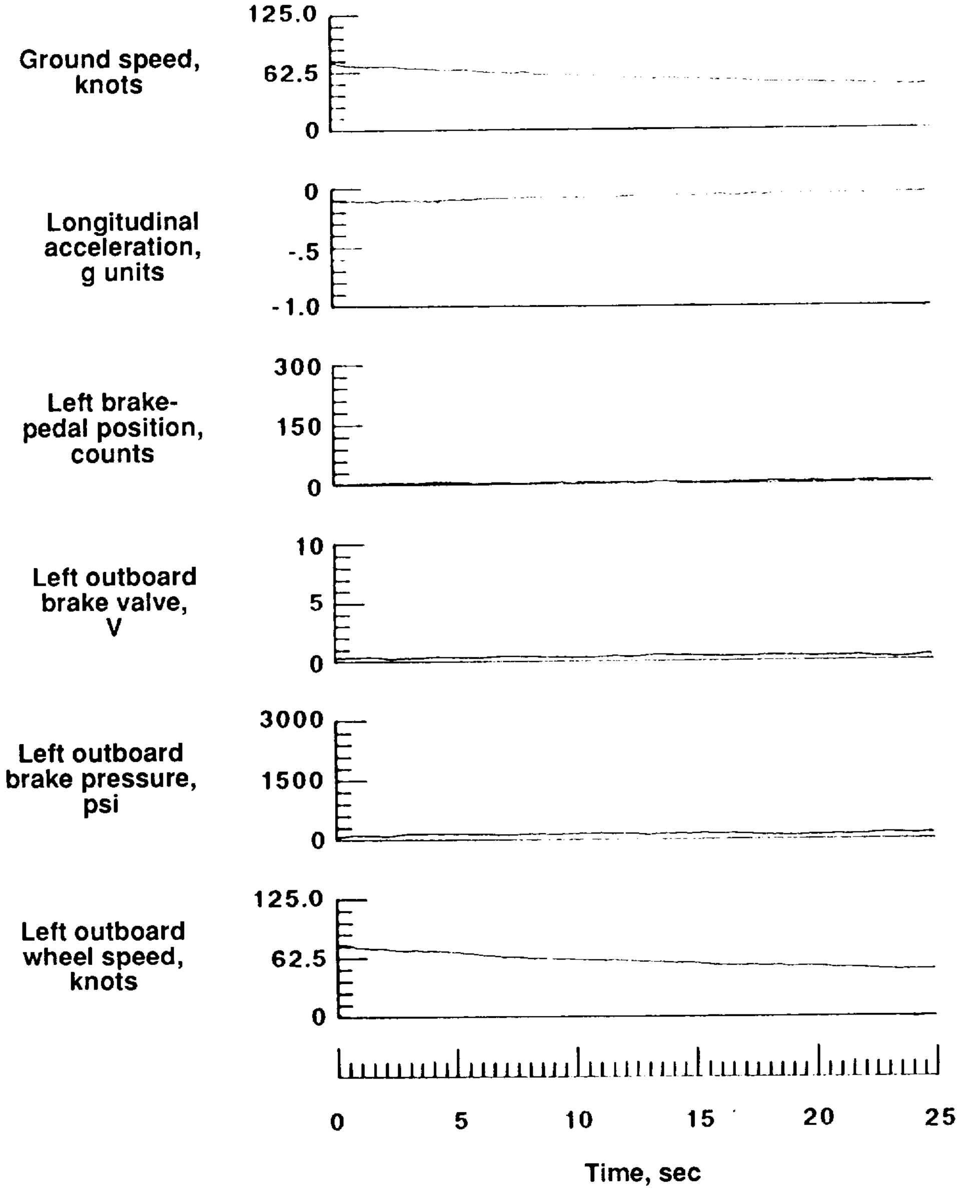
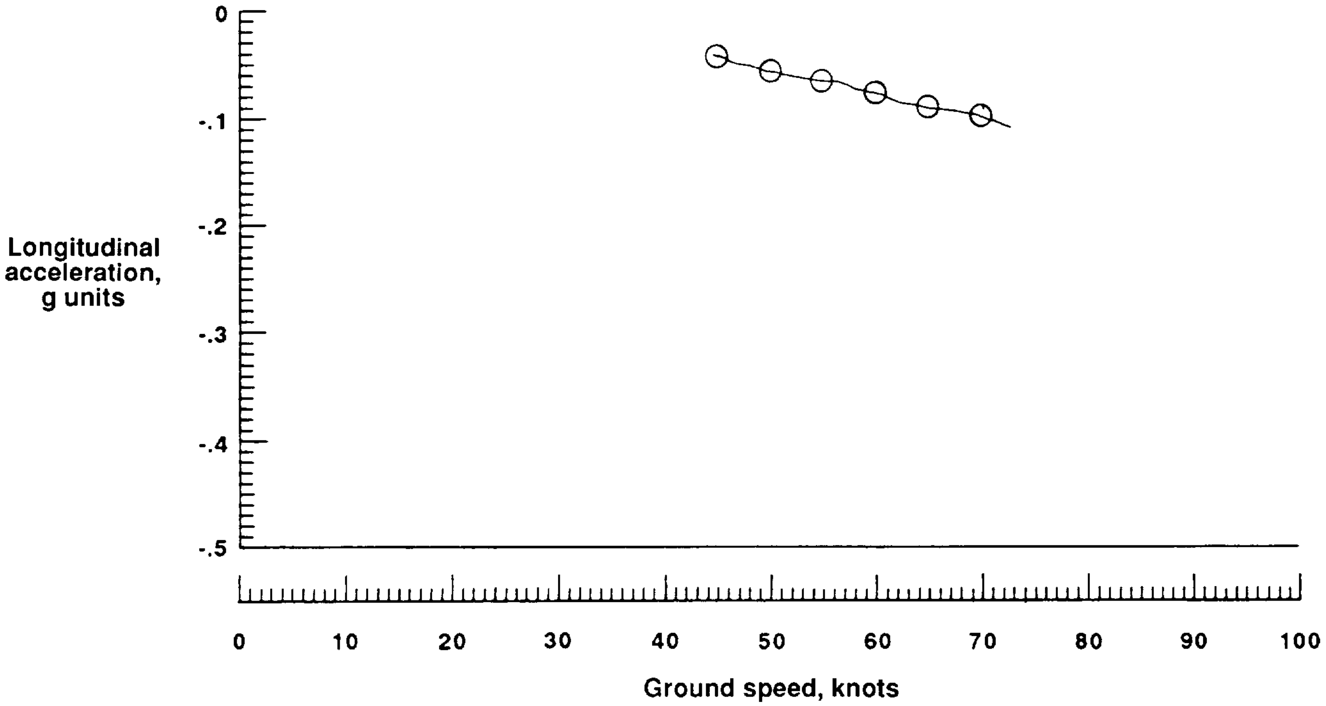


Figure 44. Flow chart of aircraft tire friction data-reduction process.



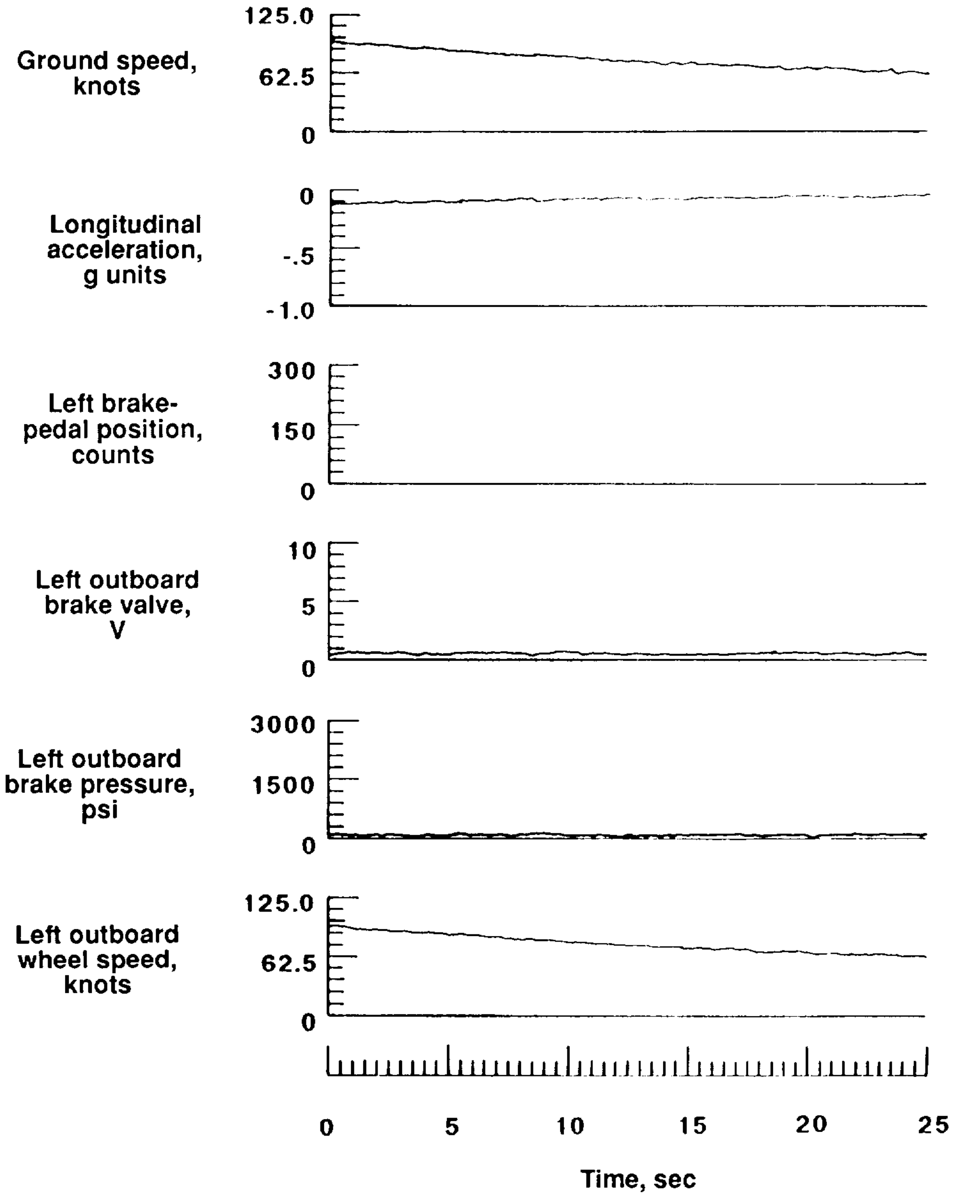
(a) Dry asphalt, nonbraking, flight 431, run 14T.

Figure 45. Examples of Boeing 737 parameter time histories and data plots obtained during test runs at BNAS.



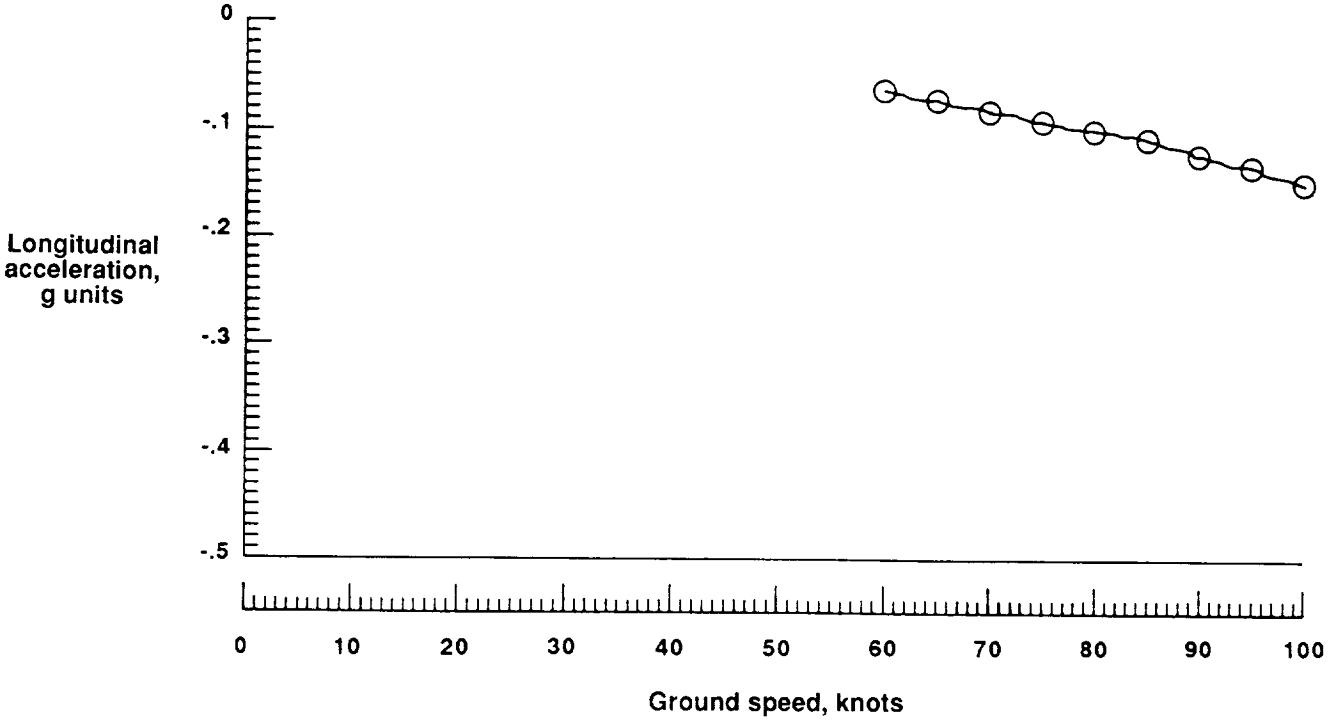
(b) Dry asphalt, nonbraking, flight 431, run 14T, longitudinal acceleration versus ground speed.

Figure 45. Continued.



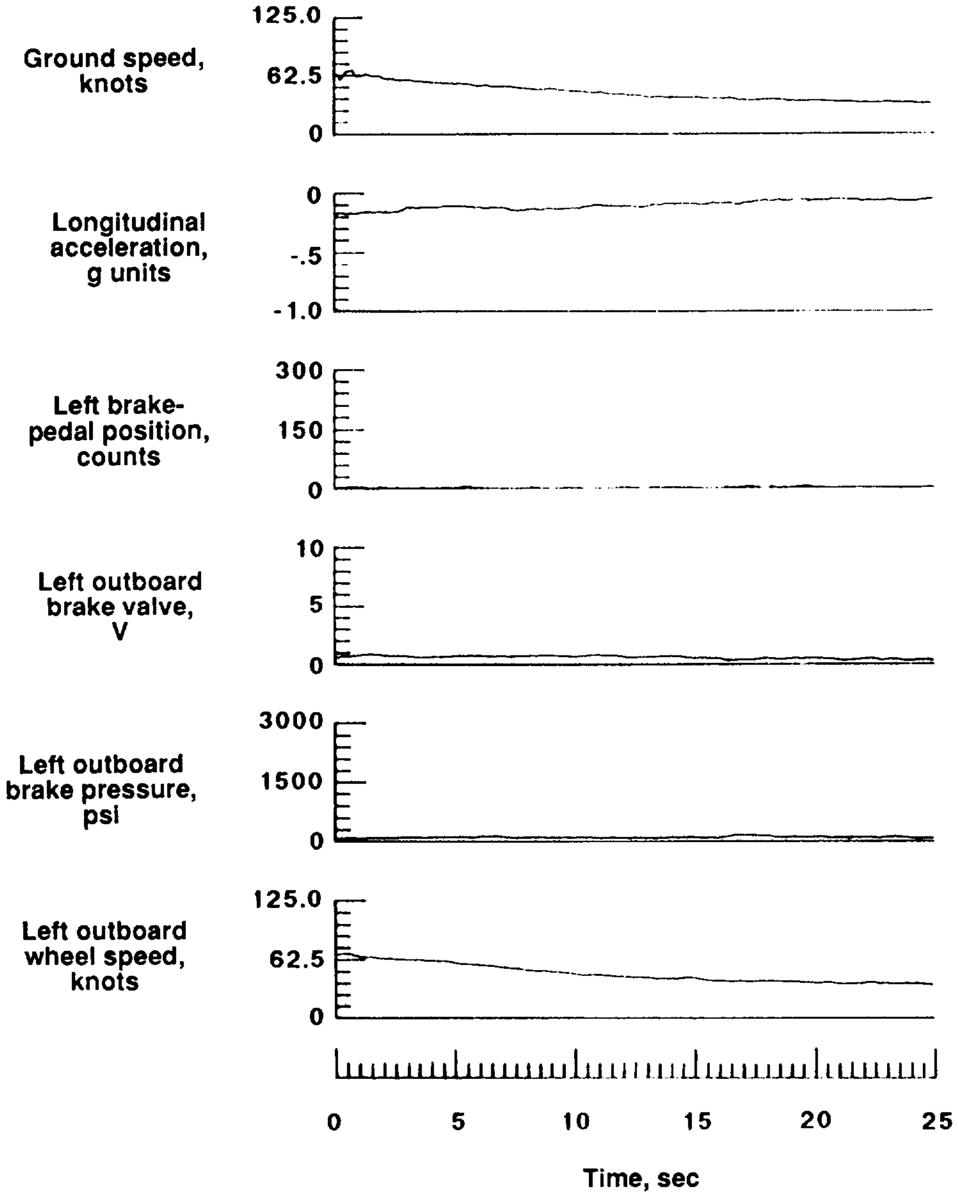
(c) Dry asphalt, nonbraking, flight 432, run 14R2.

Figure 45. Continued.



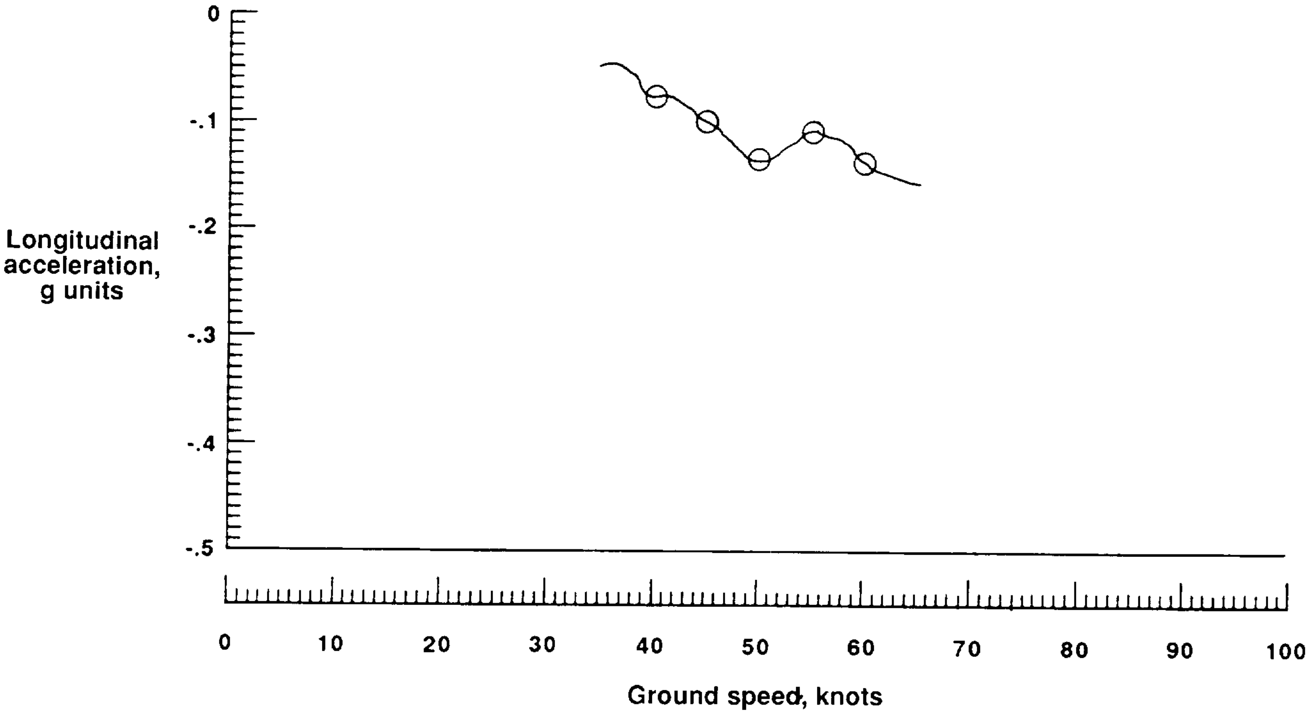
(d) Dry asphalt, nonbraking, flight 432, run 14R2, longitudinal acceleration versus ground speed.

Figure 45. Continued.



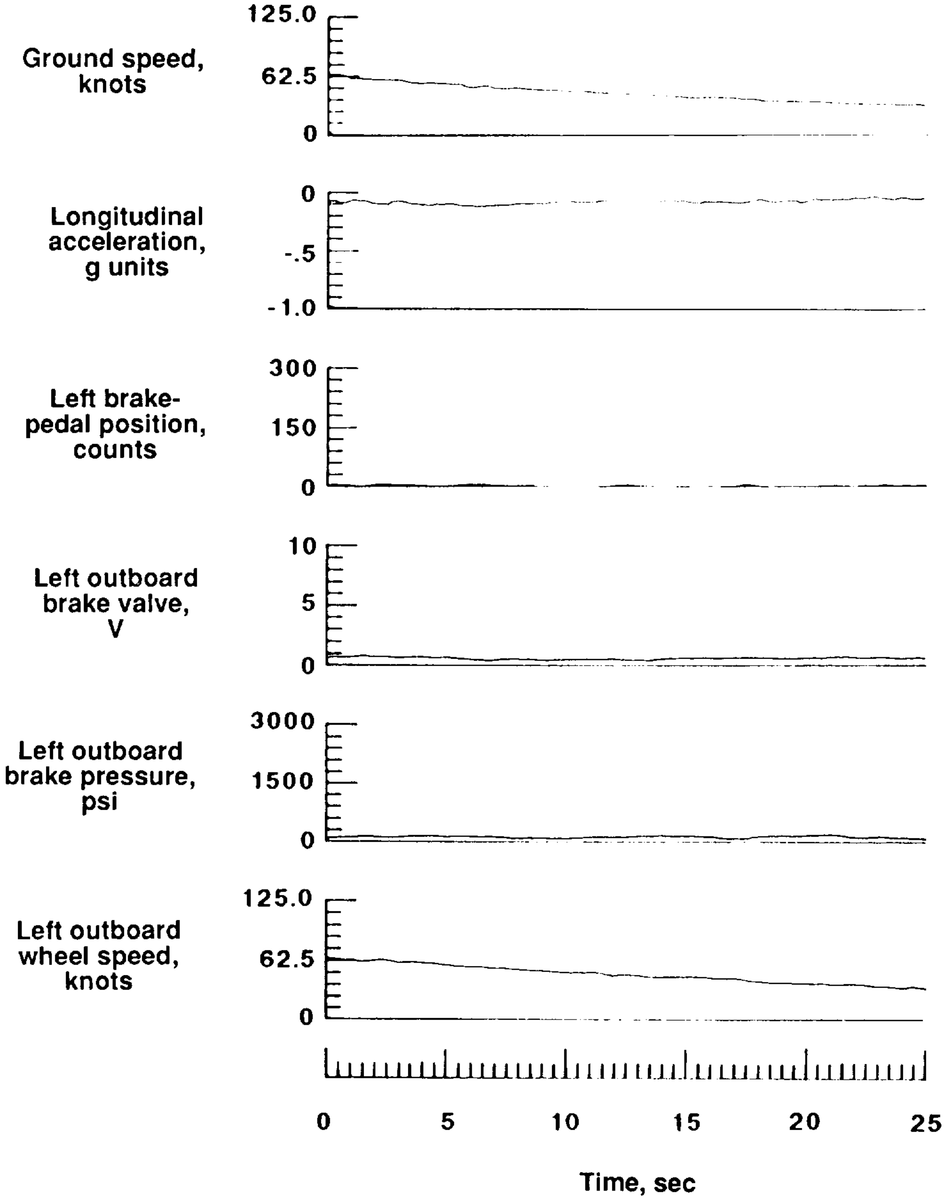
(e) 4-in. wet snow, nonbraking, flight 432, run 9.

Figure 45. Continued.



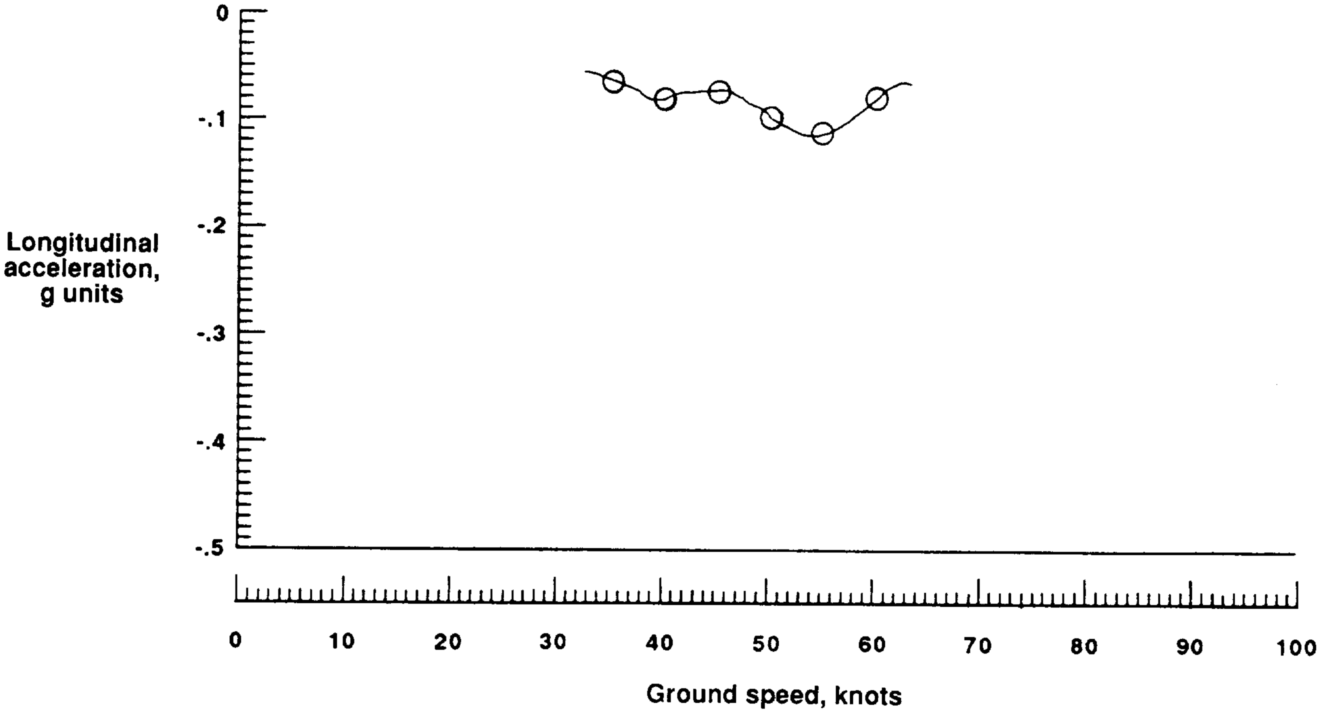
(f) 4-in. wet snow, nonbraking, flight 432, run 9, longitudinal acceleration versus ground speed.

Figure 45. Continued.



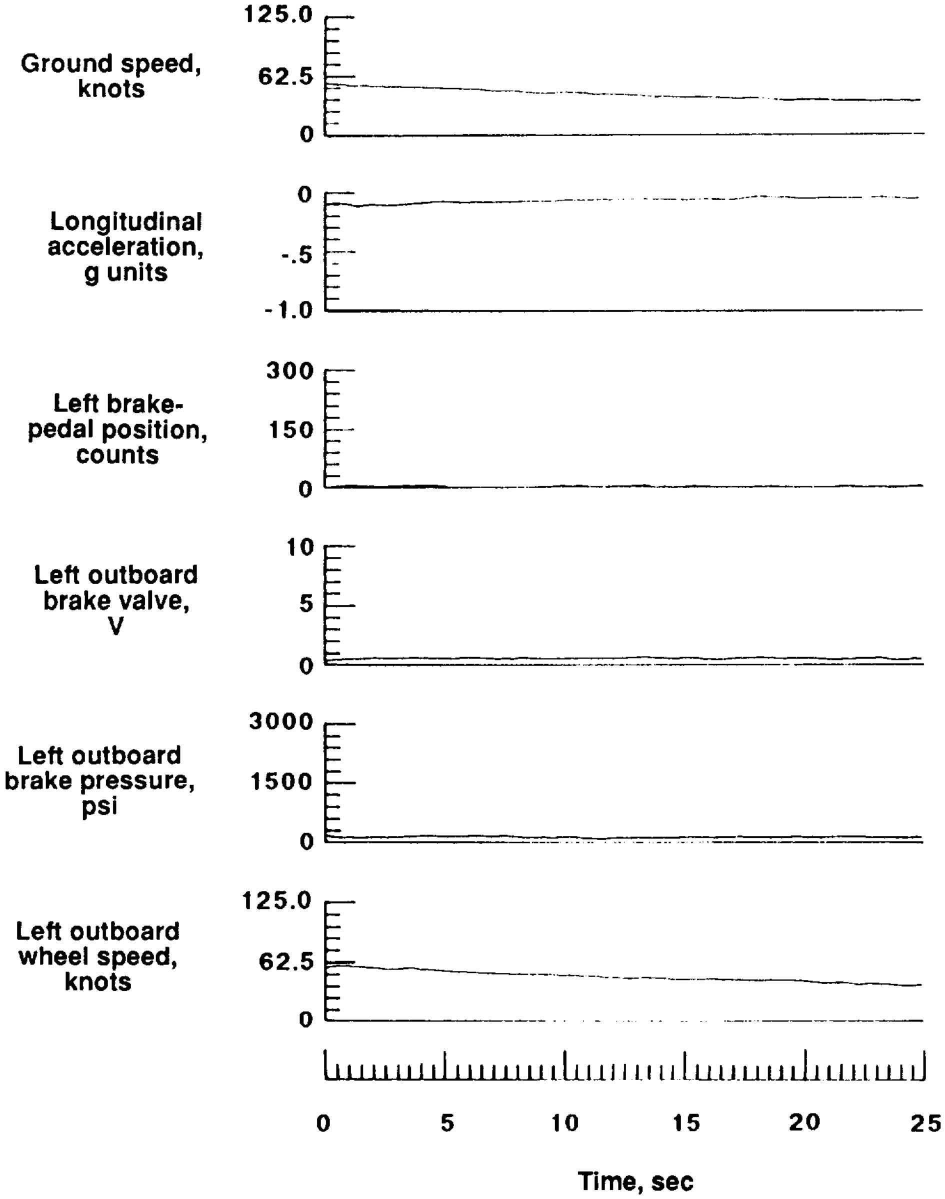
(g) 4-in. wet snow, nonbraking, flight 432, run 7.

Figure 45. Continued.



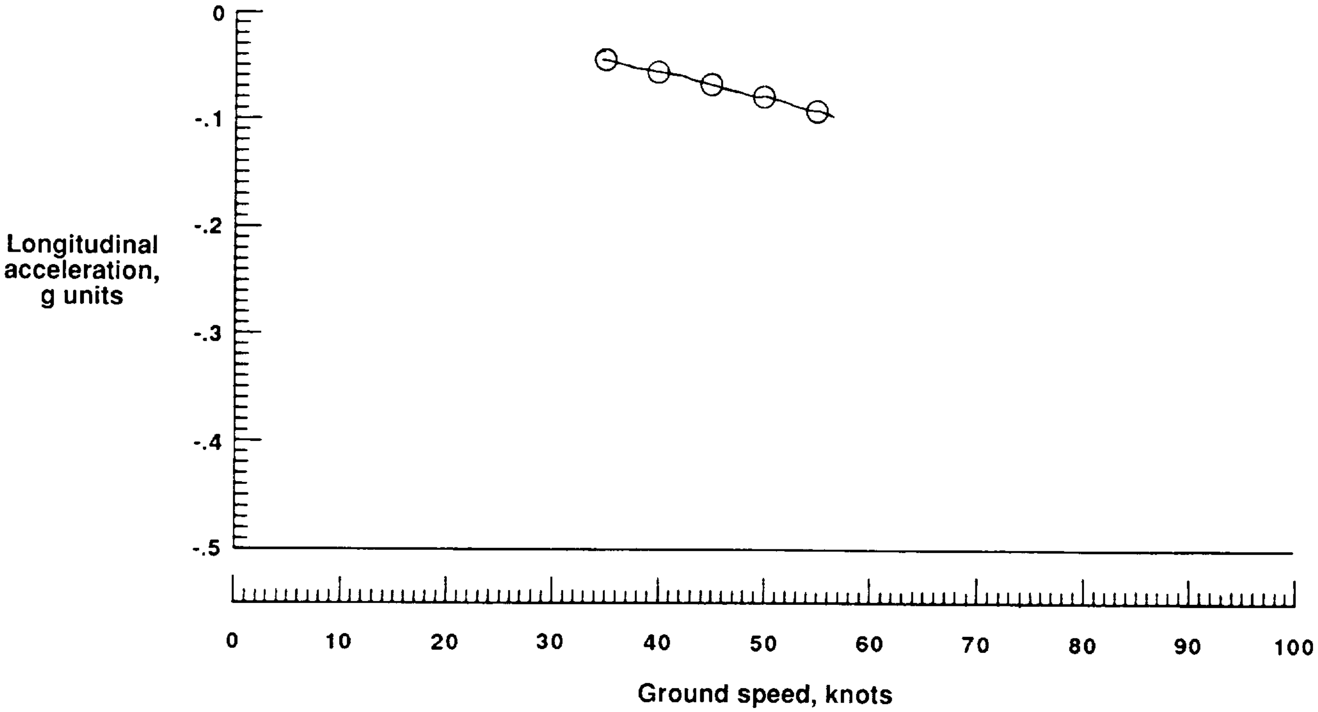
(h) 4-in. wet snow, nonbraking, flight 432, run 7, longitudinal acceleration versus ground speed.

Figure 45. Continued.



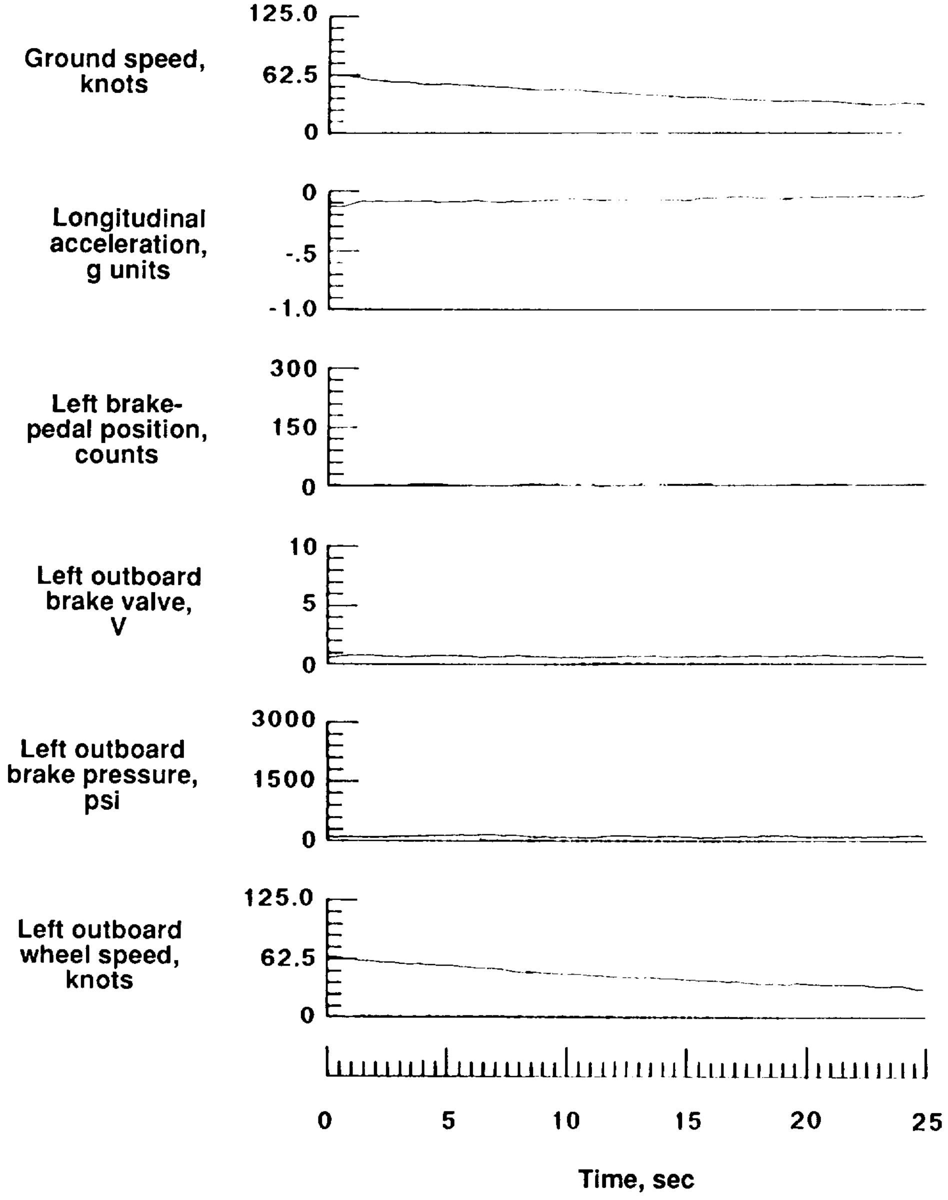
(i) 6-in. dry snow, nonbraking, flight 430, run 7.

Figure 45. Continued.



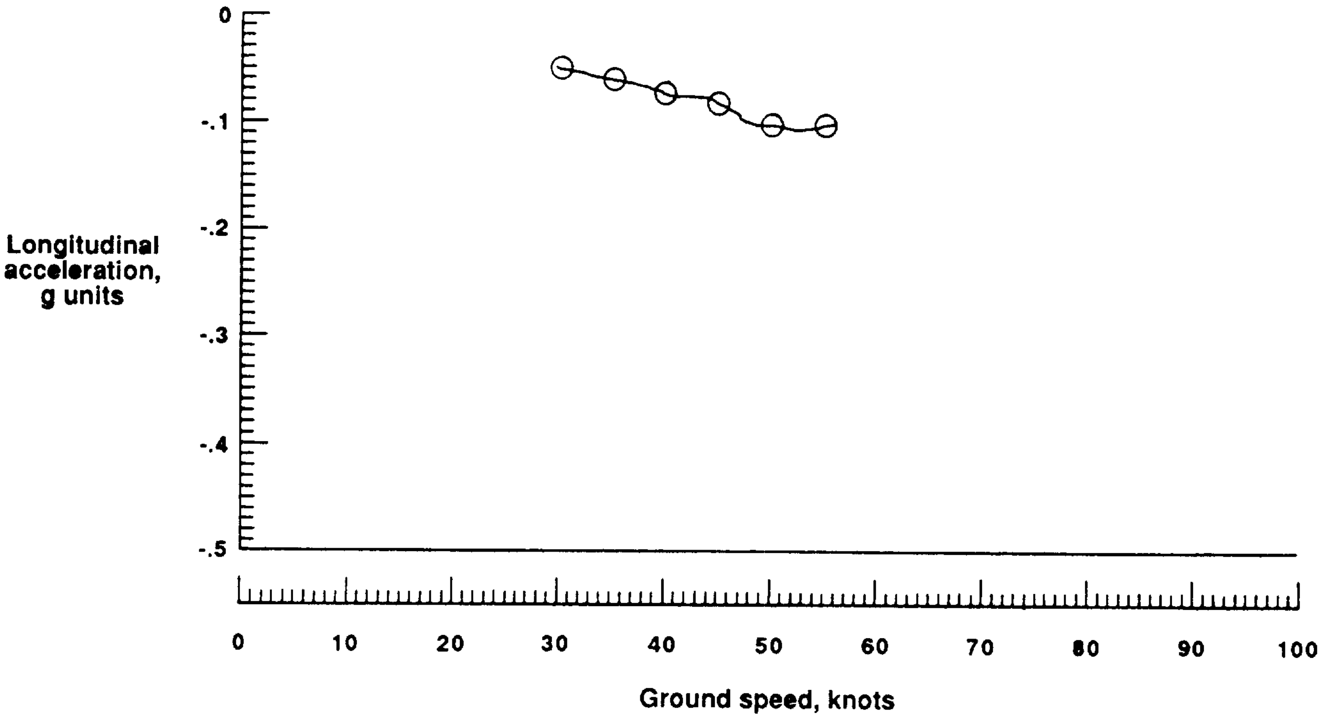
(j) 6-in. dry snow, nonbraking, flight 430, run 7, longitudinal acceleration versus ground speed.

Figure 45. Continued.



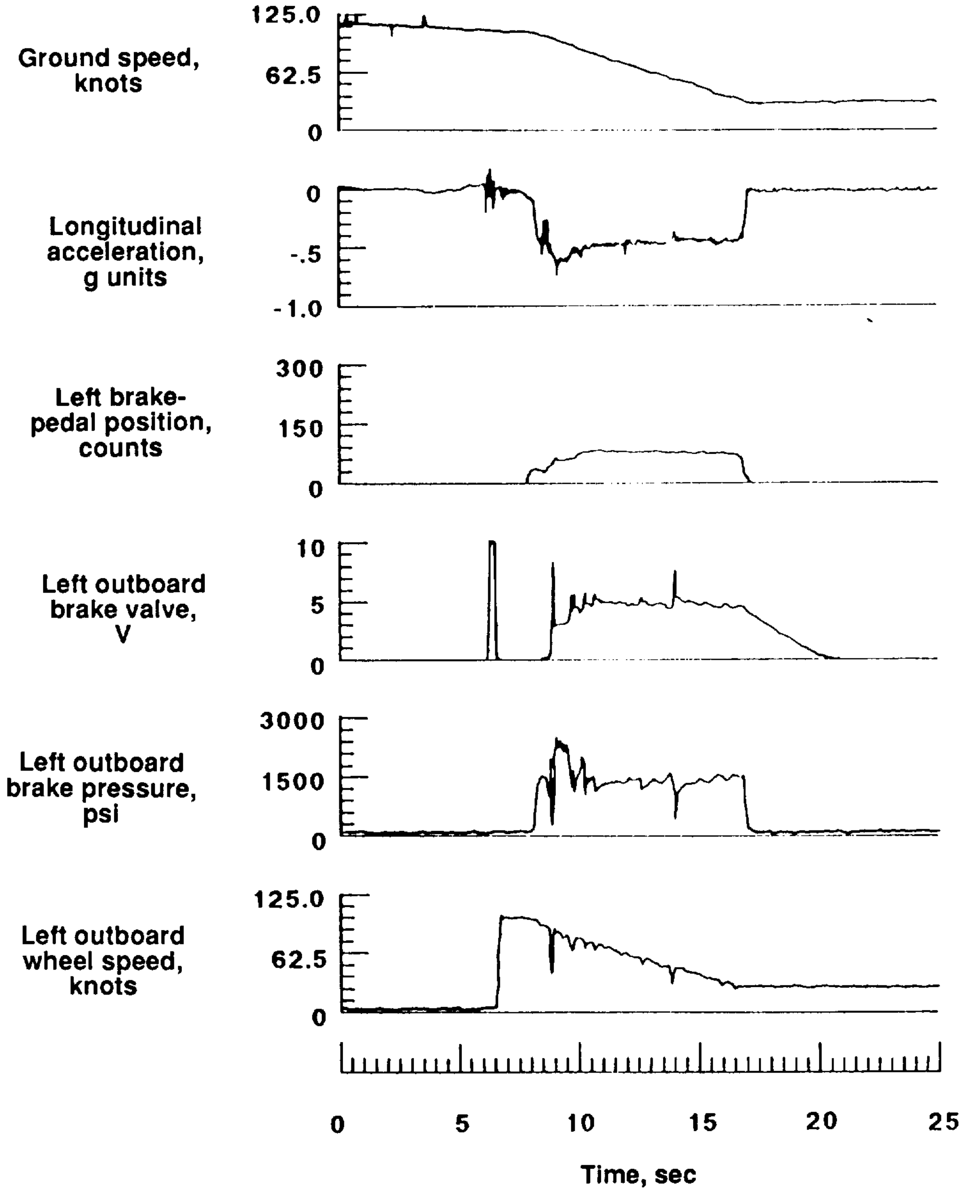
(k) 6-in. dry snow, nonbraking, flight 430, run 9.

Figure 45. Continued.



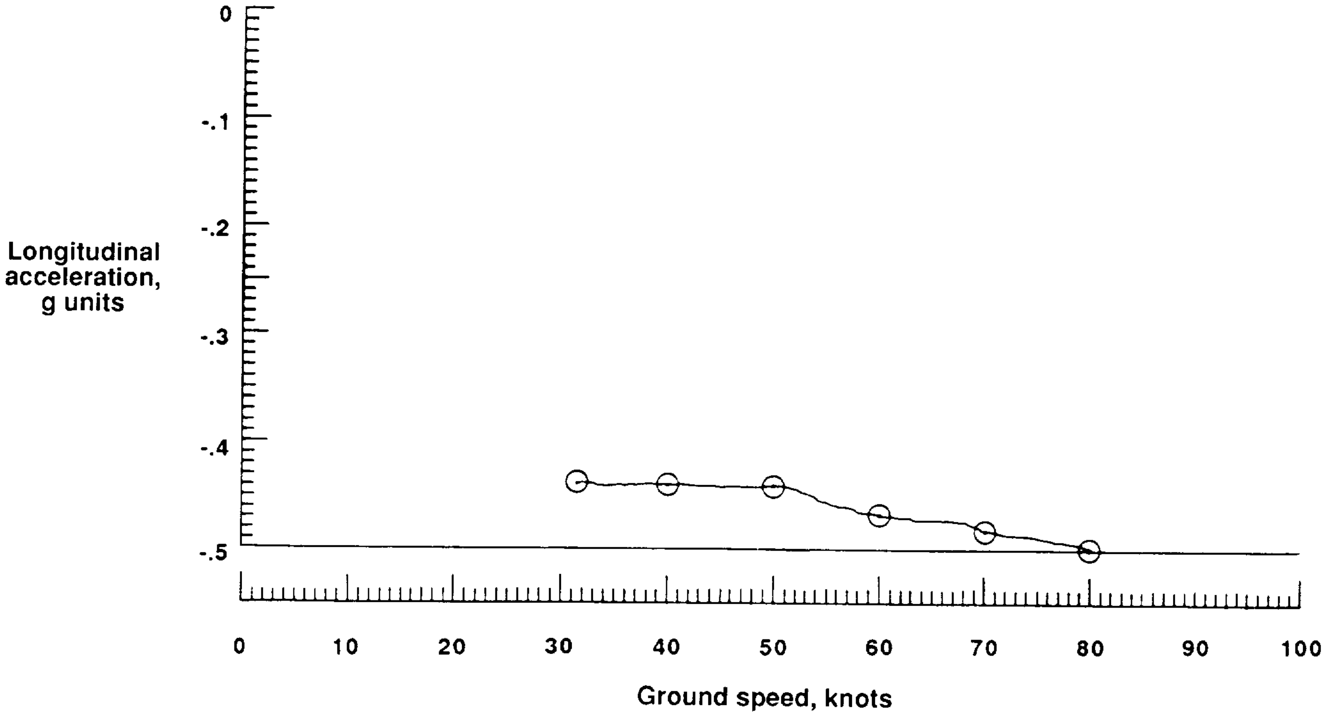
(l) 6-in. dry snow, nonbraking, flight 430, run 9, longitudinal acceleration versus ground speed.

Figure 45. Continued.



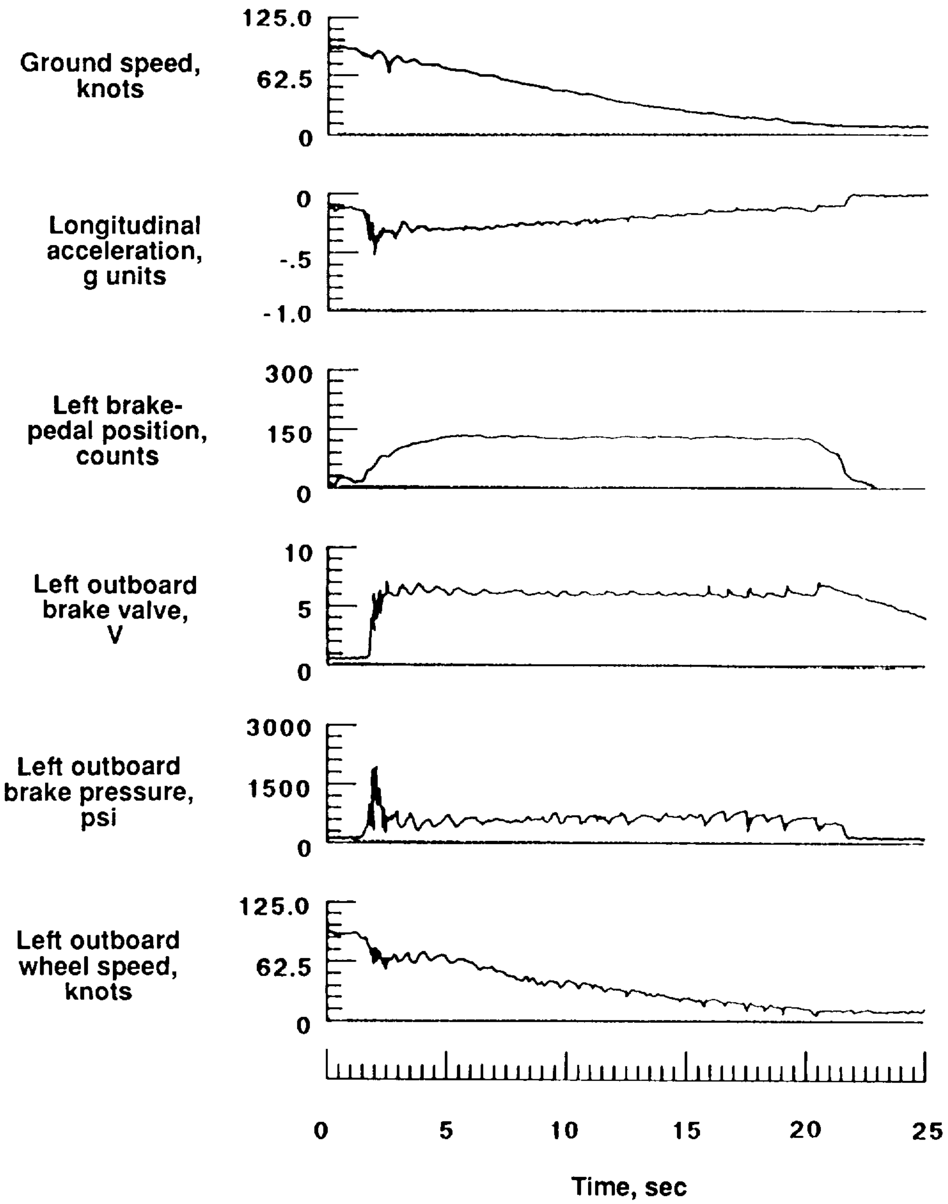
(m) Dry asphalt, maximum antiskid braking, flight 410, run 18.

Figure 45. Continued.



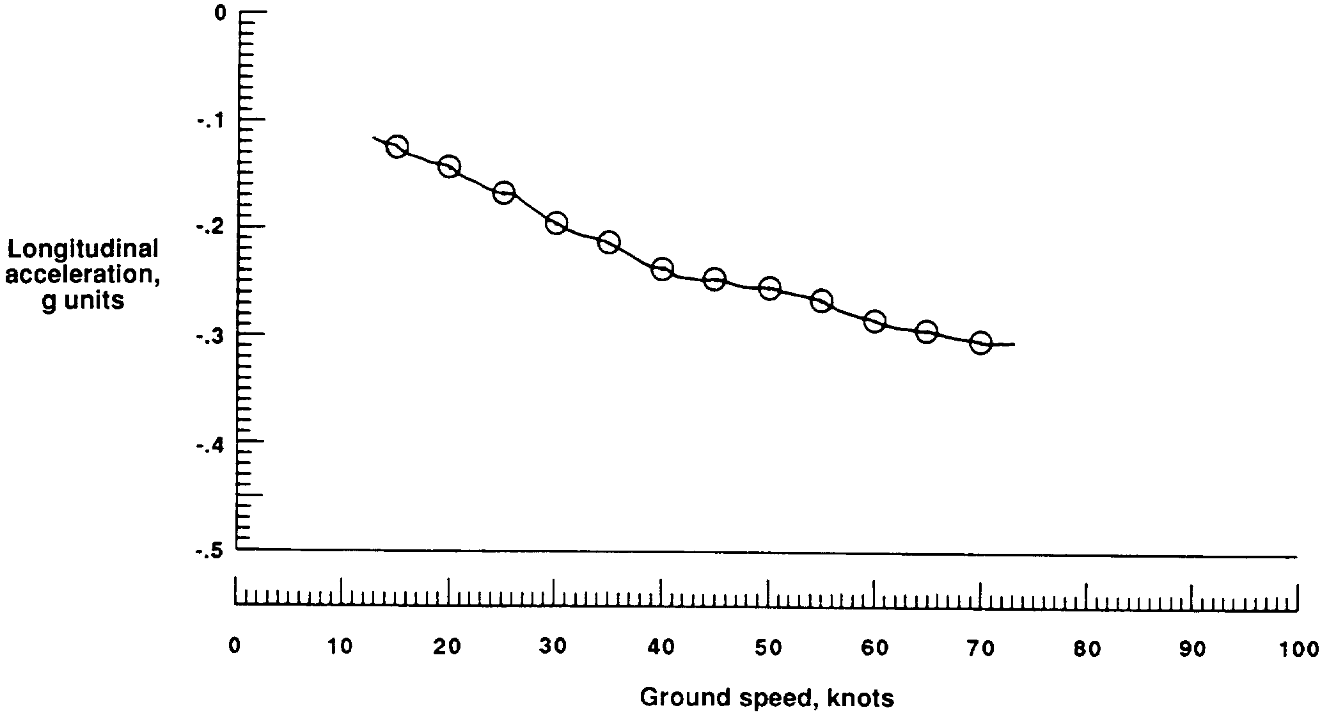
(n) Dry asphalt, maximum antiskid braking, flight 410, run 18, longitudinal acceleration versus ground speed.

Figure 45. Continued.



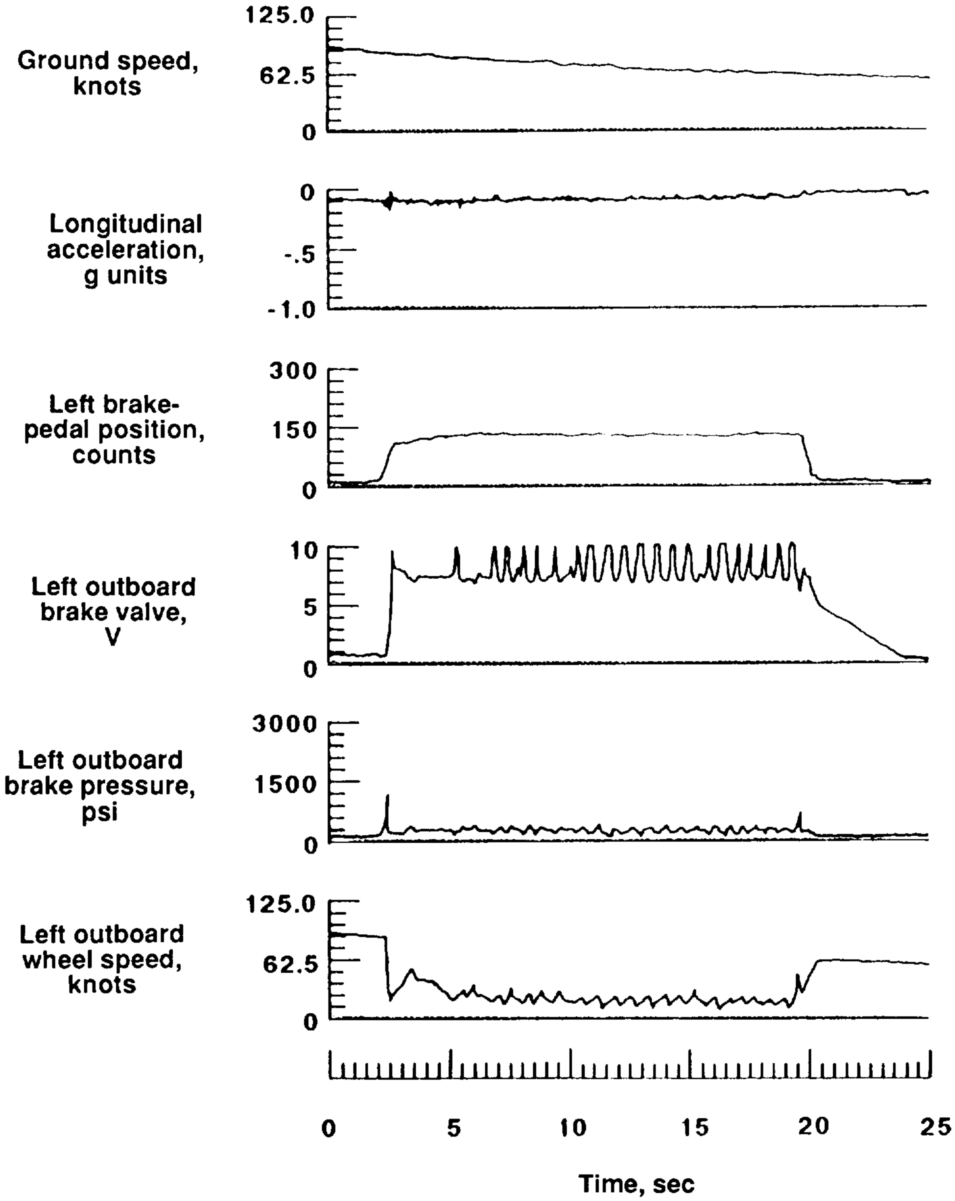
(o) 6-in. loose snow, maximum antiskid braking, flight 430, run 5.

Figure 45. Continued.



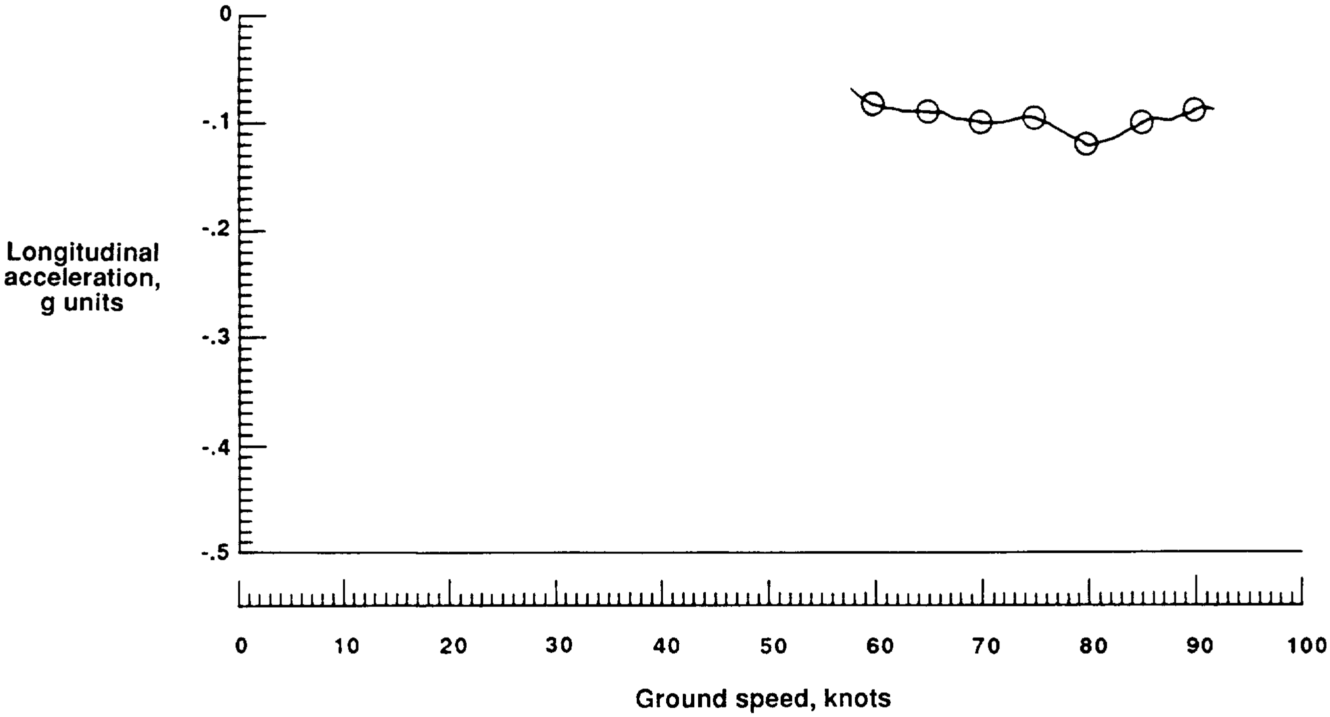
(p) 6-in. loose snow, maximum antiskid braking, flight 430, run 5, longitudinal acceleration versus ground speed.

Figure 45. Continued.



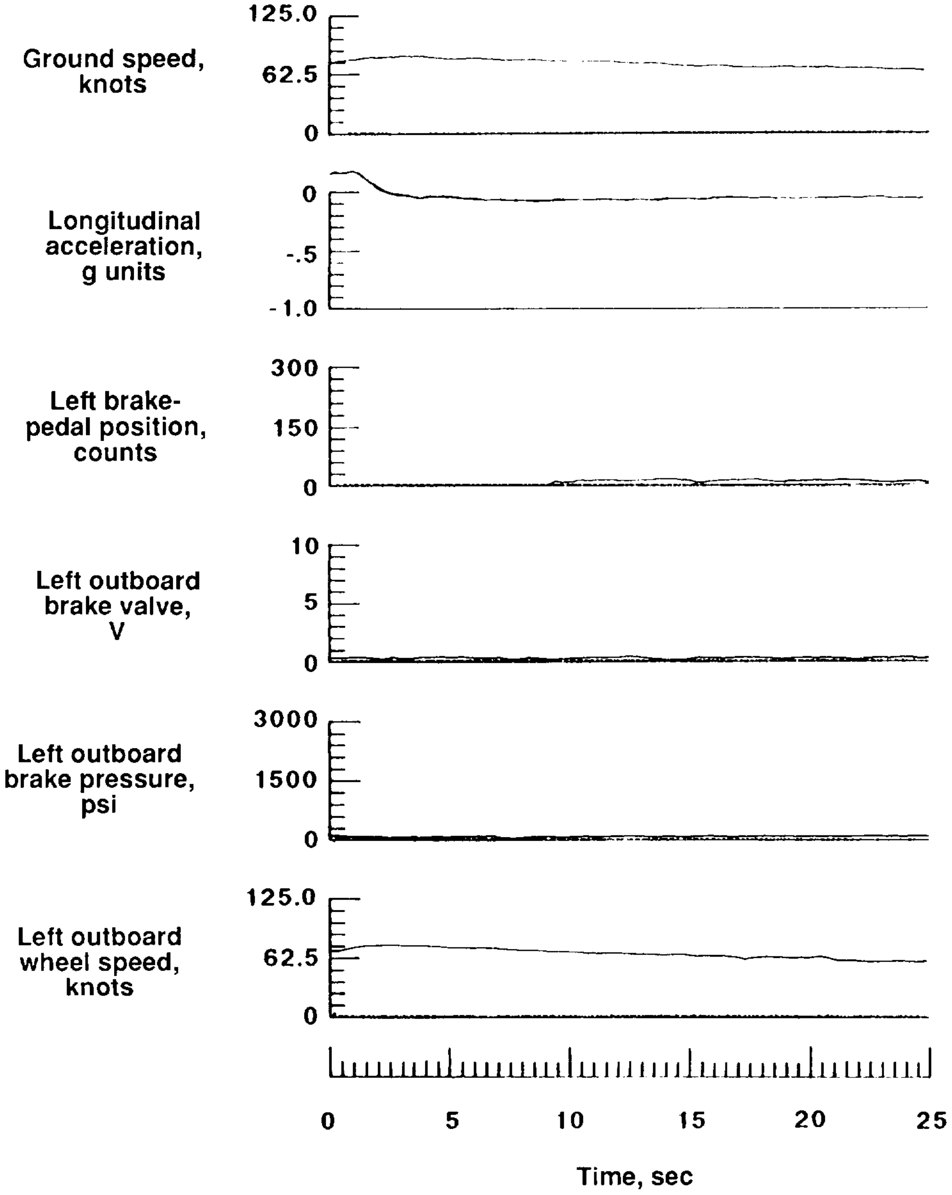
(q) Ice-covered asphalt, maximum antiskid braking, flight 433, run 5.

Figure 45. Continued.



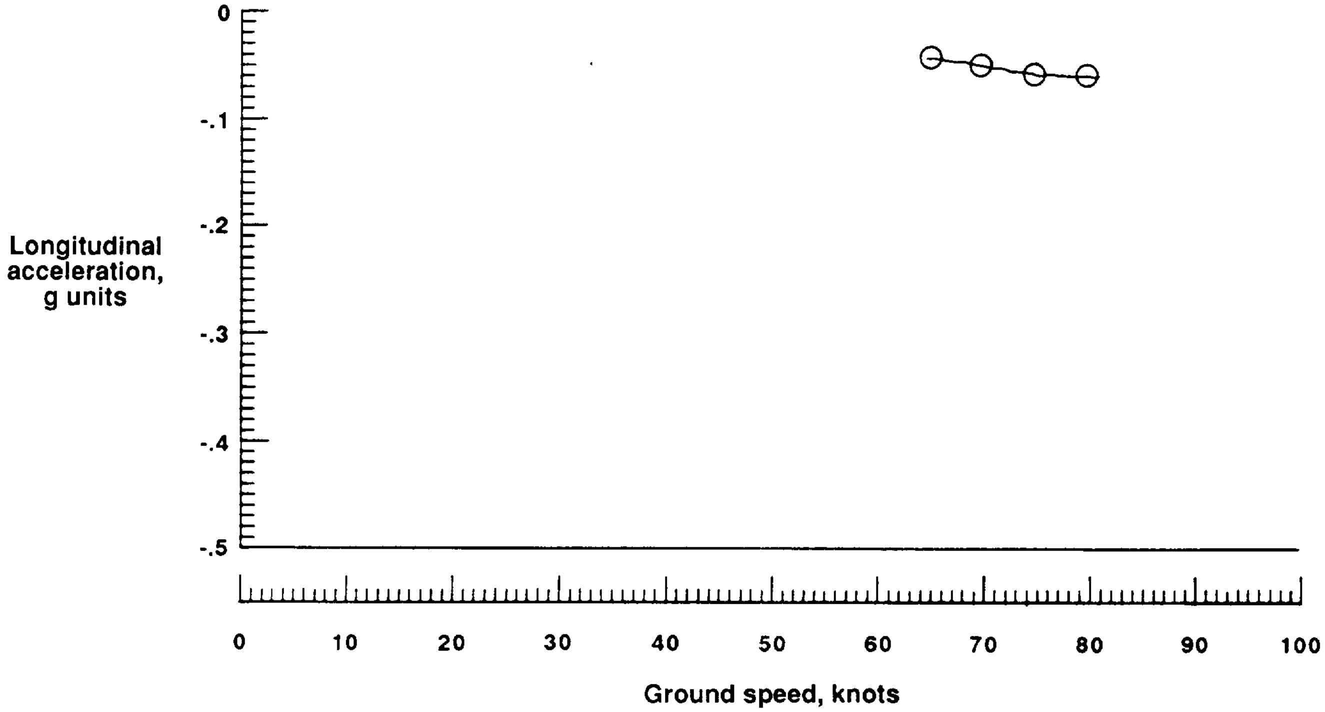
(r) Ice-covered asphalt, maximum antiskid braking, flight 433, run 5, longitudinal acceleration versus ground speed.

Figure 45. Concluded.



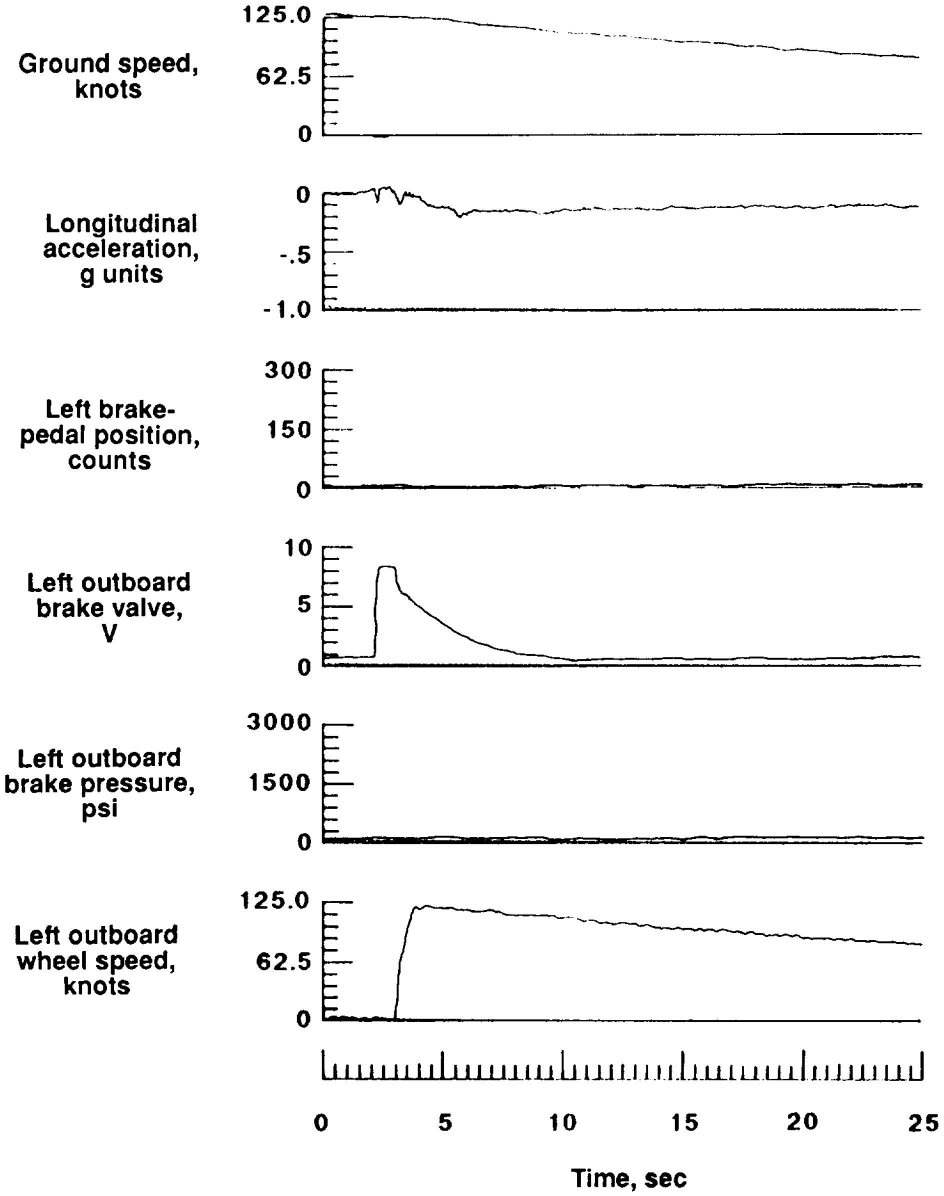
(a) Dry asphalt, nonbraking, flight 028, run CAL.

Figure 46. Examples of Boeing 727 parameter time histories and data plots obtained during test runs at BNAS.



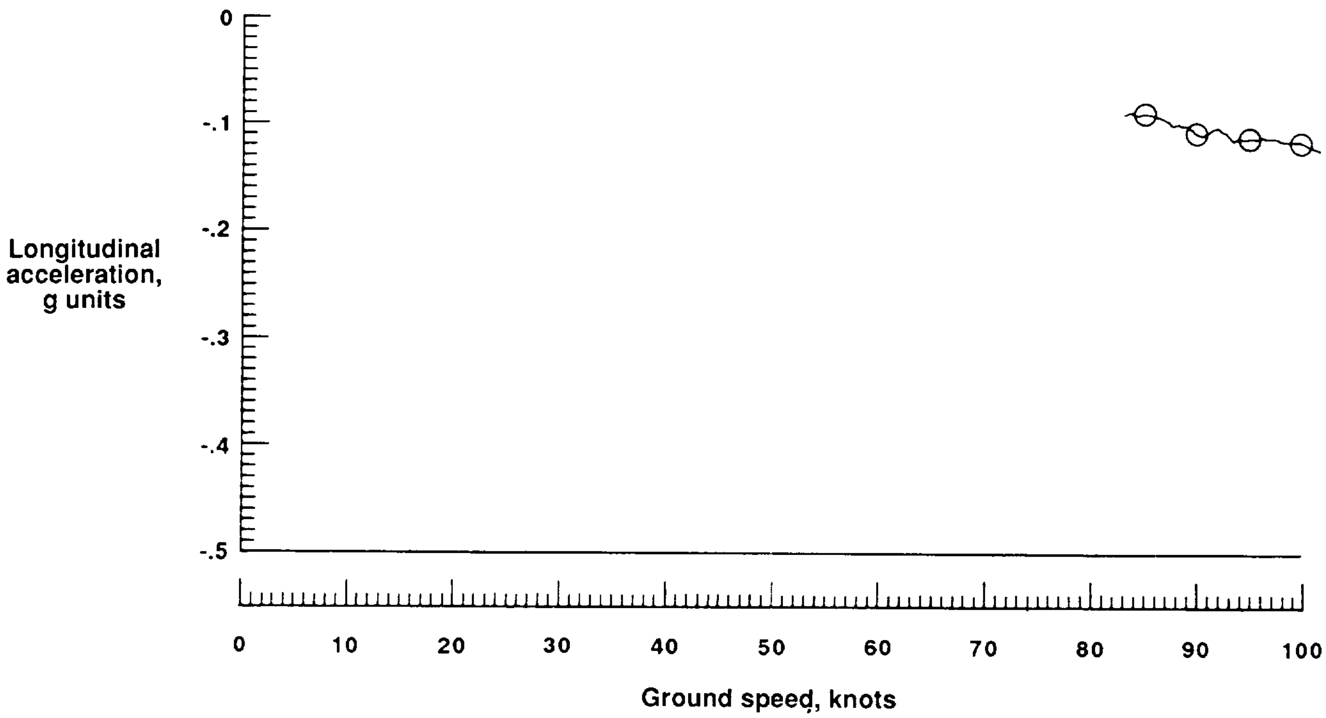
(b) Dry asphalt, nonbraking, flight 028, run CAL, longitudinal acceleration versus ground speed.

Figure 46. Continued.



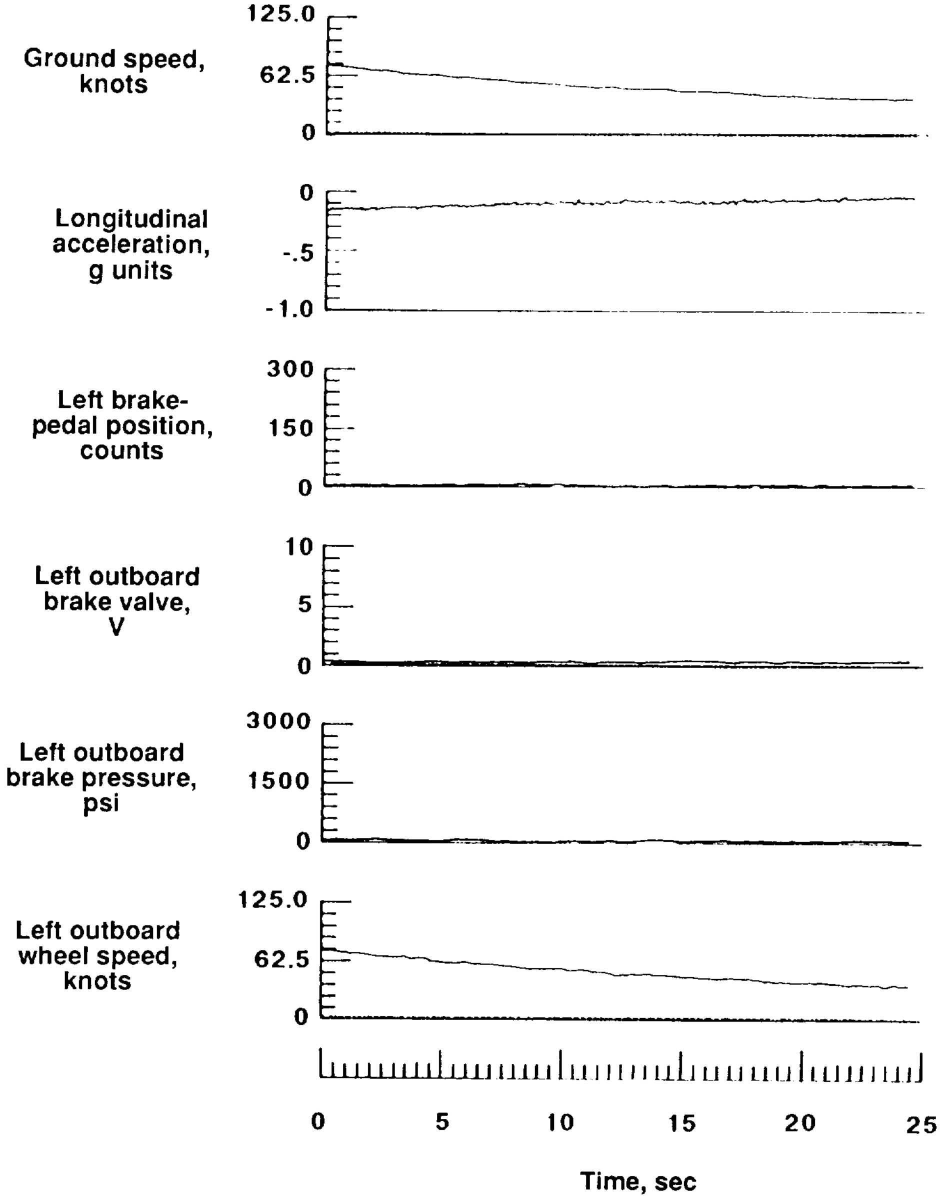
(c) Dry asphalt, nonbraking, flight 006, run 13.

Figure 46. Continued.



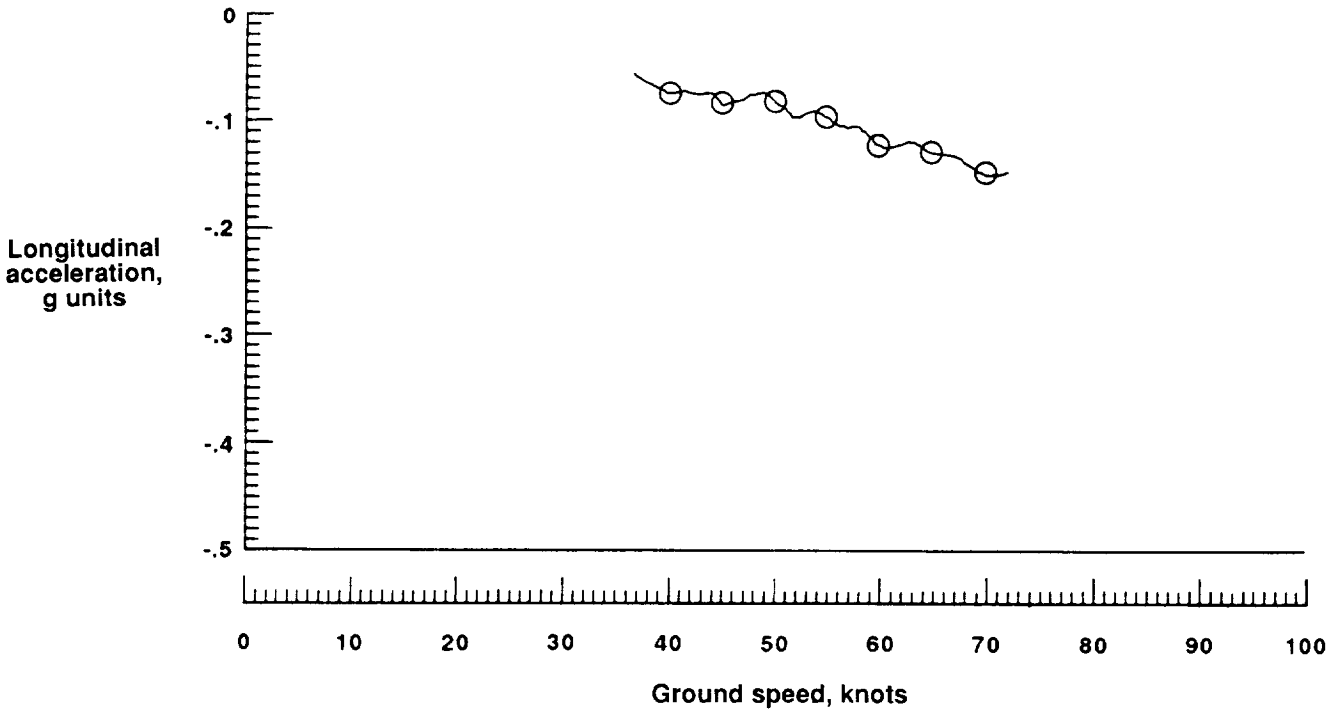
(d) Dry asphalt, nonbraking, flight 006, run 13, longitudinal acceleration versus ground speed.

Figure 46. Continued.



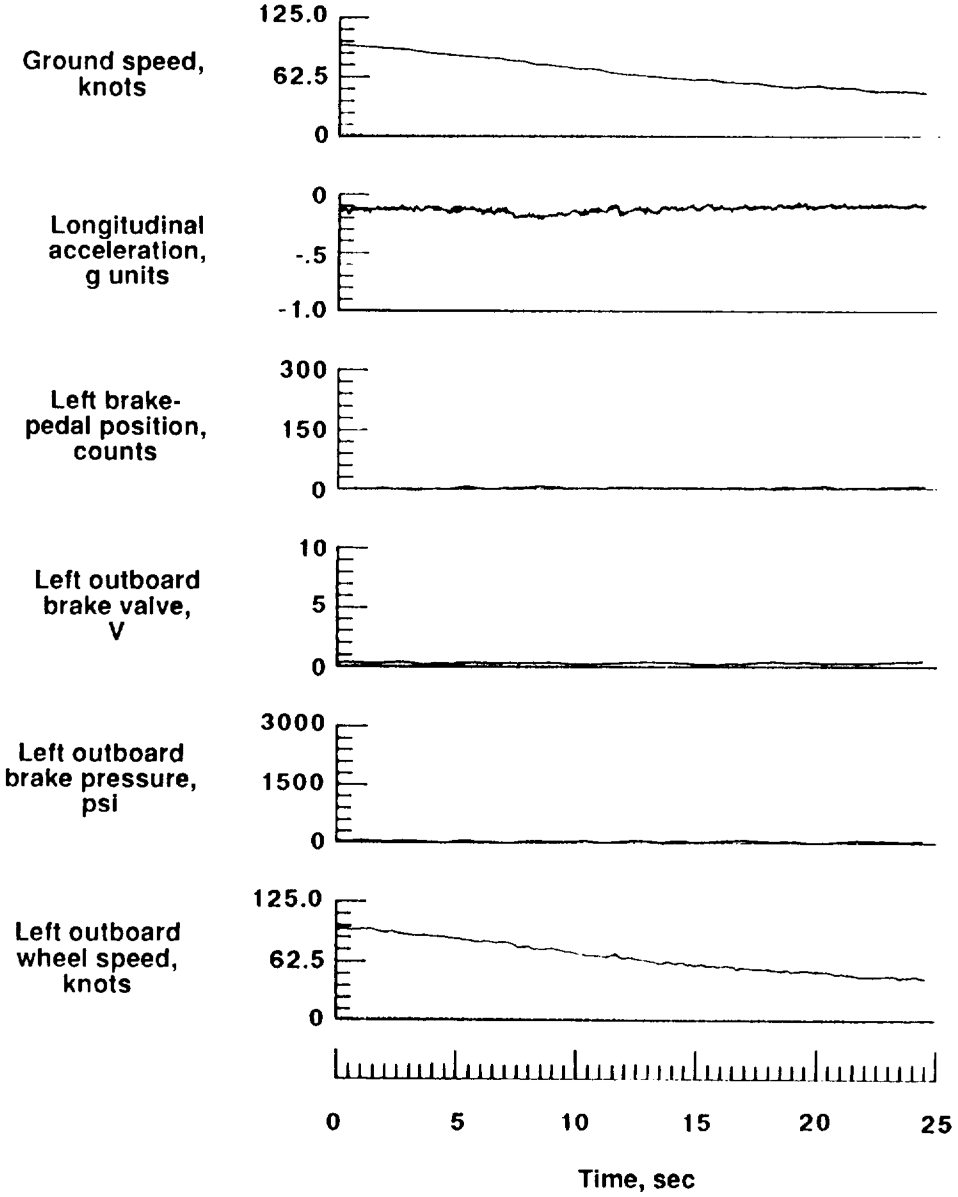
(e) 4.5-in. loose snow, nonbraking, flight 022, run 2.

Figure 46. Continued.



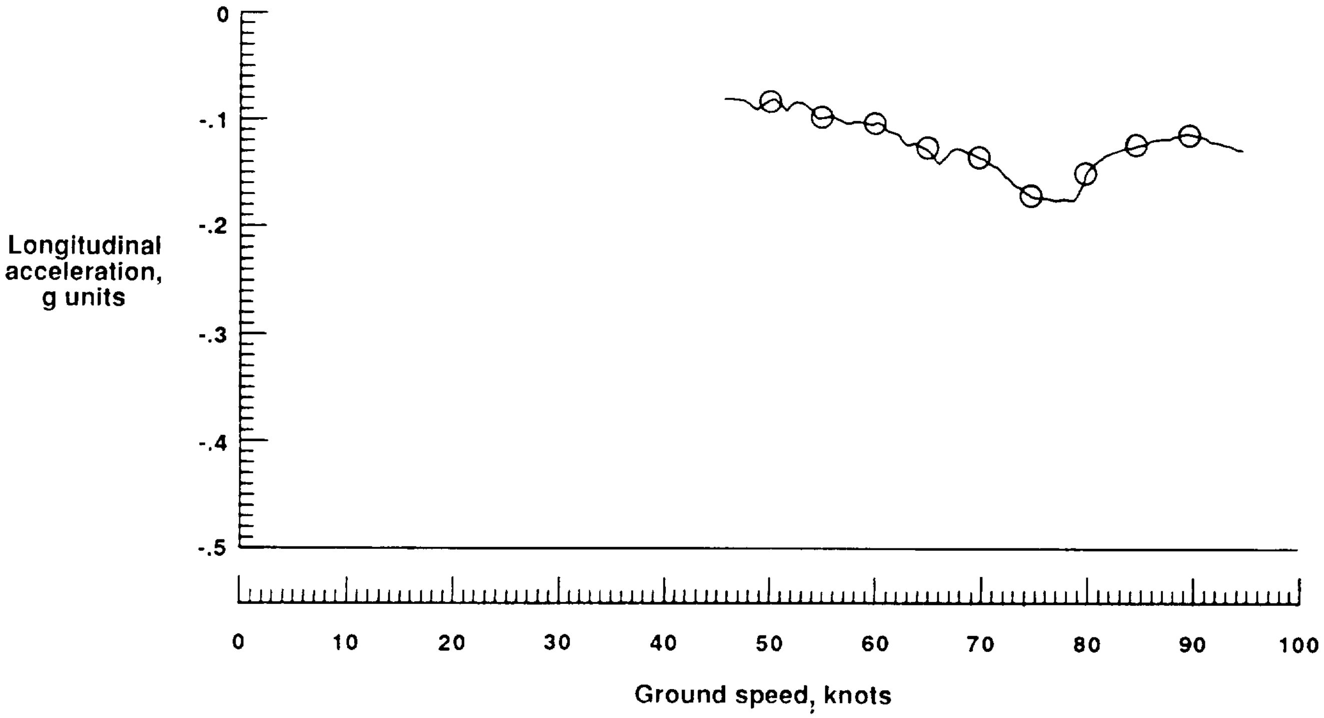
(f) 4.5-in. loose snow, nonbraking, flight 022, run 2, longitudinal acceleration versus ground speed.

Figure 46. Continued.



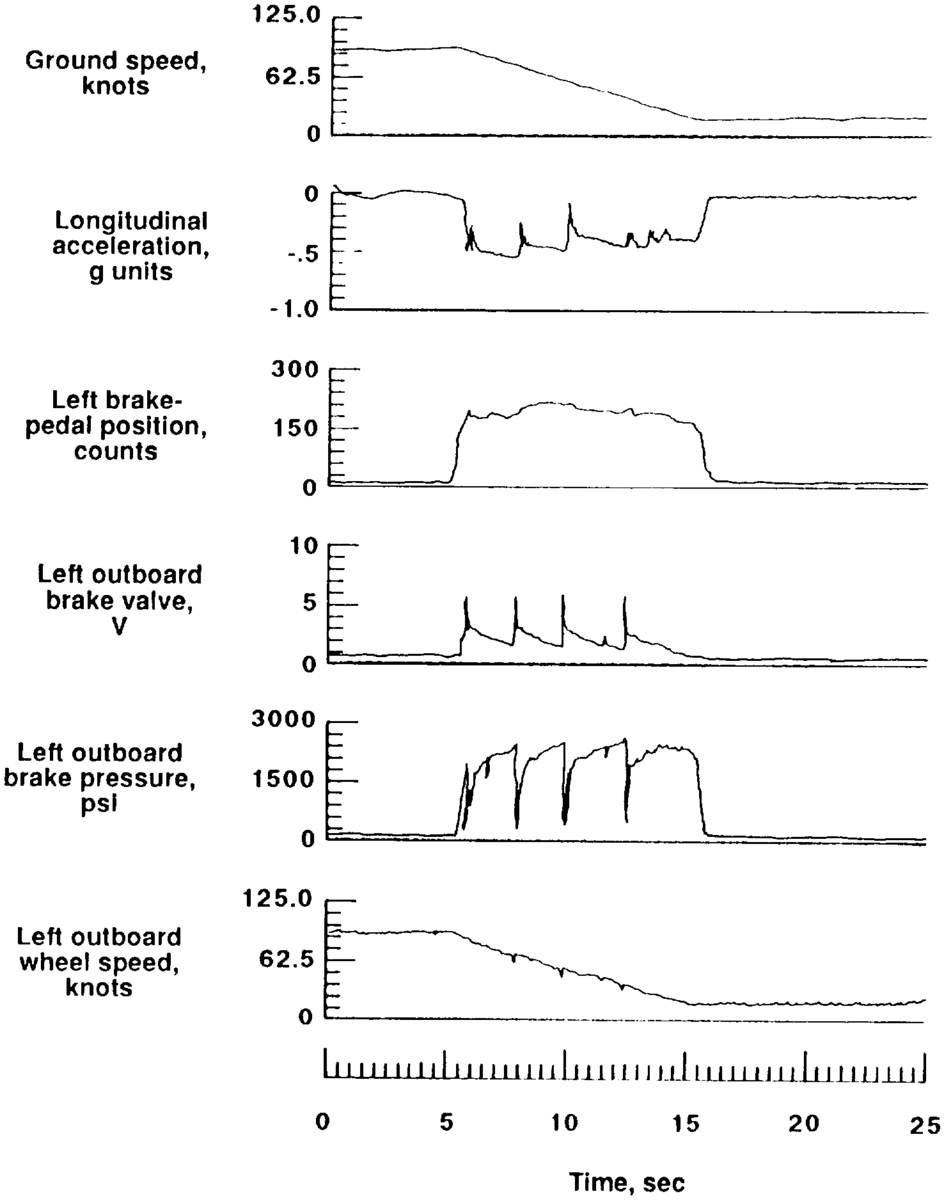
(g) 4.5-in. loose snow, nonbraking, flight 022, run 6.

Figure 46. Continued.



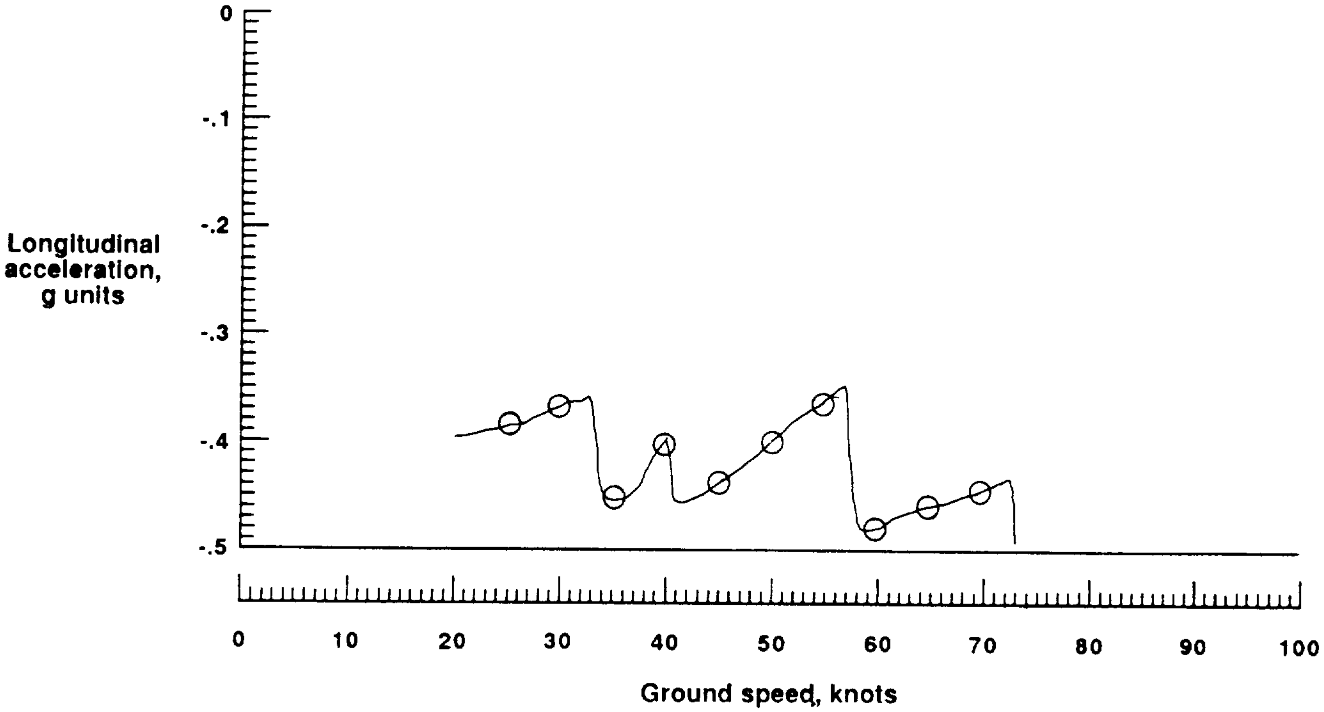
(h) 4.5-in. loose snow, nonbraking, flight 022, run 6, longitudinal acceleration versus ground speed.

Figure 46. Continued.



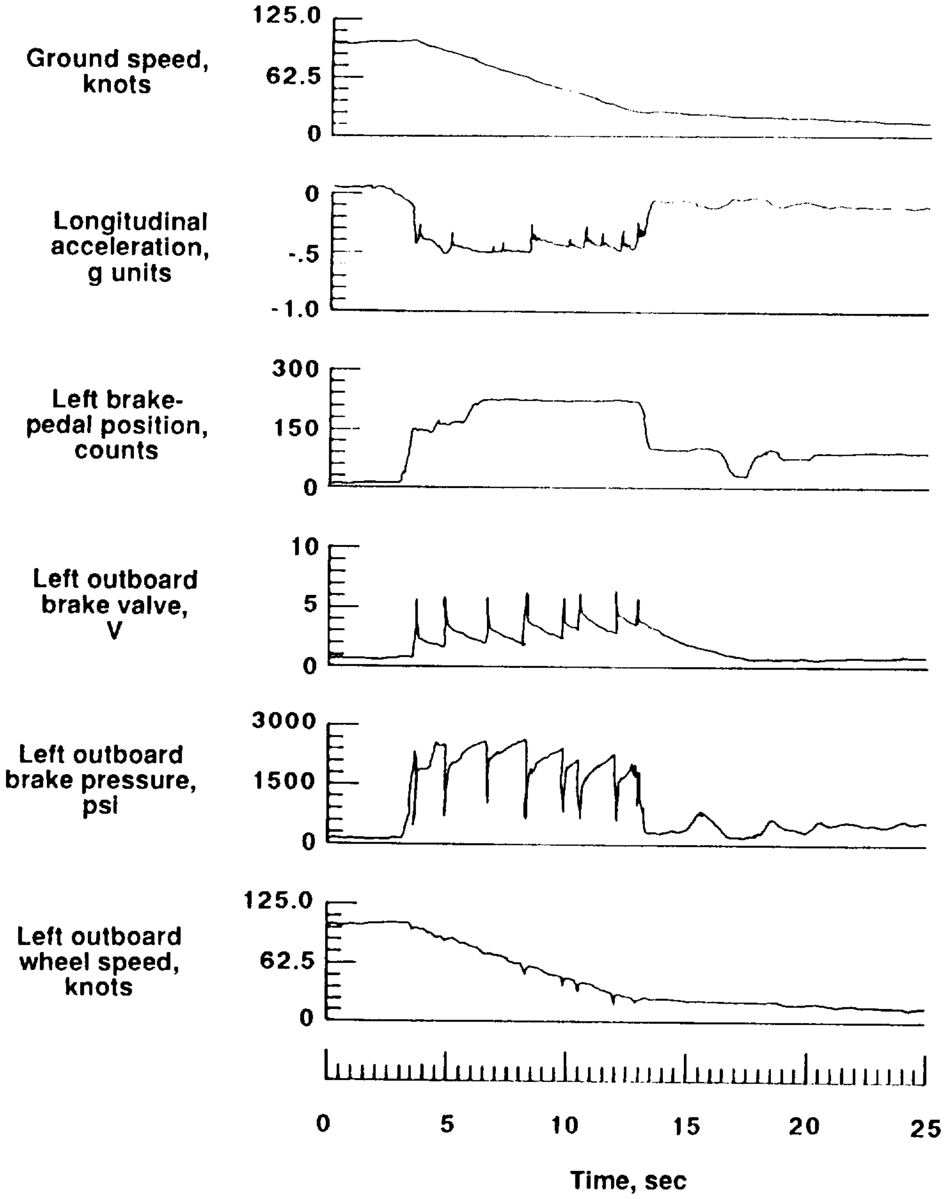
(i) Dry asphalt, maximum antiskid braking, flight 006, run 11.

Figure 46. Continued.



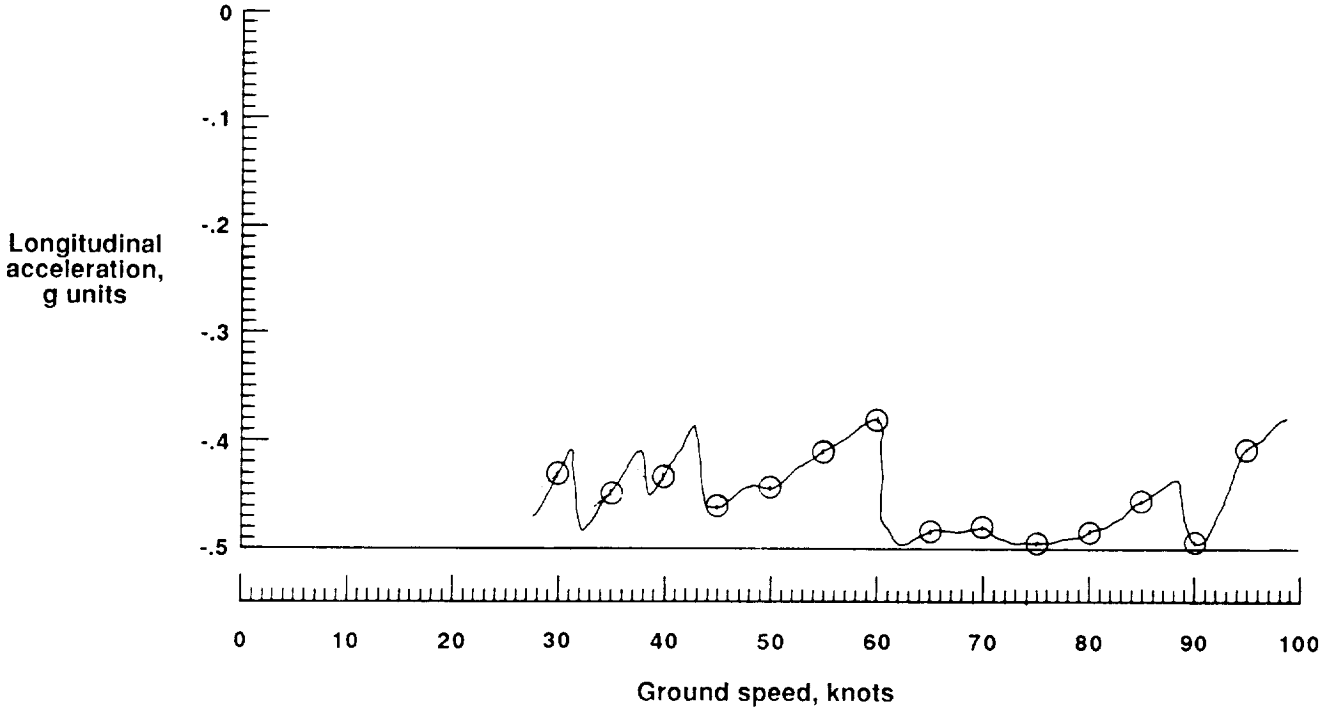
(j) Dry asphalt, maximum antiskid braking, flight 006, run 11, longitudinal acceleration versus ground speed.

Figure 46. Continued.



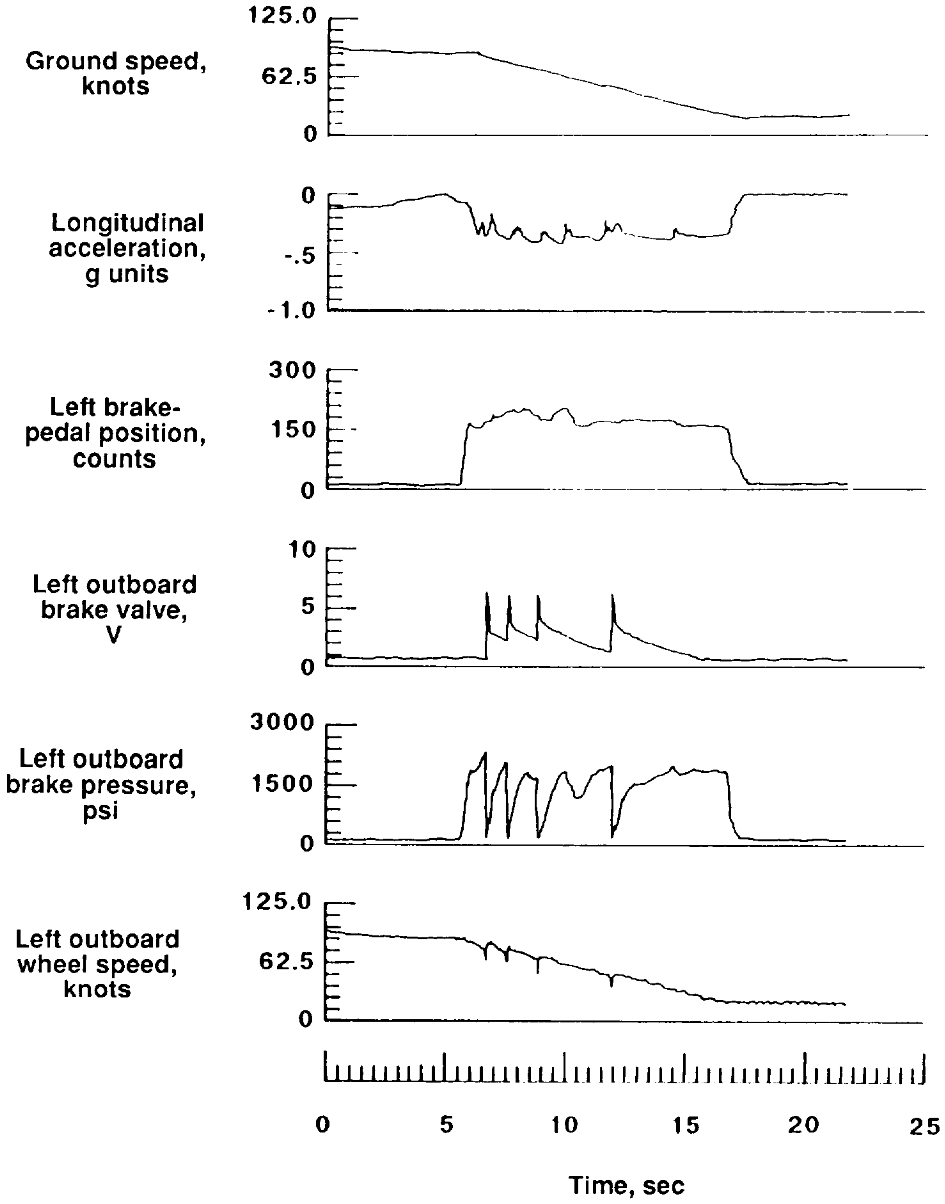
(k) Dry asphalt, maximum antiskid braking, flight 011, run 9.

Figure 46. Continued.



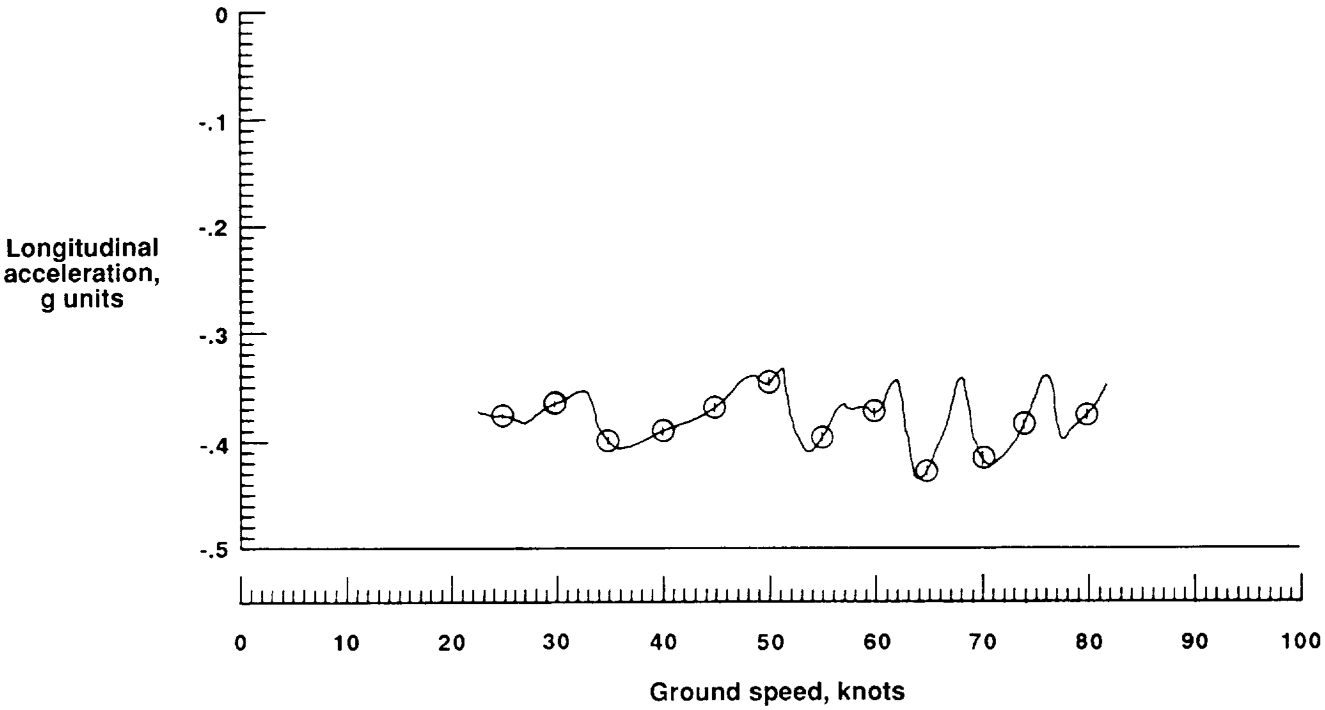
(l) Dry asphalt, maximum antiskid braking, flight 011, run 9, longitudinal acceleration versus ground speed.

Figure 46. Continued.



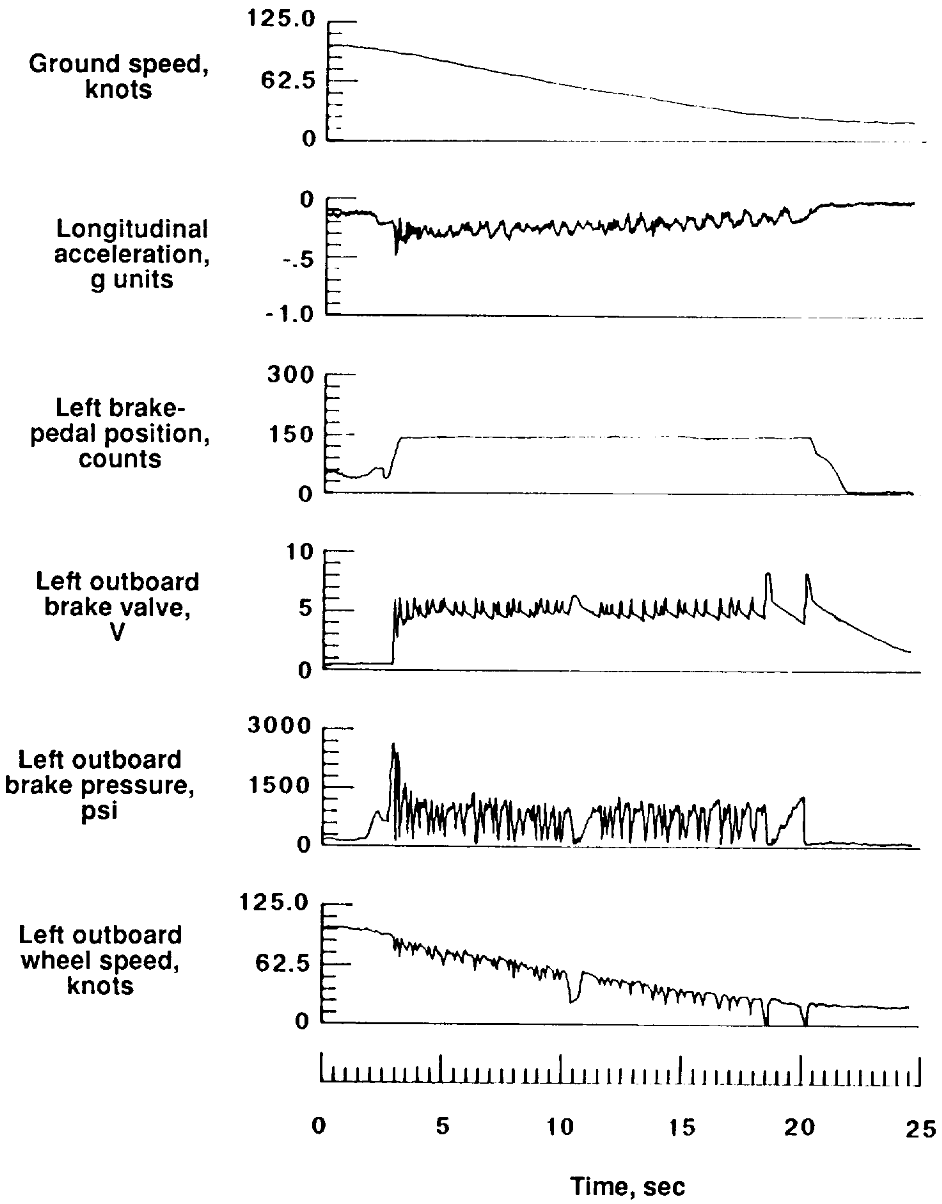
(m) Truck-wet asphalt, maximum antiskid braking, flight 005, run 8R1.

Figure 46. Continued.



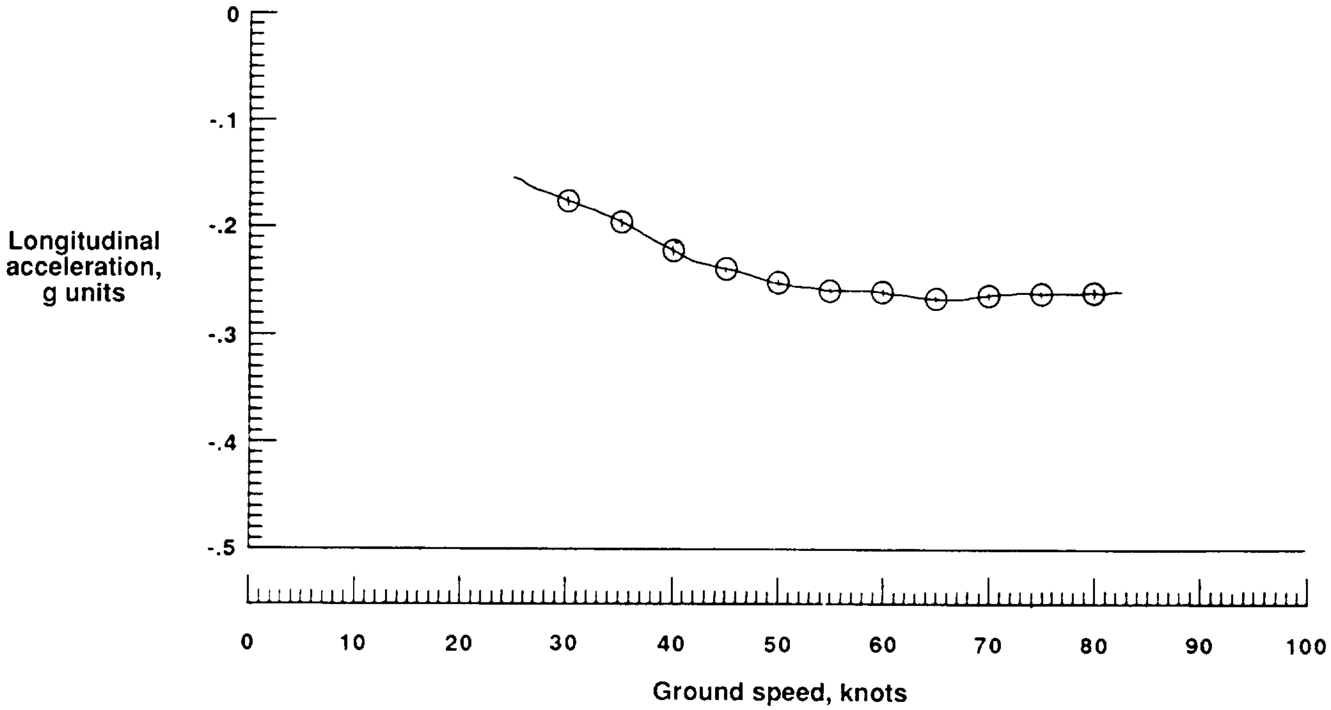
(n) Truck-wet asphalt, maximum antiskid braking, flight 005, run 8R1, longitudinal acceleration versus ground speed.

Figure 46. Continued.



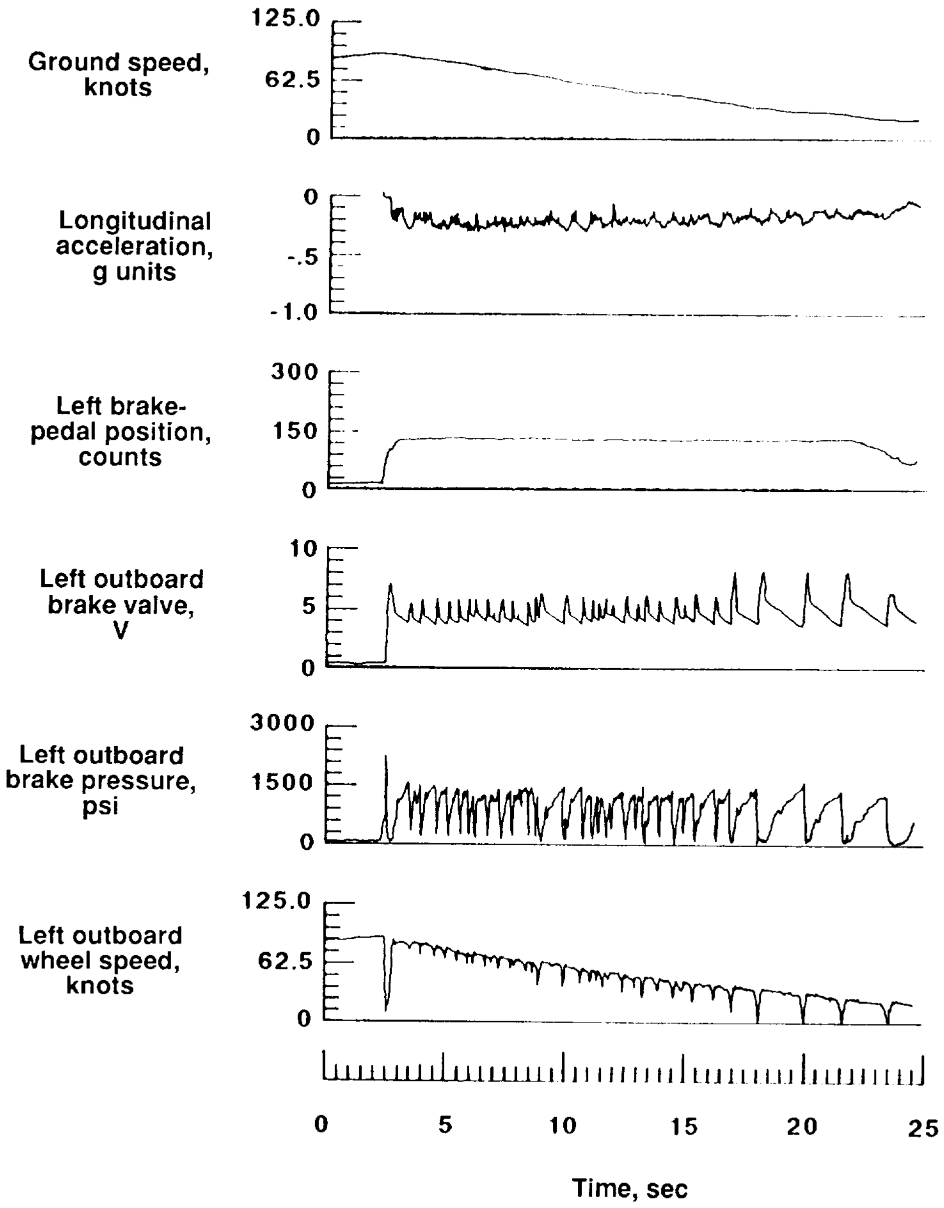
(o) 4.5-in. loose snow, maximum antiskid braking, flight 022, run 5.

Figure 46. Continued.



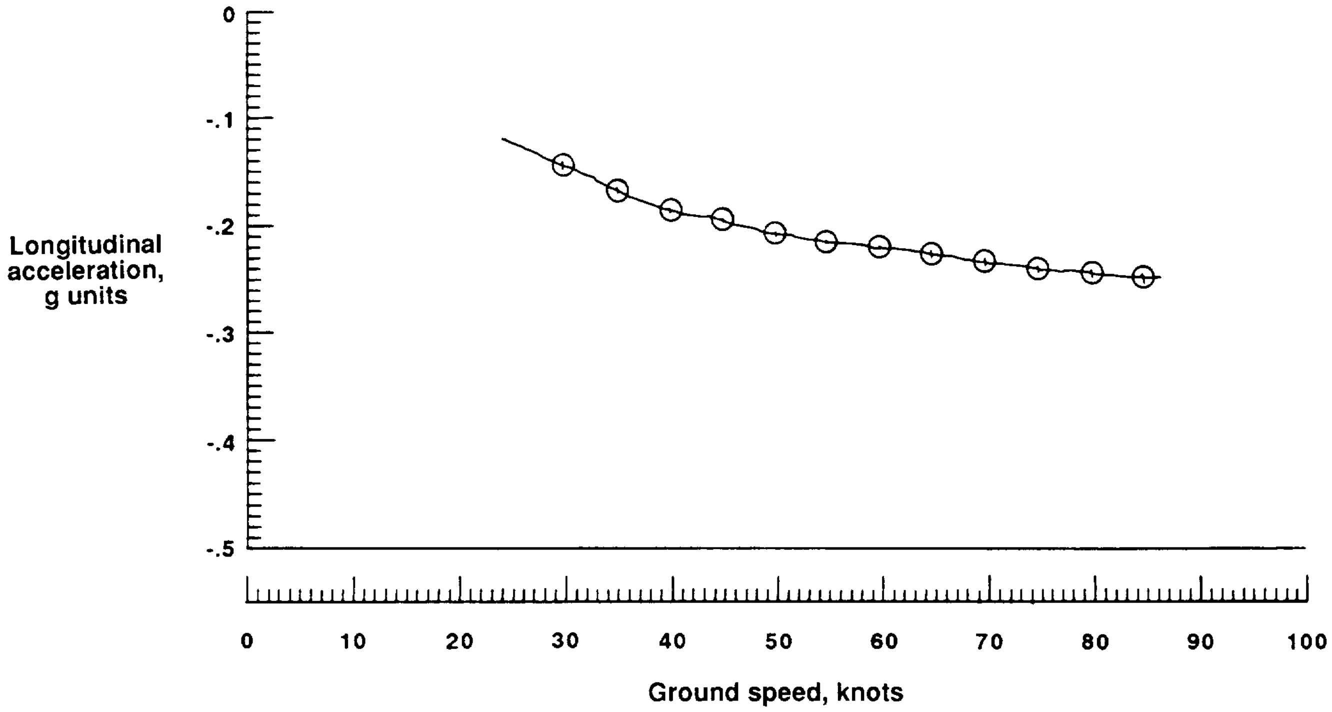
(p) 4.5-in. loose snow, maximum antiskid braking, flight 022, run 5, longitudinal acceleration versus ground speed.

Figure 46. Continued.



(q) UCAR on snow- and ice-covered asphalt, maximum antiskid braking, flight 025, run 5R1.

Figure 46. Continued.



(r) UCAR on snow- and ice-covered asphalt, maximum antiskid braking, flight 025, run 5R1, longitudinal acceleration versus ground speed.

Figure 46. Concluded.

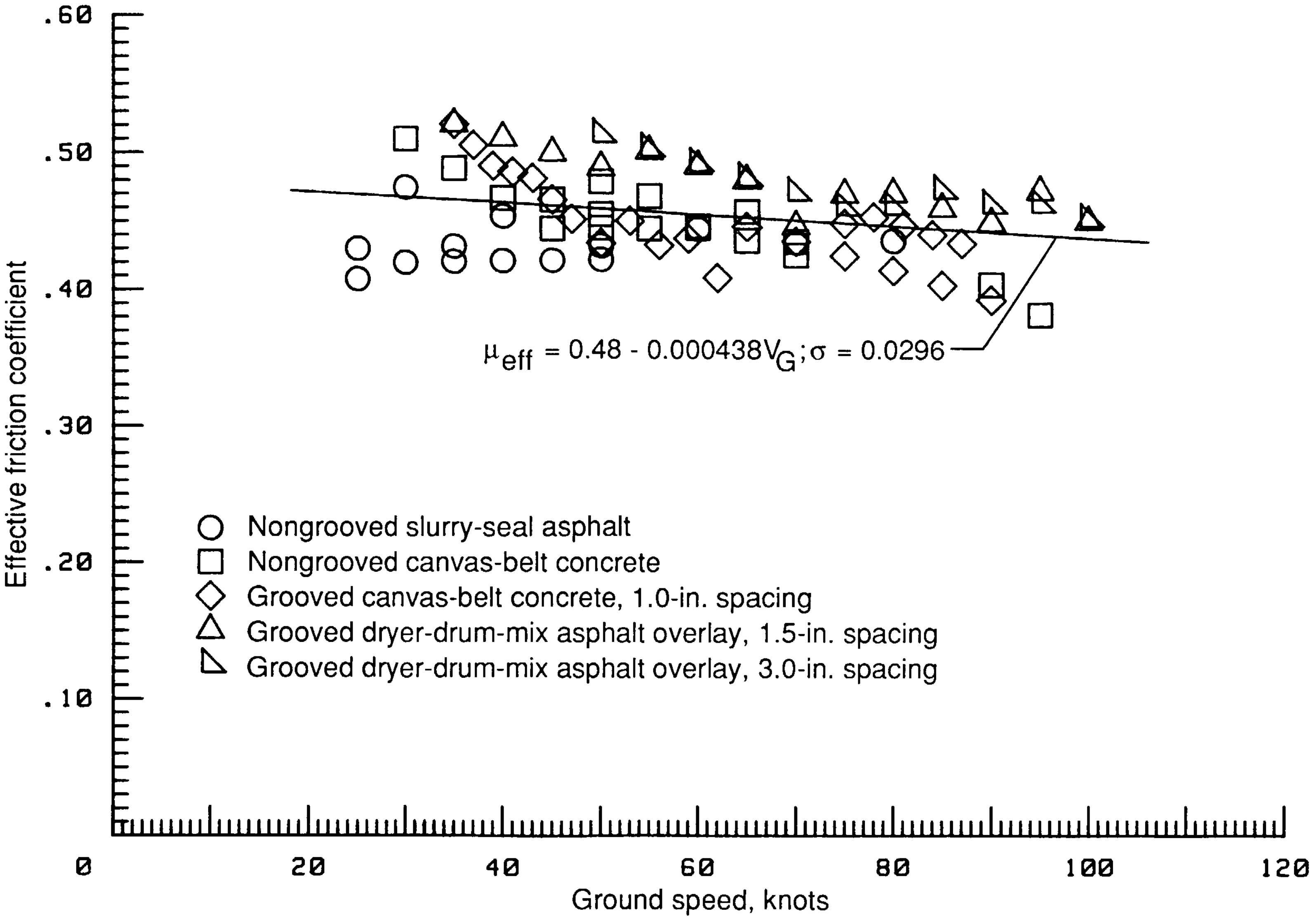


Figure 47. Variation of Boeing 737 effective friction coefficient with ground speed for dry-runway test conditions.

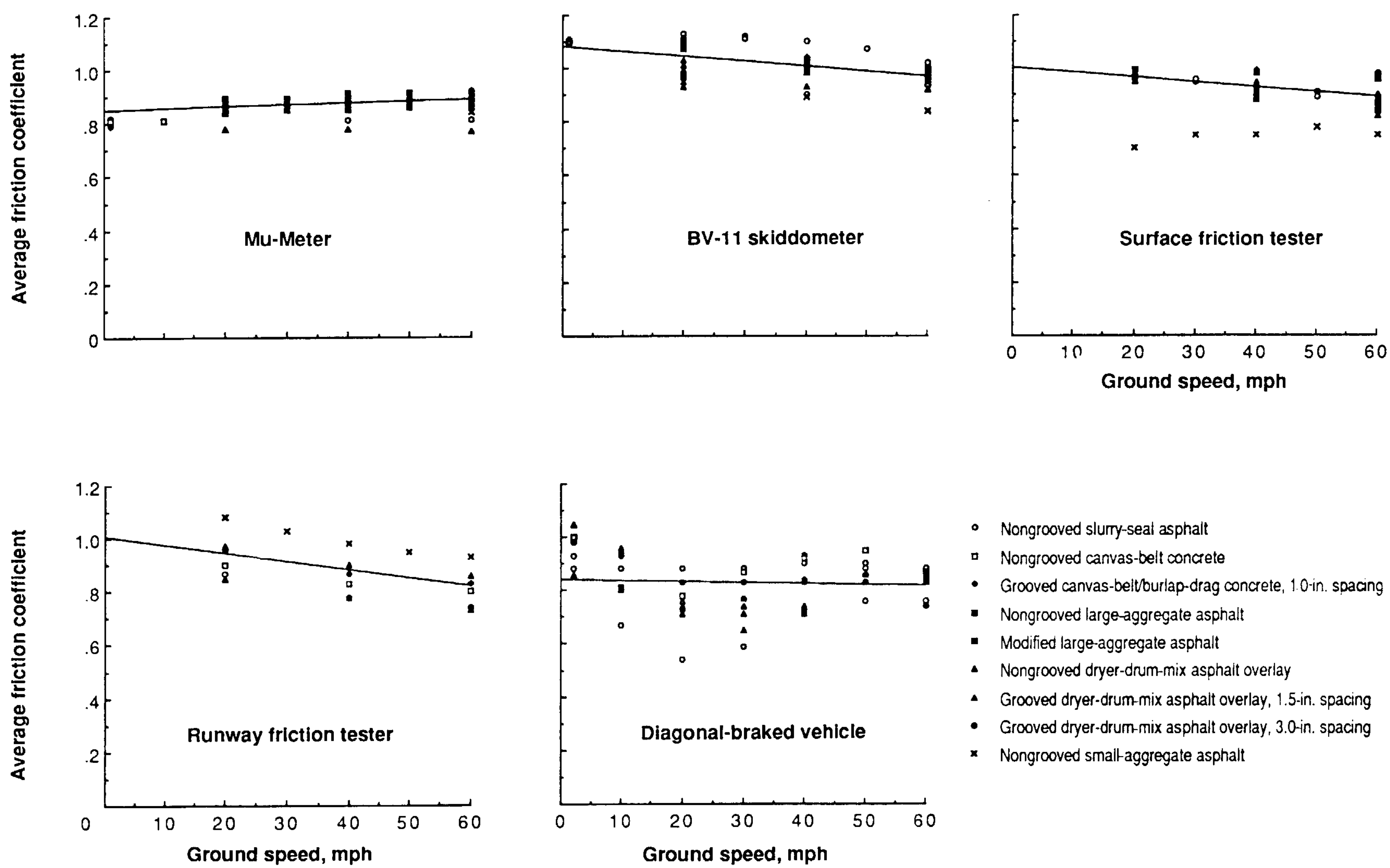
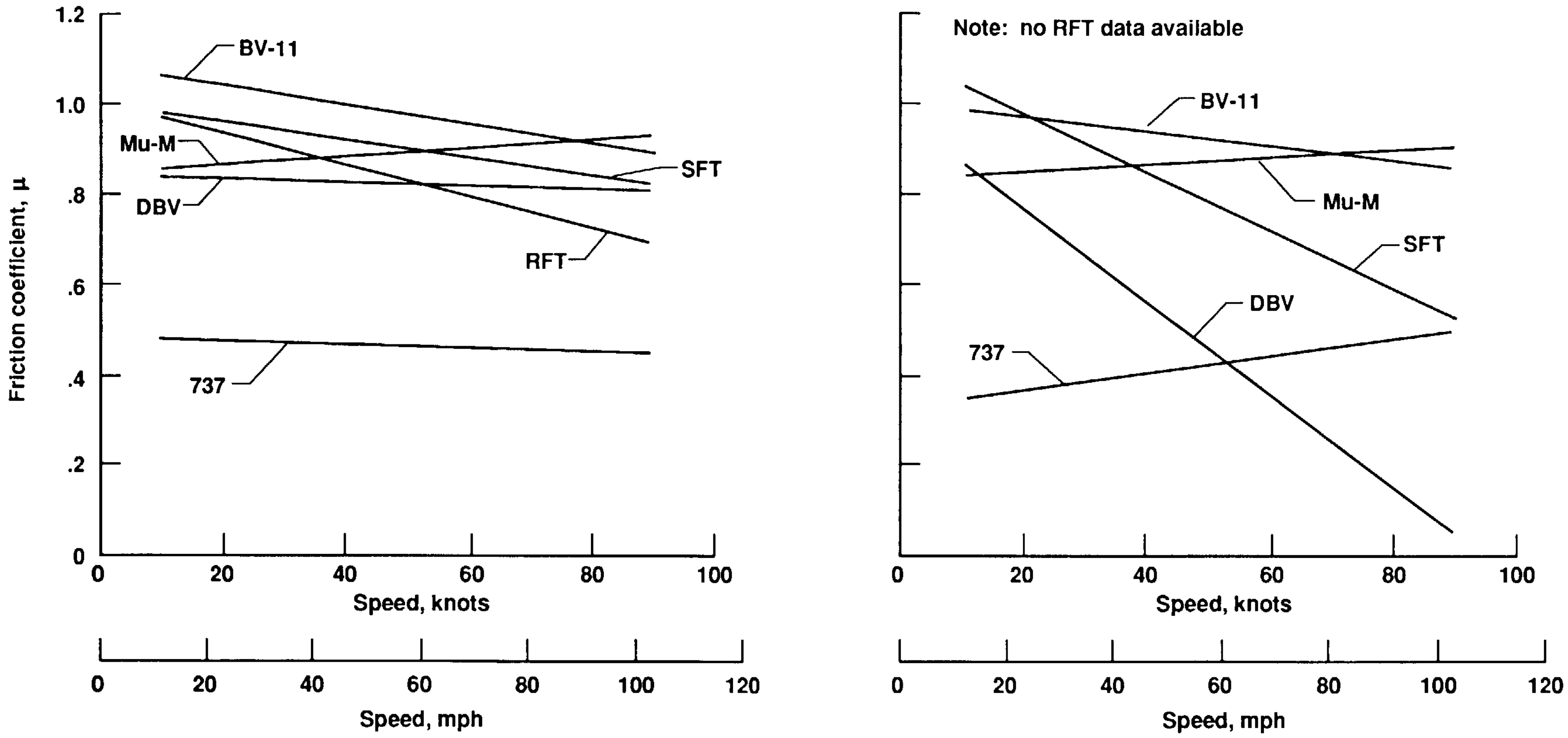


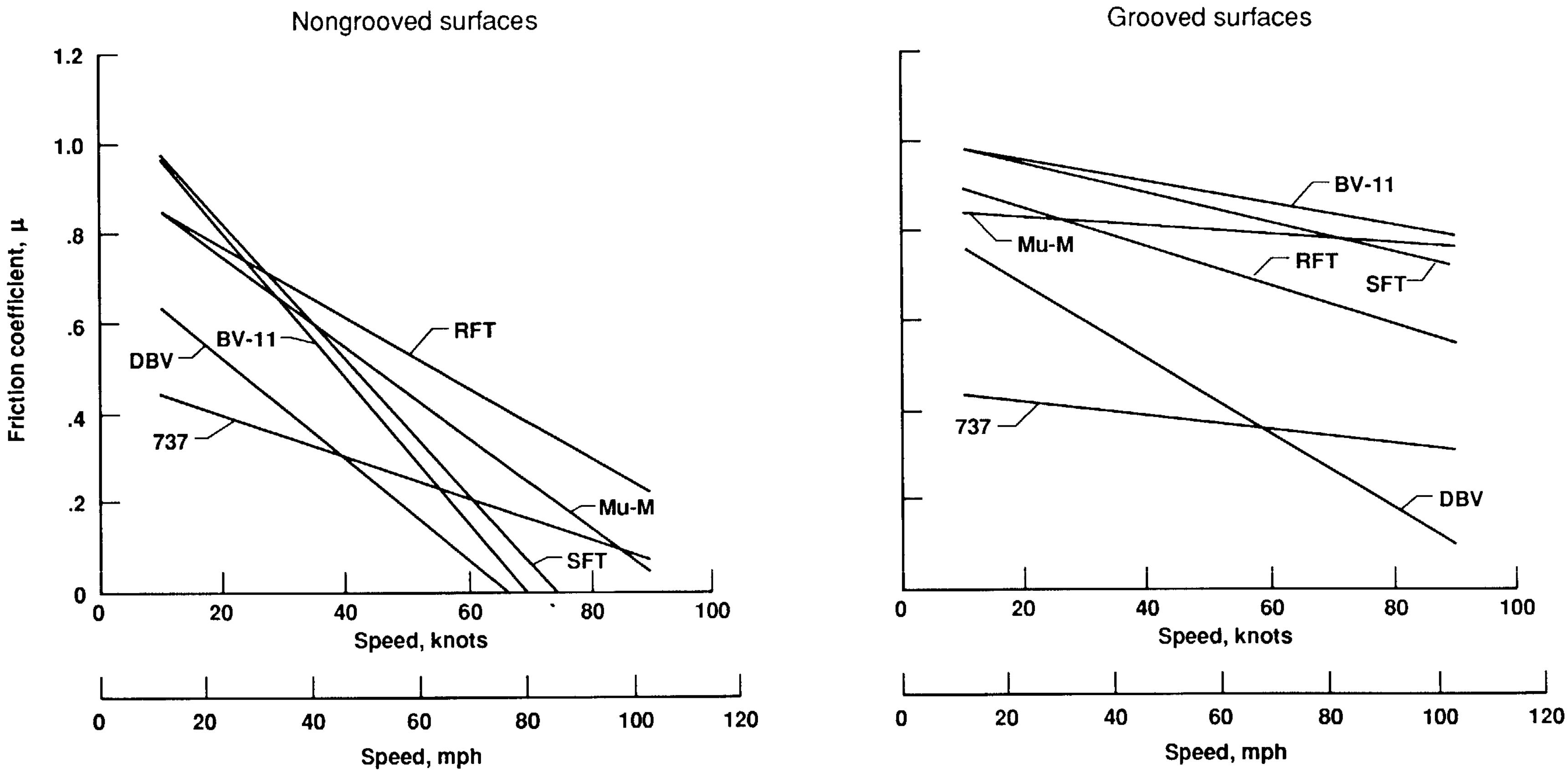
Figure 48. Ground-vehicle friction data obtained on different dry-runway test surfaces.



(a) Dry, all surfaces.

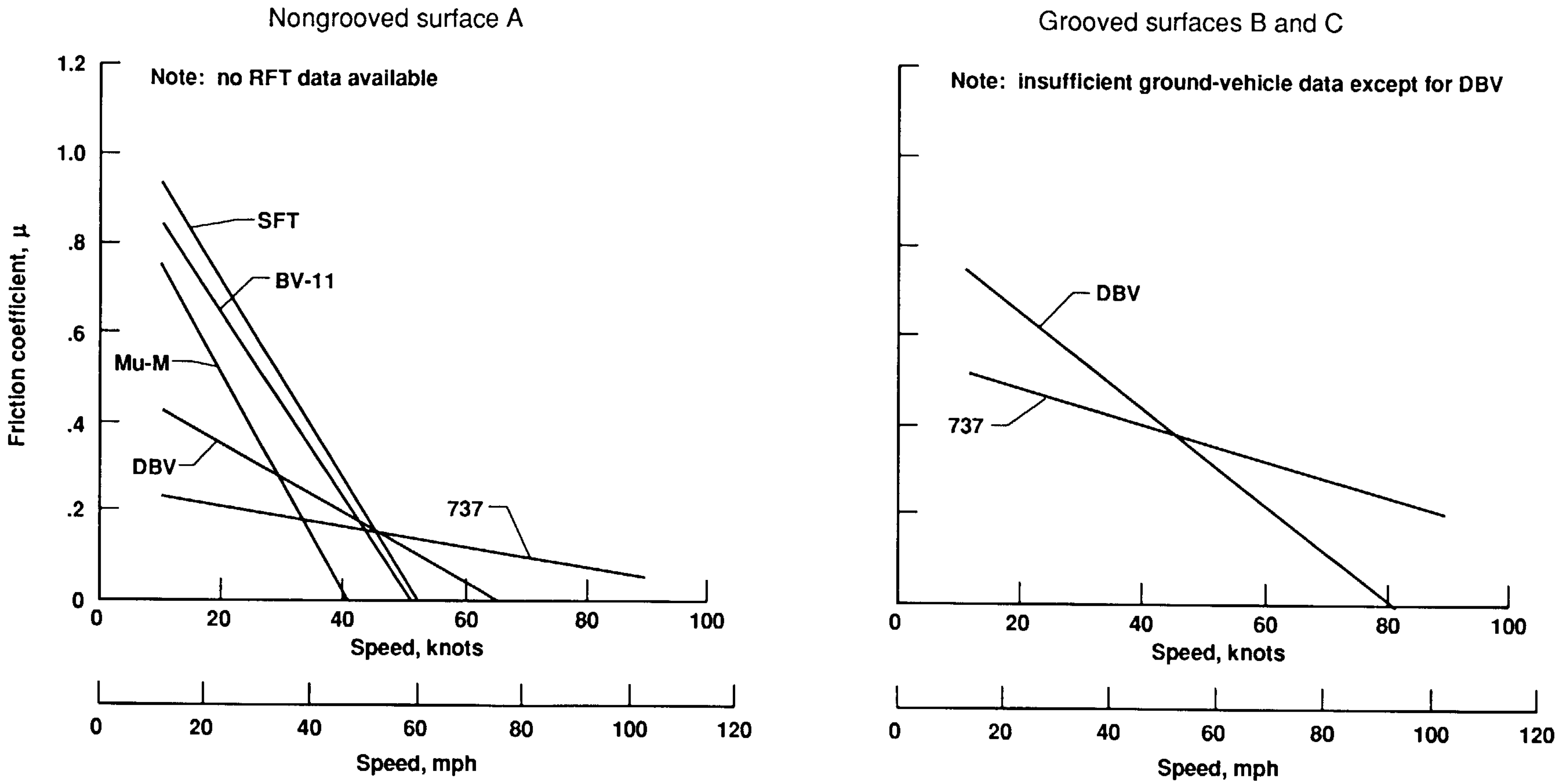
(b) Rain wet, SSA.

Figure 49. Range of Boeing 737 aircraft and ground-vehicle friction data for different runway test-surface conditions.



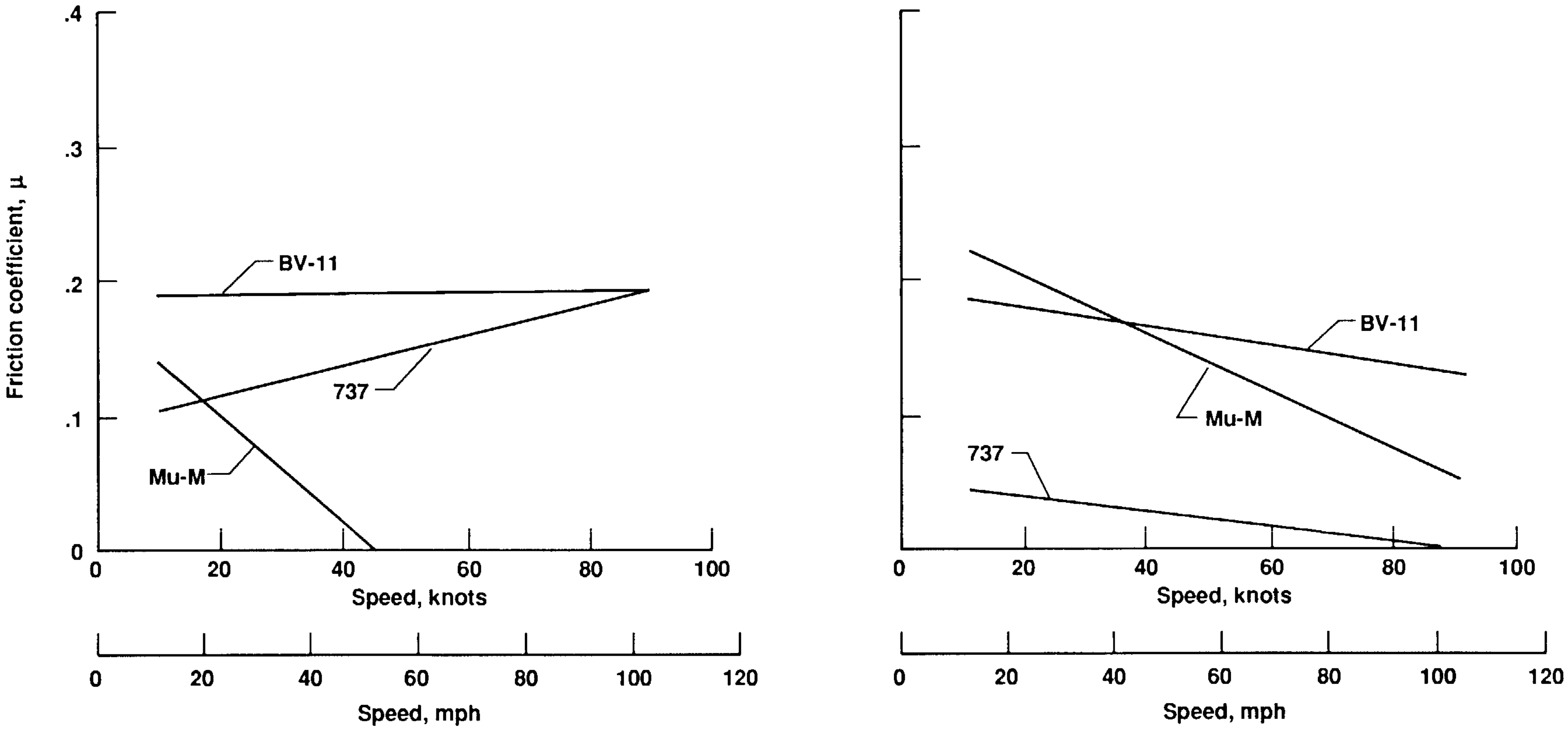
(c) Truck-wet surfaces.

Figure 49. Continued.



(d) Flooded concrete surfaces at Wallops Flight Facility.

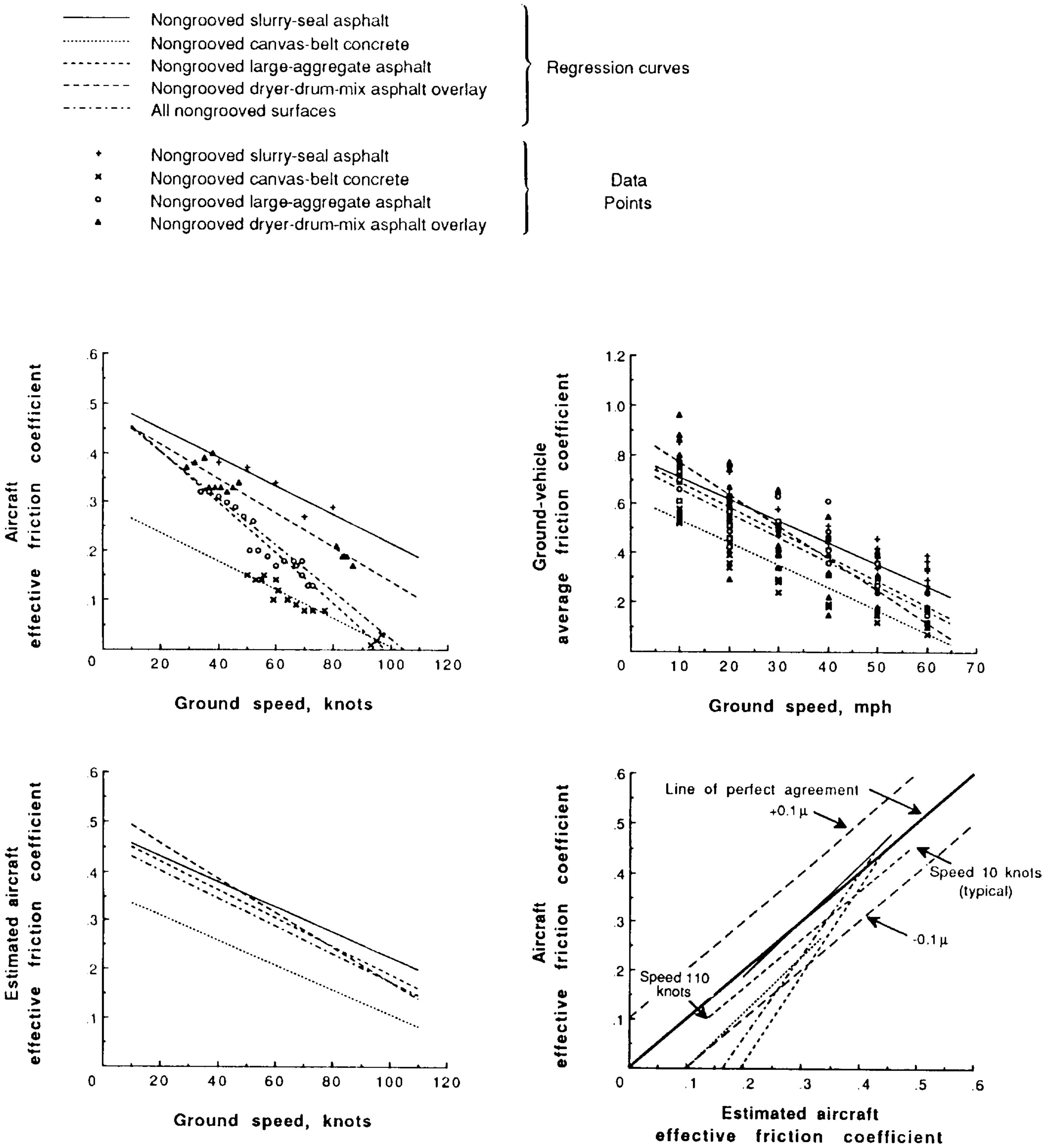
Figure 49. Continued.



(e) 1.5-in. new wet snow.

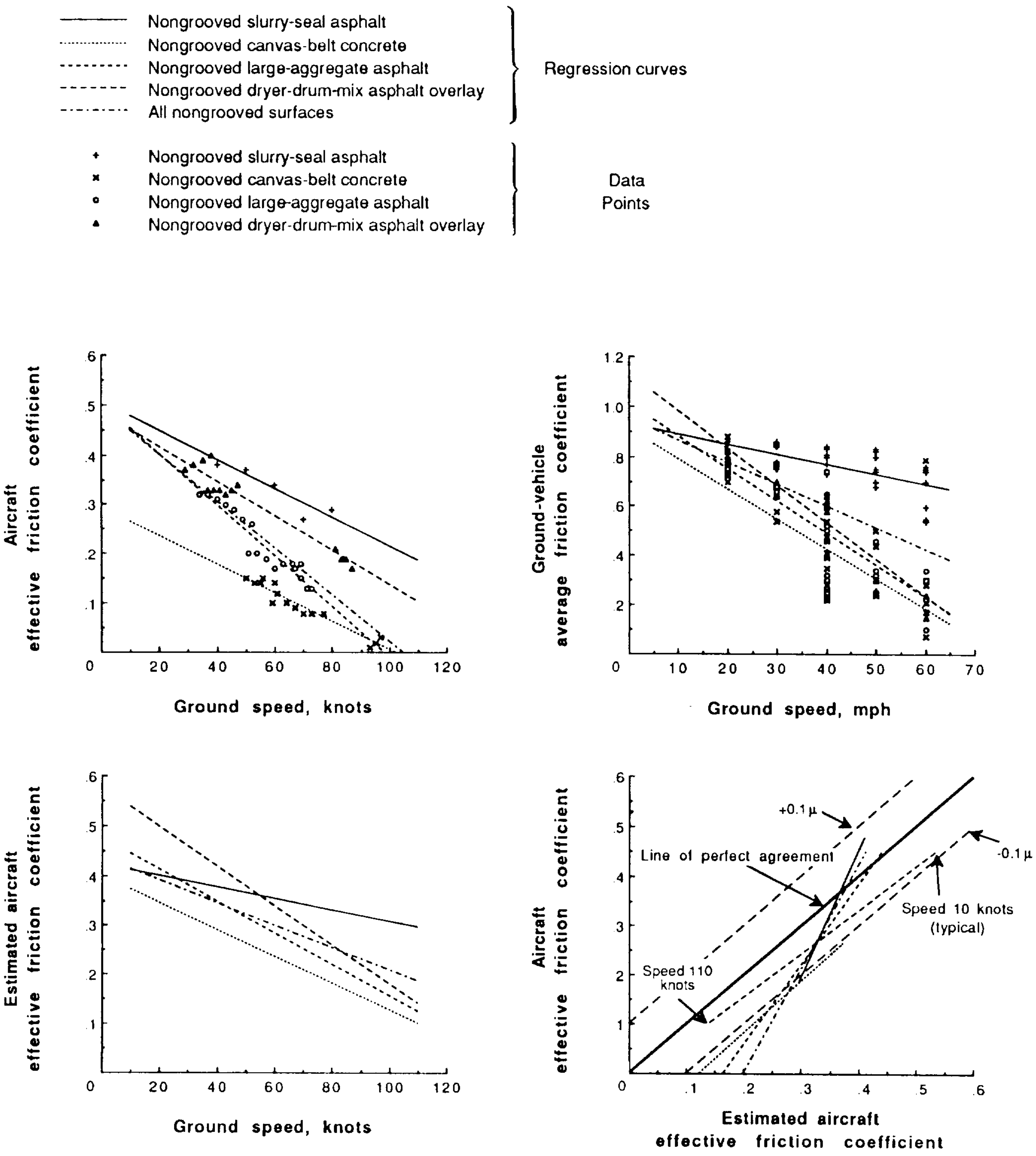
(f) Glare ice.

Figure 49. Concluded.



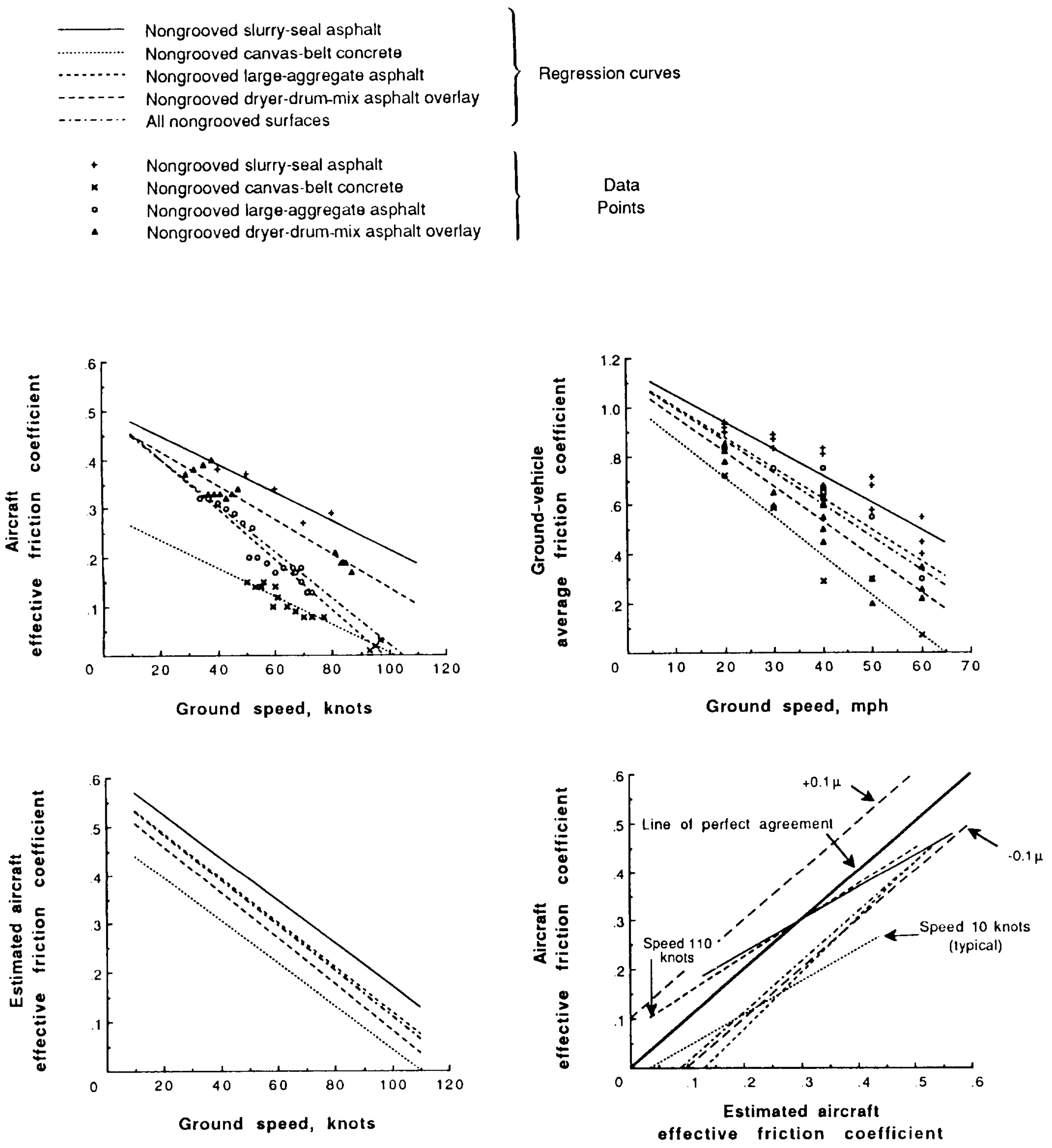
(a) DBV data.

Figure 50. Variation of Boeing 737 aircraft and ground-vehicle friction data with speed and variation of estimated aircraft braking performance with actual braking performance on truck-wet, nongrooved test surfaces.



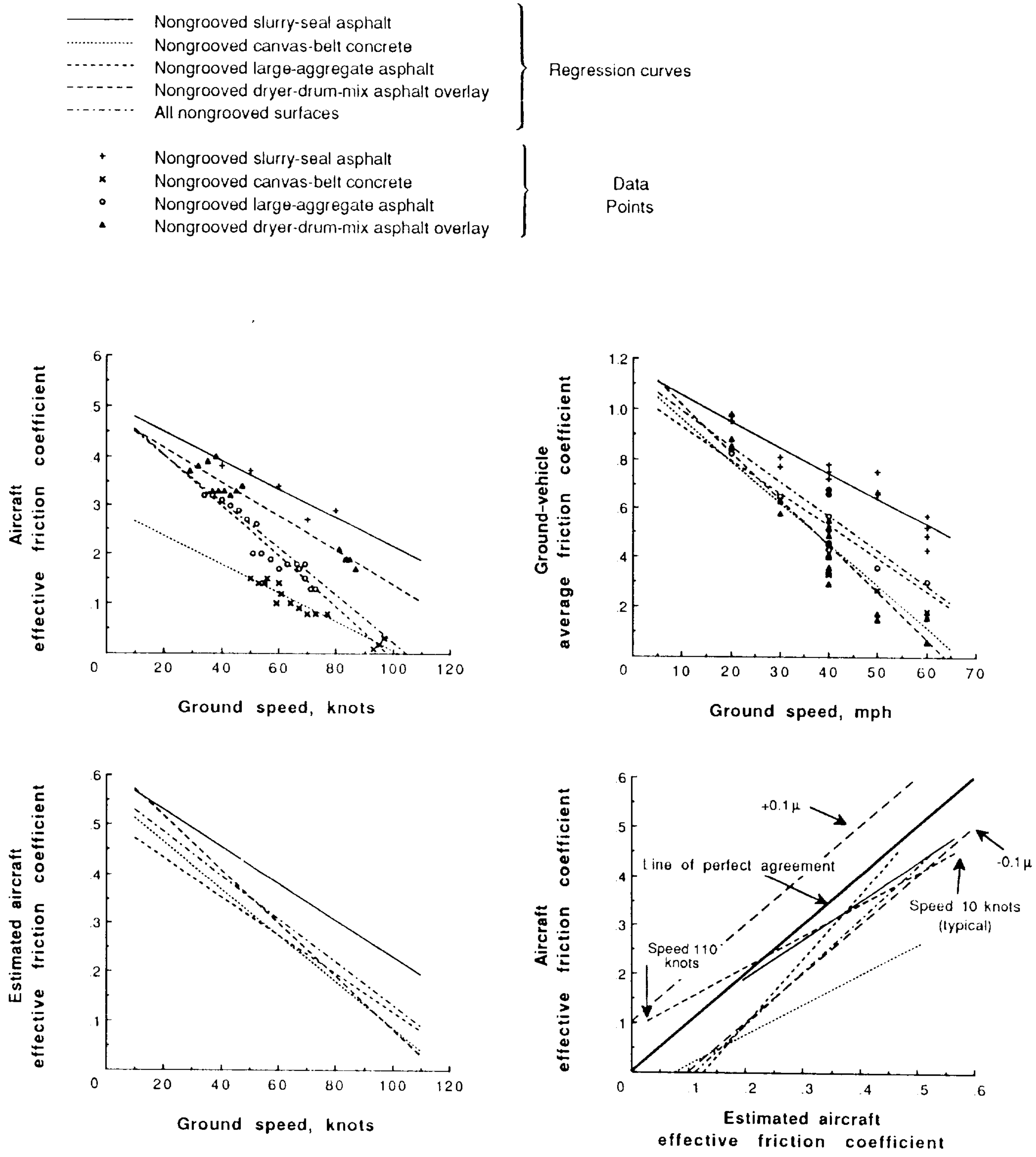
(b) Mu-Meter data.

Figure 50. Continued.



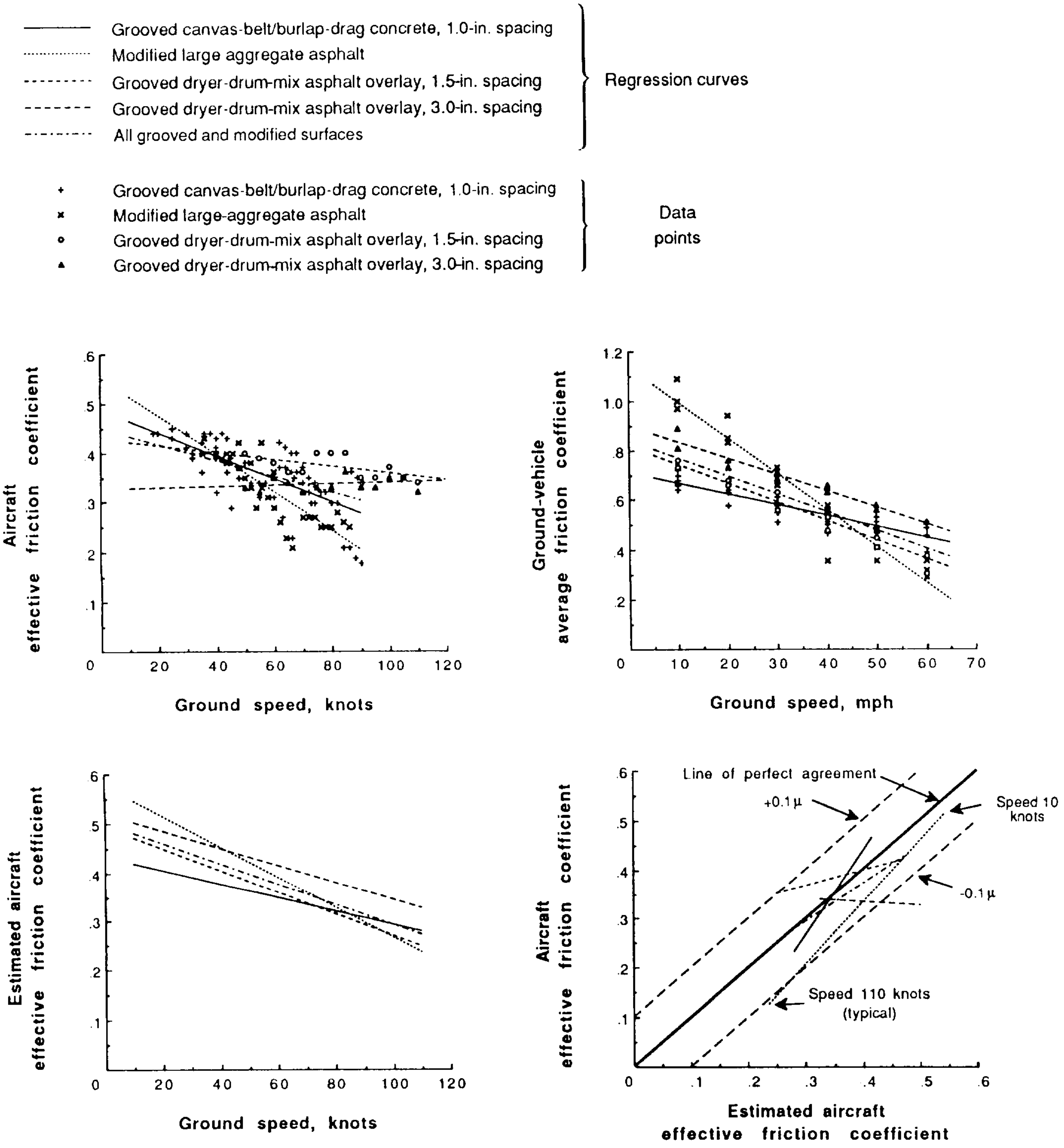
(c) SFT data.

Figure 50. Continued.



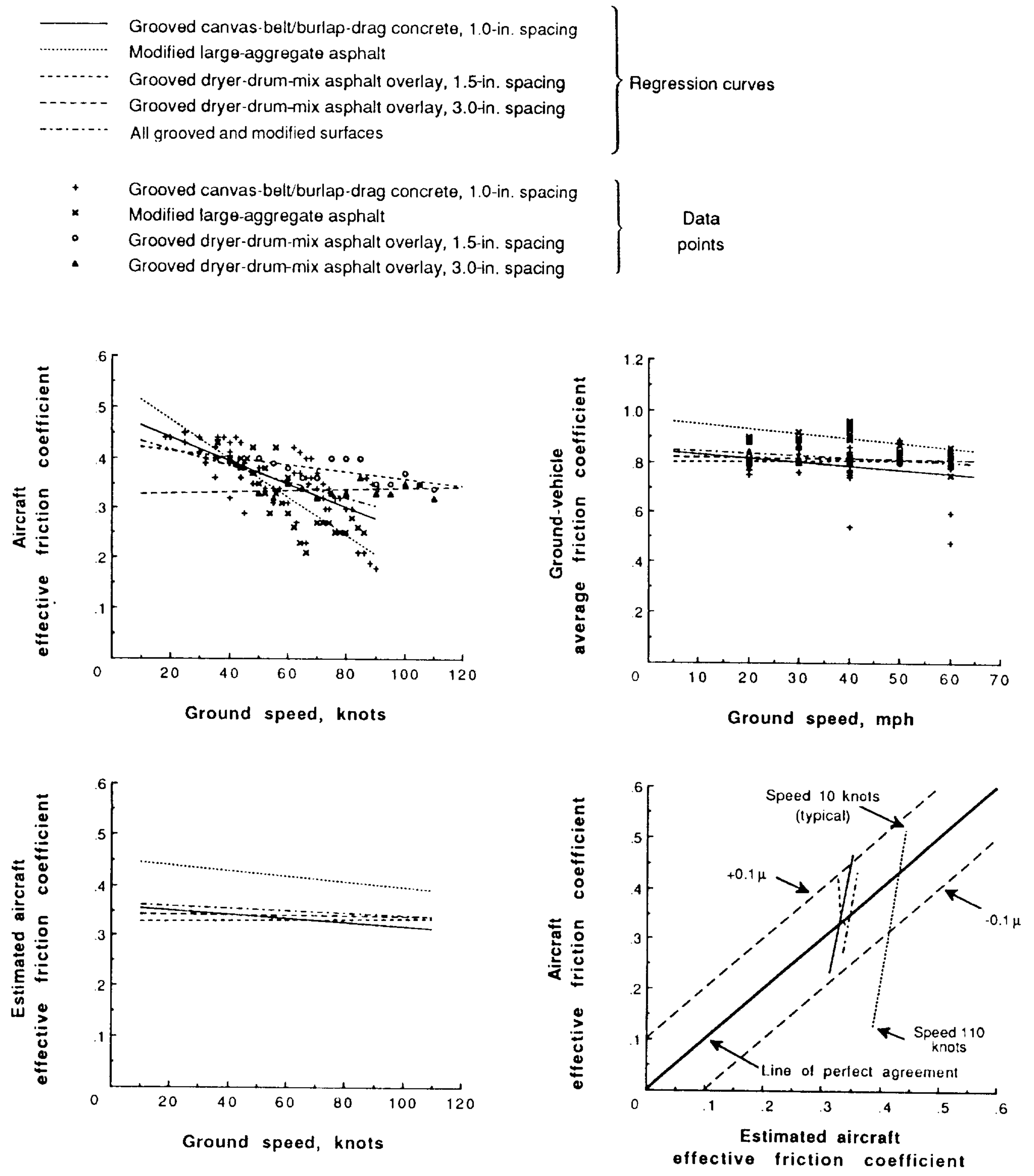
(d) BV-11 skiddometer data.

Figure 50. Concluded.



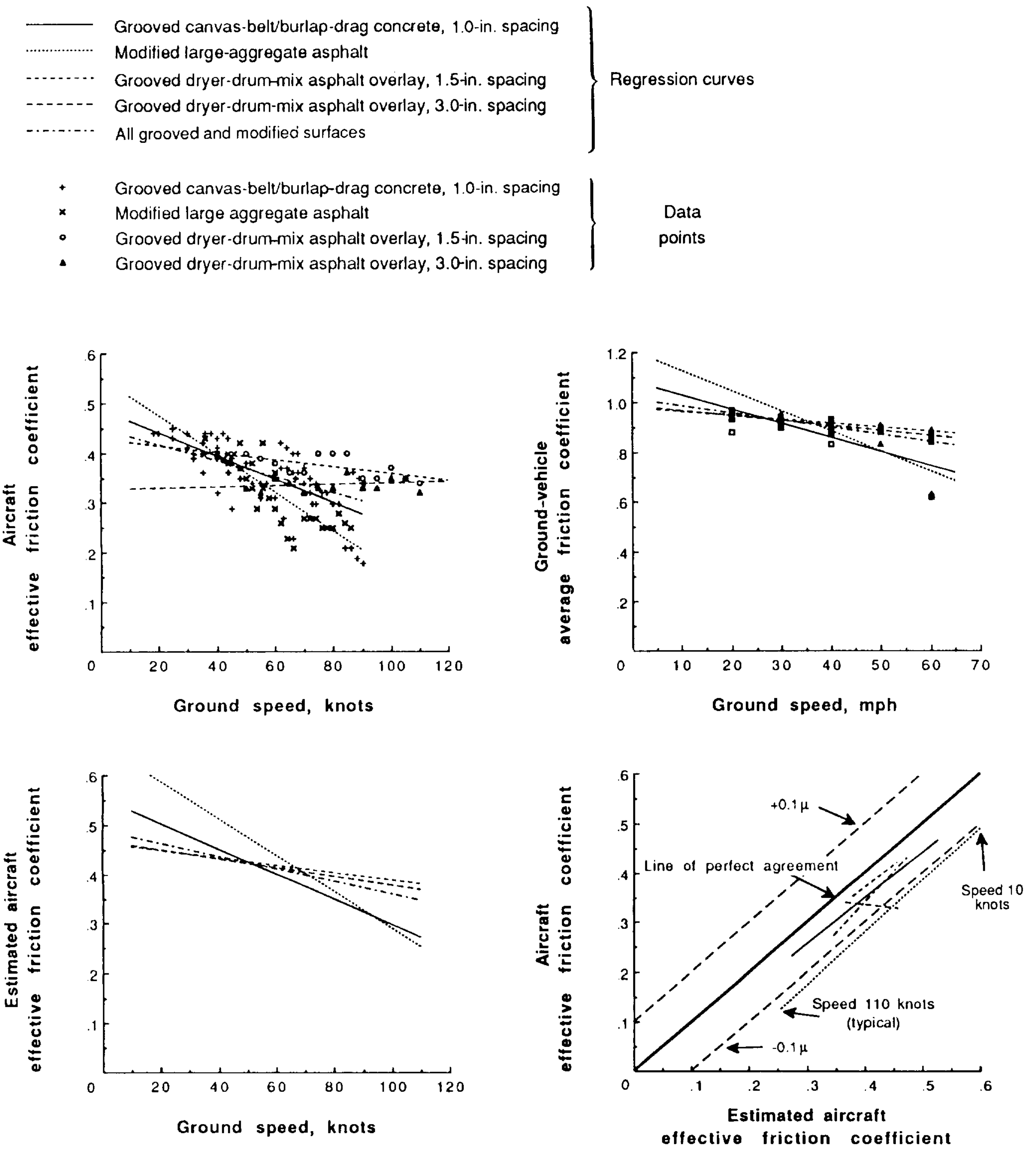
(a) DBV data.

Figure 51. Variation of Boeing 737 aircraft and ground-vehicle friction data with speed and variation of estimated aircraft braking performance with actual braking performance on truck-wet, grooved test surfaces.



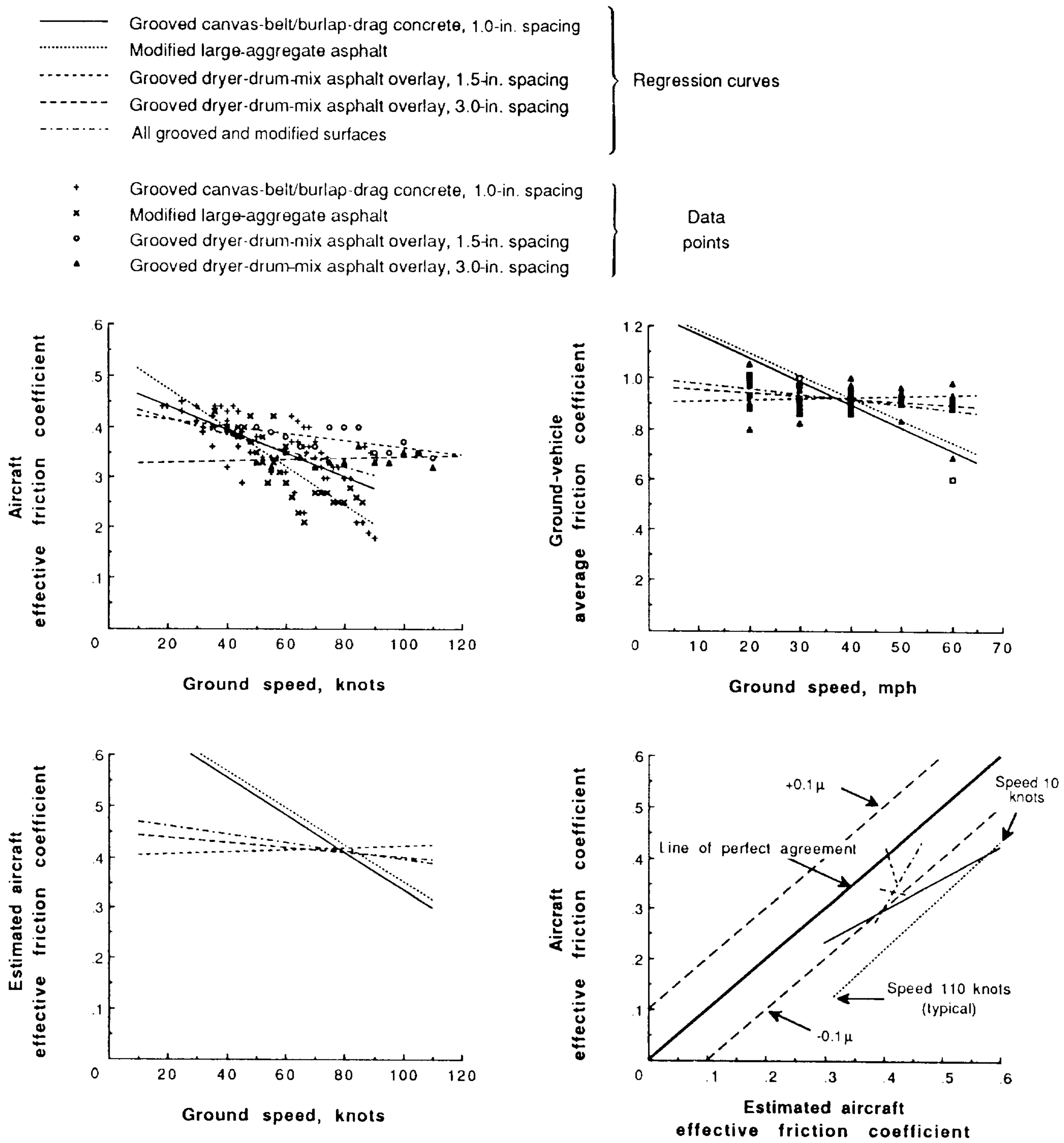
(b) Mu-Meter data.

Figure 51. Continued.



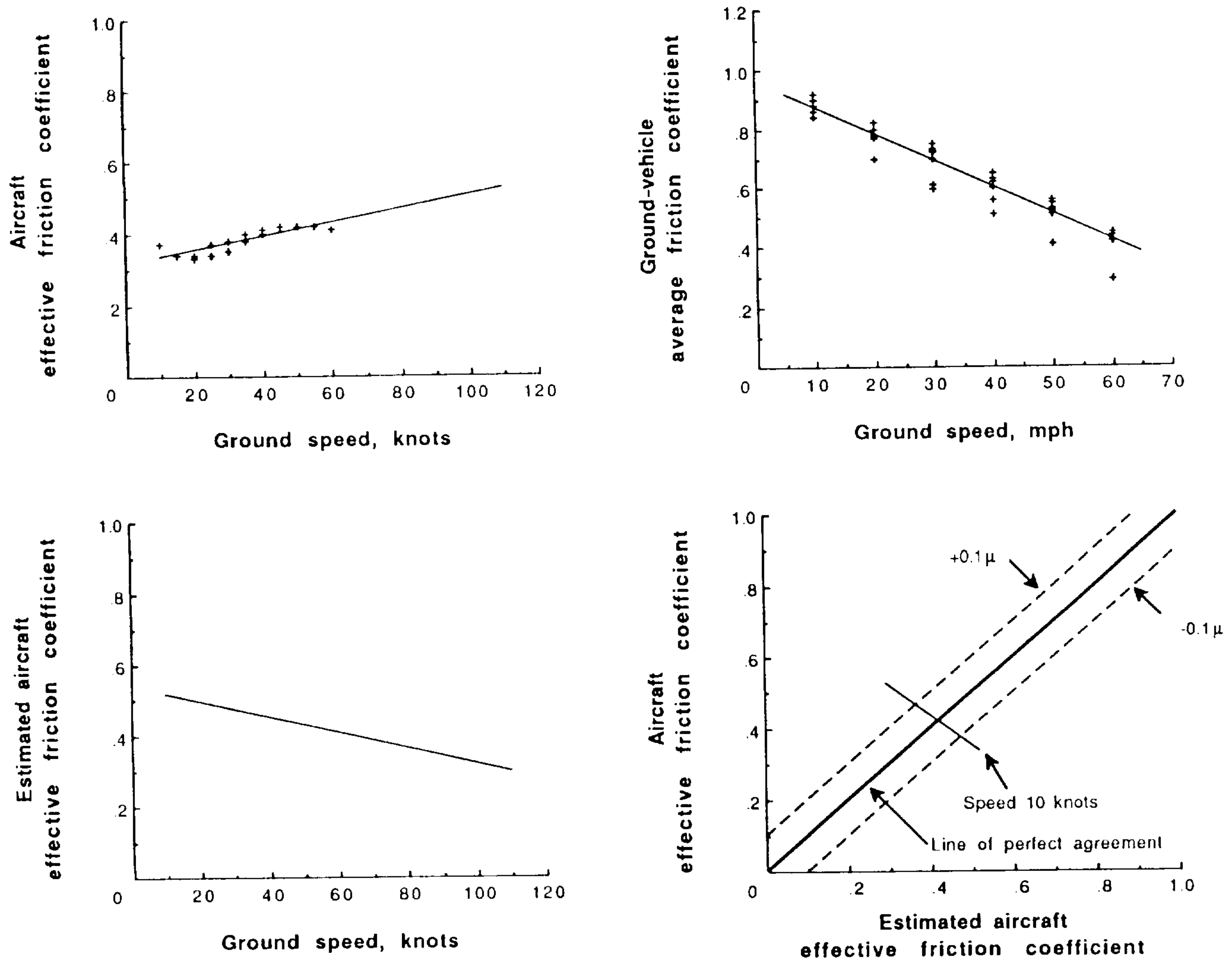
(c) SFT data.

Figure 51. Continued.



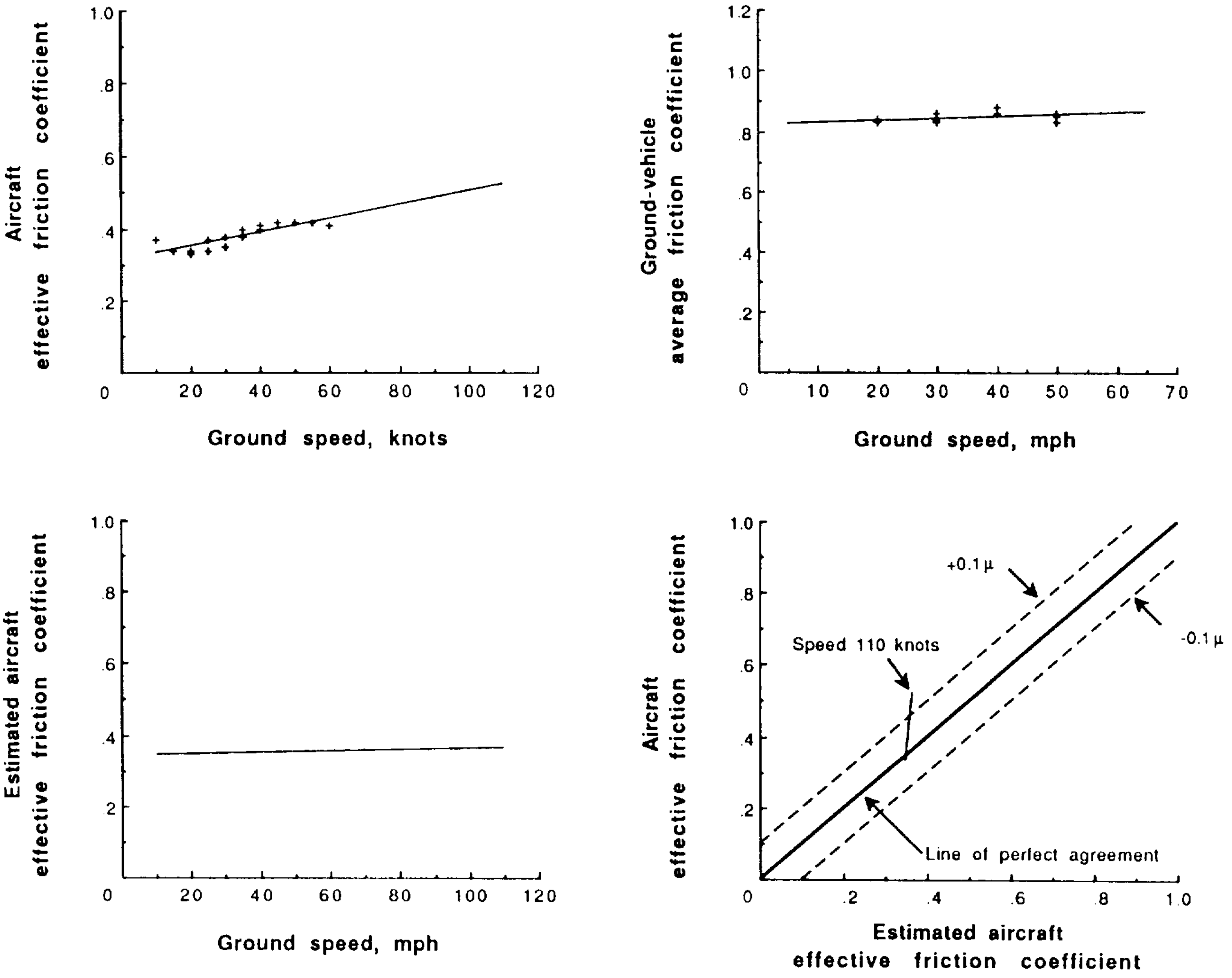
(d) BV-11 skiddometer data.

Figure 51. Concluded.



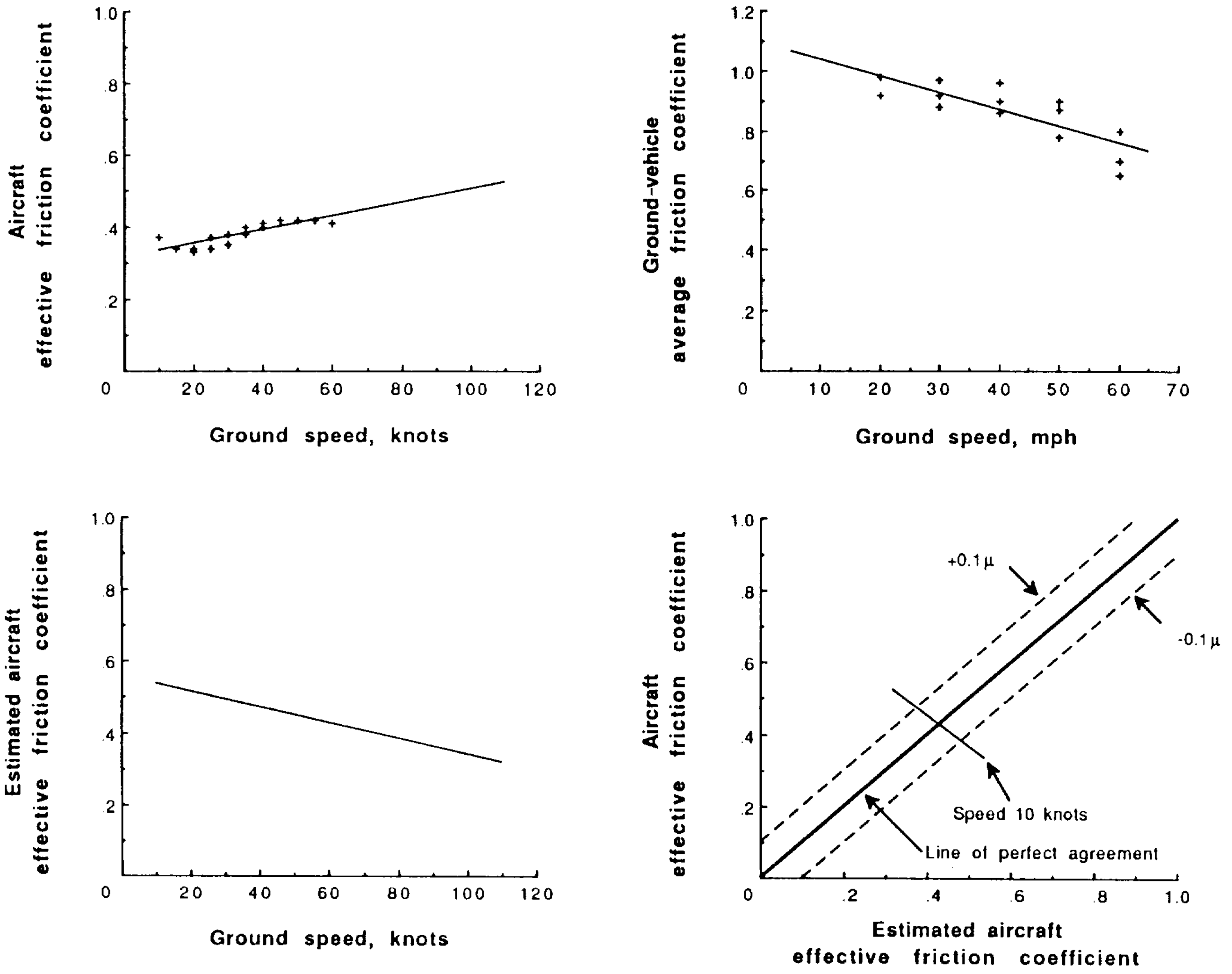
(a) DBV data.

Figure 52. Variation of Boeing 737 aircraft and ground-vehicle friction data with speed and variation of estimated aircraft braking performance with actual braking performance on rain-wet, nongrooved, slurry-seal asphalt test surfaces.



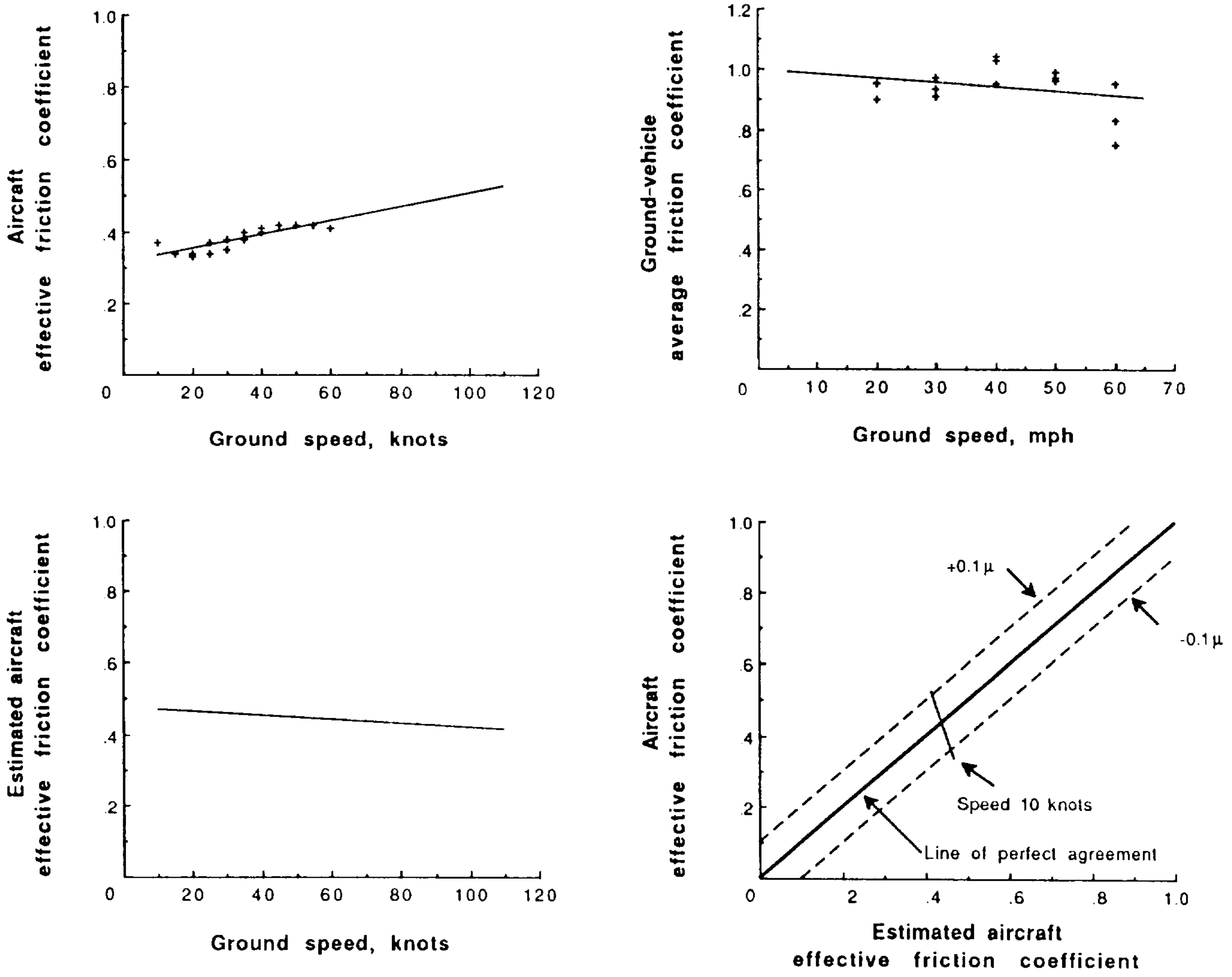
(b) Mu-Meter data.

Figure 52. Continued.



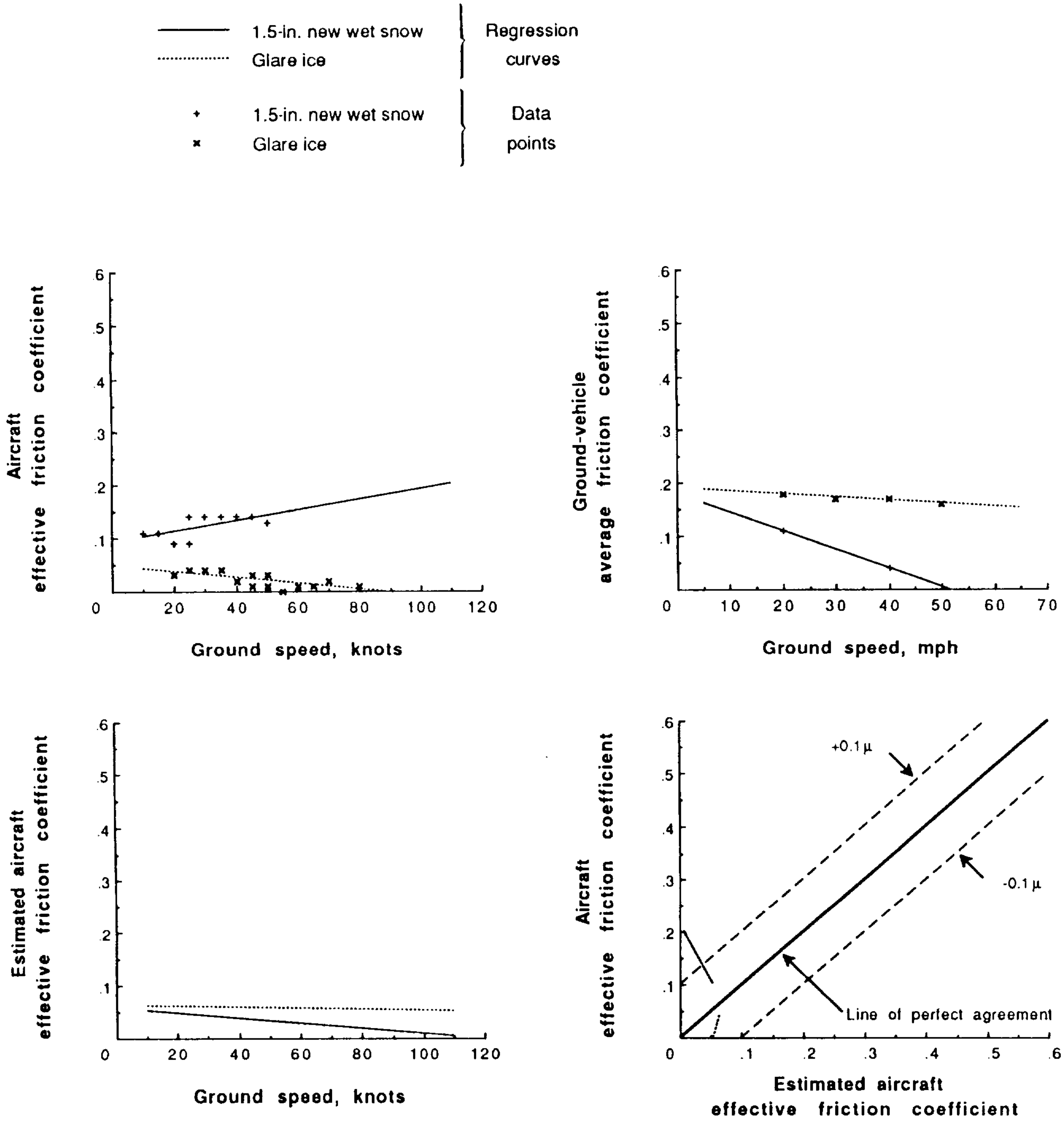
(c) SFT data.

Figure 52. Continued.



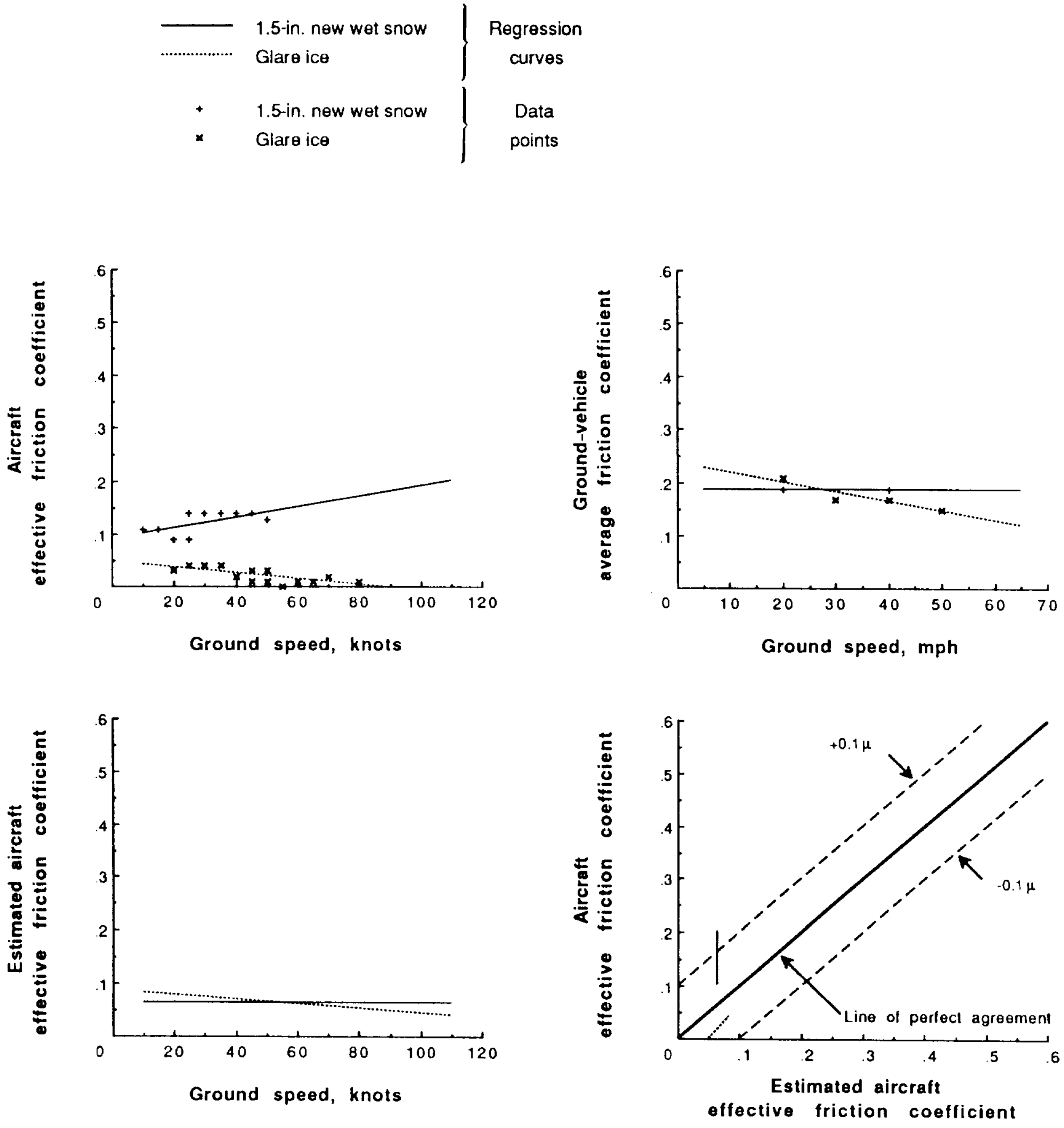
(d) BV-11 skiddometer data.

Figure 52. Concluded.



(a) Mu-Meter data.

Figure 53. Variation of Boeing 737 aircraft and ground-vehicle friction data with speed and variation of estimated aircraft braking performance with actual braking performance on snow- and ice-covered runways.



(b) BV-11 skiddometer data.

Figure 53. Concluded.

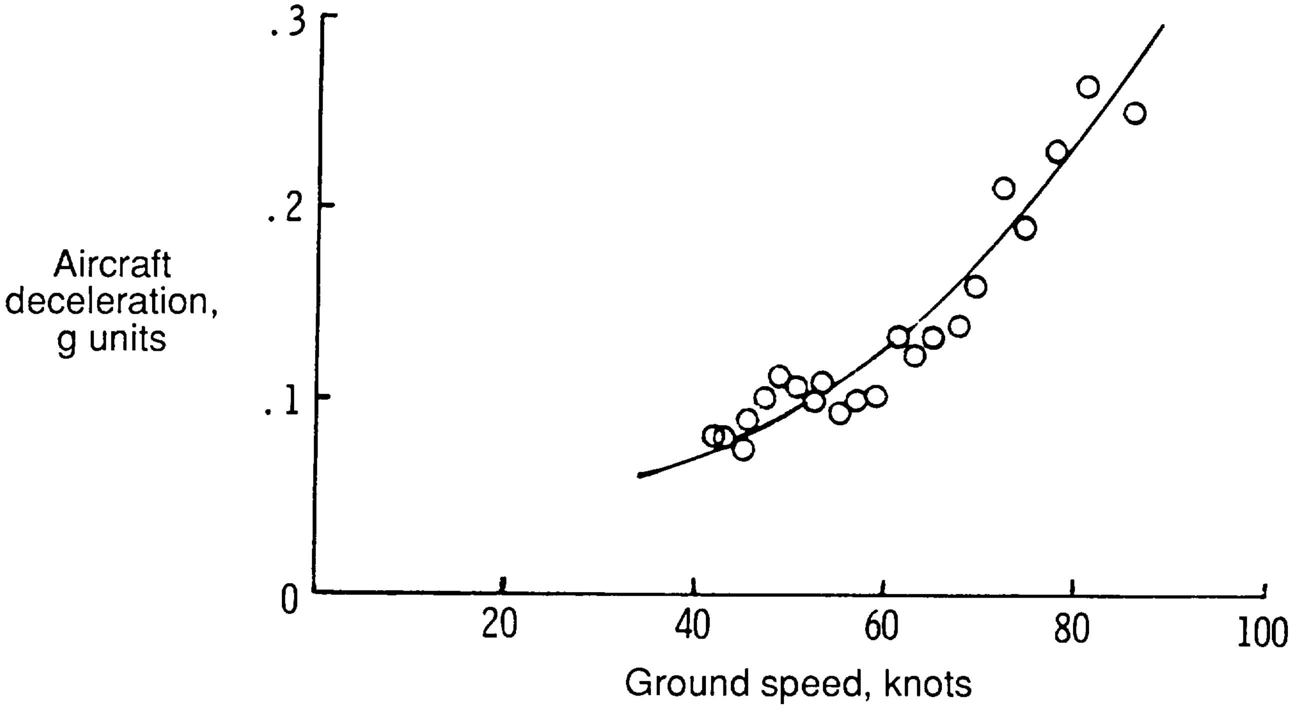


Figure 54. Boeing 737 deceleration in 6-in. loose snow. Landing flaps = 40°; spoilers extended; idle forward thrust; no wheel braking; Snow specific gravity = 0.32; Headwind component = 9.8 knots.

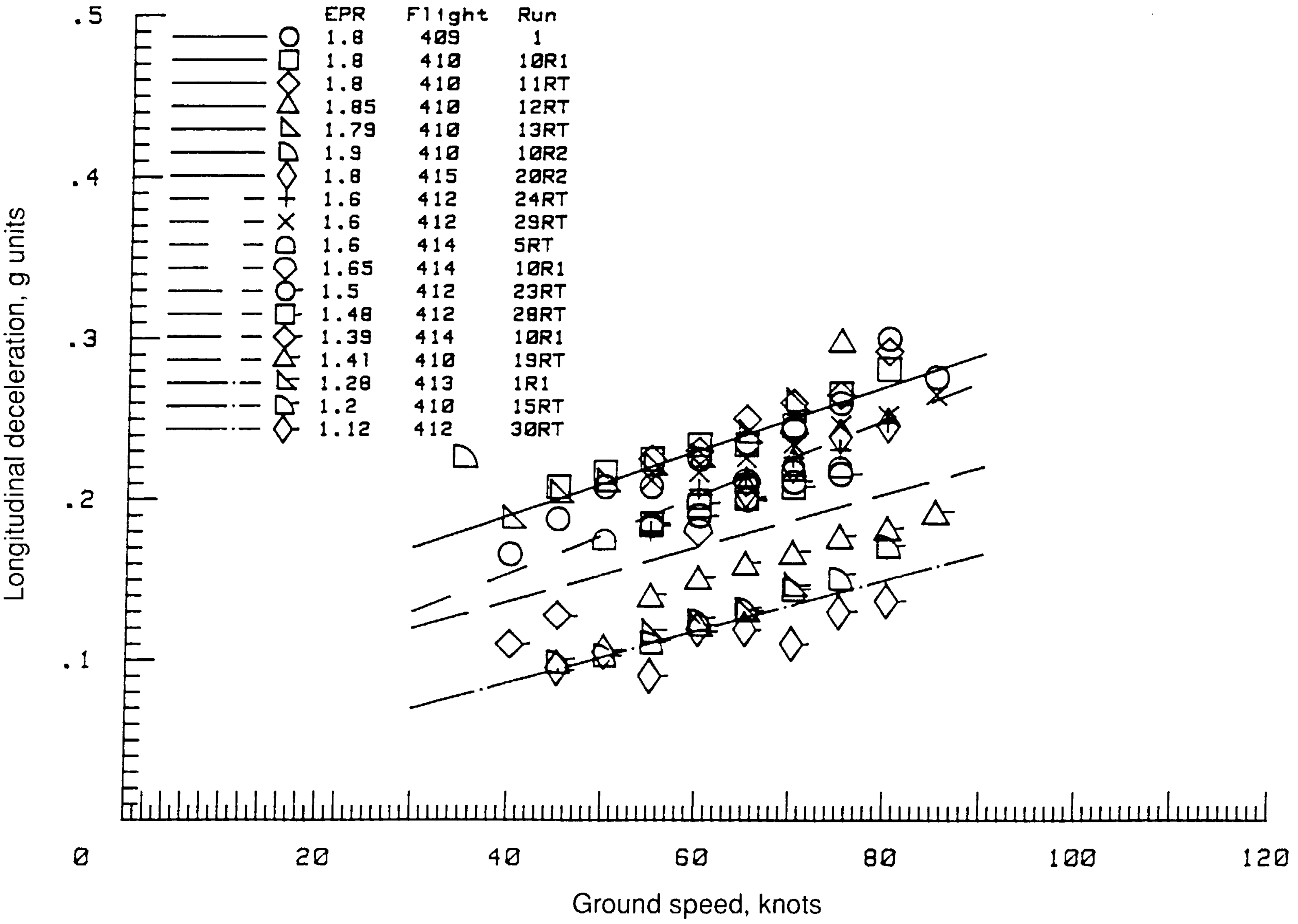


Figure 55. Reverse-thrust performance of Boeing 737 aircraft. (Data include aerodynamic drag and tire rolling resistance.)

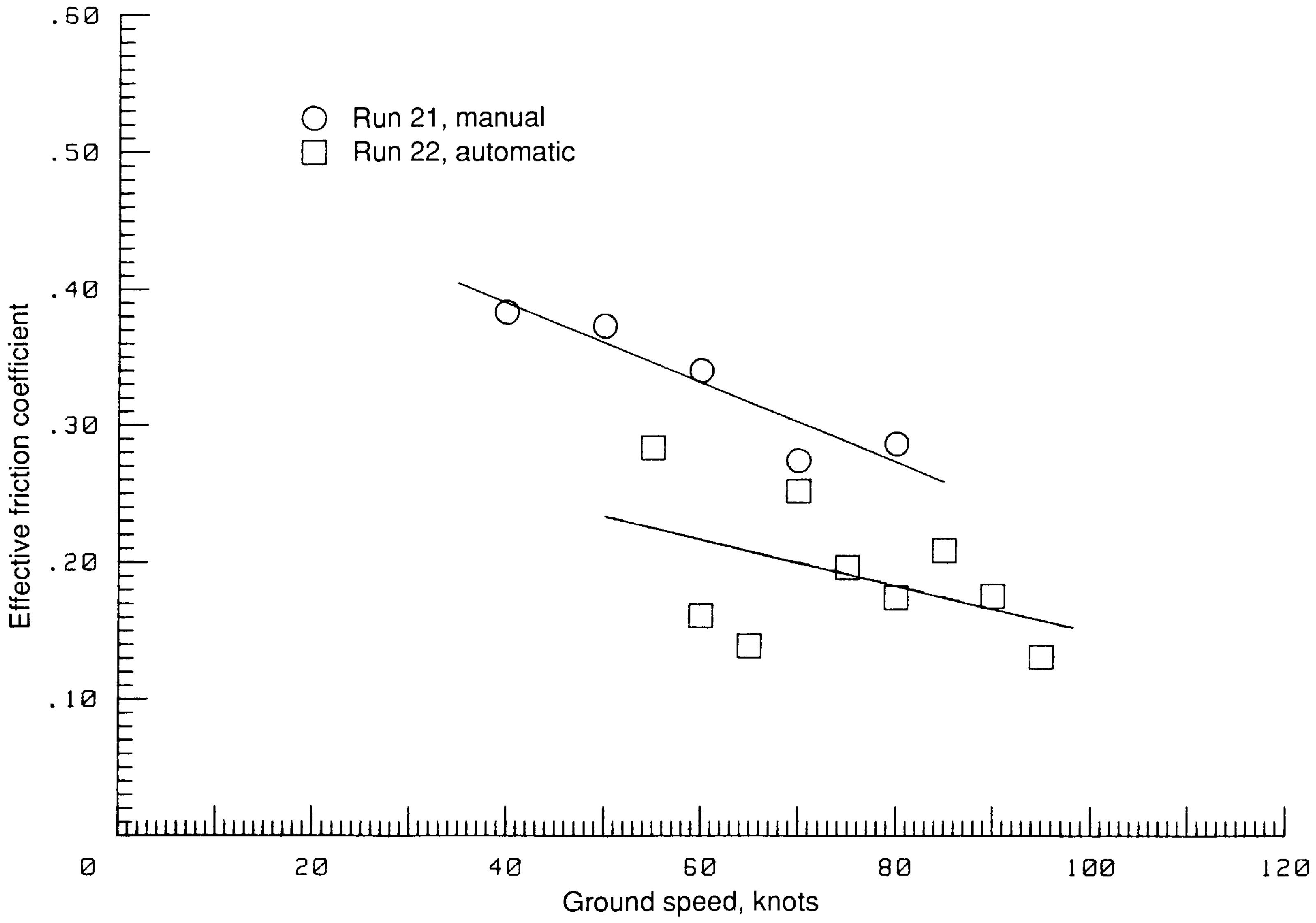


Figure 56. Comparison of Boeing 737 effective friction coefficient with ground speed for manual and automatic braking modes on truck-wet, slurry-seal asphalt, flight 412.

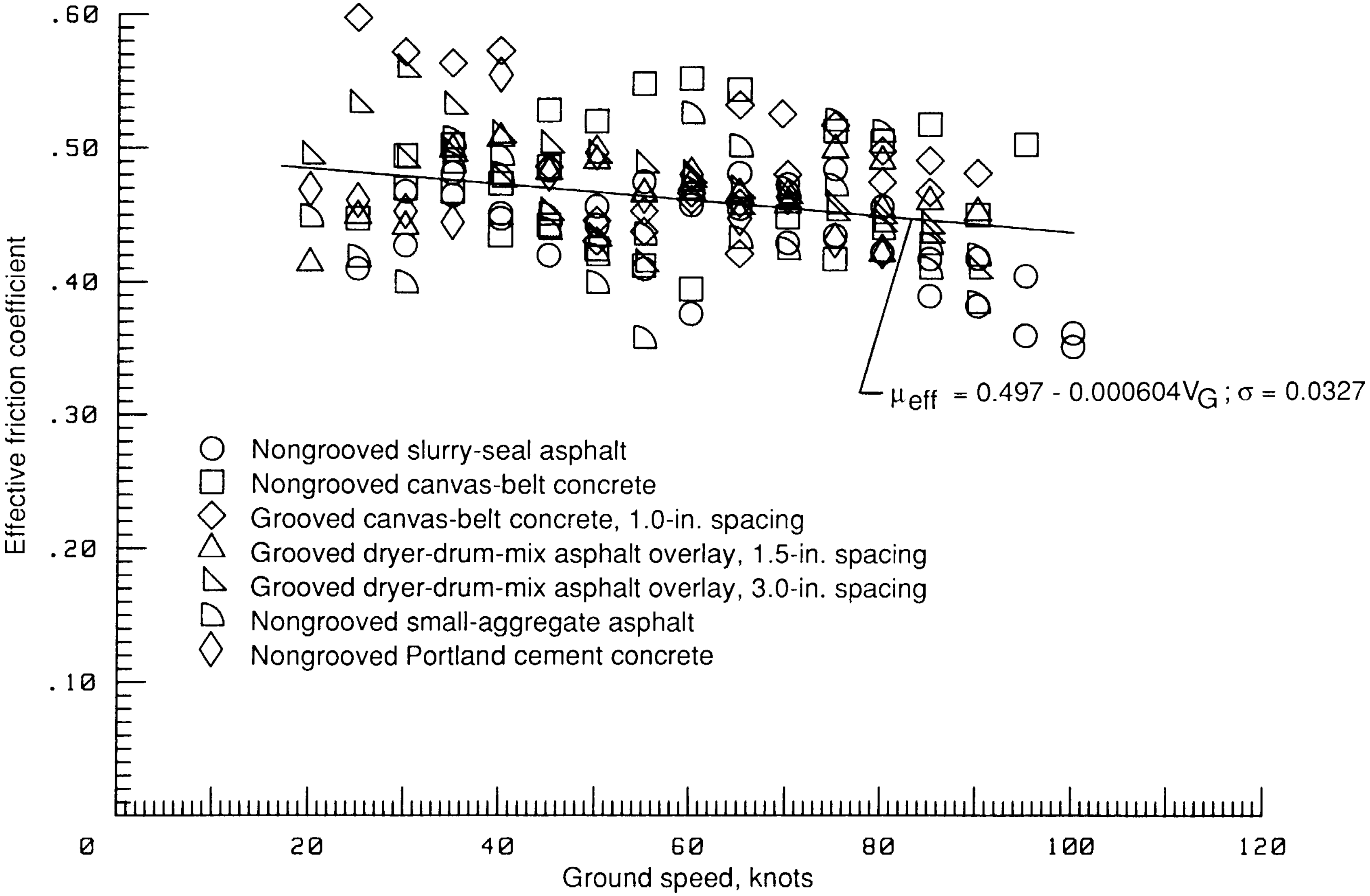
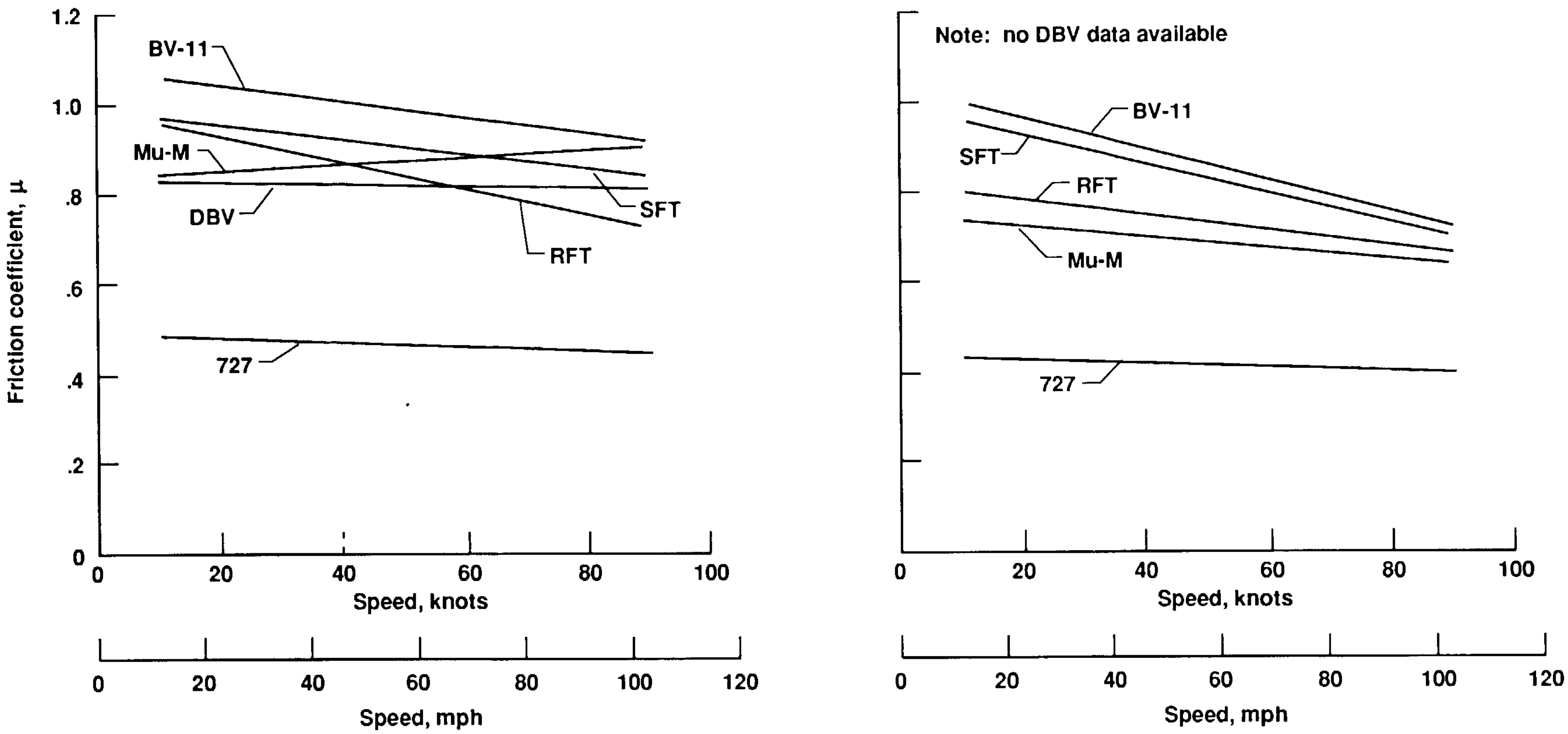


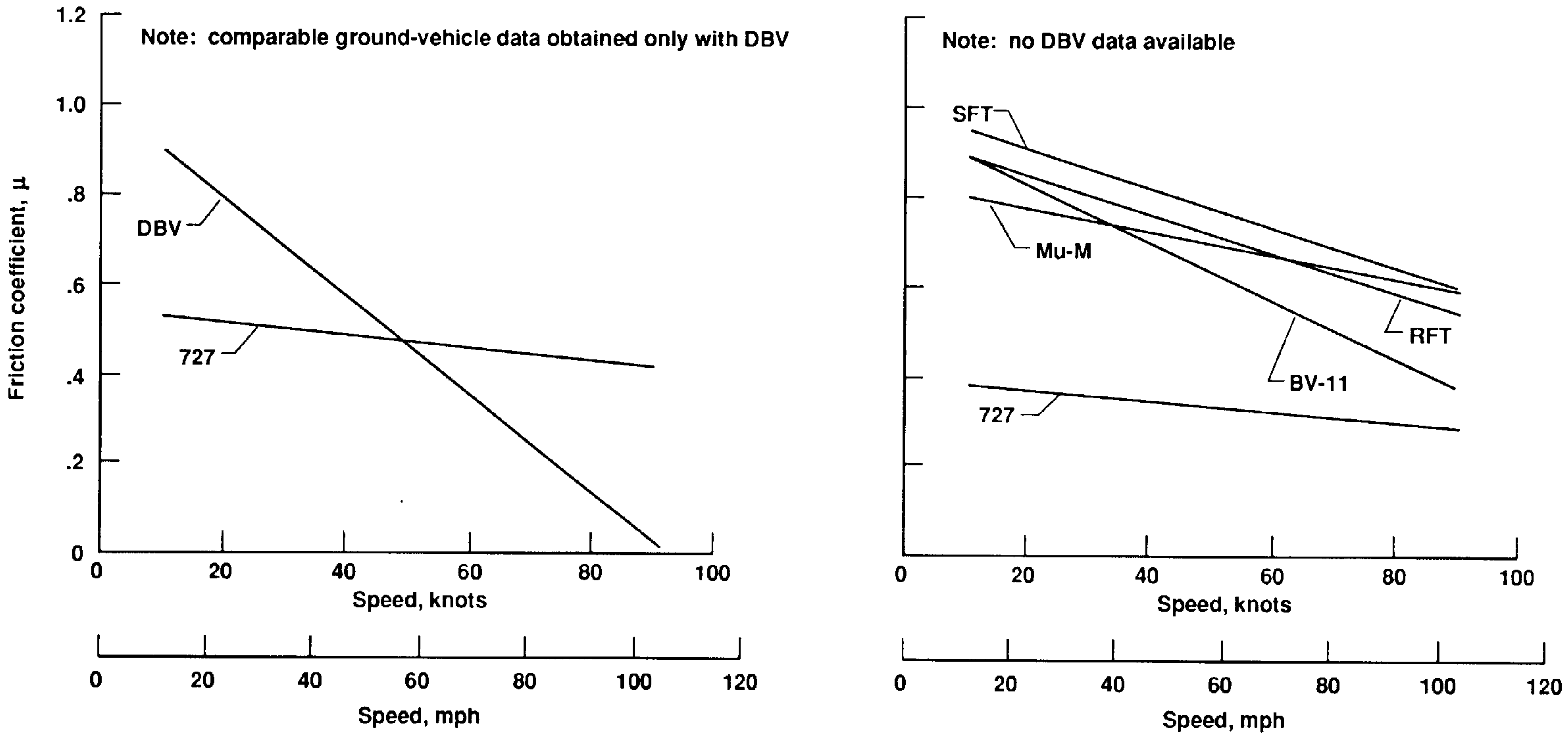
Figure 57. Comparison of Boeing 727 effective friction coefficient with ground speed for dry-runway test conditions.



(a) Dry, all surfaces.

(b) Rain-damp, PFC surface at Pease AFB; Rain rate = 0.01 in/hr; Water depth < 0.01 in.

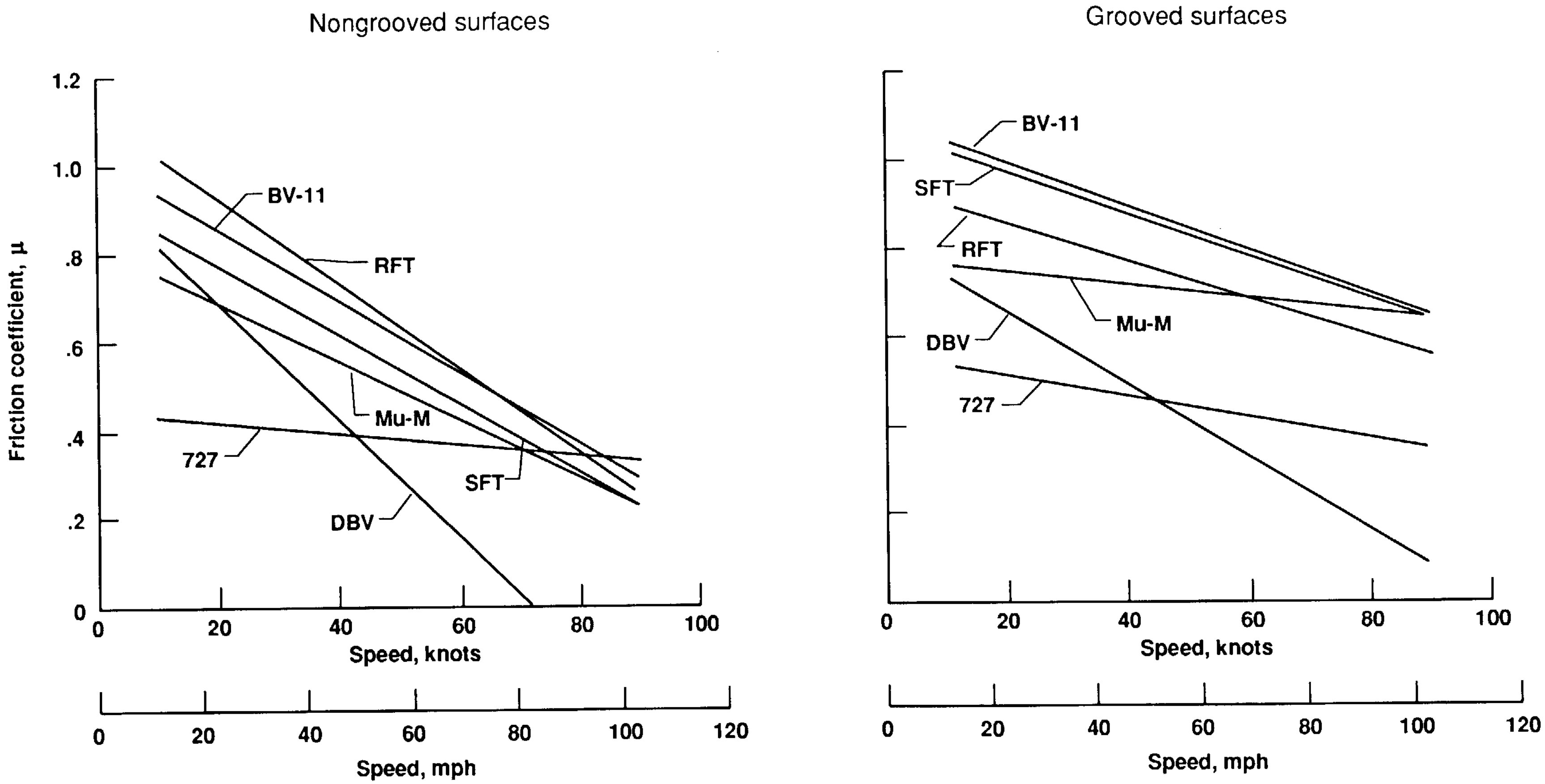
Figure 58. Range of Boeing 727 aircraft and ground-vehicle friction data for different runway test-surface conditions.



(c) Rain-damp, slurry-seal asphalt; Rain rate = 0.01 in/hr; Water depth < 0.01 in.

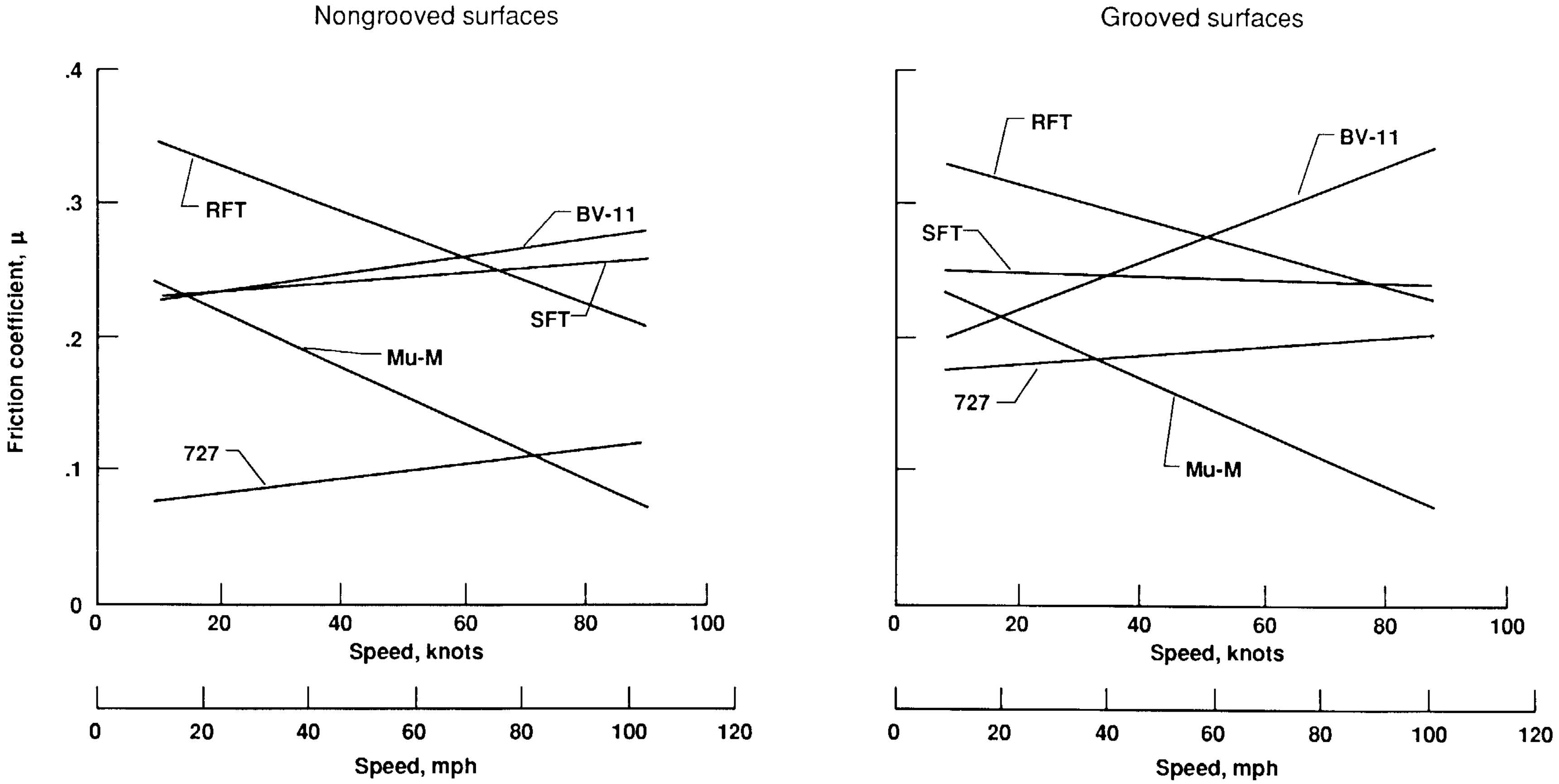
(d) Rain-wet, nongrooved, small-aggregate asphalt at BNAS; Rain rate = 0.16 in/hr; Water depth = 0.04 to 0.06 in.

Figure 58. Continued.



(e) Truck-wet surfaces.

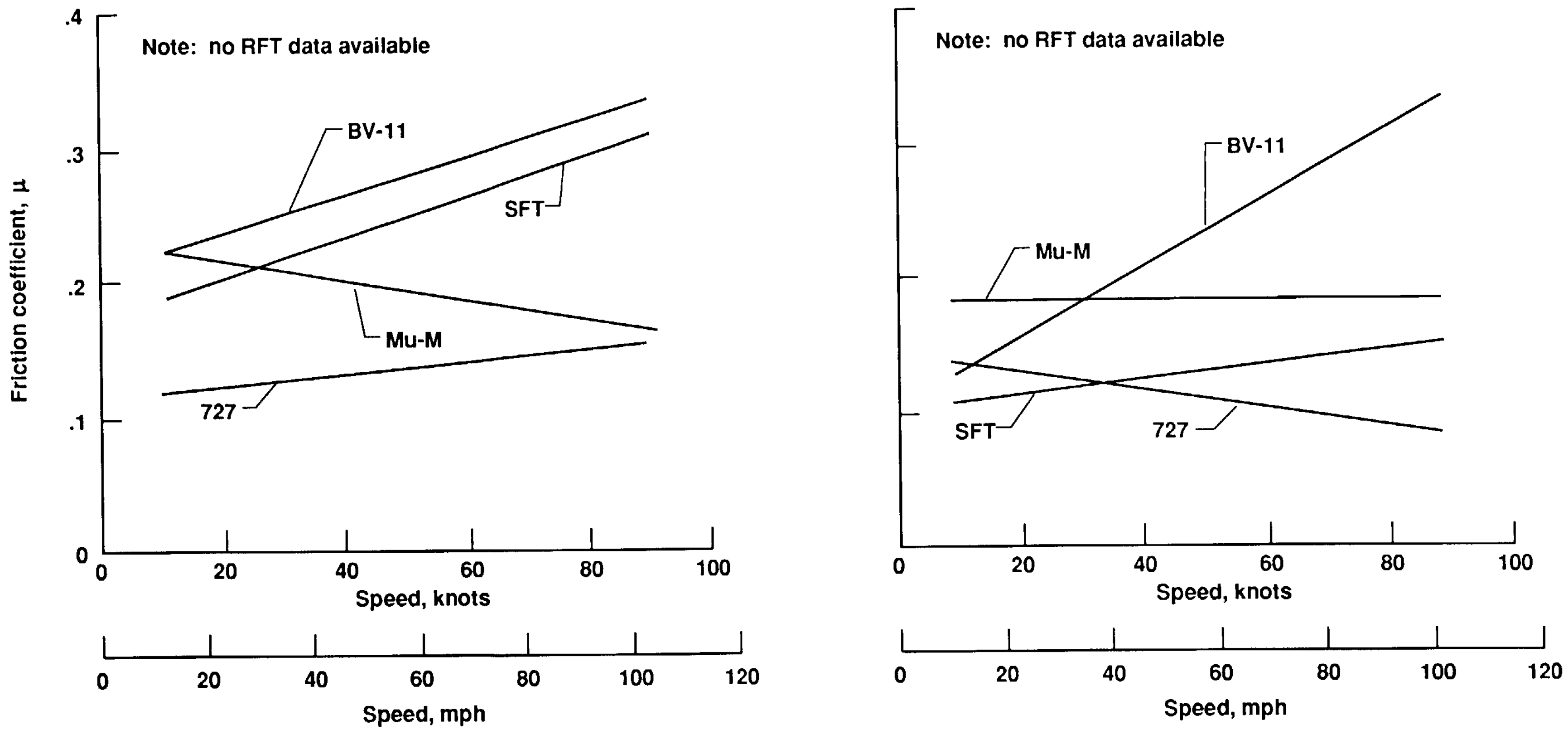
Figure 58. Continued.



(f) 1.5-in. wet snow.

(g) Packed snow on ice.

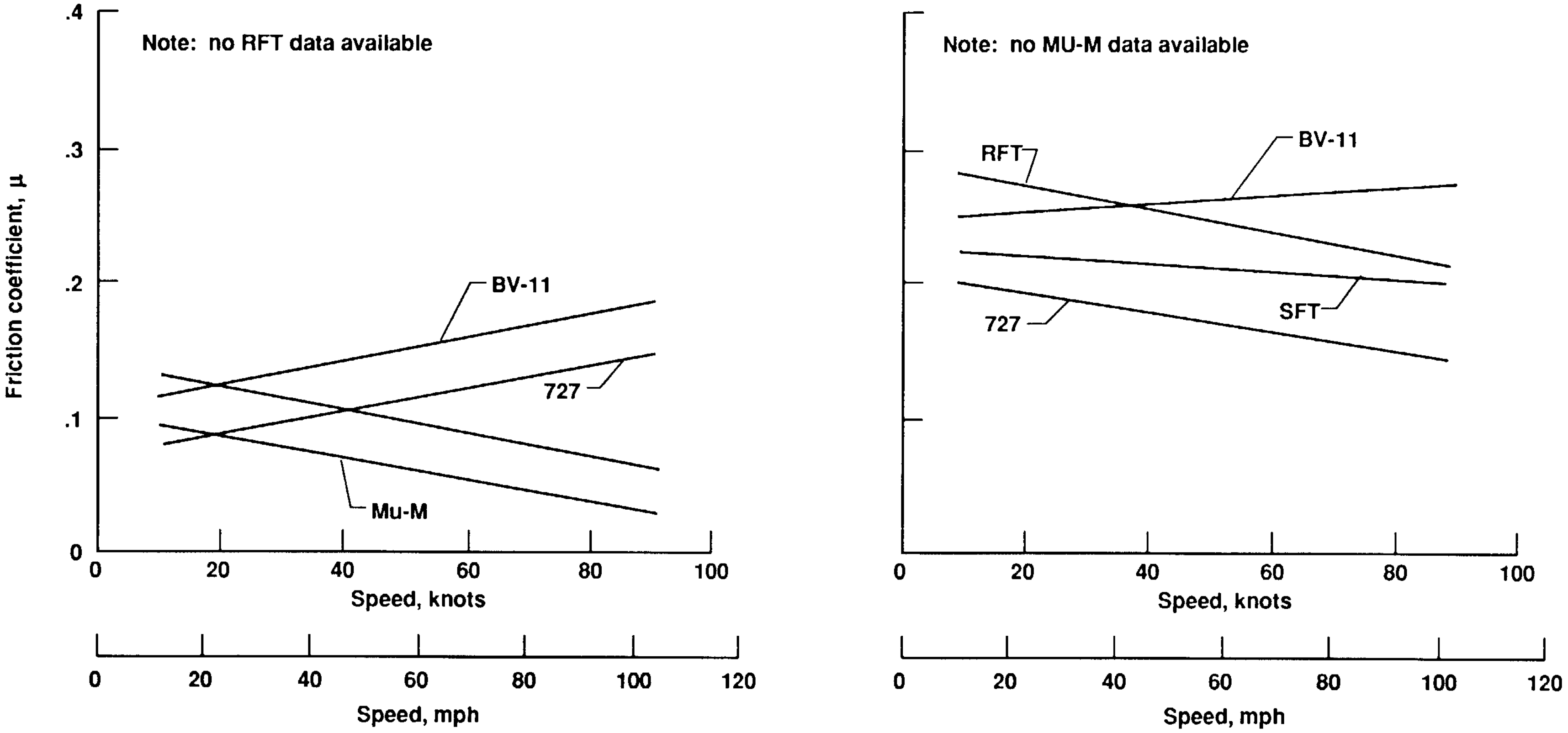
Figure 58. Continued.



(h) Dry snow on ice.

(i) Urea on ice.

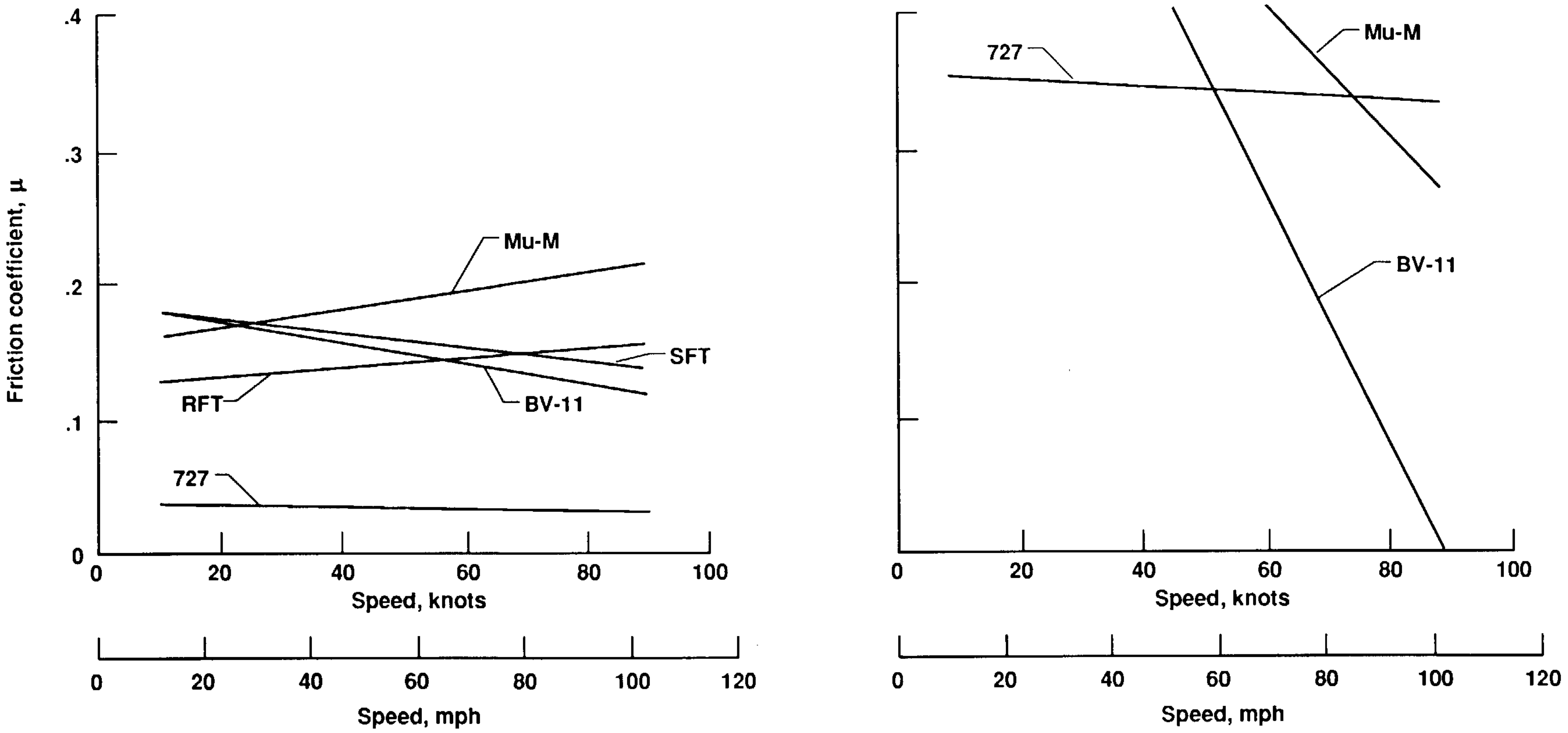
Figure 58. Continued.



(j) Loose dry snow.

(k) UCAR on ice.

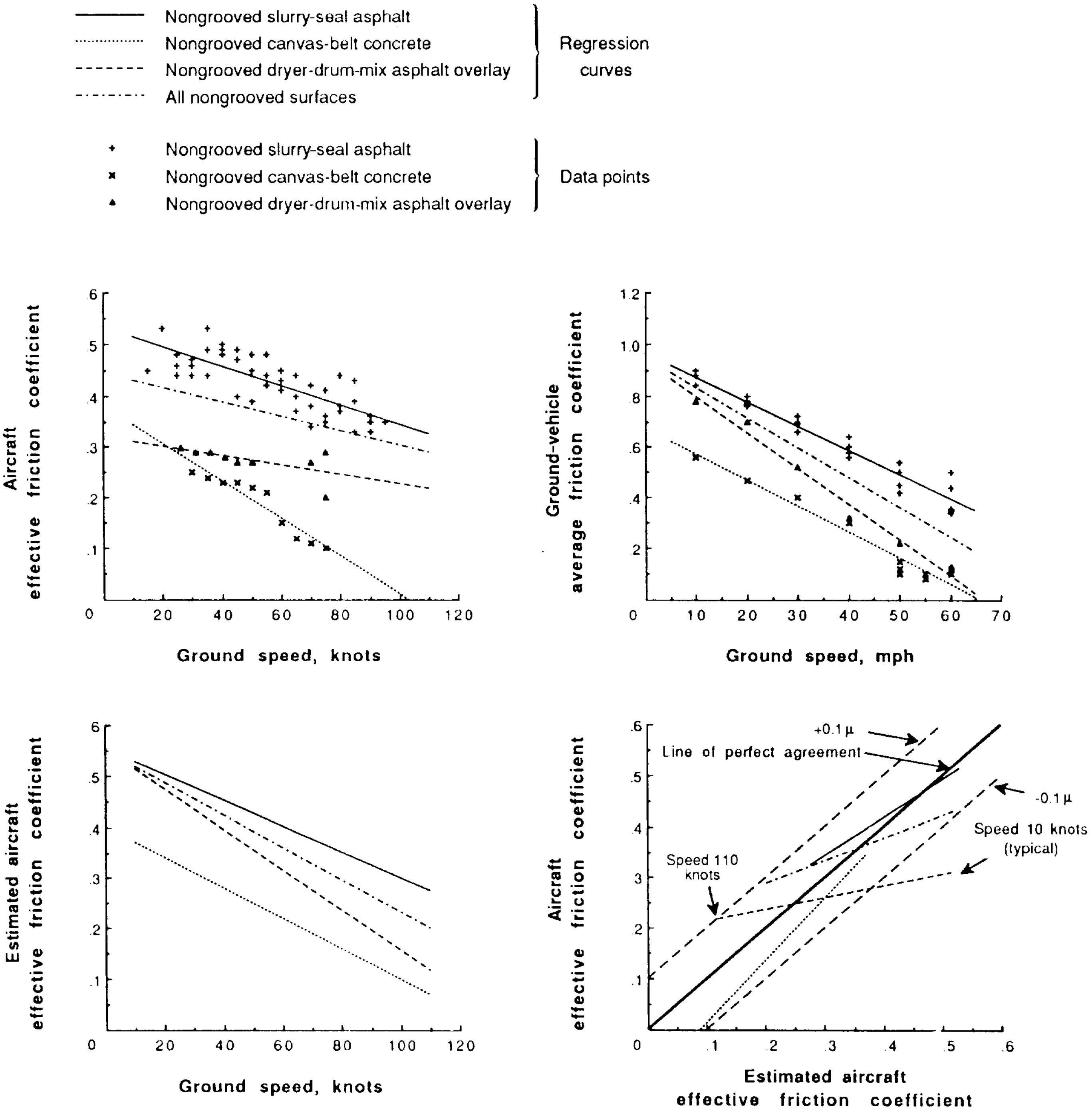
Figure 58. Continued.



(l) Solid ice.

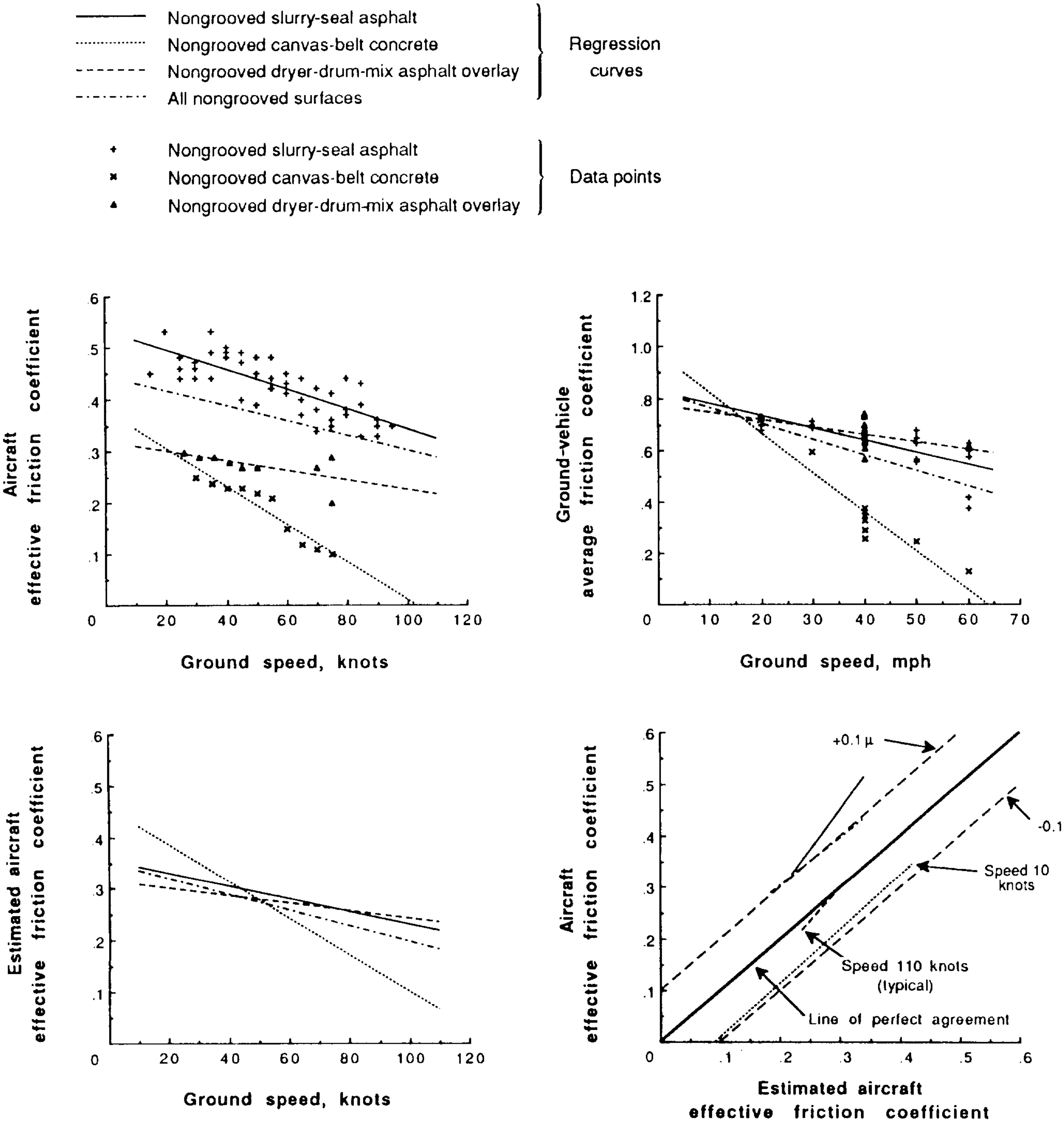
(m) 0.25-in. slush.

Figure 58. Concluded.



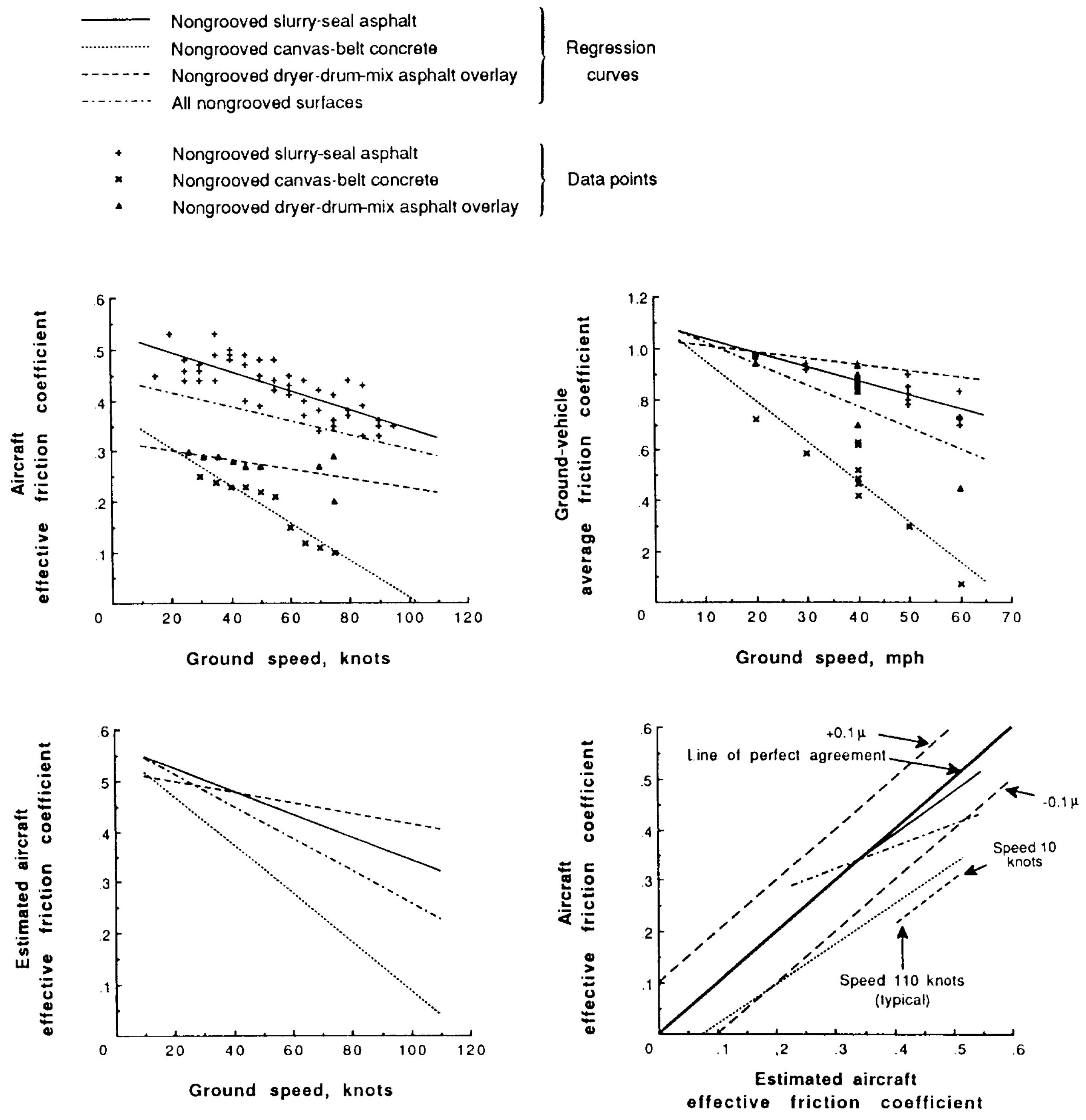
(a) DBV data.

Figure 59. Variation of Boeing 727 aircraft and ground-vehicle friction data with speed and variation of estimated aircraft braking performance with actual braking performance on truck-wet, nongrooved test surfaces.



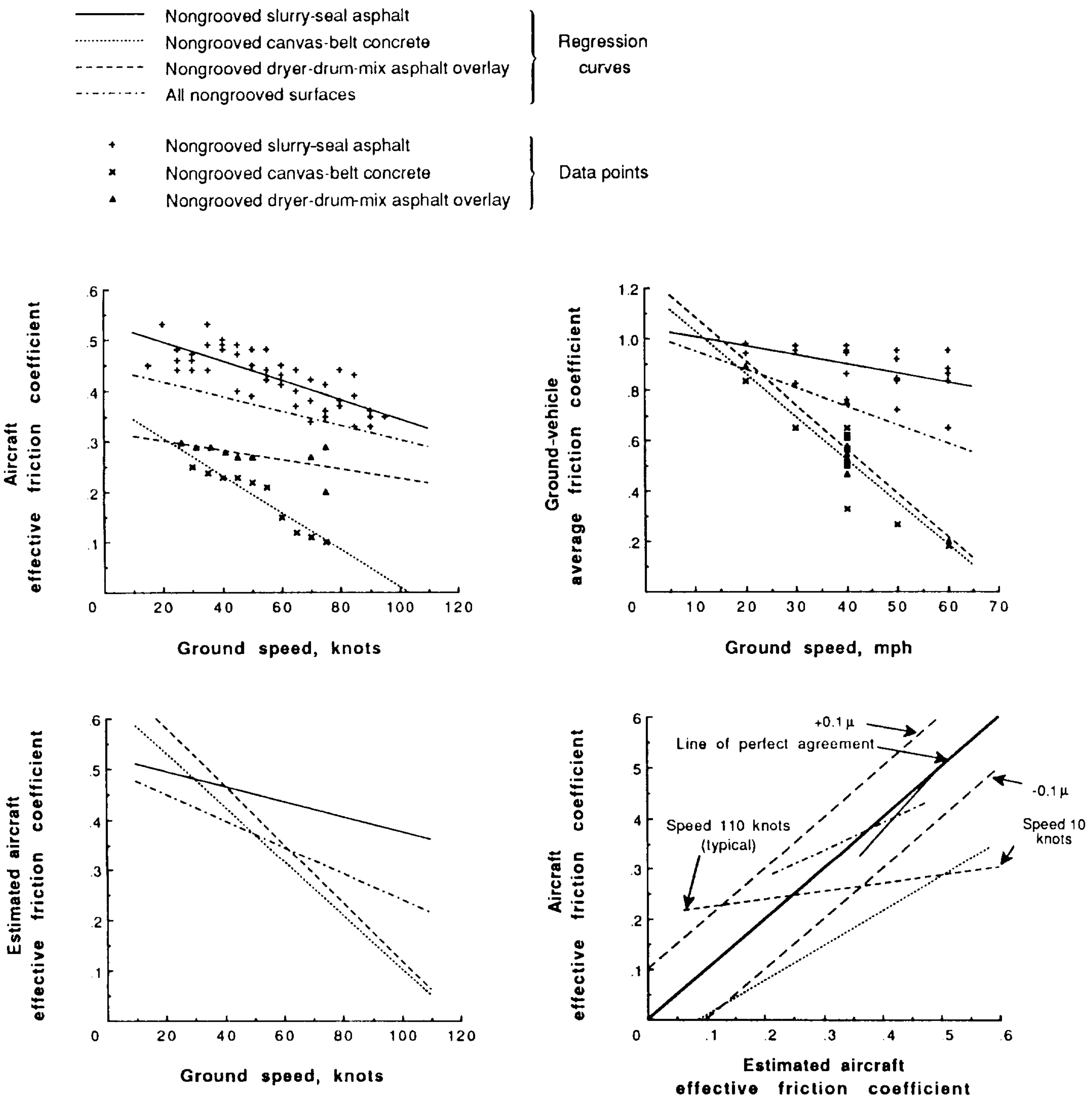
(b) Mu-Meter data.

Figure 59. Continued.



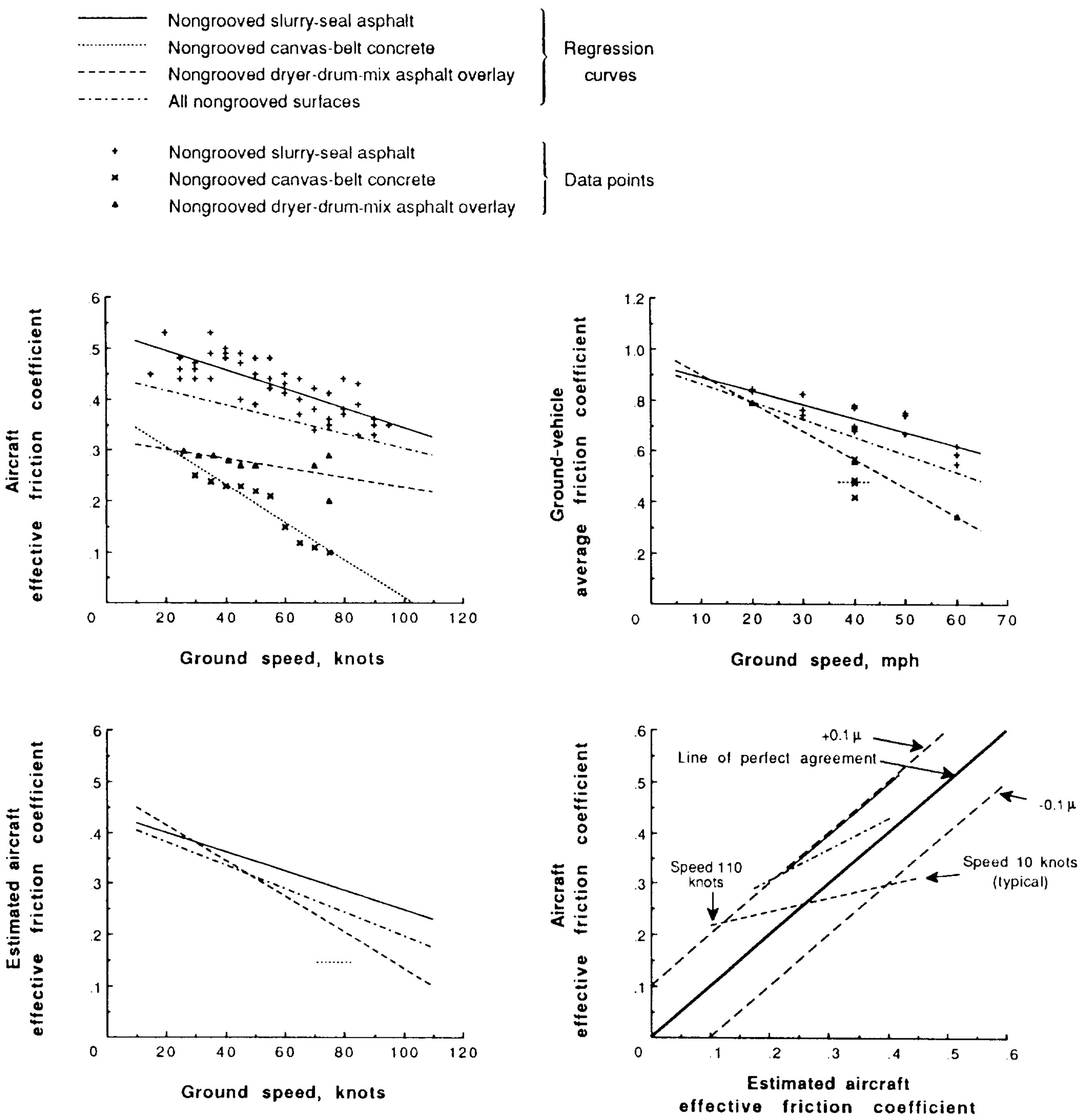
(c) SFT data.

Figure 59. Continued.



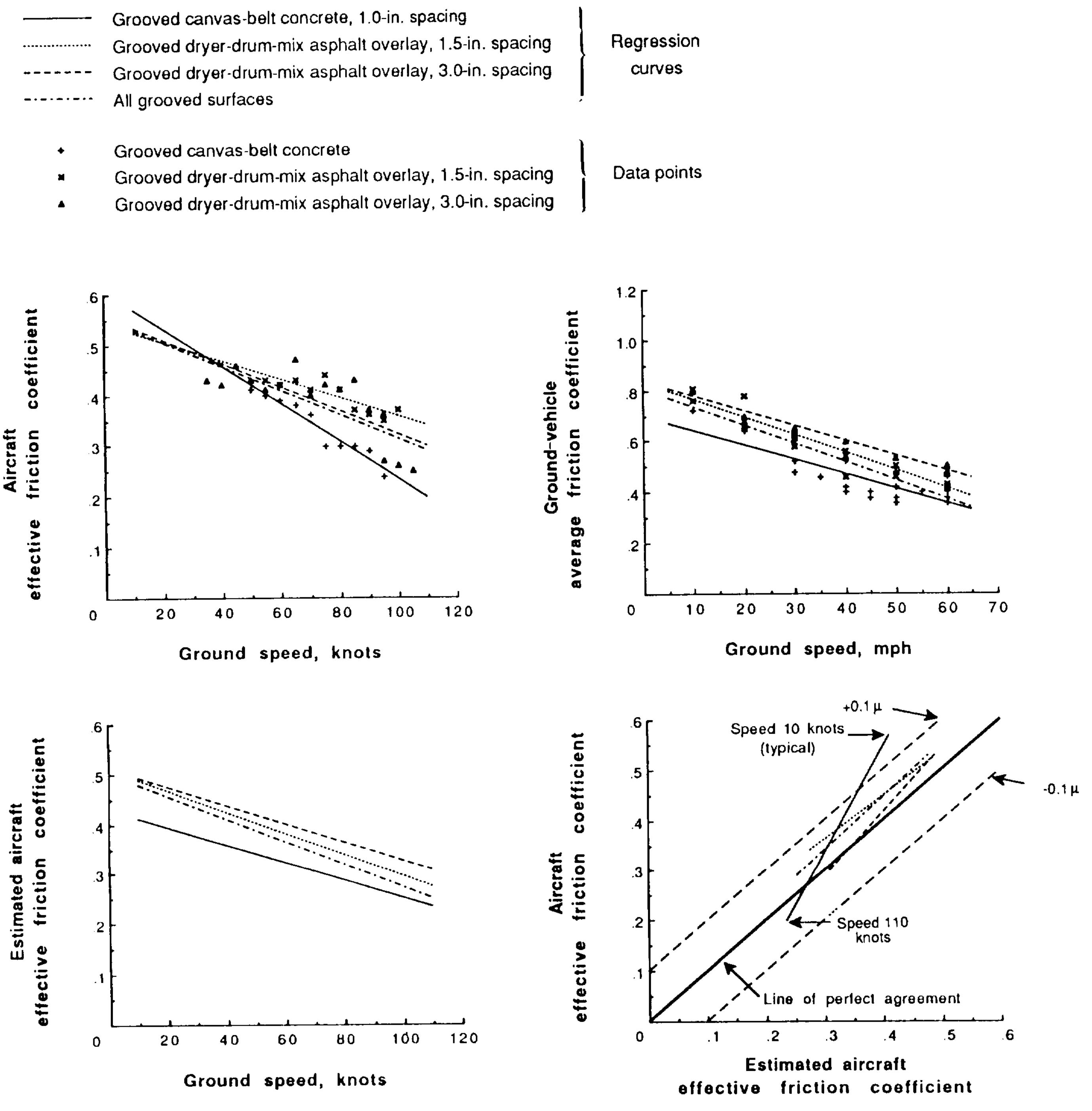
(d) BV-11 skiddometer data.

Figure 59. Continued.



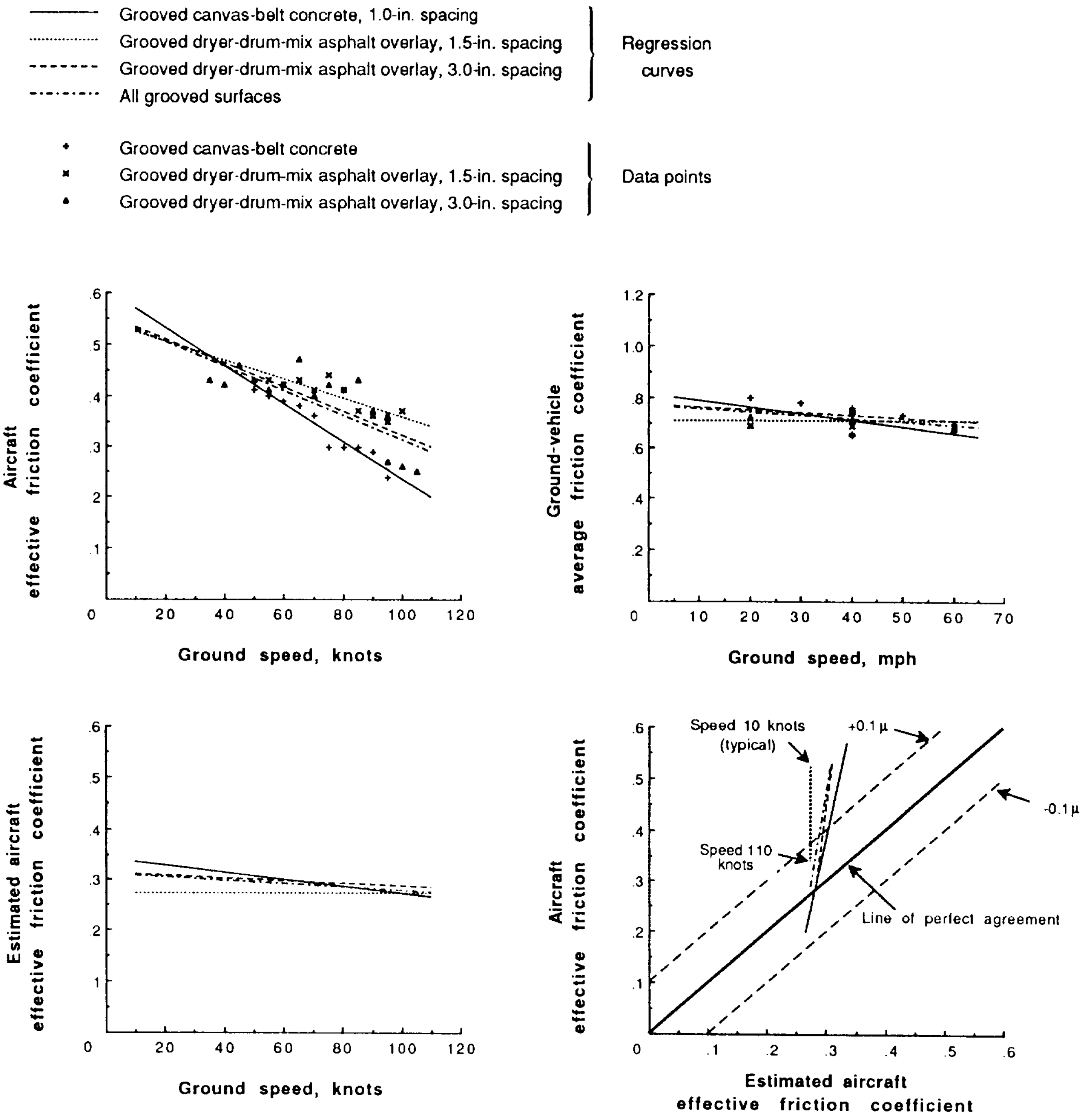
(e) RFT data.

Figure 59. Concluded.



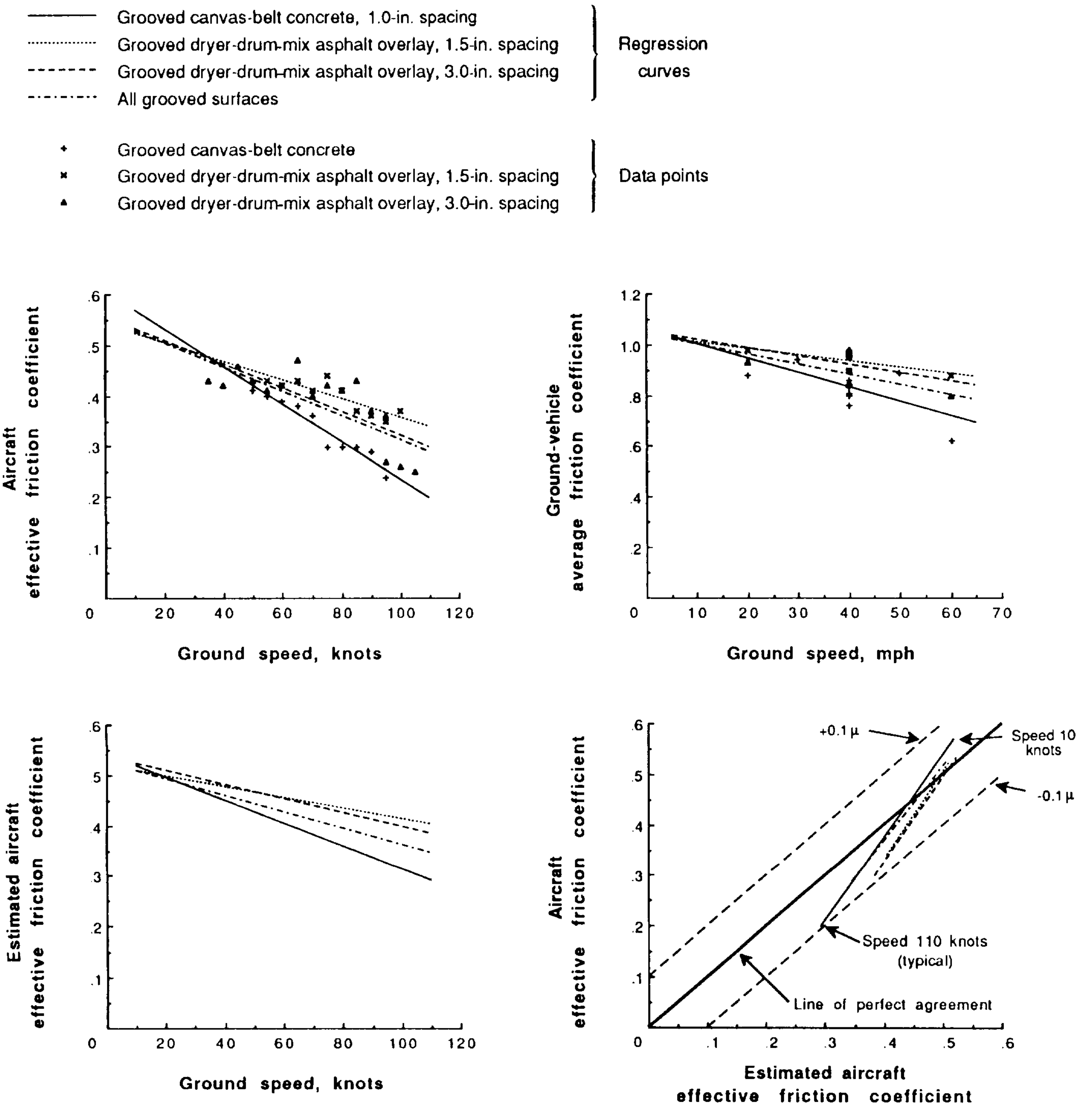
(a) DBV data.

Figure 60. Variation of Boeing 727 aircraft and ground-vehicle friction data with speed and variation of estimated aircraft braking performance with actual braking performance on truck-wet, grooved test surfaces.



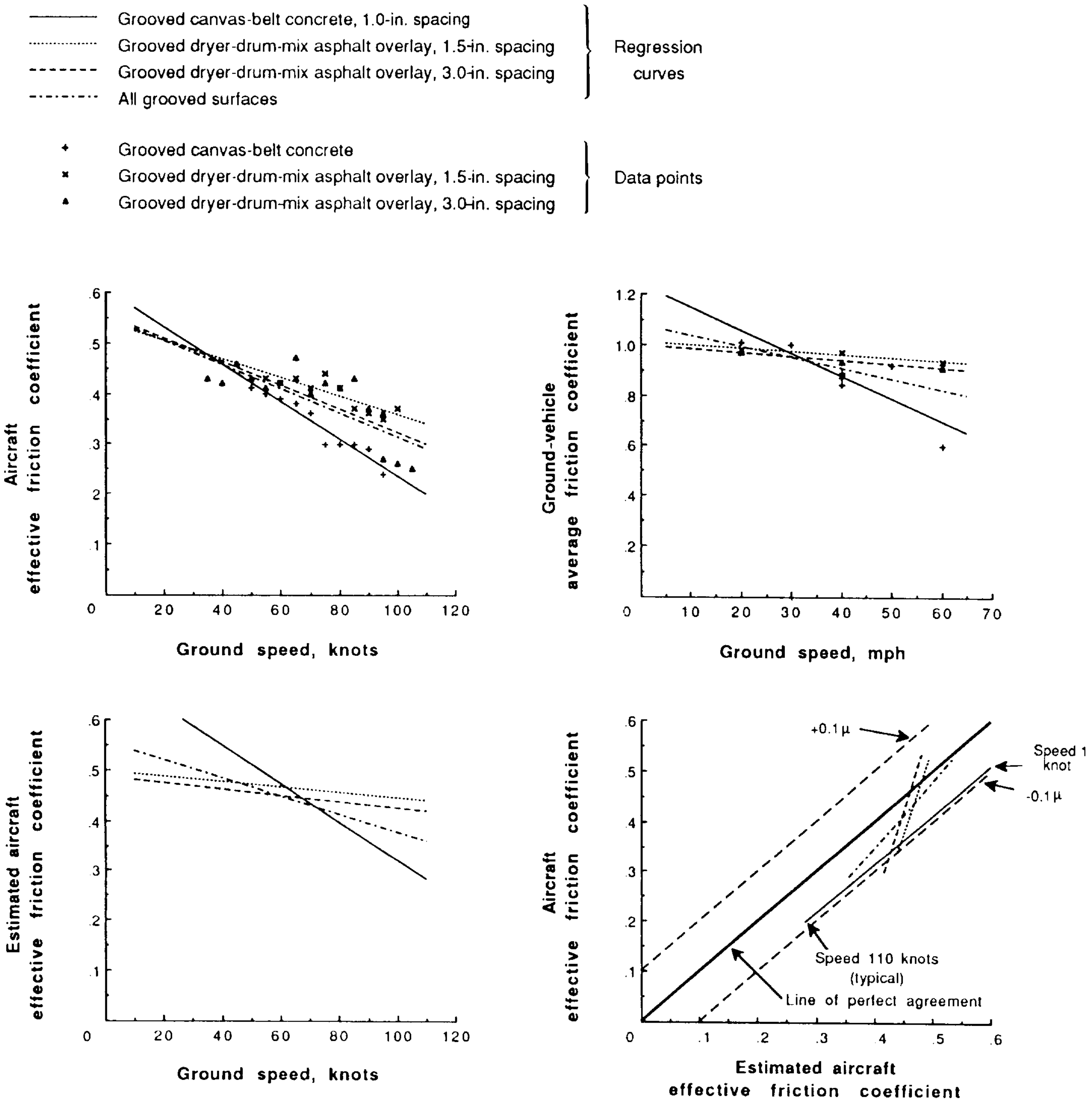
(b) Mu-Meter data.

Figure 60. Continued.



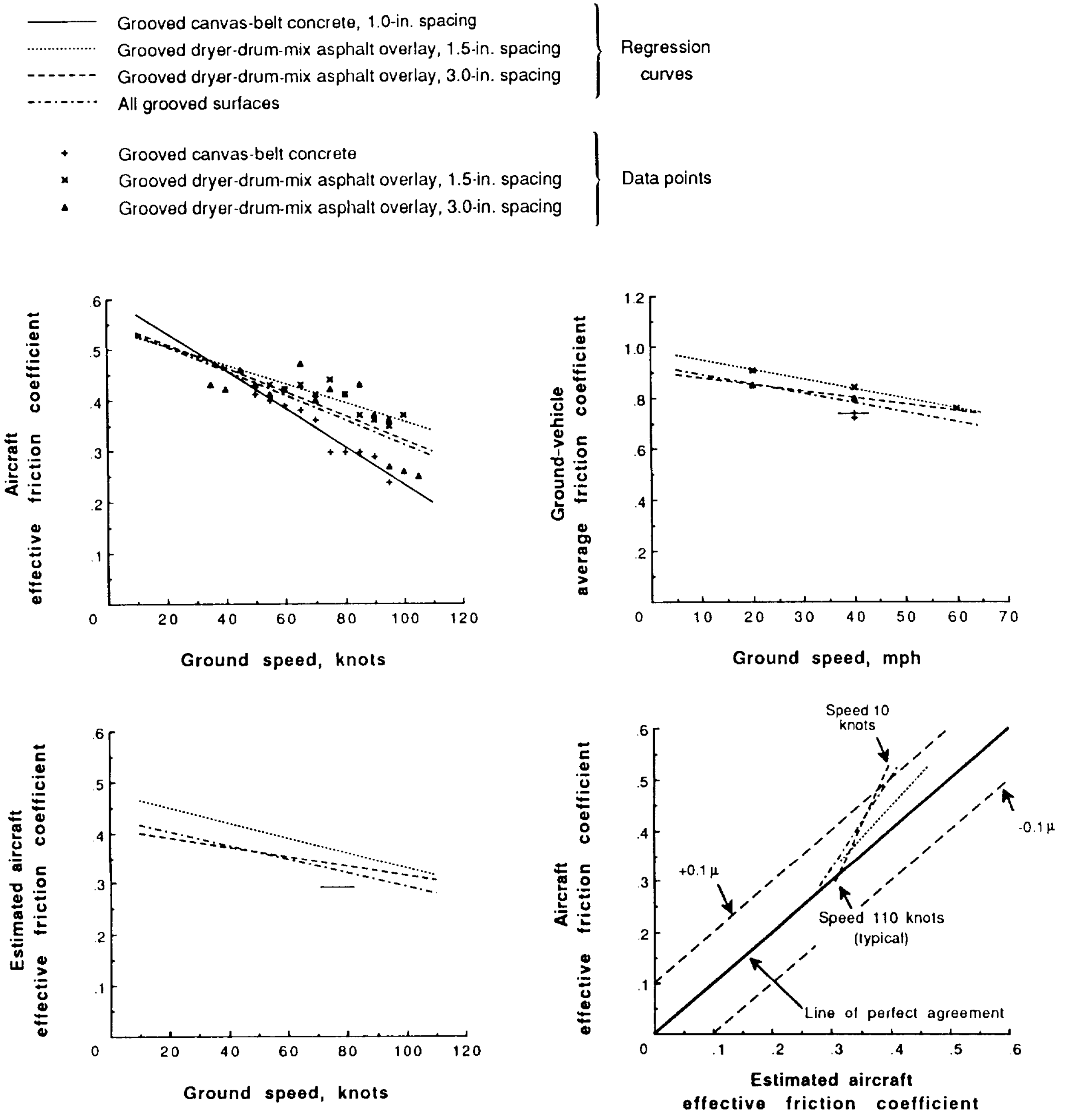
(c) SFT data.

Figure 60. Continued.



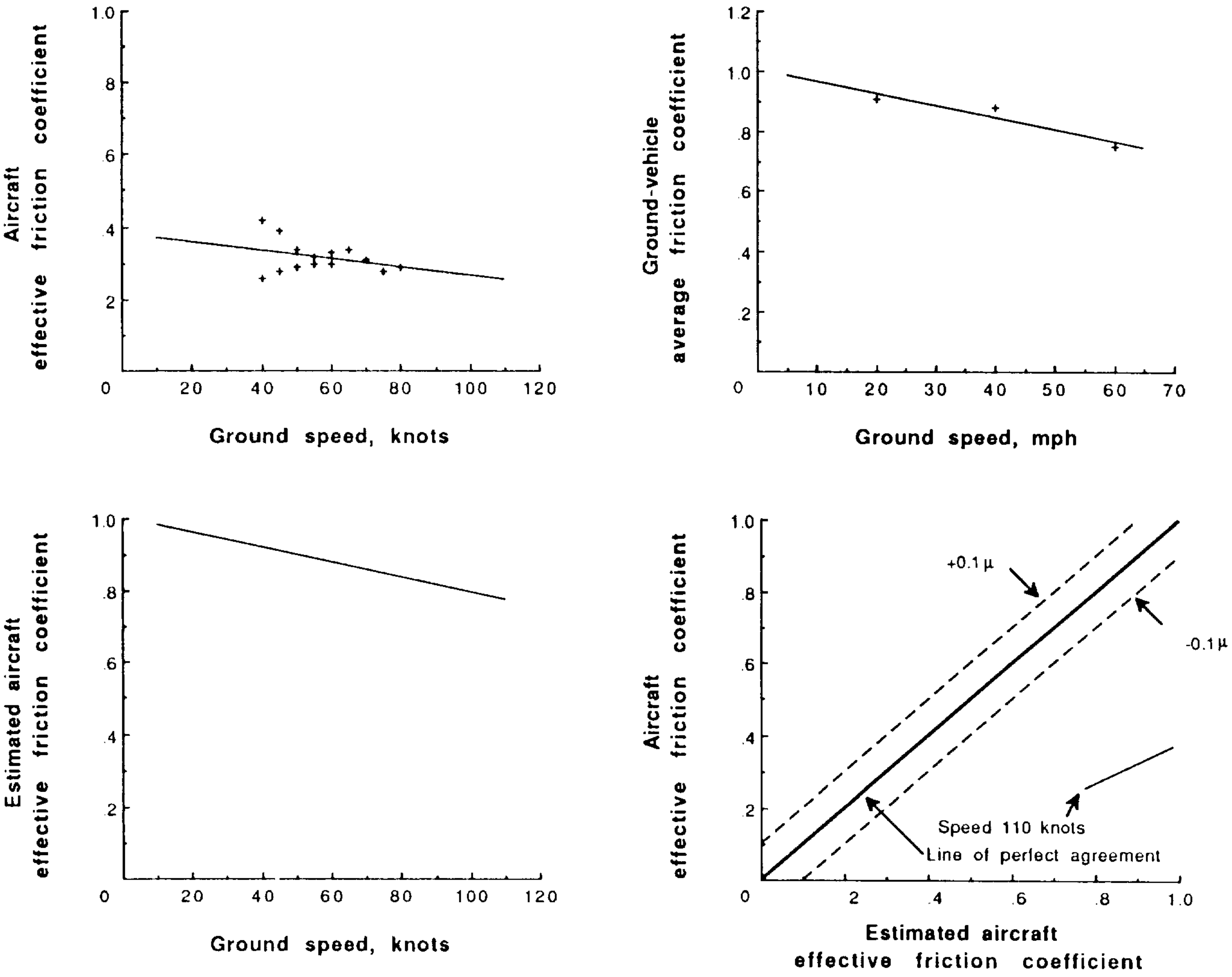
(d) BV-11 skiddometer data.

Figure 60. Continued.



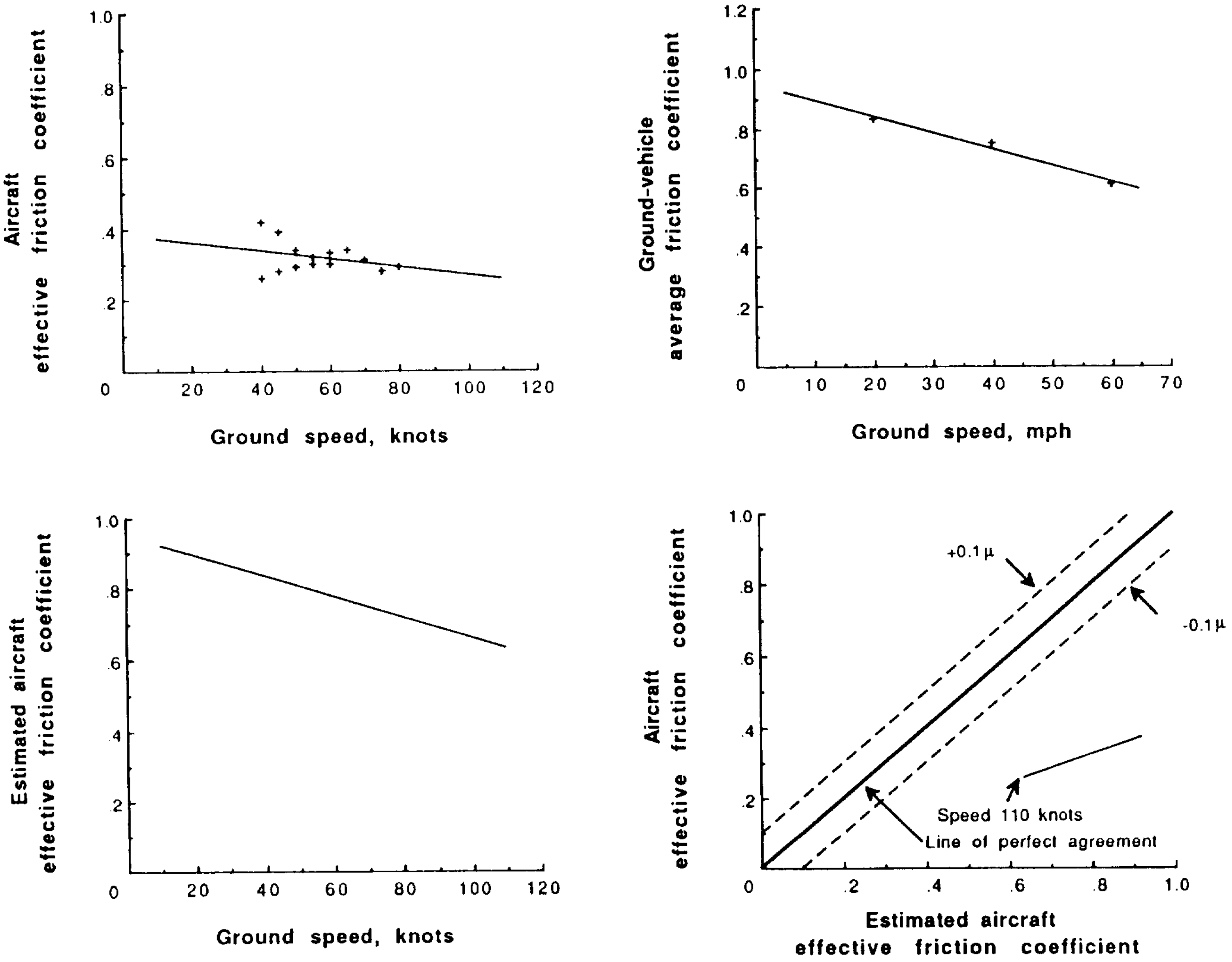
(e) RFT data.

Figure 60. Concluded.



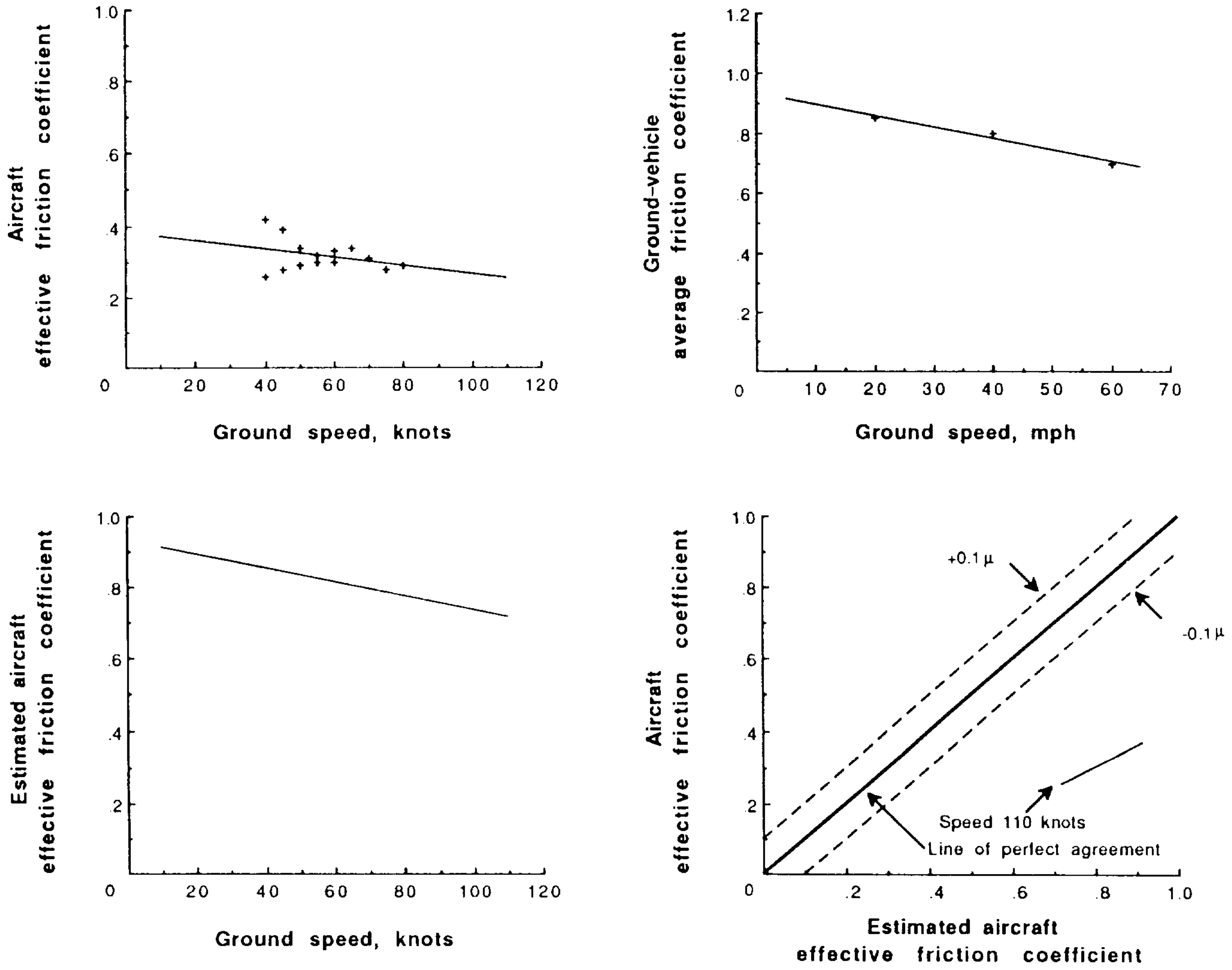
(a) SFT data.

Figure 61. Variation of Boeing 727 aircraft and ground-vehicle friction data with speed and variation of estimated aircraft braking performance with actual braking performance on rain-wet, nongrooved, small-aggregate asphalt surface.



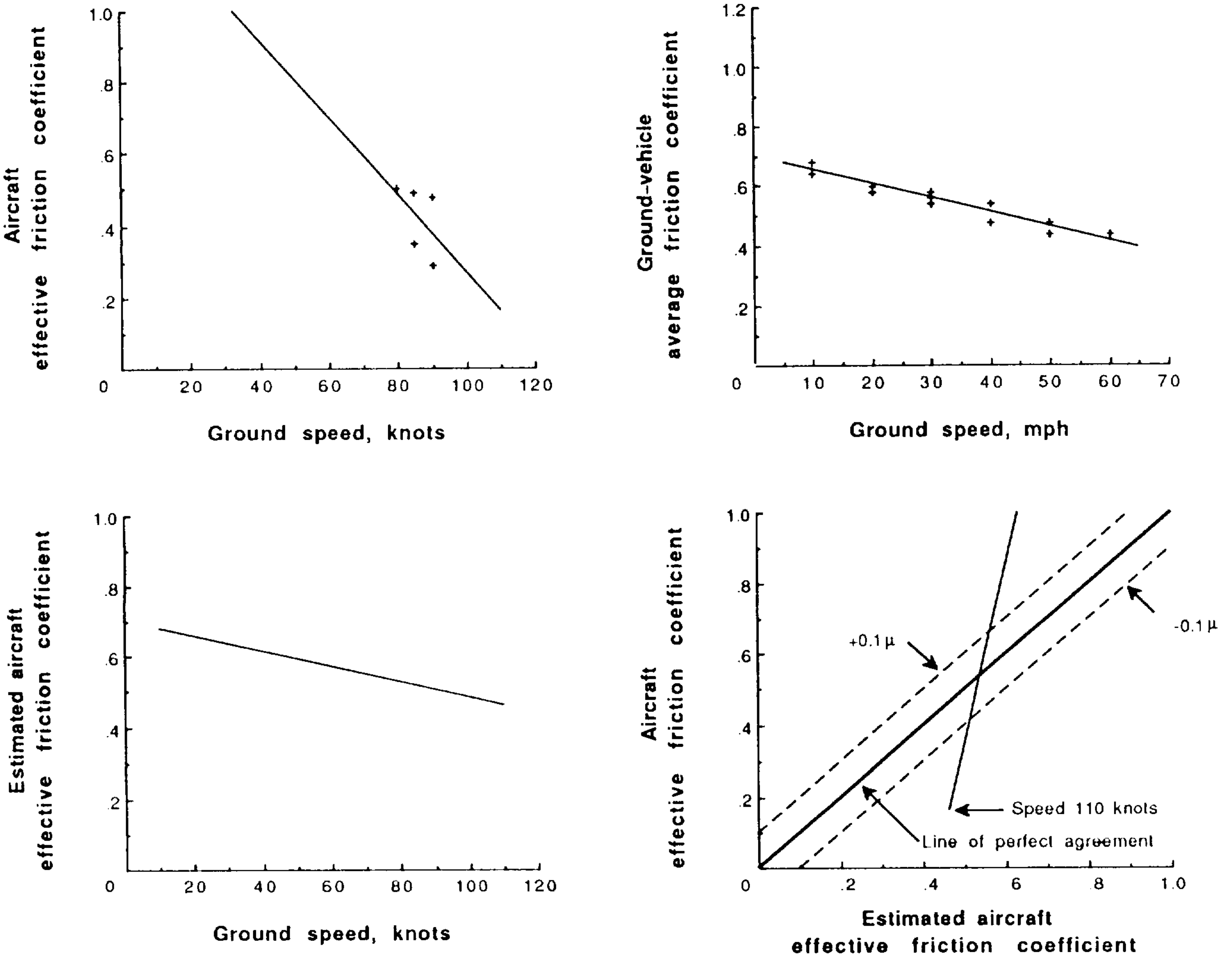
(b) BV-11 skiddometer data.

Figure 61. Continued.



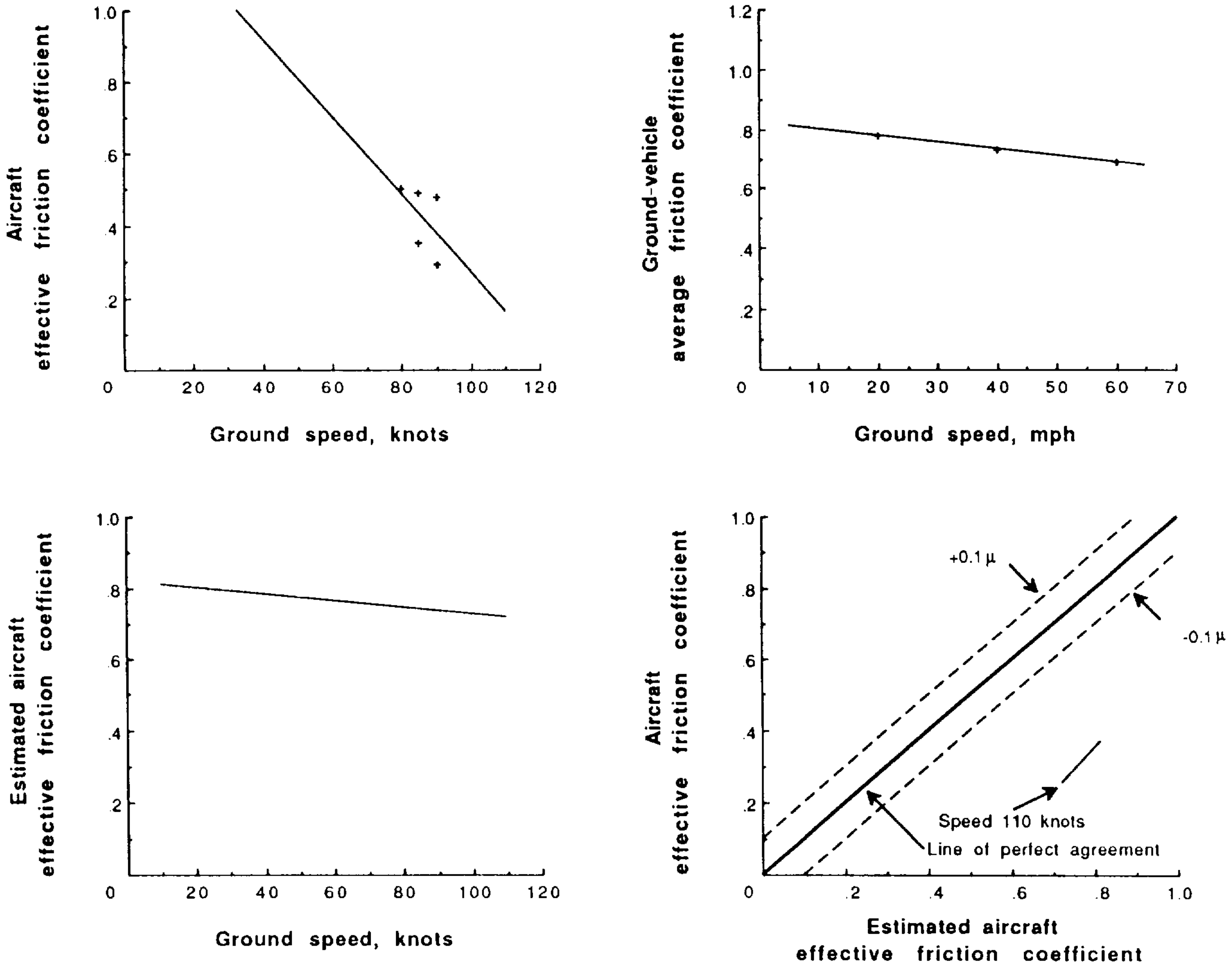
(c) RFT data.

Figure 61. Concluded.



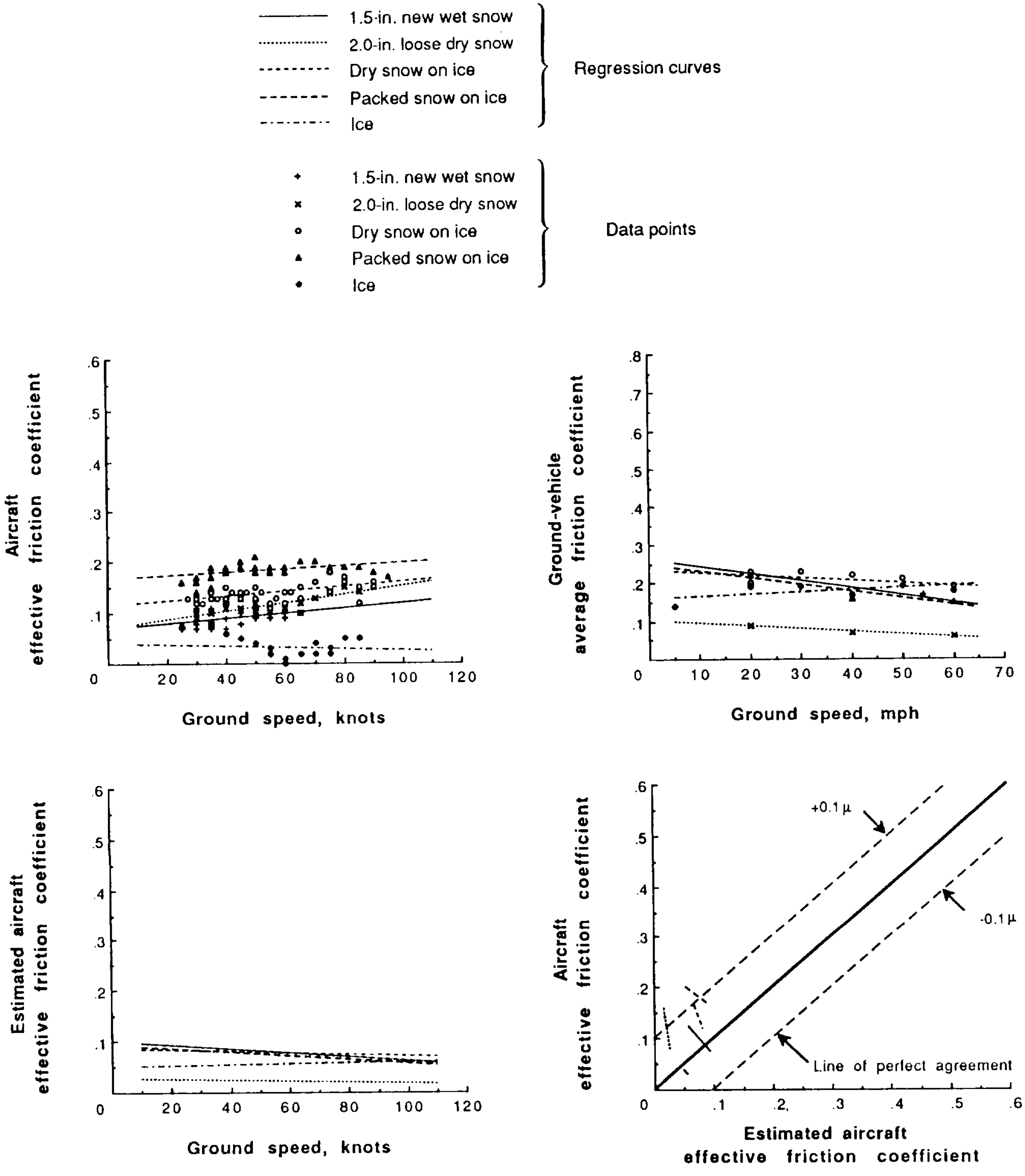
(a) DBV data.

Figure 62. Variation of Boeing 727 aircraft and ground-vehicle friction data with speed and variation of estimated aircraft braking performance with actual braking performance on rain-wet, grooved 1-in. spacing, canvas-belt, concrete surface.



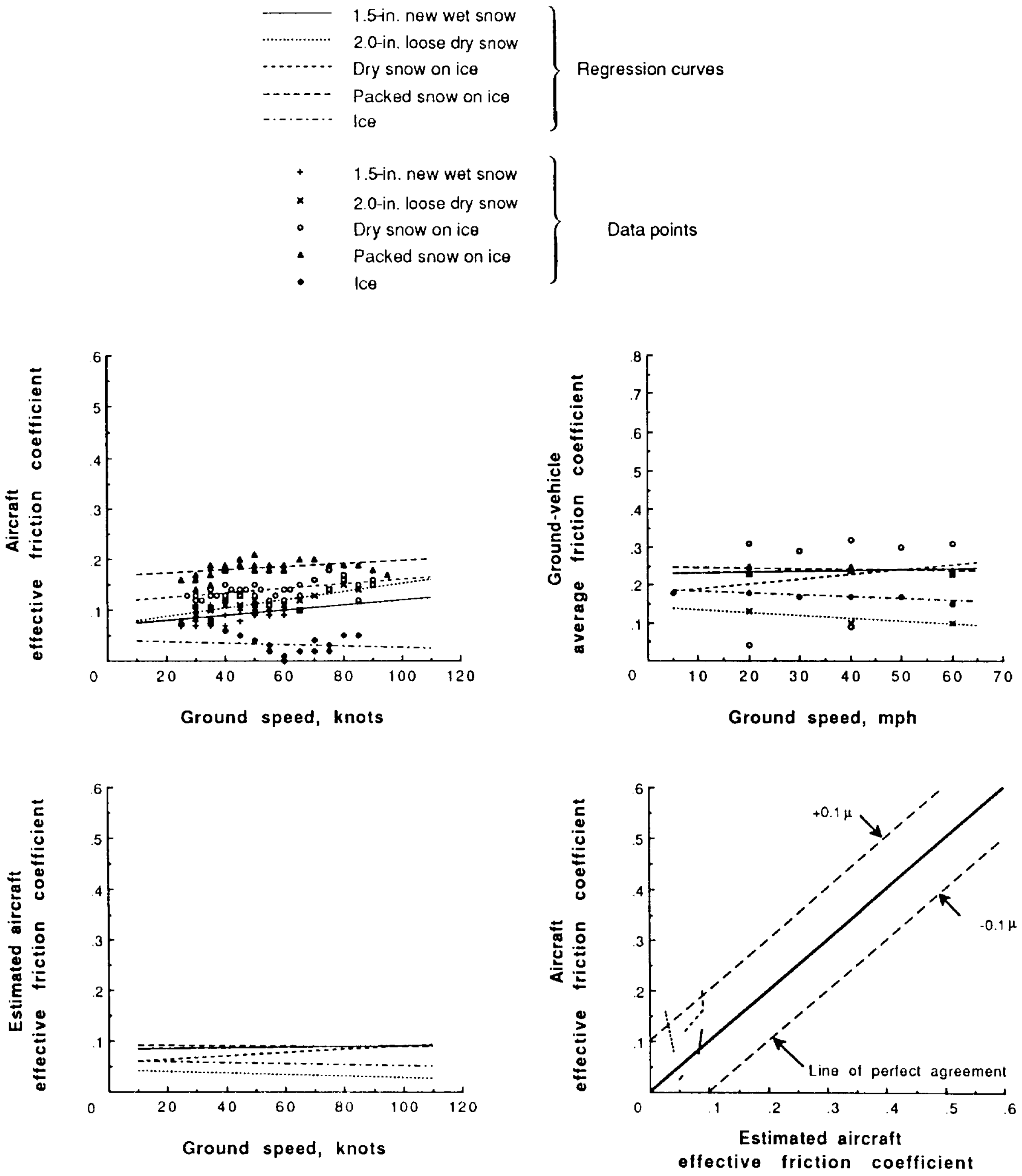
(b) Mu-Meter data.

Figure 62. Concluded.



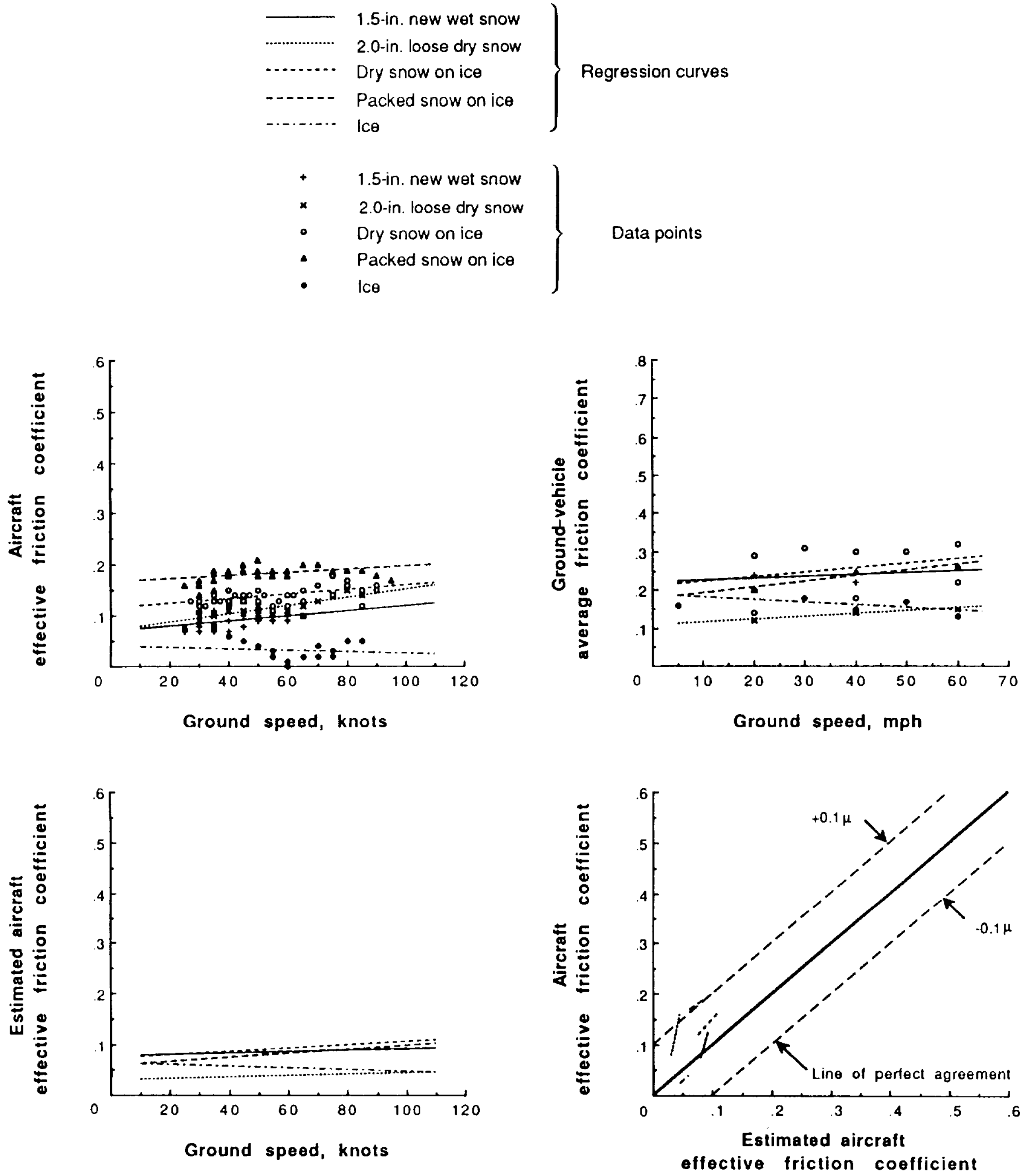
(a) Mu-Meter data.

Figure 63. Variation of Boeing 727 aircraft and ground-vehicle friction data with speed and variation of estimated aircraft braking performance with actual braking performance on snow- and ice-covered runways.



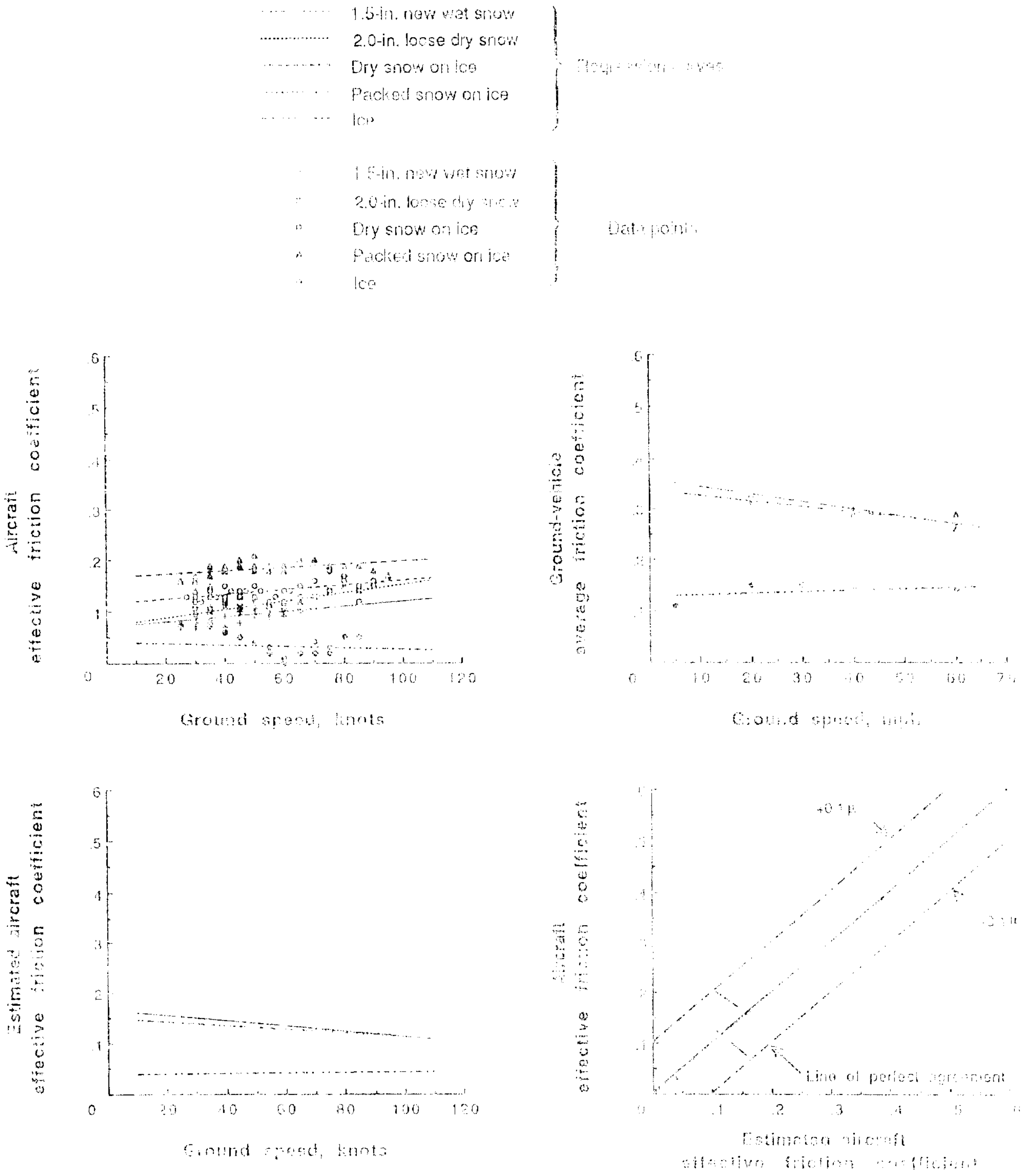
(b) SFT data.

Figure 63. Continued.



(c) BV-11 skiddometer data.

Figure 63. Continued.



(d) RFT data.

Figure 63. Concluded.

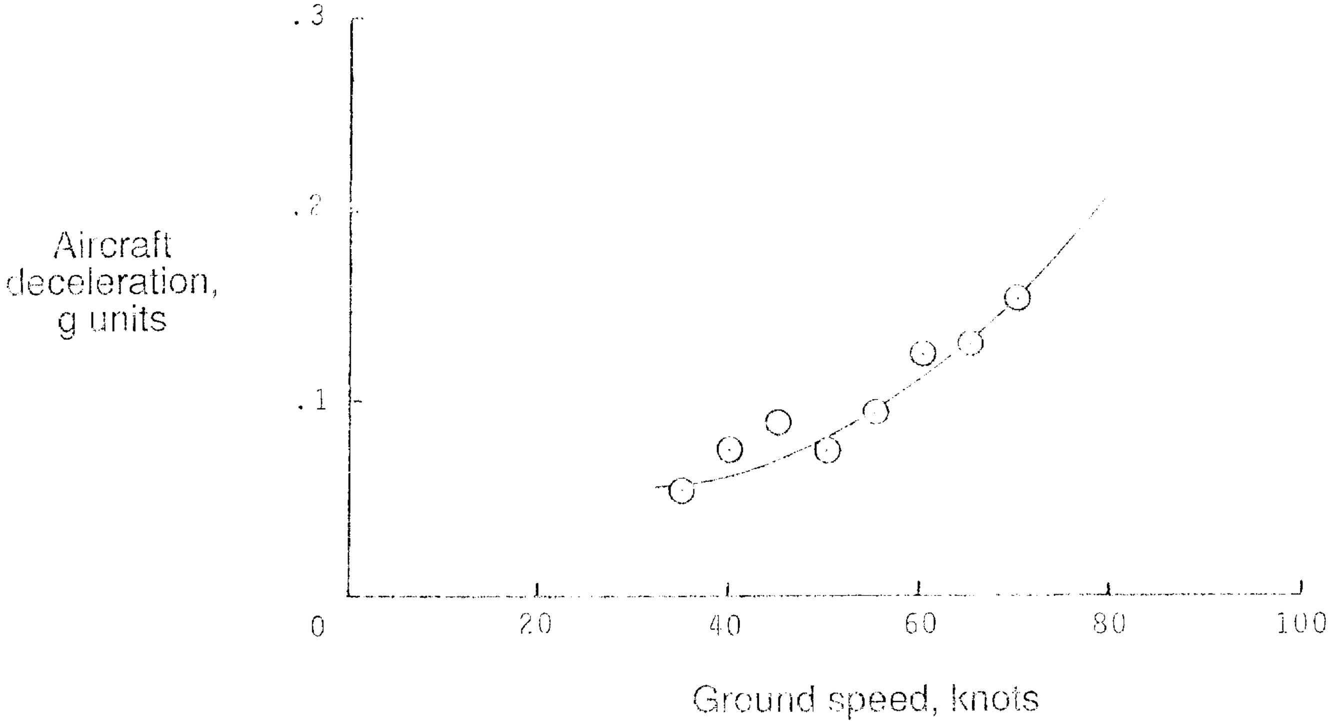


Figure 64. Boeing 727 deceleration in 4.5-in. loose snow. Landing flaps = 30°; spoilers extended; idle forward thrust; no wheel braking; Snow specific gravity = 0.27; Headwind component = 5.2 knots.

C-4

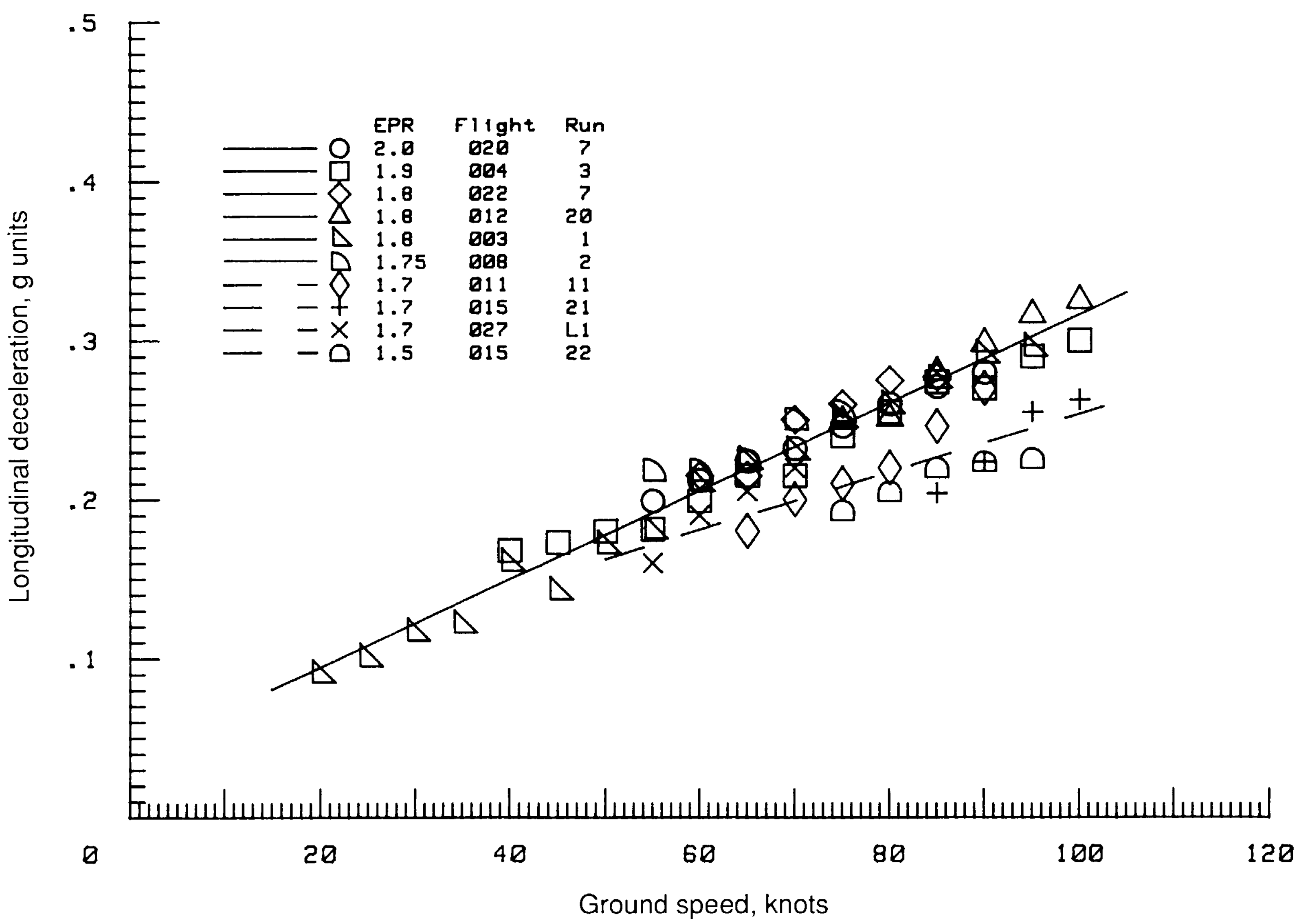


Figure 65. Reverse-thrust performance of Boeing 727 aircraft. (Aerodynamic drag and tire rolling resistance are included in the data.)

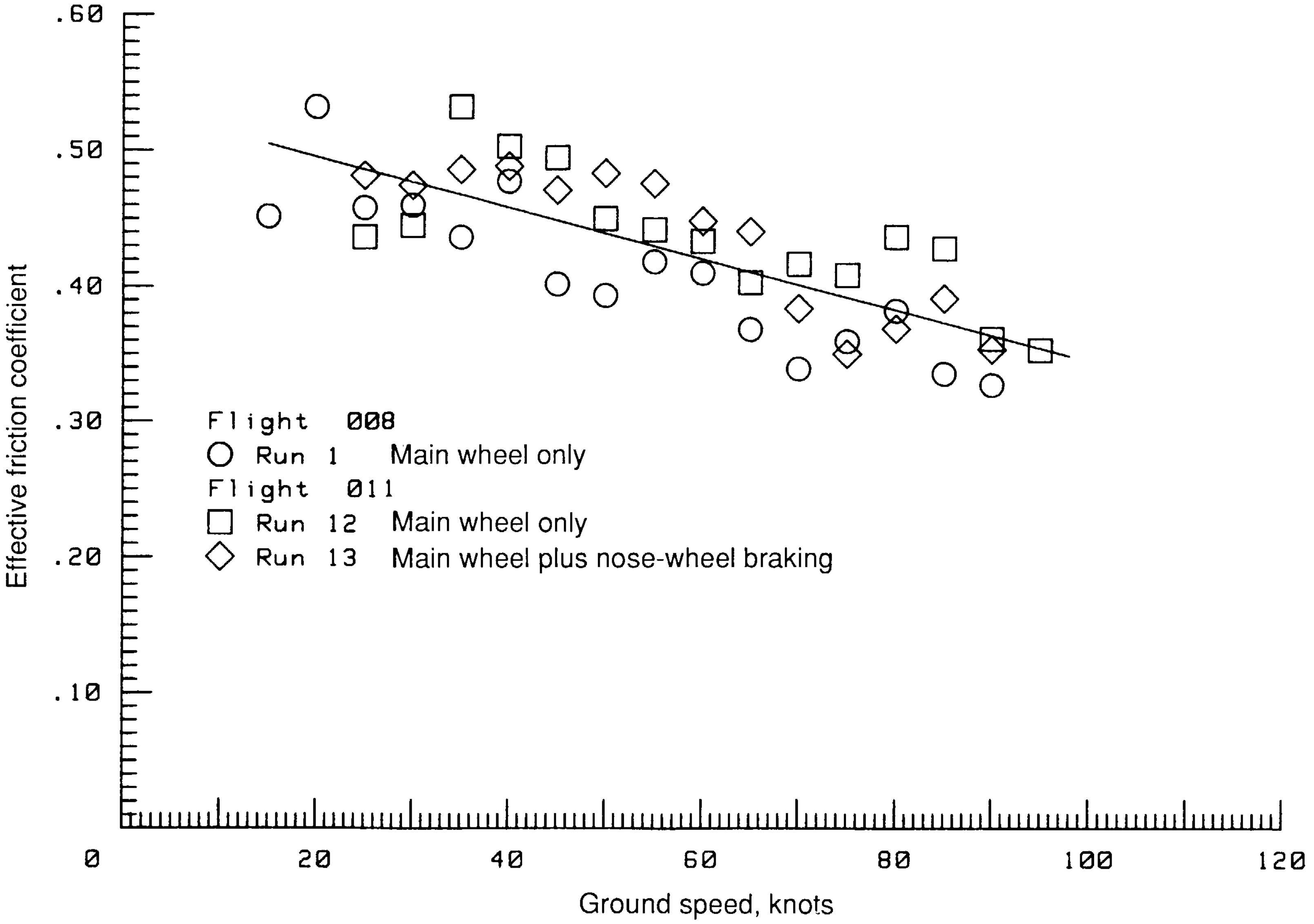
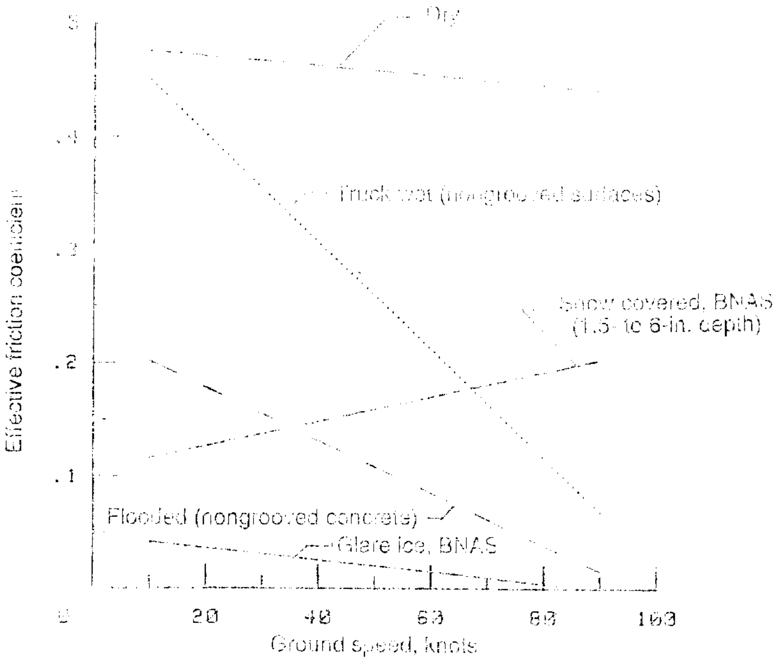
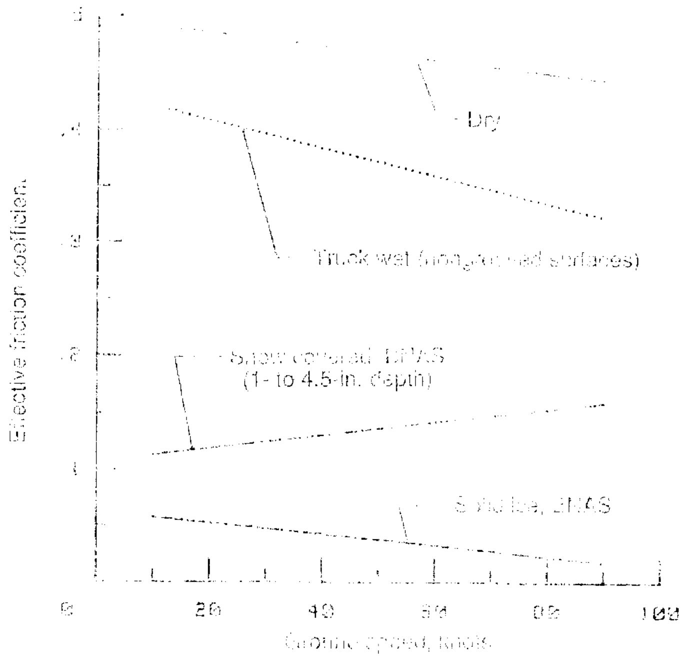


Figure 66. Comparison of Boeing 727 effective friction coefficient with speed for main wheel only and main wheel plus nose-wheel braking modes on truck-wet, slurry-seal asphalt.



(a) Boeing 737 test aircraft. Landing flaps = 40°; spoilers extended; idle forward thrust; antiskid braking.



(b) Boeing 727 test aircraft. Landing flaps = 30°; spoilers extended; idle forward thrust; main wheel braking only.

Figure 67. Comparison of aircraft braking friction performance on different runway surfaces and conditions.

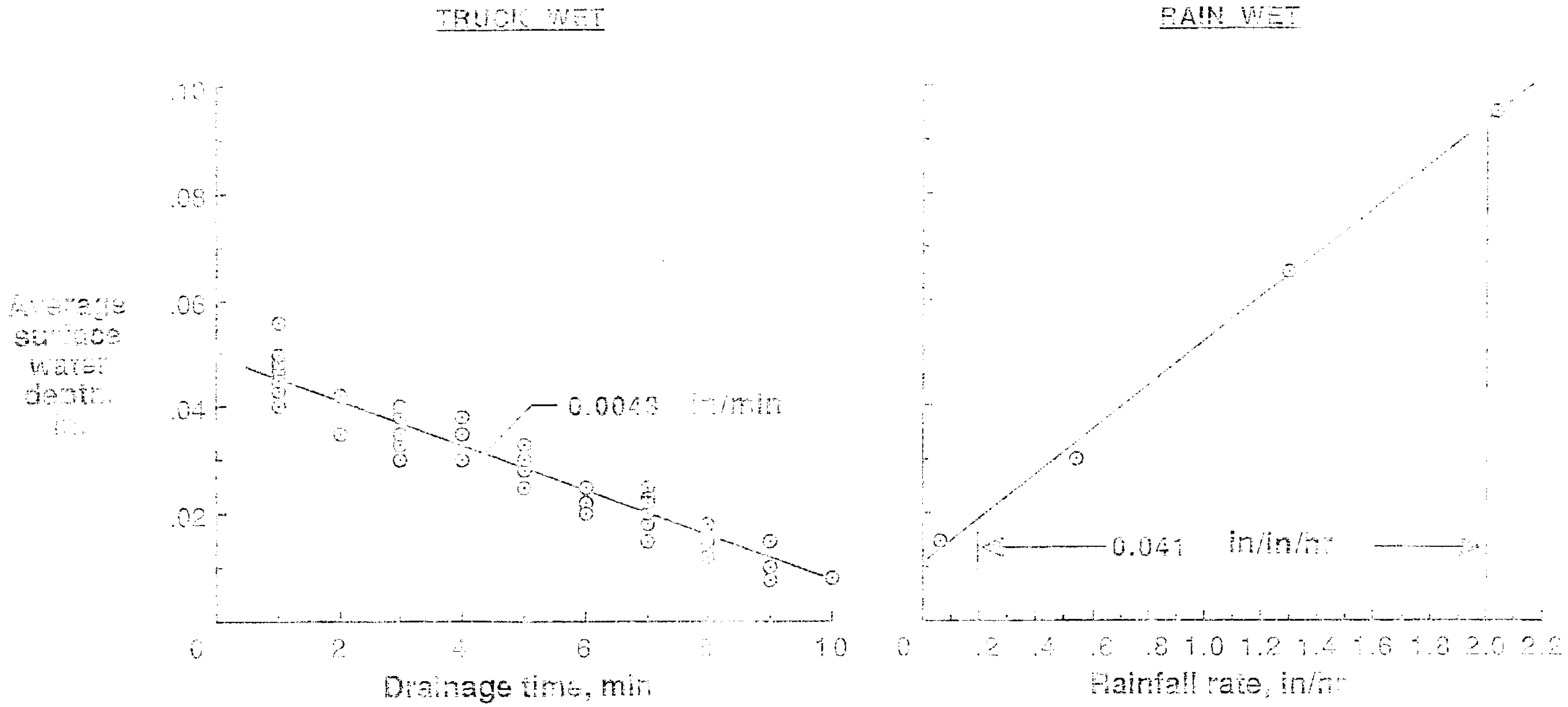


Figure 68. Surface water drainage and accumulation measurements. Nongrooved slurry-seal asphalt; calm winds; 1-percent crown; Average texture depth = 0.0263 in.

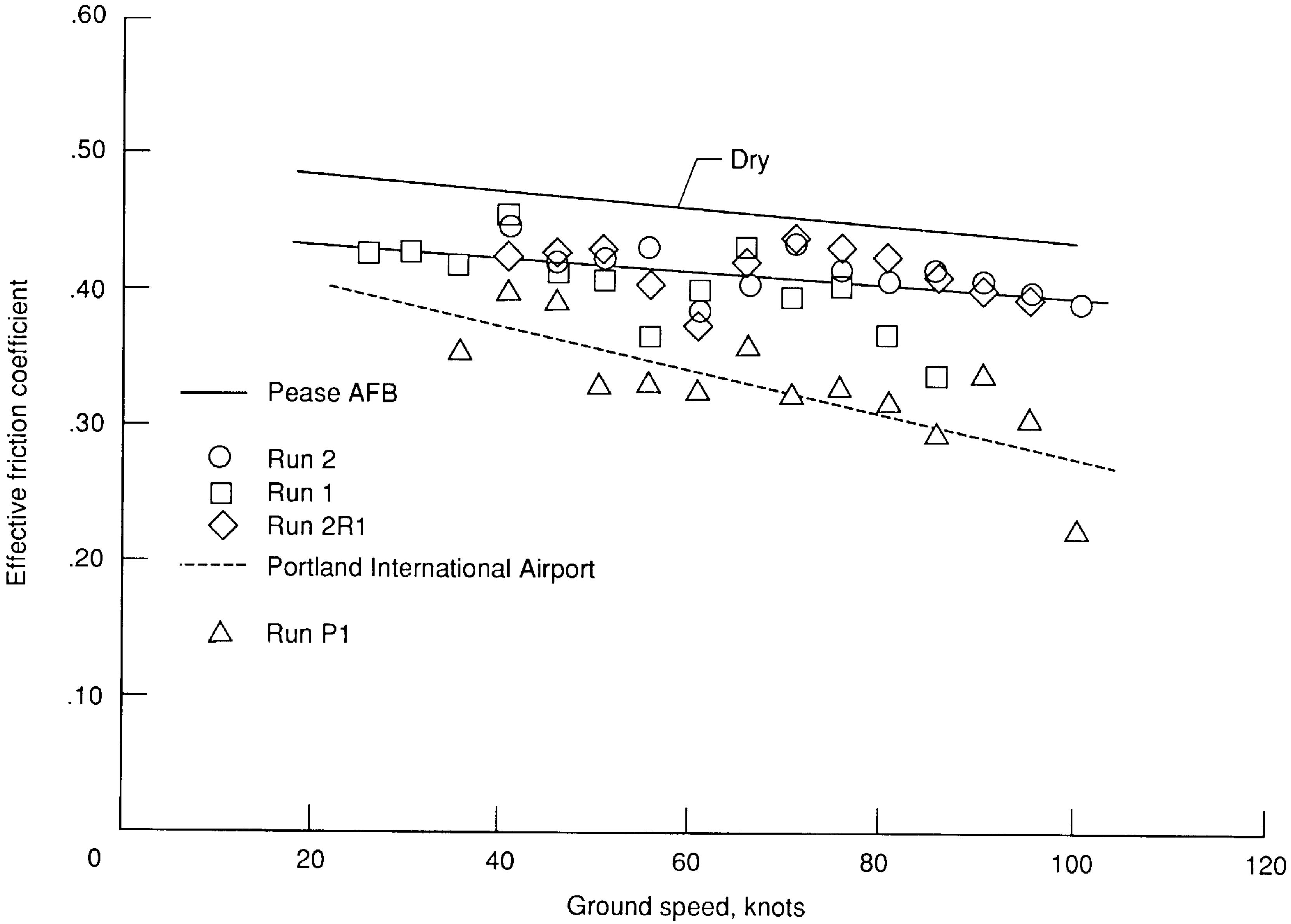


Figure 69. Boeing 727 aircraft braking friction performance obtained on rain-damp porous friction course runway surfaces.

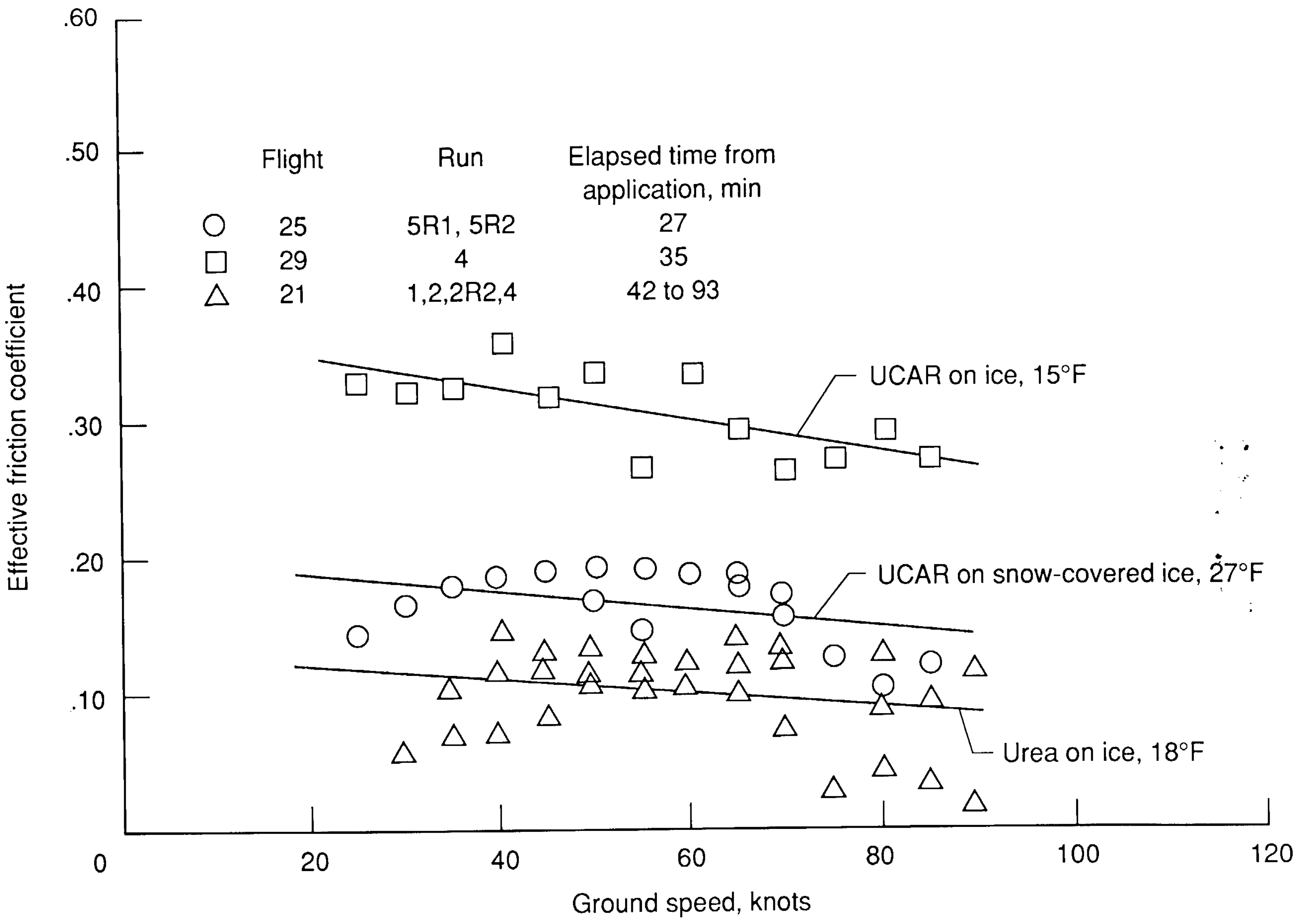


Figure 70. Effect of runway chemical treatment type and elapsed time on Boeing 727 tire friction performance on ice-covered runway at BNAS.

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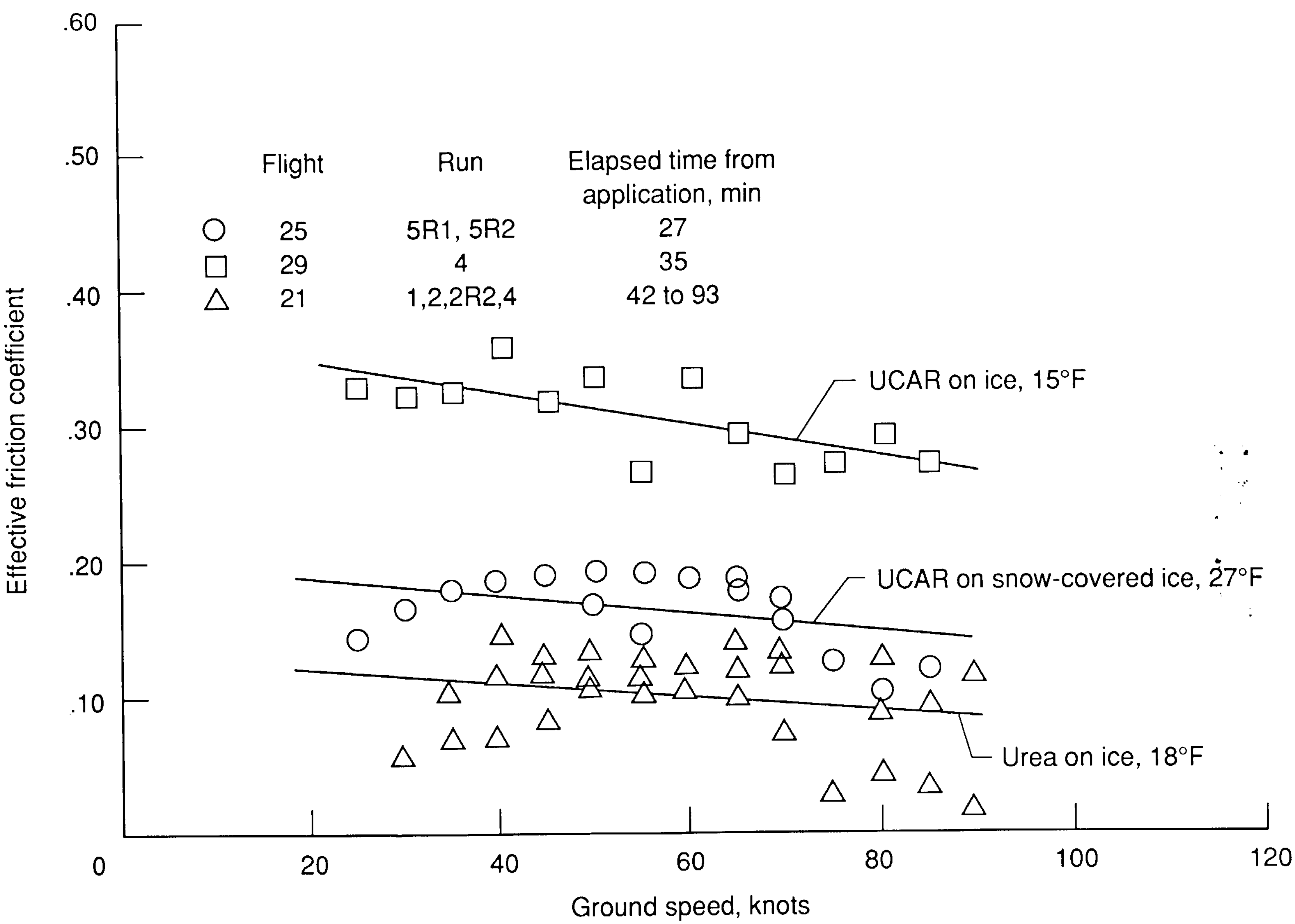

Figure 70. Effect of runway chemical treatment type and elapsed time on Boeing 727 tire friction performance on ice-covered runway at BNAS.

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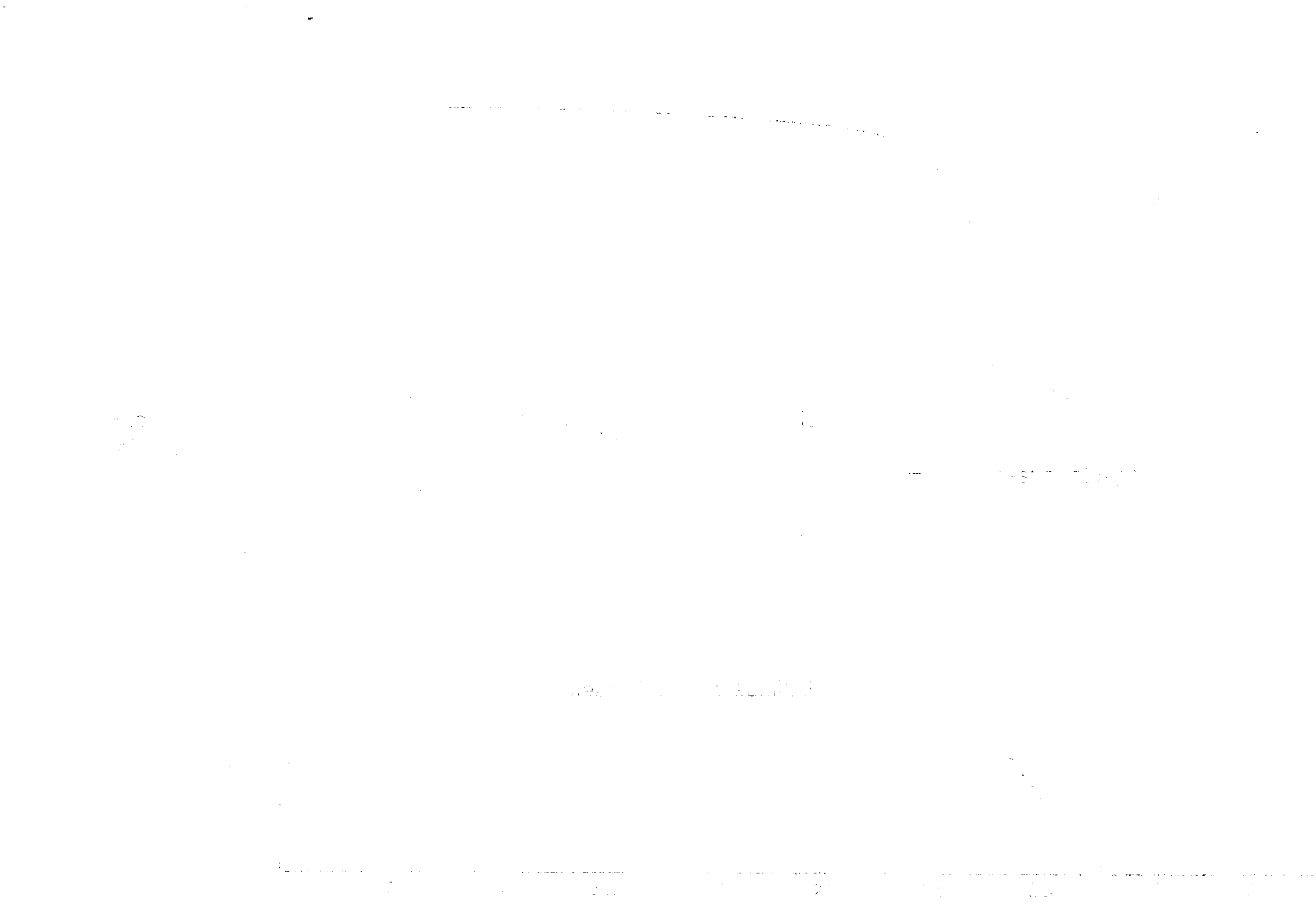

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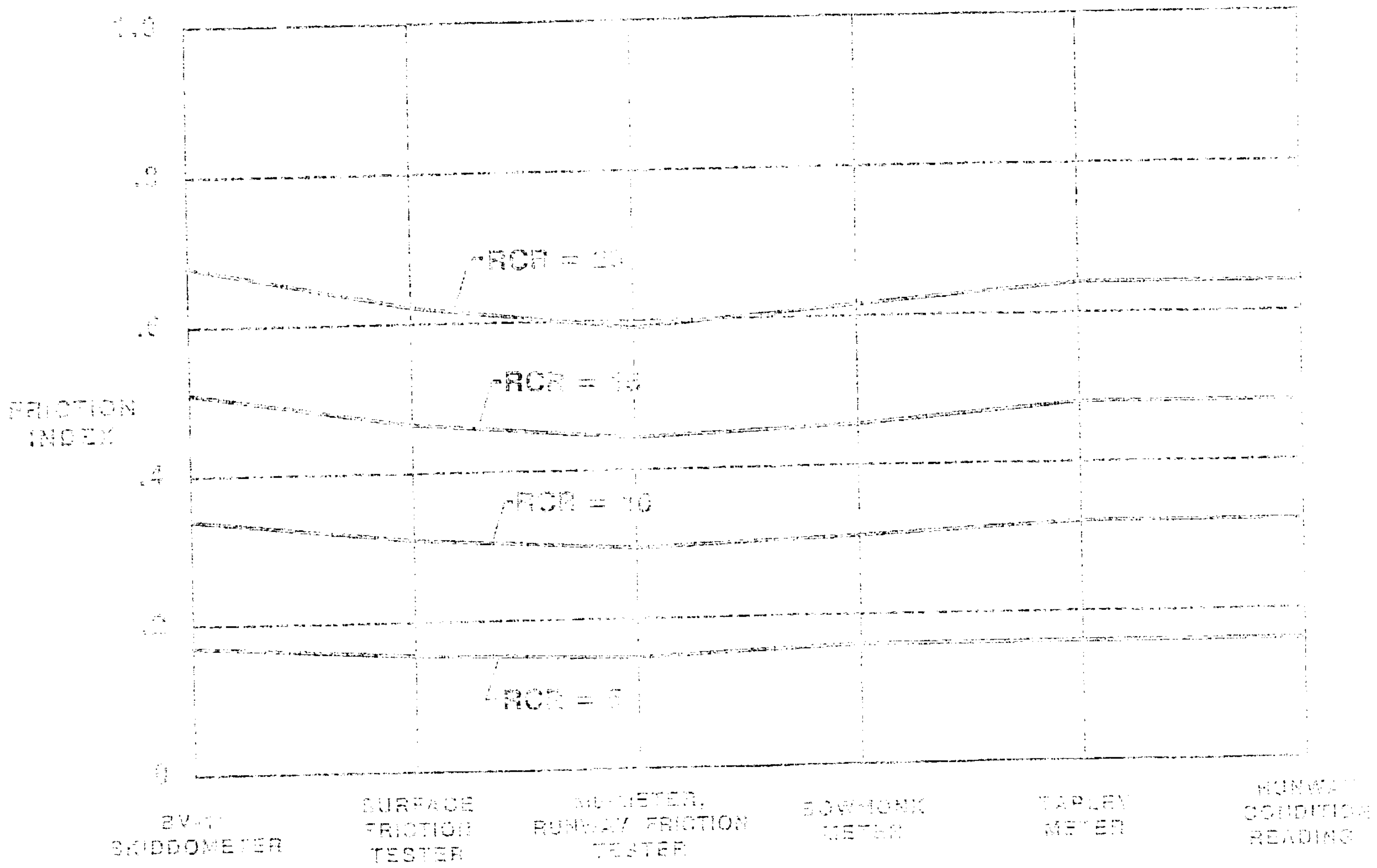

Figure 72. Ground-vehicle friction correlation to compacted snow- and ice-covered runway conditions. (Maximum friction index value of 1.0 equals RCR of 32.)

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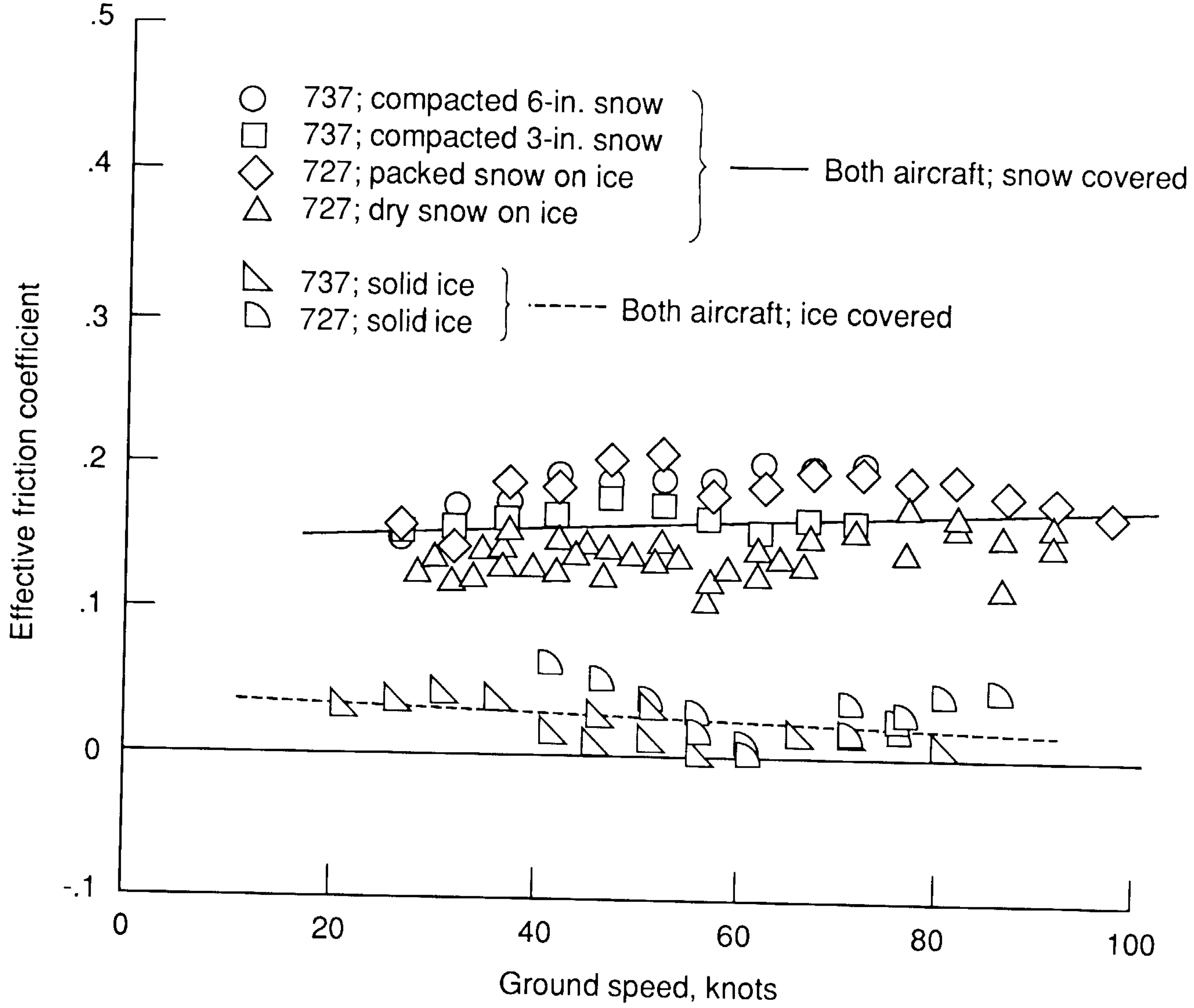

Figure 73. Comparison of Boeing 737 and 727 braking performances on compacted snow- and ice-covered runway surfaces at BNAS.

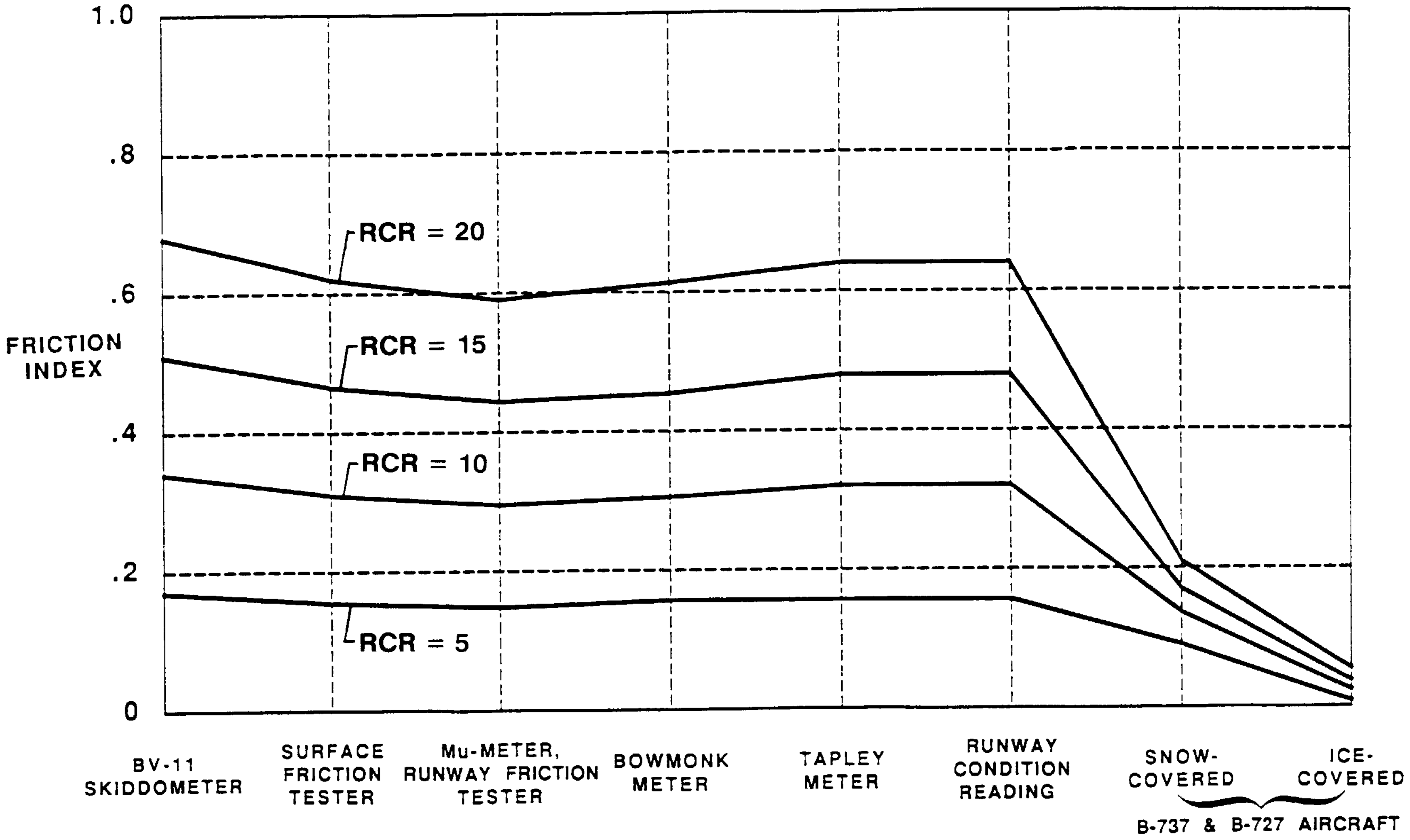

Figure 74. Aircraft and ground-vehicle correlation for compacted snow- and ice-covered runway conditions. (Maximum friction index value of 1 equals RCR of 32.)

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