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SURFACE VEHICLE RECOMMENDED PRACTICE

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(R) PNEUMATIC TIRES FOR MILITARY TACTICAL WHEELED VEHICLES

Foreword—This specification was developed by the SAE Military/Industry Tire Technology Subcommittee. It is intended for military use by all branches of the Department of Defense.

This specification shall remain open for comments and recommendations by the user(s) and shall be reviewed or revised periodically by the SAE Military/Industry Tire Technology Subcommittee when necessary to incorporate adopted comments, recommendations, and advancements in government and industry tire technology.

1. Scope

1.1 This SAE Recommended Practice applies to all combinations of pneumatic tires for **military tactical wheeled vehicles** only as defined in SAE J2013. This applies to original equipment and new replacement tires and the retread of these tires.

APPENDIX B IS NOT A RECOMMENDED PRACTICE AND MUST NOT BE USED TO EVALUATE POTENTIAL CANDIDATE TIRES. THIS APPENDIX REPRESENTS TEST PROCEDURES UNDER DEVELOPMENT.

1.2 This document describes tests, test methodology, and certain minimum requirements to evaluate and measure tire and tire-vehicle related performance. The mission profile of the vehicle determines which of these tests are required and should be selected. Therefore, all of the tests included in this document are not required for each tire.

The tire technical activity for the vehicle system has the responsibility for the selection of a specific test(s) to be used. **The selected test(s) should be limited to that required to evaluate the tire or tire-vehicle characteristic which is related to the desired vehicle performance.**

1.3 Selected requirements of this specification shall be used as the basis for procurement of tires for military tactical wheeled vehicles.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J57—Sound Level of Highway Truck Tires
SAE J751—Off-Road Tire and Rim Classification—Construction Machines
SAE J1269—Rolling Resistance Measurement Procedure for Passenger Car, Light Truck, and Highway Truck and Bus Tires
SAE J1466—Passenger Car and Light Truck Tire Dynamics Driving Traction in Snow
SAE J2013—Military Tire Glossary

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 746—Standard Test Methods for Brittleness Temperature of Plastics and Elastomers by Impact

2.1.3 AMERICAN TRUCKING ASSOCIATION (ATA) PUBLICATIONS—Available from American Trucking Association, Inc., 2200 Mill Road, Alexandria, VA 22314-4677.

All references to tire maintenance recommended practices from the Maintenance Council of ATA

2.1.4 DEPARTMENT OF TRANSPORTATION (DOT) PUBLICATIONS—Available from the Department of Transportation, National Highway Safety Administration, Washington, DC 20591, or the Government Printing Office.

FMVSS Regulation 49CFR Part 574.5—Tire identification and Record Keeping
FMVSS Regulation 49CFR Part 571.119—New Pneumatic Tires for Other Than Passenger Cars
FMVSS Regulation 49CFR Part 571.120—Tire Selection and Rims for Motor Vehicles Other Than Passenger Cars

2.1.5 FEDERAL SPECIFICATIONS—Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

ZZ-I-550—Inner Tube, Pneumatic Tire
ZZ-P-112—Patch, Repair for Inner Tubes and Tubeless Tire Liners
ZZ-V-25—Valves and Valve Spuds, Caps, and Cores, Pneumatic Tire
ZZ-T-416—Tire, Pneumatic: Retread and Repair Materials
ZZ-T-1083—Tires, Pneumatic, Low Speed, Off Highway

2.1.6 MILITARY STANDARDS—Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

MIL-STD-105—Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-45662—Calibration System Requirements

2.1.7 RMA PUBLICATIONS—Available from the Tire Technical and Standards Division, Rubber Manufacturers Association, 1400 K Street N.W., Washington, DC 20005.

Tire Reference Maintenance Manuals as published by RMA, as applicable
Tire Information Service Bulletin—Tire Storage Recommendations

2.1.8 TIRE AND RIM PUBLICATIONS—Available from the Tire and Rim Association, Inc., 175 Montrose West Ave., Copley, OH 44321.

Tire and Rim Association Yearbook
Tire and Rim Association Military Supplement
Engineering Design Information

3. Requirements

3.1 Qualification—Tires furnished under this specification shall be products which have qualified (see 4.4) by meeting the requirements of Table 1 and the selected requirements of Table 2. (See 1.2)

3.1.1 GROUP A—Nondestructive inspections of all items produced or of all samples from an inspection lot to demonstrate product compliance with contractual requirements.

3.1.2 GROUP B—Generally nondestructive inspections/tests that are more complex or of a longer duration than Group A. Fewer samples are inspected than for Group A inspections and tested articles may be offered for acceptance with little or no refurbishment. Each commodity should be individually evaluated regarding its issue after performing Group B inspection.

"X" and "S" refer to "required" and "selective" requirements in the "Qualification Inspection" column in Tables 1 and 2.

TABLE 1—CLASSIFICATION OF INSPECTION AND TEST

Title	Requirement Paragraph	Method Paragraph	Qualification Inspection (See 4.4)	Quality Conformance Inspection Examination/Testing (See 4.5)	Quality Conformance Control Test (See 4.6)
Materials	3.2	4.7.1	X		
Design and Construction	3.3	4.7.1	X		
Retreadability[1]	3.3.1	4.7.18	X	A	
Repairability	3.3.2	4.7.17	X		
Treadwear Indicators	3.3.3	4.7.21	X	A	
Age of Tires	3.3.4	4.7.20	X	A	A
Tubes/Valves	3.3.5		X		
Imbalance Limits	3.4.1	4.7.3	X	B	
Tire Dimensional Constraints	3.4.9	4.7.10	X	A	
Ozone Resist.	3.4.11	4.7.13	X		
Environmental Temperature	3.4.13	4.7.15	X		
Storage	3.4.14	4.7.16	X	A	
Tire Markings	3.5	4.7.19	X	A	A
Anomalies	3.6	4.7.2	X	--	A

NOTE—A - Group A
B - Group B
X - Required

[1] New Tires Only

TABLE 2—CLASSIFICATION OF INSPECTION AND TEST

Title	Requirement Paragraph	Method Paragraph	Qualification Inspection (See 4.4)
Tire Noise Level	3.4.2	4.7.4	S
Plunger Energy[1]	3.4.3	4.7.5	S
Endurance Test[1]	3.4.4	4.7.6	S
Tire Traction	3.4.5	4.7.7	S
Vehicle Evasive Maneuver	3.4.6	4.7.11	S
Bead Unseating	3.4.7	4.7.8	S
Rolling Resistance	3.4.8	4.7.9	S
Ride Handling and Stability	3.4.10	4.7.12	S
Tire Mechanical Reliability Test	3.4.12	4.7.14	S
Tire Treadlife Durability	3.4.15	4.7.22	S
Tire Braking	3.4.16	4.7.23	S

[1] Retread tires only.

S - Selective Requirements

3.2 Materials—The contractor shall certify that the materials used to manufacture the tires to be delivered are the same materials used to construct the pre-contract qualification tires. If during production the materials used are changed (which affect form, fit, or function), the contractor shall notify the procuring activity in writing of such changes. (See 4.7.1)

Truck and bus casings for retreading must be marked with Department of Transportation (DOT) or Department of Defense (DOD) code. Low-speed, off-highway casings for retreading must be from tires previously qualified under the Federal Qualified Products List ZZ-T-1083.

3.3 Design and Construction—The tire shall be radial or bias, tube type or tubeless constructions, and shall conform to the Tire and Rim Association (TRA) Military Supplement dimension standards for the tire size selected. The tire size selected must also have the TRA Military Supplement load-inflation rating equal to or above the maximum tire position load on the vehicle for the maximum vehicle speed capability. Tire size, load, and percentage of primary, secondary, and off-road mobility for original equipment (OE) tires will be based on the design and mission profile of the vehicle. This information will be provided to the contractor by the vehicle manufacturer prior to tire and/or vehicle qualification. For procurement of replacement tires, the tire size, load, and percentage of usage for primary, secondary, and off-road mobility will be included in the solicitation package by the procuring activity. (See 4.7.1)

3.3.1 RETREADABILITY—The construction of the new tire shall be such that the casing shall be retreadable. (See 4.7.18)

3.3.2 REPAIRABILITY—Design and construction of the tire shall be such that repair/reinforcement of an injured area can be accomplished utilizing those guidelines specified by the Rubber Manufacturers Association (RMA) repair criteria, and Federal Specification ZZ-P-112. (See 4.7.17)

3.3.3 TREADWEAR INDICATORS—Except as specified as follows, each tire shall have at least six treadwear indicators spaced approximately equally around its circumference so that it can be visually determined when tread depth has worn to 1.6 mm (1/16 inch). Tires with 12 inch or smaller rim diameter shall have at least three such treadwear indicators. Tires exempt from DOT markings do not require treadwear indicators. (See 4.7.21)

NOTE—For tread depth measurement location, refer to tire/retread manufacturer.

3.3.4 AGE OF TIRES—The age of the tires when shipped shall not be more than 18 months old from the date of manufacture or retread. (See 3.5 and 4.7.20)

3.3.5 INNER TUBES/VALVES—The inner tubes shall be in accordance with ZZ-I-550. Valves and valve spuds, caps, and cores shall be in accordance with ZZ-V-25.

3.4 Performance

3.4.1 TIRE IMBALANCE LIMITS—Tires shall be balanced as part of production to assure conformance to the static imbalance limits of Table 3. (See 4.7.3)

TABLE 3—TIRE IMBALANCE LIMITS (IN×OZ)

Type	Nominal Rim Diameter	Tire Design Section Width (Inches)	Max in×oz Highway Tires (Class r/t, a/s, t/o)	Max in×oz On/Off Highway Tires (Class s/t, a/t, o/o, d/a)	Max in×oz Special Vehicle All-Terrain
Light Truck	13	ALL	60	75	
	14	ALL	60	75	
	15	8.00 or smaller	60	75	
		8.01 to 12.00	75	105	
		12.01 or larger	105	135	
	16	8.00 or smaller	60	75	
		8.01 to 9.00	75	105	
		9.01 to 10.00	105	135	
		10.01 or larger	135	175	
	16.5	8.00 or smaller	60	75	
		8.01 to 10.00	75	105	
		10.01 to 12.00	105	135	
		12.01 or larger	135	175	
	17.5	8.00 or smaller	60	75	
		8.01 to 10.00	75	105	
		10.01 or larger	105	135	
Truck[1]	15 to 18	8.00 or smaller	75	105	
		8.01 to 9.00	105	135	
		9.01 to 10.50	135	175	
		10.51 to 11.25	175	215	
		11.26 to 12.00	215	265	
		12.01 to 14.00	265	315	
		14.01 or larger	315	365	

TABLE 3—TIRE IMBALANCE LIMITS (IN×OZ) (CONTINUED)

Type	Nominal Rim Diameter	Tire Design Section Width (Inches)	Max in×oz Highway Tires (Class r/t, a/s, t/o)	Max in×oz On/Off Highway Tires (Class s/t, a/t, o/o, d/a)	Max in×oz Special Vehicle All-Terrain
	19.5	8.00 or smaller	105	135	
		8.01 to 12.00	135	175	
		12.01 to 15.00	175	215	
		15.01 to 16.00	215	265	
		16.01 to 17.00	265	315	
		17.01 to 18.00	315	365	
		18.01 or larger	365	415	
	20/21	9.00 or smaller	105	135	200
		9.01 to 10.50	135	175	260
		10.51 to 11.25	175	215	325
		11.26 to 12.00	215	265	400
		12.01 to 14.00	265	315 AV/500 max	500
		14.01 to 15.00	315	365 AV/500 max	550
		15.01 to 20.00	400	500 AV/700 max	700
		20.01 or larger	550	675 AV/795 max	795
	22	10.50 or smaller	175	215	
		10.51 to 12.00	215	265	
		12.01 to 14.00	265	315	
		14.01 to 16.00	315	365	
		16.01 or larger	365	415	
	22.5	8.00 or smaller	105	135	
		8.01 to 10.50	135	175	
		10.51 to 11.75	175	215	
		11.76 to 14.00	215	265	
		14.01 to 16.00	265	315	
		16.01 to 17.00	315	365	
		17.01 or larger	365	415	
	24	11.00 or smaller	215	265	
		11.01 to 13.00	265	315	
		13.01 to 15.00	315	365	
		15.01 or larger	365	415	
	24.5	10.50 or smaller	175	215	
		10.51 to 12.00	215	265	
		12.01 to 14.00	265	315	
		14.01 to 16.00	315	365	
		16.01 or larger	365	415	

[1] The balance limits shown for truck tire sizes apply to tires with aspect ratios of 65 and above 80. For aspect ratios of 70, 75, and 80, reduce these balance limits by 8% for "highway" and "on/off-highway" tires. For 80 aspect ratio "all-terrain" tires, reduce these balance limits by 30%.

r/t-Regular tread tires, t/o-Trailer only tires, a/t-All-terrain tires, a/s-All season tires, s/t-Snow tread tires, o/o-On/off road tires, d/a-Drive axle tires

3.4.2 TIRE NOISE LEVEL—When specified, tire noise level requirements are applicable to all tire sizes. Candidate tire design supplied under this specification shall be no worse than +1 dB of the reference tire when tested on the same vehicle. (See 4.7.4)

3.4.3 PLUNGER ENERGY—When specified, the sample tire shall be mounted on the specified rim and tested in accordance with and meet the requirements of FMVSS 571.119. (See 4.7.5)

3.4.4 ENDURANCE TEST—When specified the sample tire shall be mounted on the specified rim and tested in accordance with and meet the requirements of FMVSS 571.119. (See 4.7.6)

3.4.5 TIRE TRACTION—When specified, a tire traction test shall be conducted as described in Appendix A, Section A.2 to determine tire performance in mud, sand, and/or snow. Acceptable tire driving traction values of the candidate tire shall be no less than 95% of the reference tire. (See 4.7.7)

3.4.6 VEHICLE EVASIVE MANEUVER—When specified, a wet and dry pavement evasive maneuver test shall be conducted as described in Appendix A, Section A.3 to determine tire performance on wet and dry pavement. Acceptable average maximum evasive maneuver speed of the candidate tire shall be no less than 95% of the reference tire. (See 4.7.11)

3.4.7 BEAD UNSEATING—When specified, a bead unseating test shall be conducted as described in Appendix A, Section A.4. The candidate tire shall exhibit equal or less tire/rim rotational displacement compared with the reference tire. The inflation pressure of the candidate tire at the conclusion of the test must not be lower than 6.9 kPa (1 psi) below the cold inflation pressure at the start of the test, provided the reference tire completed the same test requirement with no more than 6.9 kPa (1 psi) inflation pressure loss. This test does not apply to vehicles equipped with a bead lock system. (See 4.7.8)

3.4.8 ROLLING RESISTANCE—When specified, the rolling resistance coefficient of the candidate tire shall not exceed the rolling resistance coefficient of the reference tire by more than 5% under the same operating condition. (See 4.7.9)

3.4.9 DIMENSIONAL CONSTRAINTS—To assure correct dimensional requirements for vehicle tire application, tires shall comply with dimensional and load requirements as specified in the TRA Military Supplement. Additional requirements such as bead width, tire weight, revolutions per mile, maximum speed and casing percent deflection (see Appendix A, Section A.10) may be specified for a particular application. (See 4.7.10)

3.4.10 RIDE HANDLING AND STABILITY—When specified, the candidate tires must provide acceptable ride, handling, and stability characteristics. To determine acceptance or nonacceptance of the tires supplied, a jury rating system will be used. This jury will be made up of a minimum of three qualified drivers who will each conduct the same test described in Appendix A, Section A.6 of this specification. If the majority of the test result ratings on the candidate tire are equal or above the reference tire, the candidate tire is considered acceptable. (See 4.7.12)

3.4.11 OZONE RESISTANCE—All new tires, as part of production, shall be free of cracks and checking when examined under a seven power magnification at the time of shipment to the military. For retread tires, this applies to retread materials. (See 4.7.13)

3.4.12 MECHANICAL RELIABILITY—When specified, testing shall be conducted as described in Appendix A, Section A.5 for the tire durability in an off-road condition. Greater than 50% of the reference tires "failures" in the first 1931 km (1200 miles) will mean an invalid test. Greater than 50% of the candidate tires "failures" in the first 1931 km (1200 miles) will be unacceptable durability.

In addition, the candidate tire shall exhibit equal or better performance than the reference tire in areas such as resistance to impact damage, air out, number of tires completing test, tread cutting, and overall physical appearance. (See 4.7.14)

3.4.13 ENVIRONMENTAL TEMPERATURE—The operational environment requires that each tire shall be capable of operating in environments down to ambient –40 °C (–40 °F) and up to ambient 52 °C (125 °F). (See 4.7.15).

NOTE—Below –20.5 °C (–5 °F) special operating conditions and special low-temperature equipment accessories, etc., if required, are acceptable in order to meet this requirement.

Temperature requirements below –40 °C (–40 °F) must be specifically required by the vehicle specification.

3.4.14 STORAGE—Unmounted tires shall withstand extended storage for a minimum of 3 years (after manufacturer's shipment) in ambient air temperature of 29 °C (85 °F) without visual checking or cracking when stored in accordance with RMA Bulletin. (See 4.7.16)

3.4.15 TIRE TREADLIFE DURABILITY—To assure conformance to the treadlife durability requirements, the test shall be conducted in accordance with Appendix A, Section A.7. The candidate tire overall average percent tread consumed must be less than or equal to 1.05 times the reference tire overall average percent tread consumed. (See 4.7.22)

3.4.16 TIRE BRAKING TEST—Candidate tires shall have an average stopping distance no more than 105% of the reference tire and tire vehicle control equal to or better than the reference tires. Test shall be conducted in accordance with Appendix A, Section A.8. (See 4.7.23)

3.5 Tire Markings—Tires requiring Department of Transportation (DOT) markings shall be marked with standard DOT coding method in accordance with 49 CFR Part 574.5. Tires exempt from DOT markings shall be identified in such a way that date of manufacture can be determined. (See 4.7.19)

3.6 Anomalies—Tire samples shall be examined to assure that they do not contain any of the anomalies listed in Table 4 or 5 as applicable. (See 4.7.2)

4. Quality Assurance Provisions

4.1 Responsibility for Inspection—Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein with approval by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 RESPONSIBILITY FOR COMPLIANCE—Items must meet all requirements of Section 3 as specified. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of the known defective materials, either indicated or actual, nor does it commit the Government to acceptance of defective material.

TABLE 4—CLASSIFICATION OF NEW TIRE ANOMALIES

Category	Anomaly	Inspection Method
101	Cord buckles or kinks in beads	V
102	Insufficient first ply rubber coverage	V
103	Sidewall cracks	V
104	Tread or mold folds 1.3 mm (0.05 inch) deep, 12.7 mm (0.5 inch) long	V & M
105	Open tread, sidewall or liner splices	V
106	Light sidewalls (incomplete molding) 1.3 mm (0.05 inch) deep, 12.7 mm (0.5 inch) long	V & M
107	Sidewall blisters larger than 6.4 mm (0.25 inch) dia.	V & M
108	Tread pock marks and cracks deeper than 2.5 mm (0.10 inch)	V & M
109	Inner liner roughness and sharp edges greater than 0.5 mm (0.02 inch)	V & M
110	Foreign material in surface of tire	V
111	Mold tearing except for tread block edges, where two tears not more than 6.4 mm (0.25 inch) deep and 12.7 mm (0.50 inch) long are allowed per tire	V & M
112	Exposed fabric, either textile or steel	V
113	Off register treads of more than 3.2 mm (0.13 inch)	V & M
114	Tread flash at mold register line greater than 2.5 mm (0.10 inch) thickness	V & M
115	Wavy cords beyond contractors design/tolerances in radial ply or belts	X or H
116	Damaged ply cords	V & X or H
117	Belt or breaker edge anomalies larger than 6.4 mm (0.25 inch) dia.	X or H & M
118	Mold blow (voids) larger than 6.4 mm (0.25 inch) dia.	X or H & M
119	Inner liner voids, tears, creases, or blisters	V
120	Waviness of steel belts beyond contractor design/tolerances	X or H

H—Holograph M—Measurement V—Visual X—X-ray

TABLE 5—CLASSIFICATION OF RETREADED TIRE ANOMALIES

Category	Anomaly	Inspection Method
101-R	Off-center tread, maximum 6.35 mm (1/4 inch) when measured from center line	V & M
102-R	Kinked beads, unrepaired bead area damage	V
103-R	Buckled or exposed cord, either textile or steel	V
104-R	Sidewall oxidation/weather checking, with depth greater than 1.59 mm (2/32 inch) or connecting in a straight line	V & M
105-R	Unrepaired sidewall cuts or abrasions with a depth greater than 1.59 mm (2/32 inch)	V & M
106-R	Foreign material cured in tread	V
107-R	Open splices in tread, sidewall, or inner liner	V
108-R	Non-fills or cure folds with a depth greater than 3.18 mm (1/8 inch)	V & M
109-R	Off register treads more than 3.18 mm (1/8 inch)	V & M
110-R	Tread flash or mold vents that are not trimmed to within 1.59 mm (2/32 inch) of the surface	V & M
111-R	Unrepaired tire body punctures	V
112-R	Damage to body plies or tread belts that exceed industry recommendations for retreading and repairing	V & X
113-R	Repair units that are dimpled, blistered, improperly installed	V
114-R	Inner liner blisters, voids, tears, or cracks	V
115-R	Visual ply or tread separation in any part of the tire	V
116-R	Voids or anomalies in the tire larger than 6.35 mm (1/4 inch) in diameter	X or H & M
117-R	Lack of proper DOT retread marking	V

H—Holograph M—Measurement V—Visual X—X-ray

4.1.2 TEST EQUIPMENT AND INSPECTION FACILITIES—Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspections shall be established and maintained by the tire contractor. The establishment and maintenance of a calibration system to control and/or procedures used by different testing agencies need not be identical with those described herein; however, a given agency must demonstrate that the equipment and procedures it used produces test results essentially identical to those produced by the corresponding equipment and procedures described in this section to the satisfaction of the Government.

4.2 Classification of Inspection—The inspection requirements specified herein are classified as follows:

a. Qualification Inspection (4.4)
b. Quality Conformance Inspection (4.5)
c. Control Test (4.6)

4.3 Inspection Condition—Unless otherwise specified, all inspections shall be conducted under the following condition:

a. Air Temperature: 23 °C ± 10 °C (73 °F ± 18 °F)
b. Relative Humidity: 10% to 85%

4.4 Qualification Inspection—Qualification for all tires, whether original equipment, new replacement, or retreaded shall consist of all the requirements listed in Table 1 and selected requirement(s) of Table 2. Truck and bus casing for retreading must be marked with Department of Transportation (DOT) or Department of Defense (DOD) code. Low-speed, off-highway casings for retreading must be from tires previously qualified under the Federal Qualified Products List ZZ-T-1083. **The approval of tires tested in accordance with Tables 1 and 2, in whole or in part, may, at the discretion of the tire technical activity for the vehicle system, be extended to other tire sizes.**

4.4.1 RETENTION OF QUALIFICATION—To assure retention of qualification, every 24 months the procuring activity shall notify in writing those tire contractors that certification is due. The tire contractors shall then, within 30 days, submit to the procuring activity the following:

a. Written certification stating that during the previous 24 months the tire contractor has been in production or still has the capability and facilities necessary to produce.

b. If there have been any significant changes to the production methods and/or materials, the tire contractors shall indicate it in their written certification.

c. A summary of the results of tests performed for inspection of product for delivery (Group A & B) indicating as a minimum the number of lots that have passed, the number that have failed, and the group which they failed.

In addition to the periodical submission of inspection data, the contractors shall immediately notify the procuring activity at any time during the 24-month period that the inspection data indicated failure of the qualified product to meet the requirements of this specification.

Based upon the evaluation of the quality deficiency records, re-qualification may be required at the discretion of the procuring activity. If the contractor fails to submit the certification requested, the Government reserves the right to disqualify the contractor.

4.4.2 RE-QUALIFICATION—Manufacturers' tires, new/retreaded, that have been approved shall remain qualified for a period of 8 years before re-qualification is required. If, during the qualification period the manufacturer continues to supply tires, a request for waiver of re-qualification may be submitted. Approval of waiver will be based on submission and review of the certification required in 4.4.1 and the manufacturer's quality history. Failure to comply with the specified requirements will be cause for refusal of waiver and may be cause for removal of the contractor's qualifications.

4.5 Quality Conformance Inspection (QCI)—Inspection of product for delivery shall consist of the A and B examinations and tests under the quality conformance inspection listed in Table 1.

4.5.1 CLASSIFICATION OF QUALITY CONFORMANCE INSPECTION—Quality conformance inspections shall be classified into Groups A and B in accordance with the following groupings, when applicable:

4.5.1.1 Group A—See Table 1 for definition.

4.5.1.2 Group B—See Table 1 for definition.

4.5.2 INSPECTION OF PRODUCT FOR DELIVERY—Inspection of product for delivery shall consist of Groups A and B inspection.

4.5.3 INSPECTION LOT—Unless otherwise specified, a lot shall consist of tires from an identifiable production period, from one manufacturer, submitted at one time for acceptance.

4.5.4 GROUP A INSPECTION—Group A inspection shall consist of the inspections specified in Table 1.

4.5.5 SAMPLING FOR QUALITY CONFORMANCE EXAMINATION/TESTING—Samples for quality conformance examination shall be selected in accordance with Inspection Level II of MIL-STD-105.

4.5.6 INSPECTION CRITERIA—All tires shall be inspected visually after curing for outside and inside anomalies. All tires selected for sampling shall be inspected by use of x-ray or holography for anomalies, such as damaged plies, voids, buckled or wavy cords, and placement of belts. Quality shall be judged by the standards of commercial practice for pass or fail for overall appearance and shall be subject to inspections for the anomalies listed in Tables 4 or 5.

4.5.7 REJECTED LOTS—If an inspection lot is rejected, the contractor may rework it to correct the anomalies, or screen out the rejected units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.5.8 GROUP B INSPECTION—Group B inspection shall consist of the inspections specified in Table 1 and shall be made on sample units which have been subjected to and have passed the Group A inspection.

4.5.9 SAMPLING PLAN—The sampling plan shall be in accordance with MIL-STD-105 for special inspection level S-3. The sample size shall be based on the inspection lot size from which the sample was selected for Group A inspection.

4.5.10 REJECTED LOTS—If an inspection lot is rejected, the manufacturer may rework it to correct the anomalies, or screen out the rejected units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection and shall not, therefore, be tendered for acceptance unless the former rejection or requirement of correction is disclosed. Such lots shall be separate from new lots and shall be clearly identified as reinspected lots.

4.5.11 DISPOSITION OF SAMPLE UNITS—Sample units which have passed all the Group B inspection may be delivered on the contract or purchase order, if the lot is accepted.

4.6 Control Test—Control test samples shall consist of three tires, three tubes, and three flaps, if required. Samples shall be selected at the rates shown in Table 6.

TABLE 6—CONTROL TEST SAMPLE RATES

Calendar-Year Production (per plant)	Control Test
1-2500	1 sample
2501-5000	2 samples
5001 and up	2 samples plus 1 additional sample for each 5000 but not more than 1/month

4.6.1 APPLICABLE TEST—Unless otherwise specified in the contract or purchase order, tires and flaps selected shall be tested by the contractor as specified herein. Control test samples shall be examined for the anomalies specified in Tables 4 and 5 and subsequently subjected to the other applicable tests specified in Table 1.

4.6.2 FAILURE—Failure of a control test tire or flap to pass any of the specified examination or test shall result in the following, at the option of the Government:

a. Retest of two additional tires or flaps and no acceptance made of the tires or flaps on hand at the contractor's plant until retest is complete.

b. Refusal of the Government to authorize shipment of previously manufactured tires or flaps, either from untested or acceptance-tested lots, on hand at the contractor's plant.

4.6.3 PROCEDURE SUBSEQUENT TO FAILURE OF TIRES OR FLAPS—When tires or flaps are rejected on the basis of failure of retested sample, production and acceptance of new tires or flaps can be resumed in accordance with the following provisions, at the option of the Government:

a. Contractor shall submit to the Government satisfactory evidence that the deficient condition has been corrected.

b. The contractor shall then submit a control test sample, representative of the corrected condition, for test. Successful completion of test shall be required before acceptance of new production will be made by the Government.

4.6.4 SAMPLE INSPECTION—Initial control test sample shall be taken at or near the start of production under each contract. Control testing shall be accomplished by the contractor.

4.6.5 CONTRACTOR'S PRODUCTION INSPECTION—If the contractor performs tests similar to those specified in Groups A and B inspections, during and/or as a final step of his production process, the test data generated may be substituted for the Group A and B inspections. Authority to make the substitution shall be granted by the qualifying activity only. The following criteria must be met:

a. Tests conducted by the manufacturer during production shall be clearly identical to or more stringent than those specified for Group A/B inspections.

b. Contractor subject 100% of the product supplied under this specification to the production tests.

c. The parameters measured and the failure criteria shall be the same or more stringent than those specified herein.

d. The lot rejection criterion is the same or more stringent than that specified herein.

e. The contractor shall make available all information concerning the test procedures and instrumentation used in the production test. The manufacturer shall also make available to the Government all records of all detail test data resulting from production tests.

f. Once approved, the contractor shall not change the test procedures or criteria without prior notification and concurrence by the qualifying activity.

4.7 Methods of Inspection

4.7.1 MATERIALS AND CONSTRUCTION—Conformance to 3.2 and 3.3 shall be determined by inspection of contractor's records providing proof or certification that design, construction, processing, and materials conform to requirements.

4.7.2 ANOMALIES—To determine conformance to 3.6, the sample tires shall be examined visually and inspected for internal anomalies in accordance with Appendix A, Section A.1.

4.7.3 TIRE IMBALANCE LIMITS—To determine conformance to 3.4.1, tires shall be tested for static imbalance in accordance with the limits of Table 3.

4.7.4 TIRE NOISE LEVEL—To determine conformance to 3.4.2, tires shall be tested in accordance with the procedures specified in SAE J57.

4.7.5 PLUNGER ENERGY—To determine conformance to 3.4.3, tires shall be tested in accordance with the procedures specified in FMVSS 571.119.

4.7.6 ENDURANCE TEST—To determine conformance to 3.4.4, tires shall be tested in accordance with the procedure specified in FMVSS 571.119.

4.7.7 TIRE TRACTION—To determine conformance to 3.4.5, tire traction test shall be performed to determine traction performance of a tire(s) under specified conditions in accordance with the procedures described in Appendix A, Section A.2.

4.7.8 BEAD UNSEATING—To determine conformance to 3.4.7, a bead unseating test shall be conducted in accordance with the procedures described in Appendix A, Section A.4.

4.7.9 ROLLING RESISTANCE—To determine conformance to 3.4.8, a rolling resistance test shall be conducted in accordance with SAE Lab Test J1269.

4.7.10 TIRE DIMENSIONAL CONSTRAINTS—To determine conformance to 3.4.9, tires shall be examined using standard inspection equipment. For dimensions that require the tire to be mounted and inflated, the tires shall be inflated to the recommended air pressure and allowed to stand for 24 h before measurements are taken.

4.7.11 VEHICLE EVASIVE MANEUVER—To determine conformance to 3.4.6 vehicle evasive maneuver test shall be performed to determine tire performance under specified conditions in accordance with the procedures described in Appendix A, Section A.3.

4.7.12 RIDE HANDLING AND STABILITY TEST—To determine conformance to 3.4.10, the candidate tires will be subject to an on-vehicle road test as described in Appendix A, Section A.6.

4.7.13 OZONE RESISTANCE—To determine conformance to 3.4.11, all tires shipped will be free of cracks and checking when examined under seven power magnification.

4.7.14 MECHANICAL RELIABILITY—To determine conformance to 3.4.12, testing shall be conducted in accordance with the procedures described in Appendix A, Section A.5.

4.7.15 ENVIRONMENTAL TEMPERATURE—To determine conformance to 3.4.13, this test shall be performed to determine the tire's ability to operate successfully during low temperature. Testing shall be conducted in accordance with the requirements specified in the ASTM D 746, at the temperature of –40 °C (–40 °F).

4.7.16 TIRE STORAGE—To determine conformance to 3.4.14, the manufacturer shall provide written certification that tires will withstand extended storage for the time and temperature specified.

4.7.17 REPAIRABILITY—To determine conformance to 3.3.2, the contractor shall certify in writing that the construction of the tire shall be such that it is repairable utilizing those guidelines specified by the Rubber Manufacturers Association (RMA) repair criteria and Federal specification ZZ-P-112.

4.7.18 RETREADABILITY—To determine conformance to 3.3.1, the contractor shall certify in writing that the construction of the new tire shall be such that the casing shall be retreadable.

4.7.19 TIRE MARKINGS—To determine conformance to 3.5, the tires shall be examined for marking requirements.

4.7.20 AGE OF TIRES—To determine conformance to 3.3.4, tires shall be examined to assure that age of tires is not in excess of the time specified.

4.7.21 TREADWEAR INDICATORS—To determine conformance to 3.3.3, tires shall be visually examined for treadwear indicators.

4.7.22 TIRE TREADLIFE DURABILITY—To determine conformance with 3.4.15 the tires shall be tested on the courses required for the mission profile as specified on the original equipment or a revised mission profile requirement. Test shall be conducted in accordance with the procedures described in Appendix A, Section A.7.

4.7.23 TIRE BRAKING TEST—To determine conformance to 3.4.16, the test shall be conducted in accordance with the procedures described in Appendix A, Section A.8.

5. Notes

5.1 Marginal Indicia—The (R) is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

PREPARED BY THE SAE MILITARY/INDUSTRY TIRE TECHNOLOGY SUBCOMMITTEE
OF THE SAE TRUCK AND BUS CHASSIS TECHNICAL COMMITTEE

APPENDIX A
TESTS

A.1 Internal Anomalies Test—This test is to determine in a laboratory either through dissecting, x-ray, and/or holographic inspection if there are any anomalies of ply, belt, cord, or bead.

A.1.1 Test Equipment and Materials—Standard inspection equipment used to dissect tires: x-ray and/or holographic equipment.

A.1.2 The contractor may use x-ray and/or holographic examination. However, if there is doubt as to the validity of the results of x-ray or holographic examination, the contractor may be required to subject the sample tire to cutting. If required, sample tires shall be cut radially into ten equally spaced sections. Each section shall then be cut circumferentially in mid-crown and on each side of crown near breaker edge at point of maximum shoulder thickness. If deemed necessary, additional cutting shall be done in order to do a more complete inspection of the tire samples.

A.2 Tire Traction Test—This test determines the driving traction performance of a tire relative to the reference tire tested under similar specified conditions.

A.2.1 Methodology

A.2.1.1 The driving traction performance of the reference tire shall be used as a basis to compare the performance of candidate tires. Tests shall be conducted on one or more of the surface conditions mud, sand, and snow for both the reference and candidate tire tests. Desired surface conditions shall be selected in advance of the testing. Test results shall be used to determine the traction coefficient[1] of both the reference tire and candidate tire and the traction coefficient from the test shall be comparatively evaluated. Two methods of tests may be used for this determination: the single wheel traction test and/or the drawbar pull test. The single wheel traction test shall facilitate a more expedient means of selecting from multiple tire candidates. Drawbar pull tests shall then be used in making the final selection(s).

A.2.1.2 To evaluate the driving traction of all tires on mud, sand, and snow use the facilities and procedures shown in A.2.2.

A.2.1.2.1 The procedures specified in SAE J1466 may be used as an alternate method to evaluate the driving traction of light truck tires on a prepared snow surface.

A.2.2 Facilities

A.2.2.1 TEST VEHICLE

A.2.2.1.1 Single Wheel Tests—A test bed capable of providing single driving tire traction shall be equipped with an instrument package capable of measuring the longitudinal and vertical wheel forces as well as the velocity of the test wheel and ground speed. The capability of logging of the data at a minimum sampling rate of ten samples per second is required. The driving test tire shall be positioned to eliminate the test tire tracking another tire through the test course.

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[1] Traction coefficient is defined as the longitudinal force from the tire divided by vertical load.

A.2.2.1.2 Drawbar Pull Tests—The test vehicle shall be all-wheel drive equipped with the reference or candidate tires in all wheel positions. The test vehicle shall be run together with a dynamometer vehicle of adequate size and load to permit controlling the test vehicle speed. The connection between the vehicles shall be a cable or a tow bar parallel to the ground containing a load cell capable of measuring the drawbar force. Instrumentation recording the drawbar force, time, wheel speed(s), and ground speed shall be installed in the dynamometer vehicle. Sampling rate for the previous measurements shall be a minimum of 10 samples per second.

A.2.2.2 SOIL TEST COURSES—Tests shall be conducted on courses prepared to the following specifications:

A.2.2.2.1 Soil Tests—At least two courses for each selected condition shall be required to provide a large enough area to accommodate testing. The test sections shall be uniform, level, relatively smooth, with no vegetation, a minimum of twice the tire section width by 152.4 m (500 ft) long for single wheel tests and 6.1 m (20 ft) wide by 91.4 m (300 ft) long for drawbar tests. Prior to testing, the courses shall be prepared to a uniform depth and strength and exhibit no evidence of previous usage. Cone penetrometer measurement(s) shall be taken in a cross-hatch pattern not exceeding 3.0 m (10 ft) to determine uniformity of compaction. Soil samples shall be collected at three locations in the test courses at the surface, and 152.4 mm (6 inches) in depth.

A.2.2.2.2 Fine-Grained Soil (Mud)—This test section shall be constructed of silt (ML—as defined by Unified Soil Classification System). The depth of the ML soil shall be at least 762 mm (30 inches) and compacted to provide a cone index of at least 300 throughout the soil profile prior to wetting. Before the start of the tests on each course, an amount of water that simulates 12.7 mm (0.5 inch) of rainfall shall be sprayed uniformly over the course. A 5-minute waiting period shall be observed between the end of wetting and the start of traction testing, and testing shall be completed within 15 minutes of water application. Each test shall be conducted on untracked material. Soil moisture content shall be determined at three locations in the test section at 0 to 25.4 mm (0 to 1 inch), 25.4 to 76.2 mm (1 to 3 inch), and 76.2 to 152.4 mm (3 to 6 inch) depths.

A.2.2.2.3 Coarse-Grained Soil (Sand)—This test section shall be constructed of sand (SP—as determined by USCS). The depth of the SP soil shall be at least 762 mm (30 inches), tilled to at least 203.2 mm (8 inches), and dried to a moisture content of less than 2.0% in the top 76.2 mm (3 inches) of sand. The cone index at the 76.2 mm (3 inch) depth shall not exceed 100.

A.2.2.2.4 Snow—A sufficient amount of snow shall be compacted such that a first untracked pass of the test tire exhibits a sinkage of at least one tread depth. If compaction or grooming is necessary to obtain the required snow surface, the test course can be aged before testing begins. Temperatures at 25.4 mm (1 inch) below the test surface shall be between –12.2°C (+10 °F) and –3.9 °C (+25 °F). Each test shall be conducted in a fresh test surface. Snow course preparation is extremely critical for obtaining valid results.

A.2.2.2.5 Instrumentation

A.2.2.2.5.1 Longitudinal and vertical forces on the test, along with test wheel and vehicle speeds, shall be measured within 2% accuracy as established by annual National Institute of Standards Technology (NIST) traceable calibration.

A.2.3 Preparation for Tests

A.2.3.1 All transducers and instrumentation must be calibrated according to recognized procedures.

A.2.3.2 TIRES—Two new tires for the single wheel tests and two new tires for each tire position for the drawbar test shall be required as test samples for each variable. These samples shall be production tires (or experimental), inspected by the maker to be free of anomalies and conforming to applicable standards of manufacture. The tires shall be free of mold flash, lubricants, and shall have tread labels removed. In addition, test and reference tires shall not have any force or run-out grind.

A.2.3.3 RIM/WHEELS—The tires shall be mounted on the rim/wheels specified in the TRA Military Supplement for the size being tested. Rim/wheels must be compatible with actual tire maximum load and inflation pressure.

A.2.3.4 INFLATION PRESSURE—Tire pressures shall be per the applicable technical manual based on the mission profile (unless otherwise specified).

A.2.3.5 BREAK-IN—Each of the test samples shall be driven at maximum vehicle speed (not to exceed 55 mph) on a dry paved surface for 100 miles inflated to the highway tire pressure.

A.2.3.6 INITIAL TIRE MEASUREMENTS—The tires shall be inspected and measured following the break-in. Measurements shall be at three locations around the periphery of the tire and shall include: tread depth at crown and shoulders, tread profile, section width, tread radius, tread arc width, and outside diameter.

A.2.4 Test Procedure

A.2.4.1 Warm up electronic test equipment as required for stabilization.

A.2.4.2 Test tires must be stabilized at ambient temperature and shielded from direct sunlight before testing.

A.2.4.3 The test vehicle shall be loaded so that each individual static test tire load(s) is within +5% of the maximum tire load for the intended vehicle (unless otherwise specified). The single wheel tests shall measure the average dynamic tire load for a series of test runs for calculation of tractive co-efficients.

A.2.4.4 Adjust tire inflation pressure immediately before testing to the specified test inflation pressure, +7 kPa (+1 psi) –0 kPA (0 psi).

A.2.4.5 Record tire identification and other data, including date, time, ambient temperature, test surface temperature, type of test surface, etc.

A.2.4.6 Record all test data information relative to the actual test.

A.2.4.7 SINGLE WHEEL METHOD—The test vehicle shall be equipped with either the reference or candidate tire, and the load adjusted to the static load requirement. Operation shall be at a ground speed of 4.02 km/h (2.5 mph) driven by the test wheel and controlled by the action of the operator on the brakes of the non-test wheels. The vehicle shall enter the test area, and the operator engage a throttle actuator while maintaining a ground speed of 4.02 km/h (2.5 mph). The actuator shall be adjustable to allow at least 1.5 seconds for a wheel speed acceleration from 4.02 km/h to 24.1 km/h (2.5 to 15 mph). A minimum of ten of these spin-ups shall be made with each test sample and control tire.

A.2.4.8 DRAWBAR METHOD—For each test, the test vehicle shall be positioned outside the test course and immediately in front of and connected to the dynamometer vehicle with a cable or drawbar. The test vehicle shall operate in the lowest gear for a ground speed of approximately 4.02 km/h (2.5 mph) at its optimum engine rpm for maximum torque and proceed into the test course lane with no load on the drawbar. Load shall be gradually applied to the drawbar by the dynamometer operator, increasing the power required by the test vehicle to maintain a constant engine rpm. The test vehicle progresses in steps from a 0 load/0 slip condition to a high load/max slip condition. Immediately following completion of the first test, the vehicles shall be repositioned at the beginning of the test lane offsetting the tracks of the first test. A minimum of three drawbar tests shall be conducted.

A.2.5 Data Analysis

A.2.5.1 SINGLE WHEEL TESTS—Both tabular and graphical data from the ten runs shall be obtained expressing the tractive coefficient of the reference tire and the candidate tire as a function of slip velocity. The mean peak traction coefficient shall be shown as well as the area of the traction curve from 1.6 to 16.1 km/h (1.0 to 10.0 mph) slip velocity. A statistical analysis showing standard deviation and coefficient of variation of the peak and area for the group of runs is also made. The candidate tire(s) shall be rated as a percentage of the reference tire performance at 100%.

A.2.5.2 DRAWBAR TEST—Traction in terms of traction coefficient at various slip values for each test shall be obtained from the test records and plotted as tractive coefficient versus percent wheel slip (wheel speed – ground speed/ground speed x 100). A line of best fit shall be drawn through the data to produce the performance curve for each test condition. The highest traction coefficient value between 0 and 90% slip from the performance curve shall be determined from the tests. Values for candidate tires and a reference tire for the same surface condition, shall be used to compare tire performance, with candidate tire(s) rated as a percentage of the reference tire performance.

A.3 Vehicle Evasive Maneuver Test

A.3.1 Scope—This test procedure is intended to be used as a field test procedure; however, the basic criteria are also intended to provide a standard reference for simulation of the basic maneuvers through various mathematical modeling techniques.

This document provides a procedure and instructions for:

A.3.1.1 INSTRUMENTS AND EQUIPMENT

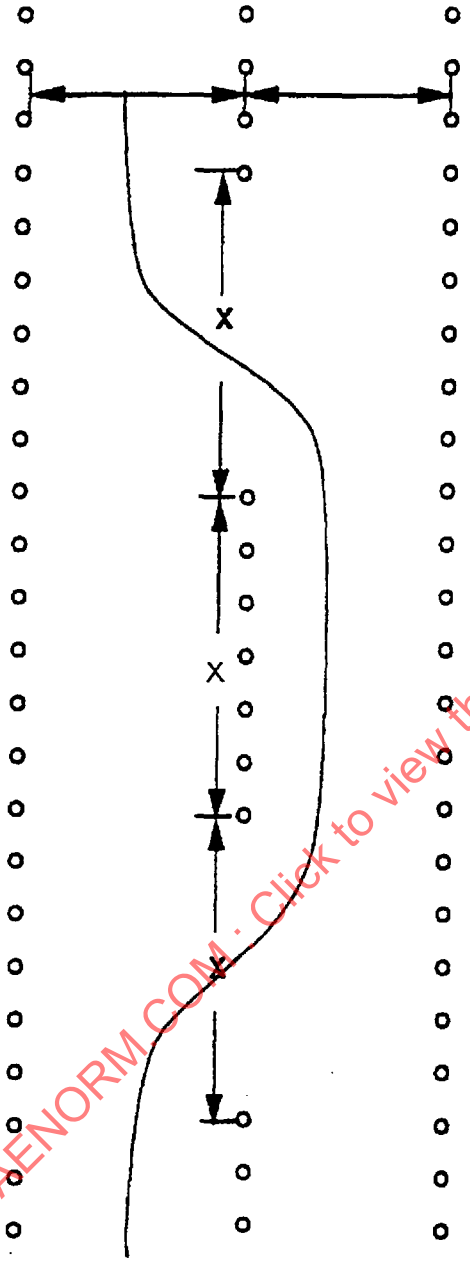
A.3.1.2 VEHICLE PREPARATION

A.3.1.3 TEST OF SINGLE AND COMBINATION VEHICLES

A.3.2 Purpose—This procedure provides a method to evaluate the stability of vehicles under simulated highway conditions. Loss of control stability is of primary concern.

A.3.3 Facilities, Instrumentation, and Equipment

A.3.3.1 A flat, level (not to exceed 1% grade) surface of concrete or black-top large enough to contain the course shown in Figure A1, as well as adequate acceleration and deceleration lanes. An adequate safety zone on each side of the course is also required. When performing the wet evasive maneuver, the surface shall be wetted by external means either with a watering truck or sprinkler trickle watering system. The water depth not to exceed 0.050 inch. In any case, there shall be no dry spots on the test course immediately prior to and during the test.



X = (2 x WB) + L

WHERE

WB = WHEELBASE OF VEHICLE
L = OVERALL LENGTH OF VEHICLE

NOTE:

PYLONS TO BE LOCATED AT 1.22 M (4 FT) INTERVALS AND BE NUMBERED TO IDENTI THEIR LOCATION ON THE COURSE

FIGURE A1—COURSE LAYOUT

A.3.3.1.1 The test surface shall be free from any loose material.

A.3.3.1.2 The wind velocity shall not exceed 5 mph (8 km/h) and both velocity and direction shall be recorded in the test results.

A.3.3.2 Vertical pylons of expendable or deformable material to mark the course as indicated by the "o" marks on Figure A1. Pylons shall be sufficiently high to assure no portion of the vehicle passes over the top without contacting the pylon.

A.3.3.3 A calibrated device shall be used to measure vehicle speed.

A.3.4 Vehicle Preparation

A.3.4.1 Vehicles to be tested shall be serviced in accordance with manufacturers' recommended procedures.

A.3.4.2 Payloads shall be loaded and secured to obtain GVW in accordance with normal military practice except that testing with abnormal payloads should be considered; i.e., loads with high center of gravity, live loads, such as partially full tank trucks, etc. It is strongly recommended that reasonable loads of these types be investigated to assure stable operation under normal usage. In particular, van bodies should be loaded with a payload distributed throughout the van interior such that the center of gravity is in the center of the van volume vertically, transversely, and longitudinally. Consideration should be given to testing with representative "worst case loads" with the load off-center transversely.

A.3.5 Calculation of Test Course Dimensions—The dimension "X" on Figure A1 shall be calculated as follows for each vehicle or vehicle combination tested:

$$X = (2\,WB) + L \qquad \text{(Eq.A1)}$$

where:

WB = wheelbase of vehicle
L = overall length of vehicle or vehicle combination

A.3.6 Method

A.3.6.1 The vehicle shall be driven by a competent test driver well trained and thoroughly familiar with the test vehicle. Successive trials shall be conducted through the test course at gradually increasing speeds to determine the maximum speed at which the vehicle (or vehicle combination) can negotiate the course without contacting any of the pylons or other loss of control. Repeat runs shall be made until the test director is satisfied that the maximum speed has been defined within ±1.6 km/h (±1 mph). The test driver shall be permitted to call any run invalid based solely on his/her judgment. For each run the vehicle shall enter the test area in the center of the lane and shall not initiate any turn until the front of the vehicle has passed the start of the "gate."

A.3.6.2 Observers shall be stationed to:

a. Observe all wheels of the vehicle(s) in order to note any "lift-off," and
b. Observe any contact between the vehicle and the pylons.

A.3.7 Tabulation of Data

A.3.7.1 The configuration of each vehicle payload combination tested shall be recorded in the format shown in Figure A2. (Additional columns should be added as needed for vehicle combinations consisting of more units.) Payload center of gravity and moments of inertia are desirable when available. When these detailed data are not available, a full description of the payload shall be included and as a minimum the individual axle loads shall be recorded for each payload configuration.

Configuration code (for cross-reference) _____

Vehicle Description:

Truck/Tractor	Trailer/Semi-Trailer/_____	Trailer
Make: _____	Make: _____	Make: _____
Model: _____	Model: _____	Model: _____
Year Mfr'd: _____	Year Mfr'd: _____	Year Mfr'd: _____
VIN (or Ser.No.): _____	VIN (or Ser.No.): _____	VIN (or Ser.No.): _____
Weight as tested: _____	Weight as tested: _____	Weight as tested: _____
Wheelbase: _____	Wheelbase: _____	Wheelbase: _____

Suspension:

Frt: _____ Rear: _____ Frt/tag: _____ Rear: _____ Frt/tag: _____ Rear: _____
Rate/type (leaf, torsion bar, air, etc.)

Axle loads:

Frt: _____ Rear: _____ Frt: _____ Rear: _____ Tag: _____ Rear: _____

Payload narrative description:

_____

_____

Center of gravity height from ground (if available)

Truck: _____	Truck payload: _____	Truck with payload: _____
Trailer: _____	Trailer payload: _____	Trailer with payload: _____
Trailer: _____	Trailer payload: _____	Trailer with payload: _____

Moments of inertia (as available):

FIGURE A2—DESCRIPTIVE INFORMATION

A.3.7.2 For each test run, the data on Figure A3 shall be recorded.

Date:_____ Wind velocity:_____ Direction:_____ Friction coefficient: _____

Configuration code:_____ Run number:_____ Direction:_____ Start from right or left:_____

Gate dimension ("X"): _____

Vehicle speed at entry: _____ Vehicle speed at exit:_____

Pylons displayed (area/number):_____/_____;_____/_____

Wheel lift-off observed: _____

Comments: _____

_____

FIGURE A3—TEST DATA

A.4 Military Tire Bead Unseating Test

A.4.1 Purpose—A test method to determine tire/rim slip, air loss or bead unseating when operated at the minimum recommended inflation pressure.

A.4.2 Definitions—For the purpose of this procedure, the following definitions apply:

A.4.2.1 VEHICLE SPEED—The actual over-ground velocity of the test bed vehicle at the time test speed is recorded.

A.4.2.2 TEST TIME—The time taken to cover the test distance, expressed in second(s).

A.4.2.3 TEST DISTANCE—The measured distance traveled by the vehicles during the test time, expressed in meters (m) or feet (ft).

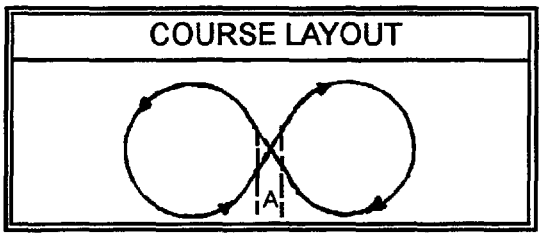
A.4.2.4 TEST VEHICLE MASS—The mass of the test vehicle as tested, including operator, fuel, and all fluid compartments at their specified levels, expressed in kilogram (kg) or pound (lb).

A.4.2.5 HOT TIRE INFLATION PRESSURE—The inflation pressure in the test tire at the conclusion of the test expressed in kilopascals (kPa) or pounds per square inch (psi).

A.4.2.6 COLD START TIRE INFLATION PRESSURE—The inflation pressure in each test tire measured prior to start of test expressed in kPa or psi.

A.4.2.7 TEST RUN—Total test distance at each test speed in terms of test course laps.

A.4.2.8 TEST COURSE LAYOUT—Equal radius figure 8 configuration of predetermined asymmetrical curvatures on a level graded surface within 0.5% grade. (See Figure A4.)



Where A=2 times vehicle wheelbase.

THE COURSE LAYOUT IS TWO OFF-SET CIRCLES CONNECTED BY TWO SHORT CRISSCROSSING STRAIGHTS.

FIGURE A4—BEAD UNSEATING TEST

A.4.2.9 TEST COURSE BASE MATERIAL—Sand with test tire travel path pre-rutted to a depth equal to one-half the tire's section height at the outside sidewall.

Course-Grained Soil (Sand)—This test section shall be constructed of sand (SP—as determined by USCS). The depth of the SP soil shall be at least 762 mm (30 inches), tilled to at least 203.2 mm (8 inches), and dried to a moisture content of less than 2.0% in the top 76.2 mm (3 inches) of sand. The cone index at the 76.2 mm (3 inch) depth shall not exceed 100.

A.4.2.10 TEST COURSE RADIUS OF CURVATURE—Outer one-half of the opposing curvatures bisected by the length of the course to be:

The radius at the centerline of the vehicle's front axle travel path is that which is produced by steering the vehicle at 90% of its specified full lock turn.

A.4.2.11 TEST TIRE LOADS—The test vehicles shall be loaded so that each individual static test tire load(s) is within +5% of the maximum tire load for the intended vehicle (unless otherwise specified).

A.4.2.12 TEST TIRE RIMS/WHEELS—Rims/wheels conforming to TRA Military Supplement and vehicle manufacturer specifications.

A.4.3 Instrumentation Required

A.4.3.1 SPEED

a. A device to measure actual ground speed.
b. A lap time measurement device.

A.4.3.2 INFLATION PRESSURE—A calibrated pressure gauge.

A.4.3.3 RIM/BEAD SEAT DIMENSION—TRA disk tape (or equivalent) for bead seat diameter and TRA Rim Contour Gauges (or equivalent) for other rim dimensions relating to tire fitment.

A.4.3.4 LOAD SCALES—Mechanical or electronic weight scales with 2% full scale accuracy.

A.4.3.5 ENVIRONMENTAL MEASUREMENTS—Ambient temperature and % relative humidity at beginning and end of each test sequence.

A.4.3.6 CONE PENETROMETER—To measure Cone Index (CI) and Remolded Cone Index (RCI) of test area berm soil before and after each test sequence (ref. NRMM procedure).

A.4.4 Test Procedures

A.4.4.1 TIRES AND WHEELS—Inspect and measure test rims.

All tires shall be mounted for this test using the same procedures. Record maximum inflation pressure required to seat bead. Inflated tires at test pressure should be stored for at least 24 hours prior to mounting on vehicle.

Test tires should be broken in by operating them on a hard surface road for 160.9 km (100 miles) at test load and maximum test inflation pressure at 80.47 km/h ± 8.05 km/h (50 mph ± 5 mph) average.

A.4.4.2 TEST TIRE POSITIONS—Both front steering positions. Any nontest wheel positions should have tires and wheels of the same size, inflation pressure, and normal maximum load distribution.

A.4.4.3 Test sequence should start at the intersection of the figure 8 and proceed clockwise into the first turn. Test speed constant should be achieved after first figure 8 lap. Cumulative lap timing for six laps at constant speed should begin after first lap is completed.

A.4.4.4 Cold tire pressures should be set at the minimum recommended inflation pressure immediately prior to the start of the six-lap sequence.

Measure inflation pressures and the tire rim rotational displacement at the completion of the six-lap sequence.

The inflation pressure of the reference tire at the conclusion of the test must not be lower than 1 psi below the cold inflation pressure at the start of the test in order to proceed to the candidate tire.

A.4.4.5 Test vehicle constant speeds limit maximum controllable safe speed.

A.4.5 Data Requirements

A.4.5.1 DATA REDUCTION—Data reduction should include:

a. Average mph
b. Total distance to air loss
c. Total time to air loss
d. Measured air loss
e. Measured rotational displacement
f. Measured rut depth
g. Measured temperature (ambient °F)
h. Measured inflation pressure at start and finish
i. Measured RCI and measured CI at each curve prior to and end of test

A.4.5.2 All test data shall be recorded.

A.5 Military Tire Mechanical Reliability Test

A.5.1 Purpose—A test method to determine a tire's ability to withstand sustained operation on severe off-road conditions.

A.5.2 Test Vehicle—The vehicle must be capable of meeting test criteria.

A.5.3 Test Course—The test course(s) shall be comprised of disjunctive section of obstacles in a natural environment developed to be discrete, repeatable, unavoidable. The life cycle course will be a mix of 30% secondary with severe washboard, 30% rock terrain, and 40% cross-country terrain.

A.5.3.1 INSTRUMENTATION—Profiling equipment or a profiling vehicle equipped and instrumented to continuously measure and record the forces and accelerations will be required to quantify the courses. A measuring device for ground speed will be required for distance measurements along the courses.

A.5.3.2 The tire test vehicle will be equipped with a miles per hour recording tachograph, either cable or electronically driven, calibrated to ±2% to provide documentation of test miles achieved.

A.5.4 Preparation for Tests

A.5.4.1 TIRES—Reference and candidate tires will be tested on each surface condition.

A.5.4.2 RIMS/WHEELS—The tires shall be mounted on rims/wheels specified in the TRA Military Supplement for the size being tested, unless the military specification requires a rim/wheel that differs from the TRA Military Supplement recommendation. In the latter case, the military specification will apply.

A.5.4.3 INFLATION PRESSURE—Tire pressures shall be per the applicable technical manual based on the mission profile (unless otherwise specified).

A.5.4.4 BREAK-IN—Each of the test samples shall be driven at maximum vehicle speed (not to exceed 88.514 km/h [55 mph]) on a dry paved surface for 160.93 (100 miles) inflated to the highway tire pressure.

A.5.4.5 INITIAL TIRE MEASUREMENTS—The tires shall be inspected and measured following the break-in. Measurements shall be at six locations around the periphery of the tire and shall include: tread depth at crown and shoulders, tread profile, section width, tread radius, tread arc width, and outside diameter.

A.5.5 Test Procedures

A.5.5.1 TEST CONDITIONS

A.5.5.1.1 Selecting Test Road—The durability course will be selected with the following characteristics as a guideline.

a. Washboard—Amplitude 25.4 to 101.6 mm (1 to 4 inches), frequency 203.2 to 914.4 mm (8 to 36 inches)
b. Rock Terrain—Irregular shaped stone embedded in clay soil with rock size 76.2 to 152.4 mm (3 to 6 inches) and protruding 25.4 to 152.4 mm (1 to 6 inches) high, randomly spaced at 942 cm^2 ($1/ft^2$)
c. Cross-Country—A combination of hills and curves across terrain with embedded stones at a random spacing frequency of no less than 557 cm^2 ($0.60/ft^2$.) The cross-country shall have a section of rutted trail with stones embedded for direct impingement of the tread and sidewall.

A.5.5.1.2 Tire Load—The test vehicle shall be loaded so that each individual static test tire load(s) is within +5% of the maximum tire load for the intended vehicle (unless otherwise specified).

A.5.5.2 TEST CYCLE—The test tires will be run in sequence of 144.84 km (90 miles) of secondary (washboard), 144.84 km (90 miles) of rock terrain, and 193.12 km (120 miles) of cross-country. This sequence will be repeated to complete a 965.61 km (600-mile) cycle.

A.5.5.3 MEASUREMENT AND RECORDING DATA—In addition to the initial tire measurement, the tires shall be measured and inspected as specified in A.6.4.5 at the end of each 965.61 km (600-mile) cycle. Inspection to establish casing growth, cutting, chipping, bruising, and air loss modes will be included. This data and the average velocity/mileage calculations will be entered on a test data sheet.

A.5.5.4 TEST DURATION—The tests shall be extended to a maximum of four cycles (3862.43 km [2400 miles]) for acceptable durability of the tires.

A.5.6 Data Reduction and Analysis—The distances traveled shall be determined by the measured course length. Odometer readings will be recorded for each course segment for reference. Time for each cycle shall be measured from start to finish of each segment of the test route as recorded on the tachograph and driver's log. A segment is defined as the completion of terrain type and the initiation on the subsequent terrain type.

A.6 Ride Handling and Stability Test

A.6.1 Purpose—A test method to determine a tire's acceptance to an on vehicle ride, handling and stability when subjectively rated by three qualified drivers operating the vehicle for 40.23 km (25 miles) each over a course which simulates the mission profile requirements of the vehicle.

A.6.2 Test Vehicle—A vehicle for which the candidate tires are intended shall be used.

A.6.3 Preparation for Tests

A.6.3.1 Test tires will be mounted on the vehicle rims and each tire/wheel assembly shall be balanced and mounted on the vehicle. Tire inflation pressure shall be adjusted to the recommended pressure for the terrain to be traversed. Vehicle drivers shall drive the test vehicle equipped with both the reference tires as well as the candidate tires prior to making their judgment.

A.6.3.2 Vehicle alignment shall be checked to assure conformance to the vehicle manufacturer's specifications.

A.6.3.3 The vehicle shall be loaded to the maximum allowable load for the terrain to be traversed.

A.6.4 Test Procedure—Each driver shall subject the vehicle to hard braking, sharp left and right turns, left and right cornering, and abrupt lane changes. Each of these maneuvers shall be repeated the minimum number of ten times for each phase of the mission profile. All testing shall be conducted on dry surfaces only at an ambient temperature of 4 to 38 °C (40 to 100 °F). All maneuvers shall be done at speeds which will not exceed the safe maneuvering speed of the vehicle.

A.6.5 Tire Failures—If any tire fails during road tests, a spare tire shall be mounted on the rim, the balanced assembly reinstalled on the vehicle and testing continued.

A.6.6 Rating of Tires—At the conclusion of testing, each driver shall rate performance for candidate tires as compared to reference tires on a scale of one to ten, with the reference tire value being arbitrarily set at five. If the majority of ratings is five and above, the candidate tires are considered acceptable. If the majority of ratings falls below five, the candidate tires shall be considered unacceptable.

A.7 Tire Treadlife Durability

A.7.1 Purpose—A test method to determine a tire's treadlife durability following vehicle mission profile requirements.

A.7.2 Facilities

A.7.2.1 TEST VEHICLES—The vehicle used for treadlife testing shall be the production or prototype vehicle designed for and specified with the tire size being tested. A suitable alternate can be used provided it has similar vehicle characteristics and suspension system as the production vehicle, has limited service miles, and is properly aligned.

A.7.2.2 TIRES—A reference tire is required for comparison and the tires must be rotated between vehicles maintaining the same wheel position to experience equal test mileage on each road service condition on all vehicles in the test.

A.7.3 Test Course—The test duration shall be a minimum of 16 093 km (10 000 miles) or the system specification tire mileage requirement. The test surfaces should reflect the mission profile contained in the system specification for the vehicle. For example: 25% paved, 25% rough gravel, 30% level x-country and 20% hilly x-country.

A.7.4 Preparation for Test

A.7.4.1 TIRES—The appropriate number of tires for the vehicle, including spares, are required for test. These samples shall be production or pre-production tires free of anomalies and conforming to the manufacturer's standards.

A.7.4.2 RIMS/WHEELS—The tires shall be mounted on rims/wheels specified by the vehicle manufacturer or the TRA Military Supplement for the tire size being tested. Rim width and bead seat diameter shall be measured to insure rims conform to TRA standards.

A.7.4.3 INFLATION PRESSURE—Tire pressure will be adjusted to the vehicle manufacturer's recommendation for the tire load, vehicle speed, and service conditions being tested. For most vehicles different pressures will be used for highway, cross-country, and mud, sand, and snow conditions.

A.7.4.4 BREAK-IN—An initial break-in period of not less than 160.9 km (100 miles) and no more than 482.8 km (300 miles).

A.7.4.5 INITIAL TIRE MEASUREMENTS—The tires shall be inspected and measured following the break-in. Measurements shall be at six locations around the periphery of the tire and shall include: tread depth at crown and shoulders, tread profile, section width, tread radius, tread arc width, and outside diameter.

A.7.5 Test Procedures

A.7.5.1 TEST CONDITIONS

A.7.5.1.1 Test courses and the percent mileage on each surface selected for treadwear test shall reflect the mission profile of the vehicle.