Designation: F 424 – 98

Standard Test Method for Tires for Wet Driving Traction in Straight-Ahead Motion Using Highway Vehicles[1]

This standard is issued under the fixed designation F 424; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the measurement of driving traction of tires designed for and to be mounted on cars or trucks traveling straight ahead on a prepared surface.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

E 274 Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire[2]

E 1337 Test Method for Determining Longitudinal Peak Braking Coefficient of Paved Surfaces Using a Standard Reference Test Tire[2]

F 377 Practice for Calibration of Braking/Tractive Measuring Devices for Testing Tires[3]

F 457 Test Method for Speed and Distance Calibration of a Fifth Wheel Equipped with Either Analog or Digital Instrumentation[3]

F 538 Terminology Relating to the Characteristics and Performance of Tires[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *driving coefficient (nd)*, *n*—the ratio of the driving force to the normal force. **(F 538)**

3.1.2 *driving coefficient, peak (nd)*, *n*—the maximum value of the driving coefficient. **(F 538)**

3.1.3 *driving force, [F]*, *n*—of a tire, the positive longitudinal force resulting from the application of driving torque. **(F 538)**

3.1.4 *driving torque, [ML^2/T^2]*, *n*—of a wheel, the positive wheel torque. **(F 538)**

3.1.5 *effective rolling radius*, *n*—the ratio of the linear velocity of the wheel center of the free rolling tire in the X' direction to the spin velocity.

3.1.6 *free rolling tire*, *n*—a loaded tire rolling without applied driving or braking torque. **(F 538)**

3.1.7 *inclination angle*, *n*—of a tire, the angle between the Z'-axis and the wheel plane. **(F 538)**

3.1.8 *longitudinal force, [F]*, *n*—of a tire, the component of a tire force vector in the X' direction. **F 538**

3.1.9 *longitudinal slip velocity, [L/T]*, *n*—the effective rolling radius multiplied by the difference between the spin velocity (in rad/unit time) of a driven or braked tire and that of a free rolling tire when each is traveling in a straight line. **F 538**

3.1.10 *slip angle*, *n*—of a tire, the angle between the X'-axis and direction of travel of the center of tire contact. **(F 538)**

3.1.11 *spin axis*, *n*—of a wheel, the axis of rotation of a wheel. **(F 538)**

3.1.12 *spin velocity*, *n*—the angular velocity of the wheel about its spin axis.

3.1.13 *test run*, *n*—a single pass of a loaded tire over a given test surface. **F 538**

3.1.14 *tire-axis system*, *n*—the origin of the tire-axis system is the center of the tire contact. The X' axis is the intersection of the wheel plane and the road plane with a positive direction forward. The Z' axis is perpendicular to the road plane with a positive direction downward. The Y' axis is in the road plane, its direction being chosen to make the axis system orthogonal and right-hand.

3.1.14.1 *Discussion*—See Fig. 1. **F 538**

3.1.15 *tire forces, [F]*, *n*—the external forces acting on a tire by the road. **F 538**

3.1.16 *vertical load*, *n*—the normal reaction of the tire on the road which is equal to the negative of the normal force. **F 538**

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[1] This test method is under the jurisdiction of ASTM Committee F-9 on Tires and is the direct responsibility of Subcommittee F09.20 on Vehicular Testing.

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[2] *Annual Book of ASTM Standards,* Vol 04.03.

[3] *Annual Book of ASTM Standards,* Vol 09.02.

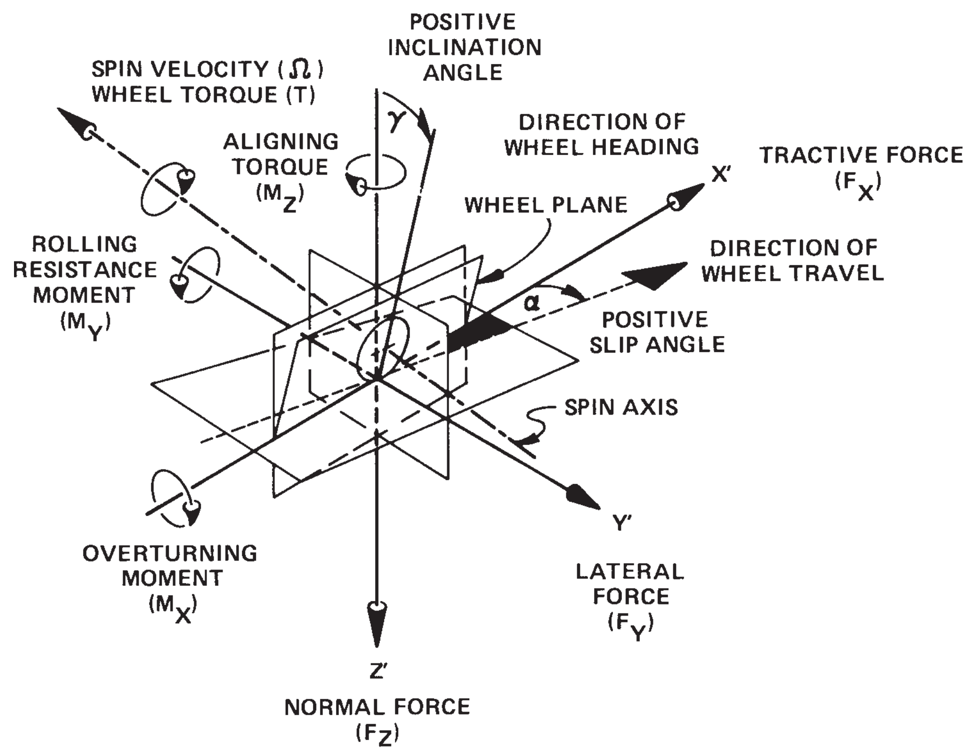

FIG. 1 Tire-Axis System

4. Summary of Test Method

4.1 This test method is conducted by towing a dynamometer vehicle behind the test vehicle moving in a straight line and gradually increasing the draw bar pull force by increasing the throttle setting of the test vehicle to compensate for brake application on the dynamometer vehicle. The dynamometer brake application is to be increased only as much as is necessary to maintain a constant test speed. The test progresses with increased throttle setting and dynamometer brake application until spinning of the test tires occurs.

4.2 The recommended vehicle test speed is 2.5 to 7 mph (4 to 10 km/h).

4.3 The test may be conducted utilizing a single-wheel driving traction truck or other specialized vehicles utilizing an independently loaded and driven test wheel position. A description of these specialized test vehicles and their appropriate test procedures are not detailed in this test method.

5. Significance and Use

5.1 The measured values are traction properties of tires in operation on a passenger car or light truck representative of the type on which the test tires would be used. These are obtained on a given road surface, under given environmental conditions (ambient and road surface temperature, humidity, wind speed and direction, purity and film depth of water used to wet the road surface) in accordance with the stated test procedures and reflect the performance of the total vehicle-environmental system. A change in any one of these factors may change the measurements on a subsequent run of the test.

5.2 These test methods are suitable for research and development purposes, where tires are compared during a single series of tests. They may not be suitable for regulatory statutes or specification acceptance because the values obtained may not necessarily agree or correlate either in rank order or absolute traction performance level with those obtained on other road surfaces (or the same surface after additional wear), under other environmental conditions, or other test vehicles (especially if not representative of the normal usage of the test tires) or with results obtained with other test procedures.

6. Apparatus

6.1 *Test Vehicle*:

6.1.1 The test vehicle shall be a rear-wheel drive, four-wheel passenger car or a light truck under 10 000 lbf (44.5 kN) GVW (gross vehicle weight).

6.1.2 The test vehicle shall be equipped, if possible, with the highest available power engine and the numerically highest available transmission and rear axle ratio.

6.2 *Towing Dynamometer Vehicle*—The towed dynamometer shall have capability to develop a draw-bar pull force up to at least 4 000 lbf (17.8 kN).

6.3 *Instrumentation*:

6.3.1 *Force Transducer*, to measure draw-bar pull force. The transducer shall meet the following requirements:

6.3.1.1 *Minimum Full-Scale Range*—0 to 4 000 lbf (17.8 kN).

6.3.1.2 *Accuracy*—±10 lbf (44 N).

6.3.1.3 *Maximum Nonlinearity and Hysteresis at Full Scale*—Less than 1 %.

6.3.1.4 *Maximum Cross-Axis Sensitivity at Full Scale*—Less than 2 % without electronic compensation of a signal.

6.3.2 *Torque Meter*, to measure vehicle drive shaft torque (optional instrumentation). The torque meter shall meet the following requirements:

6.3.2.1 *Minimum Full-Scale Range*—0 to 1500 lbf·ft (0 to 2030 N·m).

6.3.2.2 *Accuracy*—±10 lbf-ft (13.6 N·m).

6.3.2.3 *Maximum Nonlinearity and Hysteresis of Full Scale*—Less than 1 %.

6.3.2.4 *Maximum Cross-Axis Sensitivity at Full Scale*—Less than 2 %.

6.3.3 The fifth wheel used to measure vehicle speed shall have specifications in accordance with Method F 457.

6.3.3.1 *Accuracy*—±0.5 mph (0.8 km/h).

6.3.4 *Tachometer*, to measure angular velocity of each test wheel, installed on the test vehicle. The tachometer shall meet the following requirements:

6.3.4.1 *Slewing Rate*— 0 to full-scale output volts in 0.05s.

6.3.4.2 *Minimum Full-Scale Range*—0 to 1200 rpm.

6.3.4.3 *Accuracy*—±1 rpm.

6.3.5 *Multichannel Recorder or XXY, or XYY Function Plotter*, meeting the following requirements:

6.3.5.1 *Minimum Frequency Response*—Flat (±1 %) dc to 30 Hz full scale.

6.3.5.2 *Gain*—Sufficient to permit full-scale display for full-scale input signal level.

6.3.5.3 *Input Impedance*— Seven times larger than the output impedance of signal source.

6.3.5.4 It must be insensitive to vibrations, acceleration, and ambient temperature change. The error in reading shall not exceed 1 % of full scale when subjected to vibrational acceleration of 5 *g* (49 m/s^2) in the 0.5 to 40.0-Hz frequency range and operating temperature range between 32 and 125°F (0 and 52°C).

6.3.5.5 It shall not be affected by storage temperature variations between −20 and 160°F (−29 and 71°C).

6.3.5.6 The multichannel recorder shall have a variable chart speed with a maximum of at least 25 mm/s.

6.3.6 *Power Supply*, for transducers and recorder meeting requirements specified by the transducer and recorder manufacturers.

7. Selection and Preparation of Test Tires

7.1 All test tires shall be of the known age and shall be stored essentially at the same conditions.

7.2 Trim the test tires to remove all protuberances in the tread areas caused by mold air vents or flashes at mold junctions.

7.3 Mount the test tires on T & RA[4] recommended rims by using conventional mounting methods. Assure proper bead seating by use of suitable lubricant and the subsequent warm up procedures. Excessive use of lubricant should be avoided to prevent slipping of the tire on the wheel rim. Allow the tires to stand at least 24 h between mounting and testing in order to allow the mounting lubricant to dry.

7.4 Break-in the test tires a minimum of 50 miles (80 km) at T & RA[4] load and inflation at speeds of 50 to 55 mph (80 to 88 km/h) without excessive cornering, braking, or acceleration to avoid uneven wear. There shall be no visible surface scuffing. Break-in mileage should be accumulated on the front and rear axles equally for a given tire. New tire average wear prior to testing shall not exceed 5 % of the new tire tread depth.

7.5 Place the mounted test tires near the test site in such a location that they all have the same ambient temperature prior to testing. Shield the tires from the sun to avoid excessive heating by solar radiation.

7.6 Check the air pressure of the test tires just prior to testing. The test tire inflation pressure at standard test load specified in 8.1.1 shall be 24.0 ± 0.5 psi (165.0 ± 3.5 kPa) at ambient temperature (cold).

8. Preparation of Apparatus

8.1 *Test Vehicle*:

8.1.1 Weigh the test vehicle prior to testing with a full tank of gasoline, instrumentation, and test personnel seated in the same locations as that to be used during testing. Adjust the vehicle static weight by ballasting to match the static wheel load specified for test tires. In no case shall the static wheel load exceed the maximum wheel load capacity of the vehicle or of the tire. The load recommended by the T & RA manual for 24-psi (165-kPa) inflation pressure of the test tire shall be regarded as standard.

NOTE 1—In some cases it may not be possible to use static loads recommended by the T & RA[4], particularly on high-friction surfaces.

8.1.2 Install the test tires on the rear wheels and use a pair of similar tires, not necessarily identical to the test tires on the front wheels.

8.2 *Instrumentation*:

8.2.1 Install the force transducer and torque meter in locations that minimize vibration effects.

8.2.2 Install the fifth wheel according to the manufacturer's specifications and locate it as near as possible to the mid-tract position on the vehicle. Record the output of the fifth wheel and arrange for a visual display for the dynamometer operator to monitor vehicle speed.

8.2.3 Install the tachometers on driven and non-driven wheels in accordance with the manufacturer's specifications.

9. Calibration

9.1 Calibrate the transducer for measuring draw-bar pull force in a tensile force machine or some other appropriate test fixture with the drawer-bar transducer installed in series with the load cell.

9.2 Calibrate the torque meter in an appropriate test fixture equipped with the load cell.

9.3 The load cells used for calibration of draw-bar force transducer and torque meter shall be calibrated according to a dead-weight procedure using Class F weights, the calibration of which is traceable to the National Bureau of Standards (NBS).

9.4 *Fifth Wheel Calibration*:

9.4.1 Calibrate the fifth wheel in accordance with Method F 457.

9.5 *Tachometer Calibration*—Calibrate the tachometer in accordance with manufacturer's specifications.

[4] Current Issue; available from the Tire and Rim Assn., 175 Montrose West Ave., Suite 150, Copley, OH 44321.

10. General Test Conditions

10.1 Conduct the tests on a smooth and level surface with a uniform grade of not more than 2 % and vertical deviations of less than 0.25 in. (6.4 mm) when tested with a 10-ft (3-m) straightedge.

10.2 The test surface shall be a pavement of uniform age, composition and wear, and be free of loose material or foreign deposits.

NOTE 2—Uniformity of test surface, age, and composition shall be estimated by visual inspection.

10.3 Water the test surface at least ½ h prior to testing in order to equalize the surface temperature and water temperature.

10.3.1 Apply the minimum amount of water necessary to keep the test surface uniformly wet throughout the test. The amount of water shall be sufficient to keep the tops of protruding asperities wet, and shall be applied in the same manner for every test.

NOTE 3—At the present time there is no satisfactory method for determining the water depth, when using external or on-board water system. As soon as an appropriate method is developed, it will be incorporated into the future revised standard.

10.4 Measure the skid number of the test surface in accordance with Test Method E 274 at 40 mph (64 km/h).

10.5 Testing shall not be conducted when wind conditions interfere with wetting of the test surface as specified in 10.3.1.

11. Procedure

11.1 Condition the test surface by making a minimum of 20 test runs at the test speed to stabilize the surface, by using tires other than test tires to avoid an excessive wear of the latter. Do not use incompatible tread compounds.

11.2 Record ambient temperature, surface temperature, wind velocity, and wind direction with respect to the path of vehicle travel.

NOTE 4—In some test situations such information may prove to be valuable in data interpretation.

11.3 Adjust the dynamometer to obtain zero draw-bar pull force and approach a test site moving in a straight line at a constant speed of 2.5 mph (4 km/h).

11.4 Turn on the recorder chart drive just prior to reaching the test site.

11.5 Gradually increase the draw-bar pull force until the peak value is reached by concurrently increasing the throttle setting of the test vehicle and the brake application on the dynamometer without changing vehicle speed significantly.

11.6 Gradually increase the throttle application as it is necessary to maintain a constant speed.

11.7 Continue to increase the throttle until the test wheel spinning condition is reached (Note 5). Do not allow spinning to occur for longer than ½ s, as the tire may be damaged and the results will be erroneous due to water being spun from beneath the tire.

NOTE 5—Spinning of the test wheels is indicated on the tachometer or other spin indicator used in testing.

11.8 Release the throttle and the draw-bar pull force.

11.9 Repeat 11.3-11.8 ten times (five in each direction) at each test speed and each test surface.

11.10 Test consecutive sets of tires by repeating the steps outlined in 11.3-11.9, provided that the water is not turned off and the tests are completed within 1 day.

11.11 One set of test tires shall be designated as a control set. Test the control tires adjacent to each set of test tires for example in the sequence CTTCTTC....etc. where C = control tire and T = test tire.

12. Calculations and Interpretations of Test Results

12.1 Depending on availability of optional instrumentation (driveshaft torque meter), two alternative data processing techniques shall be used:

12.1.1 When drive shaft torque meter is not employed, perform the following:

12.1.1.1 Read the peak and slide values of the draw-bar pull force from oscillographic traces shown in Fig. 2.

12.1.1.2 Compute the peak and slide values of driving coefficient as follows:

$$\mu_p = \frac{F_p + D}{h/_l\, F_p + W_r} \tag{1}$$

$$\mu_s = \frac{F_s + D}{h/_l\, F_s + W_r} \tag{2}$$

where:

F_p, F_s = draw-bar pull force peak and slide values, respectively, lbf (N),
W_r = static vertical load on the rear wheels, lbf (N),
h = hitch height above the axle height, ft (m),
l = wheel base, ft or m, and
D = vehicle drag at test speed, lbf (N).

At the low speeds employed in testing, vehicle drag results primarily from the tire rolling resistance. If the vehicle drag has not been measured, it can be estimated as follows:

$$D = KW \tag{3}$$

where:

W = total weight of test vehicle, lb or N, and
K = rolling resistance force coefficient.

In case the values of rolling resistance force coefficient are not available the following values can be used as approximations for passenger car tires inflated according to manufacturer's specified pressures:

$$K = 0.08 \text{ for bias and bias belted tires} \tag{4}$$

$$K = 0.07 \text{ for radial ply tires} \tag{5}$$

12.1.2 When driveshaft torque has been measured, perform the following:

12.1.2.1 Read the peak and slide values of draw-bar pull force and corresponding values of drive shaft torque from oscillographic traces.

12.1.2.2 Perform regression analysis of measured values by treating drive shaft torque as a dependent variable and draw-bar pull force as an independent variable (Note 6). In most cases a linear relationship is applicable.

$$T = T_o + C\,F \tag{6}$$

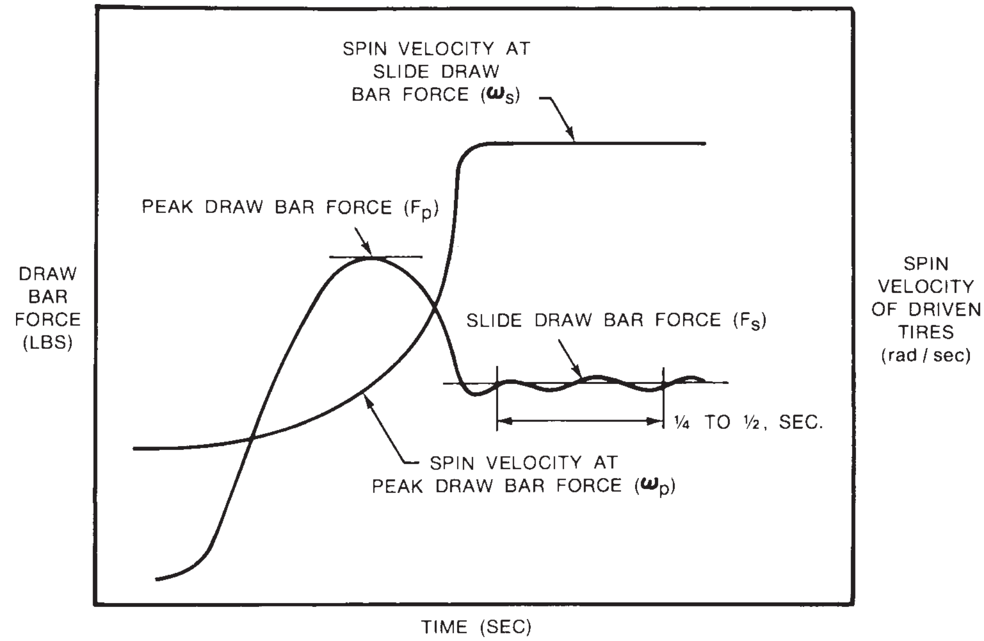

FIG. 2 Tire Traction in Straight-Ahead Motion

where:

T = driveshaft torque, lbf·ft (N·m),
F = draw-bar pull force, lbf, (N),
T_o = driveshaft torque at zero value of draw-bar pull force, and
C = regression coefficient driveshaft torque to draw-bar force transform coefficient (slope of the curve driveshaft torque versus draw-bar pull force).

NOTE 6—When sufficient data on these regression analyses have been accumulated, the reasonable mean square values for deviations from regression may be established.

12.1.2.3 Calculate the driving coefficient as follows:

$$\mu_p = \frac{T_p}{C\,(h/_l F_p + W_r)} \qquad \mu_s = \frac{T_s}{C\,(h/_l\, F_s + W_r)} \tag{7}$$

where:

T_p and T_s = values of drive shaft torque corresponding to peak and slide values of draw-bar pull force, lbf·ft (N·m).

12.2 Read from oscillographic traces shown in Fig. 2 the values of spin velocity of driven wheels corresponding to the peak and slide values of draw-bar force.

12.3 Calculate the values of longitudinal slip velocity corresponding to peak and spin values of driving coefficient as follows:

$$V_P = V_o\,[(w_P - w_o)/w_o] \tag{8}$$

$$V_S = V_o\,[(w_S - w_o)\,/w_o] \tag{9}$$

where:

V_P, V_S = longitudinal slip velocity corresponding to the draw-bar force peak and slide values, respectively, ft/s or m/s,
V_o = test vehicle speed, ft/s or m/s,
w_o = spin velocity of the non-driven tires, rad/s, and
w_P, w_S = spin velocity of driven tires corresponding to the draw-bar force peak and slide values, respectively, rad/s.

12.4 Calculate the average peak values μ_{pe} and μ_{pc} of peak driving coefficient for four or more repeated runs for each set of test and control tires for each test condition.

12.5 The values of peak driving coefficient tend to show a decline in time when testing proceeds over a period of several hours or days. The most common reason for this is test pavement polishing. To offset this trend in test tire performance, it is recommended that the values of peak driving coefficient of test tires shall be adjusted by comparing them to the corresponding values of control tires. Procedure for adjustment of values of peak driving coefficient due to time trends is shown in 12.6-12.9.

12.6 Plot the average values μ_{pe} and μ_{pc} of peak driving coefficient calculated in 12.4 for each set of test and control tires versus their consecutive order of testing for each day separately as shown in Fig. 3.

12.7 Perform linear regression analysis of each day's data points for control tires only and plot regression line through these points.

12.7.1 Calculate the values of coefficients a_p and b_p for regression equation as follows:

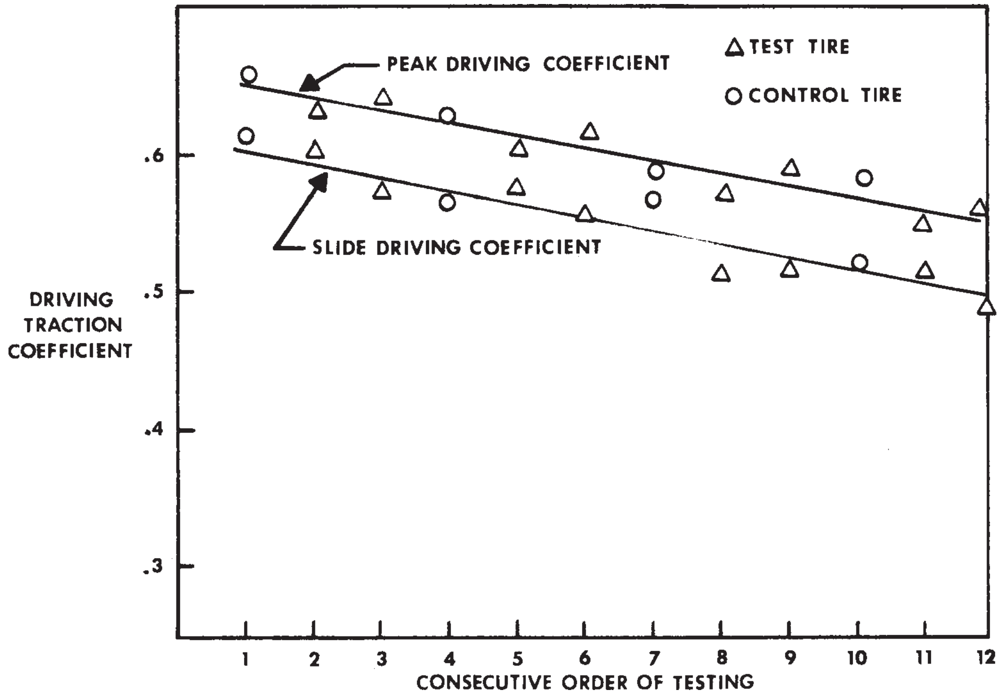

FIG. 3 Effect of Environmental Factors on Driving Traction

$$M_{pc} = a_p + b_p m \quad (10)$$

where:

M_{pc} = predicted value of peak driving coefficient for control tire,
a_p = intercept,
b_p = slope,
m = consecutive run numbers of data points for test or control tires,
m = 1, 4, 7, 10, 13.....for control tire, and
m = 2, 3, 5, 6, 8, 9, 10, 12.....for test tire.

12.7.2 The values of a and b are computed as follows:

$$a_p = \frac{1}{n}\left(\sum_{m=1,4...}^{m_{max}} \bar{\mu}_{pcm} - b_p \sum_{m=1,4...}^{m_{max}} m\right) \quad (11)$$

$$b_p = \frac{n \sum_{m=1,4...}^{m_{max}} m\bar{\mu}_{pcm} - \sum_{m=1,4...}^{m_{max}} m \sum_{m=1,4...}^{m_{max}} \bar{\mu}_{pcm}}{n \sum_{m=1,4...}^{m_{max}} m^2 - \left(\sum_{m=1,4...}^{m_{max}} m\right)^2} \quad (12)$$

where:

n = total number of data points for control tire only.

12.7.3 Calculate the grand mean peak value $\bar{\mu}_{pc}$ of the average value $\bar{\mu}_{pc}$ of peak driving coefficient, determined in 12.4 for control tire, by averaging the values of $\bar{\mu}_{pc}$ over the whole test (several days).

12.8 Calculate from regression equation shown in 12.7.1 the predicted value M_{pc} of each day's peak driving coefficient for control tires for the data points of test tires.

12.9 Correct the average values $\bar{\mu}_{pt}$ of peak driving coefficient for the test tire determined in 12.4 for environmental changes by multiplying these values by the ratio $\bar{\bar{\mu}}_{pc}/M_{pc}$ by using the values $\bar{\bar{\mu}}_{pc}$ and M_{pc} calculated in 12.7.3 and 12.8, respectively.

12.10 Calculate the average values $\bar{\mu}_{st}$ and $\bar{\mu}_{sc}$ of slide driving coefficient for four or more repeated runs, for each set of test and control tires for each test condition.

12.11 The values of slide driving coefficient tend to show a decline in time when testing proceeds over a period of several hours or days. This time trend is similar to that shown in 12.6 for peak driving coefficient. Procedure for adjustment of values of slide driving coefficient due to time trends is shown in 12.12-12.15.

12.12 Plot the average values $\bar{\mu}_{st}$ and $\bar{\mu}_{sc}$ of slide driving coefficient calculated in 12.10 for each set of test and control tires for each day separately in a manner similar to that shown in Fig. 3 for peak driving coefficient.

12.13 Perform linear regression analysis of each days's data points for control tires only and plot regression line through these points.

12.13.1 Calculate the values of coefficients a_s and b_s for regression equation as follows:

$$M_{sc} = a_s + b_s m \quad (13)$$

where:

M_{sc} = predicted value of slide driving coefficient for control tire,
a_s = intercept,
b_s = slope,
m = consecutive run numbers of data points for test or control tires,
m = 1, 4, 7, 10, 13 ... for control tires, and
m = 2, 3, 5, 6, 8, 9, 11, 12 ... for test tires.

12.13.2 The values of a_s and b_s are computed as follows:

$$a_s = \frac{1}{n}\left(\sum_{m=1,4...}^{m_{max}} \bar{\mu}_{scm} - b_s \sum_{m=1,4...}^{m_{max}} m\right) \quad (14)$$

TRACTION TEST IN STRAIGHT AHEAD DRIVING

Vehicle Data

Make, Year, Model, Type ______

Engine ______

Static Wheel Load LF ______ RF ______ LR ______ RR ______

Road Surface Description

Surface Type ______ Skid Number ______ (E-274)

Environmental Data

Ambient Temperature ______ Road Surface Temperature ______

Wind Velocity and Direction Relative to Track Direction ______

Water Temperature ______ Estimated Depth of Water ______

Method of Depth Measurement ______

Tire Data (individual test run data)

Type	Make	Size	Tire No.	Driving Coefficient Peak at Slip	Velocity	Slide at Slip	Velocity	Test Speed
Average								

FIG. 4 Data Recording Format

$$b_s = \frac{n \sum_{m=1,4...}^{m_{max}} m\bar{\mu}_{scm} - \sum_{m=1,4...}^{m_{max}} m \sum_{m=1,4...}^{m_{max}} \bar{\mu}_{scm}}{n \sum_{m=1,4...}^{m_{max}} m^2 - (\sum_{m=1,4...}^{m_{max}} m)^2} \quad (15)$$

where:

n = number of data points for control tire only.

12.13.3 Calculate the grand mean value $\bar{\bar{\mu}}_{sc}$ of the average value $\bar{\mu}_{sc}$ of slide driving coefficient determined in 12.10 for control tire by averaging the values of the whole test over several days.

12.14 Calculate from regression equation shown in 12.13.1 the predicted value of each day's slide driving coefficient for control tires for the data points of test tires.

$$m = 2, 3, 5, 6, 8, 9, 11, 12 .... \quad (16)$$

12.15 Correct the average values $\bar{\mu}_{st}$ of driving coefficient for the test tires determined in 12.10 for environmental changes by multiplying their values by the ratio $\bar{\bar{\mu}}_{sc}/M_{sc}$.

12.16 Calculate the test average values of longitudinal slip velocity corresponding to peak and slide values of driving coefficient.

13. Report

13.1 State that the test was performed in accordance with Test Method F 424.

13.2 Tabulate test data following the format shown in Fig. 4.

14. Precision and Bias

14.1 *Precision*—Data are not yet available for making a statement on the repeatability or reproducibility of this test method.

14.2 *Bias*—There are no standards or reference values with which the results of this test method can be compared. The function of the test method as indicated is to be able to make comparisons among types of tires tested within the same test program. It is believed that the results of the test method are adequate for making such comparisons without an external reference for assessing bias.