Designation: F1922 – 98 (Reapproved 2014)

Standard Test Method for Tires, Pneumatic, Vehicular, Highway[1]

This standard is issued under the fixed designation F1922; 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.

INTRODUCTION

This ASTM Standard has been developed to replace ASTM Provisional Standard PS 63-97. The provisional standard was approved so that the U.S. military and other government agencies could continue to purchase tested and qualified tires, until F1922 had been approved. The provisional standard replaced the government's specification ZZ-T-381, *Federal Specification, Tires, Pneumatic, Vehicular, Highway*, under the former Federal Tire Program. That program was discontinued and is replaced by the U.S. Army Tank Automotive Command's Cooperative Tire Qualification Program (CTQP). While fulfilling the military's commercial and tactical needs, the CTQP will continue to serve federal, state and local agencies that want to purchase qualified tires using this test method.

This test method is designed to be used in conjunction with the Administrator's Approval and Requirements Manual (CTQP F1922) (**1**),[2] to qualify tires for purchase primarily by the U.S. federal government, military, and other state and local entities.

1. Scope

1.1 This test method covers comparative tire durability and treadwear. This test method covers commercially available, over the highway pneumatic tires, new and retreaded, both tube type and tubeless, for use on conventional passenger cars, station wagons, pursuit and emergency high speed and pursuit passenger vehicles, light trucks, medium to heavy truck, trailers, buses, and similar vehicles normally operated on public roads and highways. This test method also covers commercially available, special application light truck tires for operation on non-improved road surfaces.

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

1.3 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D2240 Test Method for Rubber Property—Durometer Hardness

F414 Test Method for Energy Absorbed by a Tire When Deformed by Slow-Moving Plunger

F538 Terminology Relating to the Characteristics and Performance of Tires

F1806 Practice for Tire Testing Operations–Basic Concepts and Terminology for Reference Tire Use

3. Terminology

3.1 *Definitions:*

3.1.1 *alignment, n*—the adjustment of various parts of the vehicle's suspension system to ensure proper handling stability and to minimize abnormal tire treadwear.

3.1.2 *balancing, n*—a process to correct for heavy or light areas of a tire and wheel assembly.

3.1.2.1 *Discussion*—There are some instances where balancing is done to the tire within the factory by the manufacturer.

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

Current edition approved Jan. 1, 2014. Published February 2014. Originally approved in 1998. Last previous edition approved in 2005 as F1922 – 98 (2005). DOI: 10.1520/F1922-98R14.

[2] The boldface numbers in parentheses refer to the list of references at the end of this standard.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.3 *bead, n—of a tire*, the part of a tire that comes in contact with the rim and is shaped to secure the tire to the rim. **F538**

3.1.4 *bead separation, n*—a breakdown of bond between tire components in the bead area.

3.1.5 *belt separation, n*—a breakdown of bonding between the belts or plies or tread, or combination thereof.

3.1.6 *break, n*—a crack or tear extending into or through the reinforcing material.

3.1.7 *candidate tire, n*—a test tire that is part of a test program. **F1806**

3.1.8 *caravan, n—for purposes of a tire test*, two or more vehicles running in the same time frame, over the same test course(s), under similar but independent conditions.

3.1.8.1 *Discussion*—A caravan can have dissimilar control groups for each vehicle in the group with independent rotation schedules for each tire group and vehicle. A caravan is independent and a convoy is interdependent.

3.1.9 *casing, n—of a tire*, a used or treadless tire to which additional tread rubber may be attached for the purpose of retreading. **F538**

3.1.10 *control tire, n*—a reference tire used in a specified manner throughout a test program. **F1806**

3.1.11 *convoy, n—in tire testing*, two or more vehicles running at the same time, over the same test course, under the same interdependent conditions.

3.1.12 *cord, n—in a tire*, filament(s) or plied yarns used in making a tire ply. **F538**

3.1.13 *cross-country track, n*—surface not subject to repeated traffic in addition, no roads, routes, well-worn trails or man-made improvements; can consist of tank trails with crushed rock or having large exposed obstacles (rocks, boulders, etc.).

3.1.14 *gravel road, n*—two lane, all-weather, occasionally maintained, hard or loose surface (for example, large rock, paved, crushed rock, gravel) intended for medium-weight, low-density traffic, in accordance with the U.S. Federal Highway Administration.

3.1.15 *groove, n*—a void that is relatively narrow compared to its length. **F538**

3.1.16 *groove (void) depth, n*—measurement of the perpendicular distance from a real or calculated reference defined by edges of two adjacent ribs (lugs) to the lowest point of contact in the groove (void). **F538**

3.1.17 *load range, n*—a letter designation (A, B, C, D) or, for P-metric tires, standard load (SL) or extra load (XL), used to identify a given size tire with its load and inflation limits when used in a specific type of service. **F538**

3.1.18 *load rating, n*—the maximum load a tire is rated to carry for a given usage at a specified cold inflation pressure. **F538**

3.1.19 *outside diameter, n*—the maximum diameter of a tire when it is mounted and inflated. **F538**

3.1.20 *overall width, n*—the maximum cross-sectional width of a tire, including protective or decorative ribs. **F538**

3.1.21 *paved road, n*—two or more lanes, all-weather, maintained, hard surface roads with good driving visibility used for heavy and high-density traffic, in accordance with the U.S. Federal Highway Administration.

3.1.22 *secondary road, n*—two lane, occasionally maintained, hard or loose surface (for example, large rock, paved crush rock, gravel, soil aggregate) intended for medium-weight, low-density traffic, in accordance with the U.S. Federal Highway Administration. **F538**

3.1.23 *section width, n*—the width of a new tire, including 24-h inflation growth and including normal sidewalls, but not including protective side ribs, bars, or decorations.

3.1.24 *sidewall, n—of a tire*, that portion of a tire between the tread and the bead. **F538**

3.1.25 *tire, n*—a load-bearing ground-contacting circumferential attachment to a vehicle wheel. **F538**

3.1.26 *tire, bias, n*—a pneumatic tire in which the ply cords that extend to the beads are laid at angles substantially less than 90° to the center line of the tread. **F538**

3.1.26.1 *Discussion*—It should be noted that the International Organization for Standardization (ISO) defines the word as "*bias ply tire (diagonal), n*—a pneumatic tire in which the ply cords extending to the beads are laid at alternate angles substantially less than 90 degrees to the center line of the tread."

3.1.27 *tire, radial, n*—a pneumatic tire in which the ply cords that extend to the beads are laid substantially at 90° to the center line of the tread, the tire being stabilized by a belt. **F538**

3.1.27.1 *Discussion*—It should be noted that the International Organization for Standardization (ISO) defines the word as "*radial tire, n*—a pneumatic tire structure in which the ply cords extend to the beads and are laid substantially at 90 degrees to the center line of the tread, the carcass being stabilized by an essentially inextensible circumferential belt."

3.1.28 *tread, n—of a tire*, the part of a tire that comes in contact with the ground. **F538**

3.1.29 *tread arc width, n*—the length of the arc measured from one extreme of tread design proper to the opposite extreme; that is, from shoulder to shoulder perpendicular to the circumferential center line. **F538**

3.1.30 *tread radius, n*—the radius of a circle whose arc best fits the tread surface when radius template used in head perpendicular to the circumferential center line of an inflated tire. **F538**

4. Significance and Use

4.1 This test method establishes a standard procedure of comparative testing, for tire durability and treadwear, for the use of approving tires under the Administrator's Cooperative Approved Tire List (CATL) (**2**).

5. Procedure

5.1 Procedures for testing passenger car, light truck, and truck-bus tires are contained in Methods 1, 2, and 3, respectively. Procedures for testing Off Road Severe Application (ORSA) tires are contained in Method 4.

5.2 *Method 1—Passenger Car Tires:*

5.2.1 *Selection and Preparation of the Test Tires:*

5.2.1.1 All tires shall meet specified requirements of 49 CFR 571 Federal Motor Vehicle Safety Standard 109, 110, 117 (**3**); part 574 (**4**) ; part 575.104 (**5**); as well as state and local regulations, as applicable. All tire sidewall markings shall be recorded.

5.2.1.2 Retreaded tires submitted for testing shall meet the requirements in the Administrator's Approval and Requirements Manual for Tire, Pneumatic: Retreaded and Repaired (CTQP-441) (**6**).

5.2.2 *Tire Durability and Treadwear Road Test*—The durability and treadwear road tests shall be performed at a commercial test facility acceptable to the Administrator or at a Government test facility as specified.

5.2.3 *Vehicle(s) Selection and Preparation*—The vehicle(s) used for testing passenger car tires shall be of the same manufacture, model and model year, have identical drive trains (engine CID and horsepower, transmissions, and rear axle ratio), brake shoes/disc pads and drums/rotors, suspension components, etc., and be of identical curb weight. All vehicle(s) used for testing shall be rear wheel drive. The load on each wheel shall not be less than 85 % nor more than 90 % of the maximum single load of the test tire for passenger car, as specified in The Tire and Rim Association, Inc., Year Book (**7**), The European Tyre and Rim Technical Organization, Standards Manual (**8**), or the Japan Automobile Tire Manufacturers' Association, Inc., Year Book (**9**). After the vehicle(s) is (are) correctly loaded, it (they) shall stand for 24 h. If the suspension bottoms out during this period, the vehicle(s) shall not be used to conduct the test. A constant weight shall be maintained in the driver's seat area that will equate the driver to that of the heaviest driver in the caravan. All axles of the vehicle(s) shall be aligned in accordance with the vehicle manufacturers' specifications prior to the beginning of the test. This alignment shall be checked at each tire rotation period. Any change in the vehicle's(s') or wheel's(s') alignment outside the manufacturer's specifications shall be recorded and corrected. Vehicle(s) shall be inspected before each test period for loose steering linkage, loose suspension components, loose wheel nuts, damaged rims, etc. If an anomaly is noted, it shall be recorded and corrected. Tires of different sizes or constructions shall not be mixed on any test vehicle(s). Tires of each group shall be mounted on the test vehicle(s) as singles—one tire on each wheel position. Tires of each group shall be tested on vehicle(s) in caravan or in a convoy at the Administrator's discretion. Any modification(s) to the vehicle(s) or to test procedures to carry the load must be approved by the Administrator.

5.2.4 *Mounting*—The tires shall be mounted with tubes (when required) and flaps (if required) on rims specified in and inflated to the air pressure for the specified load as in The Tire and Rim Association, Inc., Year Book (**7**), The European Tyre and Rim Technical Organization, Standards Manual (**8**), or the Japan Automobile Tire Manufacturers' Association, Inc., Year Book (**9**). The air used for inflating tires or tubes, or both, shall be filtered to remove oil, dirt and water. Any pieces of rubber (vents, flash, etc.) remaining on the tire tread after trimming, that may interfere with proper tire measurements, shall be removed. Tire and wheel shall be dynamically balanced. Tire measurements shall be recorded as detailed in the Administrator's Approval and Requirements Manual for use with F1922 (**1**). Rims used for mounting passenger car tires are to be placed on the test vehicle(s) and shall not have more than 0.9 mm (0.034 in.) lateral and radial runout. If an anomaly is noted, the rim shall be discarded.

5.2.5 *Test Procedures:*

5.2.5.1 *Tread Measurements*—Measurements shall be taken every 5149 km (3200 miles) and shall begin following the 1287 km (800 mile) break-in period. Measurements shall not be made on the treadwear indicators.

5.2.5.2 *Control Tire Selection*—New and retreaded tires shall be tested separately. Testing for new tires shall incorporate a new passenger car tire as the control tire, and testing for retreaded tires shall incorporate a retread passenger car tire as the control tire.

5.2.5.3 *Tire Rotation Procedure*—The tire rotation period for each passenger car tire shall be at each 1287 km (800 mile) increment of the test (25 rotation periods). Each test tire shall be rotated to a different wheel position at each tire rotation period of the test. Each test tire shall be rotated to another vehicle after being mounted on two positions of a vehicle. Each test tire is to be rotated to a different wheel position at each prescribed rotation period (see Administrator's Approval and Requirements Manual for use with F1922 (**1**)). The rotation pattern is to be a rearward-cross pattern in which the tire on the forward axle of the test vehicle is moved to the rear axle of that vehicle on the opposite side. The tire on the rear axle is to be rotated to the forward axle of the next test vehicle in the convoy on the same side. The tire on the rear axle of the last test vehicle in the convoy is to be moved to the front most axle on the same side of the first test vehicle in the convoy. When only a single test vehicle is involved, the tire rotation shall continue on that vehicle for the duration of the test. The test vehicle shall remain in the same order in the convoy throughout the entire test for any particular type of tire.

5.2.5.4 *Test Course Procedure*—The test course for passenger car tires shall consist of 32 180 ± 32 km (20 000 ± 20 miles) of paved operation for each tire. The first 1287 km (800 miles) shall be a break-in period. At least 80 % of the paved surface test shall be conducted at no less than 88 kph (55 mph) and no more than 105 kph (65 mph). The remaining portion of the test shall be conducted between 0 and 105 kph (0 and 65 mph). The remaining portion of the test shall be conducted between 0 and 105 kph (0 and 65 mph). Vehicle(s) shall be operated over the same route at the same speed, to the maximum extent possible. Maximum speed is 105 kph (65 mph).

5.3 *Method 2—Light Truck Tires:*

5.3.1 *Selection and Preparation of the Test Tires:*

5.3.1.1 All tires shall meet specified requirements 49 CFR 571 Federal Motor Vehicle Safety Standard 119, 120 (**3**); part

574 (4) ; as well as state and local regulations, as applicable. All tire sidewall markings shall be recorded.

5.3.1.2 Retreaded tires submitted for testing shall meet the requirements in the Administrator's Approval and Requirements Manual for Tire, Pneumatic: Retreaded and Repaired (CTQP-441) (6).

5.3.2 *Tire Durability and Treadwear Road Test*—The durability and treadwear road tests shall be performed at a commercial test facility acceptable to the Administrator or at a Government test facility as specified.

5.3.3 *Vehicle(s) Selection and Preparation:* The vehicle(s) used for testing light truck tires shall be of the same manufacture, model and model year, have identical drive trains (engine CID and horsepower, transmissions, and rear axle ratio), brake shoes/disc pads and drums/rotors, suspension components, etc., and be of identical curb weight. All vehicle(s) used for testing shall be rear wheel drive. The load on each wheel shall not be less than 85 % nor more than 90 % of the maximum single load of the test tire for light truck tires, as specified in The Tire and Rim Association, Inc., Year Book (7), The European Tyre and Rim Technical Organization, Standards Manual (8), or the Japan Automobile Tire Manufacturers' Association, Inc., Year Book (9). After the vehicle(s) is (are) correctly loaded, it (they) shall stand for 24 h. If the suspension bottoms out during this period, the vehicle(s) shall not be used to conduct the test. A constant weight shall be maintained in the driver's seat area that will equate the driver to that of the heaviest driver in the caravan. All axles of the vehicle(s) shall be aligned in accordance with the vehicle manufacturers' specifications prior to the beginning of the test. This alignment shall be checked at each tire rotation period. Any change in the vehicle's(s') or wheel's(s') alignment outside the manufacturer's specifications shall be recorded and corrected. Vehicle(s) shall be inspected before each test period for loose steering linkage, loose suspension components, loose wheel nuts, damaged rims, etc. If an anomaly is noted, it shall be recorded and corrected. Tires of different sizes or constructions shall not be mixed on any test vehicle(s). Tires of each group shall be mounted on the test vehicle(s) as singles—one tire on each wheel position. Tires of each group shall be tested on vehicle(s) in caravan or in a convoy at the Administrator's discretion. Any modification(s) to the vehicle(s) or to test procedures to carry the load must be approved by the Administrator.

5.3.4 *Mounting*—The tires shall be mounted with tubes (when required) and flaps (if required) on rims specified in and inflated to the air pressure for the specified load as in The Tire and Rim Association, Inc., Year Book (7), The European Tyre and Rim Technical Organization, Standards Manual (8), or the Japan Automobile Tire Manufacturers' Association, Inc., Year Book (9). The air used for inflating tires or tubes, or both, shall be filtered to remove oil, dirt, and water. Any pieces of rubber (vents, flash, etc.) remaining on the tire tread after trimming, that may interfere with proper tire measurements, shall be removed. Tire and wheel shall be dynamically balanced. Tire measurements shall be recorded as detailed in the Administrator's Approval and Requirements Manual for use with F1922 (1). Rims used for mounting light truck tires are to be placed on the test vehicle(s) and shall not have more than 1.4 mm (0.055 in.) lateral and radial runout. If an anomaly is noted, the rim shall be discarded.

5.3.5 *Test Procedures:*

5.3.5.1 *Tread Measurements*—Measurements shall be taken every 5149 km (3200 miles) and shall begin following the 1287 km (800 mile) break-in period. Measurements shall not be made on the treadwear indicators.

5.3.5.2 *Control Tire Selection*—New and retreaded tires shall be tested separately. Testing for new and retreaded tires shall incorporate a new tire as the control tire.

5.3.5.3 *Tire Rotation Procedure*—The tire rotation period for each light truck tire shall be at each 1287 km (800 mile) increment of the test (25 rotation periods). Each test tire shall be rotated to a different wheel position at each tire rotation period of the test. Each test tire shall be rotated to another vehicle after being mounted on two positions of a vehicle. Each test tire is to be rotated to a different wheel position at each prescribed rotation period (see Administrator's Approval and Requirements Manual for use with F1922 (1)). The rotation pattern is to be a rearward-cross pattern in which the tires on the forward axle of the test vehicle are moved to the rear axle of that vehicle on the opposite side. Tires on the rear axle are to be rotated to the forward axle of the next test vehicle in the convoy on the same side. Tires on the rear axle of the last test vehicle in the convoy are to be moved to the front most axle on the same side of the first test vehicle in the convoy. When only a single test vehicle is involved, the tire rotation shall continue on that vehicle for the duration of the test. The test vehicle shall remain in the same order in the convoy throughout the entire test for any particular type of tire.

5.3.5.4 *Test Course Procedures*—The test for light truck tires shall consist of 32 180 ± 32 km (20 000 ± 20 miles) of paved operation for each tire. The first 1287 km (800 miles) shall be a break-in period. At least 80 % of the paved surface test shall be conducted at no less than 88 kph (55 mph) and no more than 105 kph (65 mph). The remaining portion of the test shall be conducted at between 0 and 105 kph (0 and 65 mph). Maximum speed is 105 kph (65 mph).

5.4 *Method 3—Truck-Bus Tires:*

5.4.1 *Selection and Preparation of the Test Tires:*

5.4.1.1 All tires shall meet specified requirements of 49 CFR 571 Federal Motor Vehicle Safety Standard 119, 120, (3); part 574 (4) ; as well as state and local regulations, as applicable. All tire sidewall markings shall be recorded.

5.4.1.2 Retreaded tires submitted for testing shall meet the requirements in the Administrator's Approval and Requirements Manual for Tire, Pneumatic: Retreaded and Repaired (CTQP-441) (6).

5.4.2 *Tire Durability and Treadwear Road Test*—The durability and treadwear road tests shall be performed at a commercial test facility acceptable to the Administrator or at a Government test facility as specified.

5.4.3 *Vehicle(s) Selection and Preparation*—The vehicle(s) used for testing truck-bus tires shall be of the same manufacture, model and model year, have identical drive trains (engine CID and horsepower, transmissions, and rear axle ratio), brake shoes/disc pads and drums/rotors, suspension

components, etc., and be of identical curb weight. All vehicle(s) used for testing shall be rear wheel drive. For truck-bus tire testing, a tandem axle tractor with a tandem axle, flat bed trailer shall be used as the test vehicle. All tractors for truck-bus tire testing shall have the same or similar wheel base, suspension, and driveline. All trailers used for testing truck-bus tires shall be identical. Test tires shall not be used on the steerable wheels of the tractor or the inside position of dual wheels if the test vehicle(s) is equipped with the same. The load on each wheel shall not be less than 90 % nor more than 95 % for truck-bus tires, as specified in The Tire and Rim Association, Inc., Year Book (**7**), The European Tyre and Rim Technical Organization, Standards Manual (**8**), or the Japan Automobile Tire Manufacturers' Association, Inc., Year Book (**9**). After the vehicle(s) is (are) correctly loaded, it (they) shall stand for 24 h. If the suspension bottoms out during this period, the vehicle(s) shall not be used to conduct the test. A constant weight shall be maintained in the driver's seat area that will equate the driver to that of the heaviest driver in the caravan. All axles of the vehicle(s) shall be aligned in accordance with the vehicle manufacturers' specifications prior to the beginning of the test. This alignment shall be checked at each tire rotation period. Any change in the vehicle's(s') or wheel's(s') alignment outside the manufacturer's specifications shall be recorded and corrected. Vehicle(s) shall be inspected before each test period for loose steering linkage, loose suspension components, loose wheel nuts, damaged rims, etc. If an anomaly is noted, it shall be recorded and corrected. Tires of different sizes or constructions shall not be mixed on any test vehicle(s). Tires of each group shall be mounted on the test vehicle(s) as singles—one tire on each wheel position. Tires of each group shall be tested on vehicle(s) in caravan or in a convoy at the Administrator's discretion. Any modification(s) to the vehicle(s) or to test procedures to carry the load must be approved by the Administrator.

5.4.4 *Mounting*—The tires shall be mounted with tubes (when required) and flaps (if required) on rims specified in and inflated to the air pressure specified for the load as in The Tire and Rim Association, Inc., Year Book (**7**), The European Tyre and Rim Technical Organization, Standards Manual (**8**), or the Japan Automobile Tire Manufacturers' Association, Inc., Year Book (**9**). The air used for inflating tires or tubes, or both, shall be filtered to remove oil, dirt, and water. Any piece of rubber (vents, flash, etc.) remaining on the tread after trimming, that may interfere with proper tire measurements, shall be removed. Tire and wheel shall be either dynamically balanced or statically balanced. Tire measurements shall be recorded as detailed in the Administrator's Approval and Requirements Manual for use with F1922 (**1**). Rims used for mounting truck-bus tires are to be placed on the test vehicle(s) and shall not have more than 1.7 mm (0.065 in.) lateral or radial runout. If an anomaly is noted, the rim shall be discarded.

5.4.5 *Test Procedures:*

5.4.5.1 *Tread Measurements*—Measurements shall be taken every 5149 km (3200 miles) and shall begin following the 1287 km (800 miles) break-in period. Measurements shall not be made on the treadwear indicators.

5.4.5.2 *Control Tire Selection*—New and retreaded tires shall be tested separately. Testing for new and retreaded tires shall incorporate a new tire as the control tire.

5.4.5.3 *Tire Rotation Procedure*—The tire rotation period shall be at each 1287 km (800 mile) increment of the test (25 rotation periods). Each test tire shall be rotated to a different wheel position at each tire rotation period of the test. Each test tire shall be rotated to another vehicle after being mounted on two positions of a vehicle. Each test tire is to be rotated to a different wheel position at each prescribed rotation period (see Administrator's Approval and Requirements Manual for use with F1922 (**1**)). The rotation pattern is to be a rearward pattern in which the tires on the forward axle of the test vehicle are moved to the next rearward axle of that vehicle on the same side. Tires on the rear axle are to be rotated to the forward axle of the next test vehicle in the convoy on the same side. Tires on the rear axle of the last test vehicle in the convoy are to be moved to the front most axle on the same side of the first test vehicle in the convoy. When only a single test vehicle is involved, the tire rotation shall continue on the vehicle for the duration of the test. The test vehicles shall remain in the same order in the caravan throughout the entire test.

5.4.5.4 *Course Test Procedure*—The test for truck-bus tires shall consist of 32 180 ± 32 km (20 000 ± 20 miles) of paved operation for each tire. The first 1287 km (800 miles) shall be a break-in period. At least 80 % of the paved surface test shall be conducted at no less than 88 kph (55 mph) and no more than 105 km (65 mph). The remaining portion of the test shall be conducted at no less than 105 kph (65 mph). Maximum speed is 105 kph (65 mph). Ten percent of the test (3218 km (2000 miles)) shall be conducted over rough gravel secondary roads (pea gravel not acceptable), free of ice and snow. At least 85 % of the gravel road testing shall be conducted at 48 kph (30 mph).

5.5 *Method 4—Off Road Severe Application (ORSA) Tires:*

5.5.1 *Selection and Preparation of the Test Tires:*

5.5.1.1 All tires shall meet specified requirements of 49 CFR 571 Federal Motor Vehicle Safety Standard 119, 120 (**3**); part 574 (**4**) ; as well as state and local regulations, as applicable. All tire sidewall marking shall be recorded.

5.5.2 *ORSA Tire Durability Tests*—ORSA tires include all terrain and on-off road light truck tires. The durability test shall be performed at a commercial test facility acceptable to the Administrator or at Government test facility as specified. Tires shall be subjected to 3862 km (2400 miles) of off-road testing.

5.5.3 *ORSA Vehicle Selection and Preparation*—The test vehicle(s) shall be a four wheel drive (4 × 4), one-ton (0.91 metric tons) payload capacity, regular cab, pick-up truck. Transmission shall be automatic with a part-time transfer case. If more than one vehicle is required for a test run, the other vehicles shall be of the same manufacture, model, and model year, have identical drive trains (engine CID and horsepower, transmissions, and rear axle ratio), brake shoes/disc pads and drum/rotors, suspension components, etc., and be of identical curb weight. The suspension system shall have the load carrying capacity to carry the required test load without the springs bottoming out. Occasional light contact with the jounce

bumpers is acceptable. The test vehicle(s) shall be approved by the Administrator prior to a particular test run.

5.5.4 *ORSA Test Course*—The test course and test vehicle speeds over the test segments shall be inspected and approved by the Administrator, prior to the beginning of each individual ORSA test. Once the test course and segment speeds have been approved, they shall not be altered at any time during testing. The course segments shall be free of ice and snow. Sustained mud operation shall be avoided. Loose rock of 127 mm (5 in.) or greater in diameter shall be removed from the test course.

5.5.4.1 *Procedure for New ORSA Tires*—Testing shall consist of 3862 km (2400 miles) of operation for all tires. The test vehicles shall be operated over the same route at the same speeds. In no event shall any test vehicle exceed the maximum prescribed, posted, or otherwise regulated speed limit for the public way and course segments upon which the testing is conducted.

5.5.4.2 One test period (driving shift) shall consist of not less than 160 km (100 miles). During accumulation of this mileage, each course segment shall be traversed. Should the test vehicle, because of course conditions or mechanical problems, be unable to maintain course segment speeds the test shall be suspended at that point until the conditions creating the problem are alleviated. The test vehicle shall be removed from the course at that point on the non-interest carrying tires.

5.5.4.3 A list of the major categories and the percentage of the test to be conducted on those categories (± 5 % subject to the approval of Administrator) can be found in Table 1.

5.5.4.4 The test contractor shall submit course roughness profile (see Administrator's Approval and Requirements Manual for use with F1922 (**1**)) prior to each new test run to quantify the specific roughness of the course demonstrating that the roughness did not change significantly from the last test run. Approval shall be conducted by Administrator.

5.5.5 *ORSA Mounting*—The tires shall be mounted and inflated. Inflation pressure shall be 300 kPa (45 psig). Rims used for mounting all tires to be placed on the test vehicle shall not have more than 1.4 mm (0.055 in.) of lateral and radial runout.

5.5.6 *ORSA Rotation Procedures*—Rotation period shall be each 965 km (600 mile) increment of the test. Control and test tires shall be rotated by pairs from one axle to the other, maintaining the same direction of tread rotation.

TABLE 1 Major Categories and Percentage of Test to be Conducted in Those Categories

Environment	Percent of Total Test Mileage	Kilometers (Miles) per Shift	Total Kilometers (Miles) at End of Test
Paved road, high speed	6	10 (6)	232 (144)
Paved road, hill and curve	6	10 (6)	232 (144)
Degraded pavement (pot-holes, loose surface, etc.)	8	13 (8)	309 (192)
Secondary road, gravel road	25	40 (25)	965 (600)
Secondary road, embedded rock	25	40 (25)	965 (600)
Level cross-country track, mild	10	16 (10)	386 (240)
Level cross-country track, severe	10	16 (10)	386 (240)
Hilly cross-country track, mild	7	11 (7)	271 (168)
Hilly cross-country track, severe	3	5 (3)	116 (72)

5.5.7 *Selection of the ORSA Control Tire*—The control tire for ORSA testing shall be selected by the Administrator. The control tire shall represent the minimum performance level for light truck severe application tires for military or agency's use. The control tire will be selected from satisfactory performance displayed in previous ORSA testing in the o/o/s category.

5.5.8 *ORSA Candidate and Control Tire Load*—The load on each tire shall be at 100, –0 or +5 %, of the 300 kPa (45 psig) load as specified in The Tire and Rim Association, Inc., Year Book (**7**), The European Tyre and Rim Technical Organization, Standards Manual (**8**), or the Japan Automobile Tire Manufacturers' Association, Inc., Year Book (**9**). Vehicle load distribution shall be checked in accordance with 5.5.3. Front end and axle alignments shall be checked and adjusted, if required, at each rotation period (see 5.5.6). Each wheel and tire assembly shall have a "free roll" brake adjustment. All brake adjustments shall be identical.

5.5.9 *ORSA Candidate Tires' Weights*—The test candidate tires' unmounted weights shall be taken at the beginning and at the end of testing, or on removal for cause (non-repairable damage or tire failure). All foreign debris shall be removed from the tire prior to weight measurements.

5.5.10 *ORSA Candidate and Control Tire Inflation Pressure*—The air inflation pressure shall be checked and recorded in each tire immediately before each test shift, at mid-shift, and immediately at the end of the test shift. Any changes in air loss shall be investigated to determine if anomalies in tire structure exist.

5.5.10.1 The first test measurement shall be performed 24 h after initial mounting of the candidate and control tires. Test tires shall be stored inflated to 300 kPa (45 psig) in a controlled temperature environment of 15–32°C (60–90°F) for the 24-h period.

5.5.11 *ORSA Measurements*—Tread depth measurements shall be taken in eight equally-spaced locations around the tire in each groove with all grooves measured to the nearest 0.025 mm (0.001 in.) at the same point across the tire tread. At least four measurements across the tread are required. For test tires having only three grooves, the center groove shall be repeated twice in the data for extrapolation formula accuracy purposes (see Administrator's Approval and Requirements Manual for F1922 (**1**)). Measurements shall not be made at treadwear indicators or in sipes. Tread depth measurements, outside diameter, section width, tread radius, tread arc width, and Shore A will be taken at 0, 1931, and 3862 km (0, 1200, and 2400 miles).

5.5.11.1 Outside diameter measurements shall be taken in three equally spaced locations across the tire.

5.5.11.2 Section width, tread radius, and tread arc width measurements shall be taken in three equally spaced locations around the tire.

5.5.11.3 Shore A measurement shall be taken in the crown area in three equally spaced locations around the tire.

5.5.12 *X-ray Examination*—Bead-to-bead x-ray examination shall be performed 360° around the test tires at the beginning and at the conclusion of the test or after tire removal

from the test for non-repairable damage or tire failure. (See Administrator's Approval and Requirements Manual for use with F1922 (**1**).)

5.5.13 *ORSA Tire Maintenance:*

5.5.13.1 Dynamic balance shall be also be checked and corrected at these intervals. Balance limits in Table 1 of the Administrator's Approval and Requirements Manual for use with F1922 (**1**) shall apply.

5.5.13.2 All repairs due to course hazards shall be done in accordance with Administrator's Approval and Requirements Manual for Tire, Pneumatic: Retreaded and Repaired (CTQP-441) (**6**).

6. Precision and Bias

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

6.2 *Bias*—There are no standards or reference values with which the results of this test method can be compared; therefore, bias cannot be evaluated.

7. Keywords

7.1 tire durability; tire treadwear

REFERENCES

The following documents form a part of this test method to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

(1) "Administrator's Approval and Requirements Manual for use with F1922, Standard, Test Method for Tires, Pneumatic, Vehicular, Highway (CTQP F1922)," U.S. Army Tank Automotive and Armaments Command, AMSTA-JD, Warren, MI, 48397-5000; or Administrator, Cooperative Tire Qualification Program, PO Box 296, Roseville, MI 48066-2096.

(2) "Cooperative Approved Tire List (CATL)," U.S. Army Tank Automotive and Armaments Command, AMSTA-JD, Warren, MI 48397-5000; or from Administrator, Cooperative Tire Qualification Program, PO Box 296, Roseville, MI 48066–2096.

(3) "Federal Motor Vehicle Safety Standards, 49 CFR 571, Standard 109, *New Pneumatic Tires*; Standard 110, *Tire Selection and Rims*; Standard 117, *Retreaded Pneumatic Tires*; Standard 119, *New Pneumatic Tires for Vehicles Other Than Passenger Cars*; Standard 120, *Tire Selection and Rims for Motor Vehicles Other Than Passenger Cars,*" Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(4) "Tire Identification and Recordkeeping Regulation, 49 CFR 574," Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(5) "Federal Motor Vehicle Safety Standard and Regulations, Supplement 11, 49 CFR 575.104, *Uniform Tire Quality Grading Standards, Appendix C,*" available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(6) "Administrator's Approval and Requirements Manual for Tire, Pneumatic: Retreaded and Repaired (CTQP-441)," U.S. Army Tank Automotive and Armaments Command, AMSTA-JD, Warren, MI 48397-5000; or Administrator, Cooperative Tire Qualification Program, PO Box 296, Roseville, MI 48066-2096.

(7) "The Tire and Rim Association, Inc., Year Book," The Tire and Rim Association, Inc., Crown Pointe, Suite 150, 175 Montrose West Avenue, Copley OH 44321.

(8) "The European Tyre and Rim Technical Organization, Standards Manual," European Tyre and Rim Technical Organization, The General Secretary, ETRTO, Avenue Brugmann 32, Boite 2, B-1060, Brussels, Belgium.

(9) "Japan Automobile Tire Manufacturers' Association, Inc., Year Book," Japan Automobile Tire Manufacturers" Inc., 9th Floor, Toranomon Bld., No. 1-12, 1-Chome Toranomon, Mina To-Ku, Tokyo, Japan 105.