

MIL-T-45301D
22 June 1987

Superseding
MIL-T-45301C
26 August 1982

MILITARY SPECIFICATION

TREAD ELASTOMER: SOLID TIRE, FOR TRACK LAYING VEHICLES

This specification is approved for use by the US Army Tank-Automotive Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers 6 classes of unvulcanized tread elastomer used in the rebuilding of roadwheels and track support rollers for track laying vehicles.

1.2 Classification. Tread elastomer shall be classified as follows:

Class 1	Piece (cut to length).
Class 2	Roll (cut to length).
Class 3	Sheet.
Class 4	Unmixed sheets (two part batch).
Class 5	Strip form (for cold feed extruder and injection molding).
Class 6	Black master batch with separate unmixed chemicals (for mill mixing).
Group A	Physical properties - Standard tensile.
Group B	Physical properties - High tensile.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Tank-Automotive Command, ATTN: AMSTA-GDS, Warren, MI 48397-5000, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

MIL-T-45301D

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

L-P-512 - Plastic Sheet (Sheeting), Polyethylene.

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-177 - Rubber Products, Terms for Visible Defects of 1
MIL-STD-45662 - Calibration System Requirements.

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity, or as directed by the contracting officer.)

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D297 - Rubber Products - Chemical Analysis.
ASTM D412 - Rubber Properties in Tension.
ASTM D518 - Rubber Deterioration - Surface Cracking.
ASTM D573 - Rubber Deterioration in an Air Oven.
ASTM D792 - Specific Gravity and Density of Plastics by Displacement.
ASTM D1149 - Rubber Deterioration - Surface Ozone Cracking in a Chamber (Flat Specimen).
ASTM D1415 - Rubber Property, International Hardness.
ASTM D1566 - Standard Definitions of Terms Relating to Rubber.
ASTM D1646 - Rubber - Viscosity and Vulcanization Characteristics (Mooney Viscometer).

MIL-T-45301D

ASTM D2137	- Rubber and Rubber-Coated Fabrics - Brittleness Temperature by Impact, Test Methods for.
ASTM D2240	- Rubber Property - Durometer Hardness.
ASTM D2702	- Rubber Chemicals - Determination of Infrared Absorption Characteristics.
ASTM D3182	- Rubber Materials, Equipment and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets.
ASTM D3183	- Rubber - Preparation of Pieces for Test from Other than Standard Vulcanized Sheets.

(Application for copies should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and Federal agencies).

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First article. Unless otherwise specified, the contractor shall furnish tread elastomer which shall be subjected to first article inspection (see 4.4 and 6.4). The first article sample shall consist of the following material:

- (a) Class 1: 10 preformed pieces.
- (b) Class 2: 3 rolls.
- (c) Classes 3, 4, 5, and 6: 360 pounds (lb) [164 kilograms (kg)].
- (d) All classes: Five (5) platen press sheets (see 4.6.1). If several die sizes of class 1 and class 2 tread elastomer are ordered, unless otherwise specified (see 6.2), die size for tire size 26 x 6 and die size for tire size 24 x 2 1/8 shall be furnished.

First article inspection samples, properly marked with identifying information shall be representative of the elastomer to be furnished to the Government. All subsequent tread elastomer delivered to the Government shall conform to these samples in all their pertinent physical and performance attributes.

3.2 Materials.

3.2.1 Tread elastomer. The chemical compounding of tread elastomer shall be such that all classes and sizes of both groups are black. When Group B elastomer is furnished in the P-12 material, its compound formulation shall be in accordance with table I (see 4.1.2).

MIL-T-45301D

3.2.2 Tie gum. Tie gum, when specified (see 6.2), shall be elastomer. Tie gum shall not include any reclaimed rubber (see 4.1.3).

3.2.3 Backing. Backing shall conform to L-P-512 and may be either flat or embossed (see 4.1.3).

3.2.4 Processability. The unvulcanized tread elastomer furnished under this specification shall be capable of being processed in existing rebuilding equipment, without modification, utilizing the methods and related materials of the facility performing the vulcanization. Vulcanization time for laboratory ASTM 3182 specimens shall not exceed 90 minutes at a temperature of 280 degrees Fahrenheit ("F") [137 degrees Celsius ("C")]. Processing instructions and recommended curing time and temperature shall be furnished for class 3, 4, 5 and 6 tread elastomer (see 4.1.3).

3.2.5 Recycled, virgin, and reclaimed materials. There are not requirements for the exclusive use of virgin materials; however, all materials shall be new and unused. The use of recycled or reclaimed (recovered) materials is acceptable provided that all other requirements of this specification are met and that the suppliers' employees are not exposed to undue hazards from the recovered materials (see 6.7.1).

TABLE I. Compound formulation
Group B, P 12 material.

Materials	Relative weight	Chemical composition
SBR 1500	70.000	Polymer
Cis-4 1203 or CB 220 <u>1/</u>	30.000	Polymer
Zinc oxide	3.00	
Stearic acid	2.00	
N220 carbon black	62.00	
Flexzone 7-L <u>1/</u>	3.00	(N-1, 3-Dimethybutyl-N'-phenyl-p-phenylenediamine)
Sunolite 100 <u>1/</u>	1.50	(Blend of Waxy Hydrocarbons)
Agerite Resin D <u>1/</u>	2.00	(Polymerized 2, 2,4-trimethyl-1, 2-dihydroquinoline)
Sundex 790 <u>1/</u>	2.00	Oil
Nobs special <u>1/</u>	1.20	[N-oxydiethylene-2-benzothiazole-sulfenamide (2-morpholinothio) benzothiazole]
Santogard PVI <u>1/</u>	0.20	[N-(cyclohexylthio) phthalimide]
Sulfur	1.60	
178.50		
Total Formula Weight		

1/ Substitution may be made with chemical equivalents from other manufacturers.

MIL-T-45301D

3.3 Construction.

3.3.1 Class 1 and class 2. Unless otherwise specified (see 6.2), class 1 and class 2 tread elastomer shall be supplied with a 0.003 inch (in) [0.076 millimeter (mm)] minimum layer of plastic sheet backing (see 3.3.3) on the tread surface with the greatest dimension. When tie gum is specified (see 6.2), the tread elastomer shall be an assembly consisting of a layer of tread compound (see 3.3.1), a 0.031 in (.787 mm) minimum layer of tie gum on the tread surface with the greatest dimension (see 3.3.2), and a 0.003 in (0.076 mm) minimum layer of a plastic sheet backing on the tie gum (see 3.3.3). The bonding of these materials shall be such that they will not separate during shipping, normal" handling, and processing, including vulcanizing of the tread and tie gum, if applicable, to the wheels. The bond between the tie gum and tread elastomer must be not less than 5 pounds per inch [875.6 newtons per meter (N/m)] of width. Removal or separation of the plastic backing shall not result in separation of the tie gum from' the tread (see 4.1.4).

3.3.2 Class 3, class 4, class 5 and class 6. Unless otherwise specified (see 6.2), classes 3, 4, 5, and 6 tread elastomer shall be furnished with an anti-stick material either applied to the elastomer or inserted 'between the elastomer sheets, This anti-stick material, a coating intended to be blended into the tread elastomer when milled and extruded, shall not produce any deleterious changes in the physical properties or performance of the cured tread elastomer. Tread elastomer shall be capable of being milled and 'extruded to the required die sizes and cured to meet the requirements of this specification (see 4.1.4).

3.3.2.1 Class 4. Class 4, tread elastomer shall be furnished in two unmixed sheets (sheet 1 and sheet 2) with the reactive agents separated. The two sheets shall be sized so that equal lengths of sheet, when properly mixed, extruded and cured, shall provide a tread elastomer that meets all of the requirements of this specification. Adequate marking shall be provided. to alert processing personnel as to proper ratios and identity. Identification and instructions shall include directions for mixing equal lengths of sheet 1 and sheet 2. The contractor's recommended temperature, curing time and processing instruction shall be included (see 4.1.4).

3.3.2.2 Class 6. Class 6 tread elastomer shall be furnished as masterbatch blocks or presized sheets of elastomer with the curing agents and chemical additives packaged in premeasured quantities. The masterbatch elastomer, when processed to the contractor's recommended procedure and with the ingredients supplied, shall provide a tread elastomer that meets all of the requirements of this specification (see 4.1.4).

3.4 Classes and sizes.

3.4.1 Class 1. Unless otherwise specified (see 6.2), the class 1, die size and length shall be as specified in table 11. Unless otherwise specified (see 6.2), class 1 tread elastomer shall be cut as shown in figure 1 (see 4.1.5).

MIL-T-45301D

3.4.2 Class 2. Unless otherwise specified (see 6.2), the class 2, die size and length shall be as specified in table 11 (see 4.1.5).

3.4.3 Class 3. Unless otherwise specified (see 6.2), class 3 tread elastomer s furnished in sheet form, 16 ± 2 inches (406 ± 50 mm) wide,, $3/8 \pm 1/8$ inch (9.5 ± 3 mm) thick and 60 ± 12 inches (1525 ± 305 mm) in length (see 4.1.5).

3.4.4 Class 4. Class 4 tread elastomer shall be furnished in sheet form as two sheets (sheet one and sheet two) whose relative cross sectional areas shall be regulated by the manufacturer so that equal lengths may be mixed and successfully processed. Sheets shall be 18 inches (457 mm) wide, 1/2 inch (13 mm) thick and 72 inches (1830 mm) in length (see 4.1.5).

3.4.5 Class 5. Class 5 tread elastomer shall be furnished in strip form, $7/16 \pm 1/32$ inch ($11.1 \pm .8$ mm) thick by $2 \ 3/4 \pm 1/8$ inch (70 ± 3 mm) wide suitable for use in a cold feed extruder and injection molding (see 4.1.5).

3.4.6 Class 6. Class 6 masterbatch tread elastomer shall be furnished in preweighed or presized blocks or sheets of elastomer with the curing agents and chemical additives packaged in premeasured quantities sufficient for mixing on a 42 inch (1.07 m) elastomer mill at one time (see 4.1.5).

TABLE II. Classes and sizes. 2/

Die size 1/	Class	Group	Minimum length in. [meters (m)]	Applicable tire size
50-50-16	2	A	600 (15.24)	9 x 6
30-30-16	2	A	600 (15.24)	10 x 3
50-50-16	1	A	70 (1.78)	10 x 5
36-36-16	1	A	70 (1.78)	11 x 3
36-36-28	1	A	70 (1.78)	12 x 3
42-42-32	2	A	600 (15.24)	12 x 4-1/8
26-26-26	2	A	600 (15.24)	13-7/16 x 1-11/16
40-40-24	1	A	86 (2.18)	13-1/2 x 3-1/2
40-40-24	1	A	86 (2.18)	13-1/2 x 3-3/4
16-26-48	1	A	58 (1.47)	18 x 2-1/2 (x 3-3/4)
62-62-48	1	A	65 (1.65)	20 x 6 x 16
65-65-60	1	A	70 (1.78)	20-1/2 x 6-1/4
26-26-28	1	A	70 (1.78)	22 x 1-11/16 (was 22 x 2)
22-22-24	1	B	70 (1.78)	22 x 1-3/4
62-62-52	1	A	70 (1.78)	22 x 6-1/4
32-32-22	1	A	70 (1.78)	23 x 1-1/4
36-36-30	1	B	79 (2.01)	24 x 2.12 (wide) (AL)
34-34-30	1	B	79 (2.01)	24 x 2-1/8
36-36-30	1	B	79 (2.01)	24 x 2.38 (steel)
47-47-42	1	A	79 (2.01)	24 x 3-3/4 (was 24 x 5)
42-42-48	1	A	81 (2.06)	25-1/2 x 4-1/2
60-64-48	1	A	81 (2.06)	25 x 5.59

MIL-T-45301D

TABLE II. Classes and sizes 2/ - Continued.

Die size <u>1/</u>	Class	Group	Minimum length in. [meters (m)]	Applicable tire size
45-45-42	1	A	84 (2.13)	26 x 4-1/2
56-64-44	1	A	84 (2.13)	26 x 5-3/4
64-64-46	1	A	84 (2.13)	26 x 6
36-36-28	1	A	91 (2.31)	28 x 2-3/4
42-42-48	1	A	93 (2.36)	28 x 4-1/2
42-42-36	1	A	110 (2.79)	32-1/4 x 3-1/2

The die size signifies the crown width, in inches and eighths, base width, in inches and eighths, and thickness in thirty seconds of an inch. For example: 45-45-42 indicates 4-5/8 inch crown, 4-5/8 inch base width, and 42/32 inch (1 10/32 inch) thickness. Tolerance on width shall be minus 0, plus 1/8 inch; and on thickness shall be minus 0, plus 2/32 inch.

2/ See 6.3 for corresponding Army drawing numbers for wheels.

3.5 Performance.

3.5.1 Physical properties. The physical properties of the tread elastomer and the tie gum shall be as specified in table III for all groups. Curing characteristics shall be as specified in table IV (see 4.7.1). 1/

1/ Note: Special physical properties are specified for group B elastomer when furnished in the P-12 material.

3.5.2 Adhesion. The tread elastomer shall be such that, when vulcanized onto the metal wheel with the user's approved bonding agent and processes, the adhesion of the tire shall be complete. There shall be no areas of deficient adhesion. The load required to separate the tread from a base band or wheel, per inch of width on any line of separation around the circumference shall be not less than the following when the different materials are used (see 4.7.2):

Group A	- 100 lb (220 kg)
Group B	- 130 lb (286 kg), 150 lb (330 kg) average
Group B, P-12 material	- 130 lb (286 kg)

3.5.3 Resistance to blowout. When assembled per 4.6.2, the roadwheel (tire) shall withstand six hours continuous running at 30 miles per hour (mph) [48 kilometers per hour (km/h)] on a rotating steel wheel drum without evidence of cracking, chunking, blowout, separation, blistering, contamination, porosity, delamination or lack of adhesion. Any undercutting shall be not in excess of 0.25 inch (6.35 mm) deep (see MIL-STD-177) (see 4.7.3).

MIL-T-45301D

3.5.4 Resistance to separation. When assembled per 4.6.2, the roadwheel (tire) shall withstand 48 hours continuous running at 10 mph (16 km/h) on a rotating steel wheel drum without evidence of cracking, chunking, blowout, separation, blistering, contamination, porosity, delamination or lack of adhesion. Any undercutting shall be not in excess of 0.25 inch (6.35 mm) deep (see MIL-STD-177) (see 4.7.4).

3.5.5 Storage life (see 4.7.5 and 6.2).

3.5.5.1 Classes 1, 2, 3 and 5. Tread elastomer shall be capable of being stored for a minimum period of 6 months after date of manufacture without any evidence of pre-curing, provided storage has complied with all the following conditions (see 4.7.5.1):

- The materials have been protected from physical damage during the storage period.
- The ambient air temperature during storage has been within the range of 40°F (4°C) to 90°F (32°C).
- The average ambient air temperature during storage has not exceeded 70°F (21°C).

TABLE 111. Mechanical and physical properties.

Properties	Tie gum and tread elastomer requirements, all classes		
	Group A	Group B	Group B, P-12 material
<u>Before aging</u>			
Hardness (Durometer, Shore A, or IRHD)	73 + 5	72 + 7	73 + 5
Tensile strength min. pounds per square inch (psi) [kiloPascals (kPa)]	2100 (14480)	3000 (20685)	2700 (18620)
Elongation, percent	200 min.	400 min.	350 min.
Modulus, 200 percent min. psi (kPa)	1600 (11030)	-----	-----
Modulus, 300 percent min. psi (kPa)	-----	-----	2000 (13790)
Modulus, 400 percent min. psi (kPa)	-----	2000 (13790)	-----
Specific gravity	1.190 max.	1.20 mx.	1.170 max.
Ozone resistance	7 day duration	7 day duration	7 day duration
Low temperature flexibility	-40°C (-40°F)	-40°C (-40°F)	-40°C (-40°F)
<u>After aging</u>			
Tensile strength min. psi (kPa)	-----	-----	2500 (17240)
Tensile strength change (percent)	+ 25	+ 25	-----
Elongation change (percent)	+ 35	+ 35	-----

MIL-T-45301D

TABLE IV. Curing characteristics.

This table covers the curing characteristics of classes 1, 2, 3 and 5 elastomers and tie gum, and classes 4 and 6 after mixing, using the shearing disk viscometer (ASTM D1646), small rotor, 250°F (121°C), for measuring the Mooney viscosity of the applicable elastomers and tie gums. <u>1/</u>		
	Curing characteristics	
	Tread elastomer and tie gum	
	Before aging	After aging 7 days @ 158°F (70°C)
Initial reading, max. Mooney units	60	100
4 minute reading, max. Mooney units	40	60
Minutes to 5 point rise, maximum	65	65
Minutes to 5 point rise, minimum	35	19

1/ To determine the uniformity of heavy extruded stocks 1 inch (25.4 mm) and above in thickness, Mooney test specimens will be prepared, 1/4 inch (6.4 mm) in thickness and 1 3/4 inches (44.5 mm) in diameter, from the surface and inner center of the stock. The difference between the Mooney results shall be not more than 10 minutes to the five point rise. Tie gum can be stripped from tread elastomer cut from overhanging edges and. plied together to prepare Mooney test specimens 1/4 inch (6.4 mm) in thickness and 1 3/4 inches (44.5 mm) in diameter.

3.5.5.2 Classes 4 and 6. Tread elastomer shall evidence no pre-curing for two years after the date of manufacture when the unmixed sheets or materials are stored in separate containers, protected by suitable material applied by the manufacturer and under normal inside storage conditions (see 4.7.5.2).

3.5.6 Mooney viscometer samples for accelerated aging for classes 1, 2, 3 and 5 tread elastomer. The unvulcanized tread elastomer shall withstand oven aging at 158 \pm 3°F (70 \pm 2°C) for 166 \pm 2 hours and meet the after aging Mooney requirements specified in table IV. During the oven aging cycle, the test pieces shall be completely inclosed in cellophane and suspended in the oven (see 4.7.1 and 4.7.6).

3.5.7 Accelerated aging for classes 4 and 6 tread elastomer. Separate samples of unmixed classes 4 and 6 tread elastomer shall be subjected to and withstand oven aging for 166 \pm 2 hours at 158 \pm 3°F (70 \pm 2°C). The samples shall then be mixed and subjected to the tests specified (see 4.7.1 and 4.7.7).

3.5.8 Ozone resistance. The elastomer materials used in the solid tires shall evidence no cracks when inspected at 7-power magnification, after exposure for 7 days in an ozone test chamber (see 4.7.1 and 4.7.8).

MIL-T-45301D

3.5.9 Low temperature flexibility. At a temperature of -40°F (-40°C) the specimen shall withstand the requirements of ASTM D2137, method A, without evidence of cracks, fissures, or holes visible to the naked eye (see 4.7.9).

3.5.10 Infrared absorption spectra. An infrared absorption spectra shall be prepared and submitted to the acquisition activity during first article submission and each control test. Changes in absorption of more than 5 percent in wavelength position and 25 percent in percent transmission (see ASTM 2702) at any specific wavelength shall require re-verification of the physical properties or performance testing to determine if any degradation in composition has occurred. The lack of change in spectra does not negate the requirement for control testing (see 4.7.10).

3.5.11 Measuring curing characteristics with the oscillating disk cure meter. A curing characteristics curve shall be obtained as specified in 4.7.11. The curve shall be within the following tolerances when compared to the charts representing the approved first article test elastomer compound. Parameter definitions shall be according to ASTM D2084 (see 4.7.11):

Minimum torque (M_L): ± 2 pound inch (lb-in) [.23 newton-meter (N m)]

Maximum torque (M_{HR}): ± 4 lb-in (.45 (N m)

Time to 60 percent of M_{HR} : $T(60) \pm 0.4$ minutes

Time to reach 5 lb-in (.57 N m) above minimum torque: ± 0.4 minutes

3.6 Workmanship. Workmanship shall be such as to produce tread elastomer which will be free of foreign materials, cracks, blisters, or folds. Mixing of compound formulation shall be complete and of the best commercial practice to adequately disperse all ingredients of the formula (see 4.8).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility-for inspection. Unless otherwise specified in the contract or purchase order (see 6.2), the contractor is responsible for 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, unless disapproved by the Government. The Government reserves the right to perform or witness any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Inspection equipment. Unless otherwise specified in the contract (see 6.2), the supplier is responsible for the provision and maintenance of all inspection equipment necessary to assure that supplies and services conform to contract requirements. Inspection equipment must be capable of repetitive measurements to an accuracy of 10 percent of the measurement tolerance. Calibration of inspection equipment shall be in accordance with MIL-STD-45662.

MIL-T-45301D

4.1.2 Tread elastomer. Conformance of compound color shall be determined by visual examination. To confirm that compound formulation for Group B, P-12 material conforms to table I, tests shall be performed according to the methods of ASTM D297 (see 3.2.1).

4.1.3 Materials. To determine conformance to 3.2.2 through 3.2.4 and 4.7.5, inspection and material certification records shall be maintained by the contractor. Records shall be subject to review by the Government and shall include date, part, or characteristic identification, inspection results, and disposition of lot (accepted or rejected). Corrective action taken on noted defects shall be subject to approval by the Government,

4.1.4 Construction. Conformance to 3.3.1 thru 3.3.4 shall be determined by examination in accordance with 4.5.2.

4.1.5 Classes and sizes. Conformance to 3.4.1 thru 3.4.6 shall be determined by examination in accordance with 4.5.2.

4.2 Classification of inspection:

- a. First article inspection (see 4.4).
- b. Quality conformance inspections (see 4.5).
 1. Examination (see 4.5.2).
 2. Acceptance tests (see 4.5.3.1).
 3. Control tests (see 4.5.3.2).

4.3 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be conducted under the following conditions:

- | | |
|------------------------|---|
| a. Air temperature | $73 \pm 18^{\circ}\text{F}$ ($23^{\circ} \pm 10^{\circ}\text{C}$) |
| b. Relative humidity | 50 ± 30 percent |
| c. Barometric pressure | $28.5 \pm 2.0, -4.5$ inches of mercury (Hg)
[96 ± 7 kilopascals (kpa) Hg] |
| | - 15 |

4.4 First article inspection. Unless otherwise specified (see 6.2), the Government shall select tread elastomers in the quantities specified in 3.1, which shall have been produced under the production contract (see 6.4), for first article inspection. A certified test report showing actual results of the tests specified in table V for first article (contractor) shall be submitted by the contractor. Those first article tests identified by table V as first article (Government), shall be conducted by the Government at a place designated by the Government. The contractor may, upon request, witness the tests conducted by the Government. The manufacturers recommended processing instructions, curing time and temperature, shall be submitted at the time of first article inspection. First article samples shall be examined as specified in 4.5.2 and tested as specified in table V. Approval of the first article sample by the Government shall not relieve the contractor of his obligation to supply tread elastomer that is fully representative of that inspected as a first article sample. Any changes or deviation of the production units from the first article sample shall be subject to the approval of the contracting officer.

MIL-T-45301D

TABLE V. Classification and location of tests.

Title	Requirement	Tests	First article (contractor)	First article (Government)	Acceptance	Control
Tread elastomer	3.2.1	4.1.2	X			
Tie gum	3.2.2	4.1.3	X			
Backing	3.2.3	4.1.3	X			
Processability	3.2.4	4.1.3	X			
Construction	3.3	4.1.4	X			
Classes and sizes	3.4	4.1.5	X			
Physical properties	3.5.1					
Hardness	3.5.1	4.7.1	X		X	
Tensile strength	3.5.1	4.7.1	X		X	
Elongation	3.5.1	4.7.1	X		X	
Modulus	3.5.1	4.7.1	X		X	
Specific gravity	3.5.1	4.7.1	X		X	
Ozone resistance	3.5.1 & 3.5.8	4.7.1 & 4.7.8	X		X	
Low temperature flexibility	3.5.1 & 3.5.9	4.7.1 & 4.7.9X		X	
Mooney viscometer before aging	3.5.1	4.7.1	X	X	X	X
Adhesion	3.5.2	4.7.2		X		
Resistance to blowout	3.5.3	4.7.3		X		
Resistance to separation	3.5.4	4.7.4		X		
Storage life	3.5.5					
Classes 1,2,3 and 5	3.5.5.1	4.7.5.1	X			
Classes 4 and 6	3.5.5.2	4.7.5.2	X			
Mooney viscometer						
Accelerated aging, classes 1,2,3 and 5	3.5.6	4.7.1 & 4.7.6	X	X		X
Accelerated aging classes 4 & 6	3.5.7	4.7.1 & 4.7.7	X	X		X
Infrared absorption spectra	3.5.10	4.7.10	X	X		X
Curing characteristics	3.5.11	4.7.11	X	X	X	X

MIL-T-45301D

4.4.1 First article inspection failure. Failure of any first article sample to pass specified examinations or tests shall be cause for refusal to grant first article approval until corrective action by the contractor has been approved by the Government.

4.5 Quality conformance inspection.

4.5.1 Sampling.

4.5.1.1 Lot formation. Unless otherwise specified (see 6.2), a lot shall consist of not more than 300 pieces, 300 rolls, or 5000 pounds (2270 kg) from an identifiable production period, from one manufacturer, submitted at one time for acceptance. Lot size for class 1 shall be given in pieces, for class 2 shall be given in rolls, for classes 3, 4, 5 and 6 shall be given in pounds.

4.5.1.2 Sampling for examination. Samples for examination shall be selected in accordance with inspection level II of MIL-STD-105.

4.5.2 Quality conformance examination.

4.5.2.1 Acceptable quality level. Each sample, selected in accordance with 4.5.1.2, shall be examined for conformance to the following acceptable quality levels (AQL's), on the basis of percent defective:

<u>Classification</u>	<u>AQL</u>
Major	1.0
Minor	2.5

4.5.2.2 Classification of defects. For examination purposes, defects shall be classified as shown in table VI.

TABLE VI. Classification-of defects.

Categories	Defects	Method of inspection
Critical	NONE	
<u>Major</u>	<u>AQL 1.0% Defective</u>	
101	Tie gum not as specified (see 3.2.2).	Visual
102	Backing, classes 1 and 2, not as specified (see 3.2.3).	Visual
103	Anti-stick material, classes 3, 4, 5 and 6, not as specified (see 3.3.2).	Visual
104	Dimensional nonconformance (see 3.4).	Scale
<u>Minor</u>	<u>AQL 2.5% Defective</u>	
201	Poor workmanship (see 3.6).	Visual
202	Packaging not as specified (see 5.1).	Visual

MIL-T-45301D

4.5.3 Quality conformance tests.

4.5.3.1 Acceptance tests. From each lot which has passed the visual and dimensional characteristics specified in table VI, a representative sample shall be selected in accordance with inspection level S-2 of MIL-STD-105, and shall be subjected to the tests specified in table V.

4.5.3.2 Control tests.

4.5.3.2.1 Sampling for control tests. Samples for control testing shall be selected at the rate of one sample per month. The first test sample shall be taken at or near the start of production. A sample of classes 1, 2, 3 and 5 tread elastomer shall consist of four (4) lbs (1.8 kg) of uncured elastomer. A sample of class 4 tread elastomer shall consist of equal lengths of unmixed sheets to total of at least 4 lbs (1.8 kg) when mixed and processed by the manufacturer. A sample of class 6 tread elastomer shall consist of at least 4 lbs (1.8 kg) after mixing and processing by the manufacturer.

4.5.3.2.2 Applicable tests. The control test samples shall be identified as to production period and subjected to the tests specified in table V.

4.5.4 Failure. Failure of any tread elastomer to pass any of the specified inspections shall be cause for the Government to refuse acceptance of the production quantity represented, until action taken by the contractor to correct defects and prevent recurrence has been approved by the Government.

4.6 Test procedures.

4.6.1 Preparation of sheet specimens. Platen press sheets, 0.080 + 0.010 inch (2.08 ± 0.25 mm) in thickness and 6 x 6 inches (150 x 150 mm) square, with a cure of 90 minutes at a temperature of 280°F (138°C) shall be used for conducting the physical properties tests specified in 4.7.1 and prepared in accordance with ASTM D3182.

4.6.2 Preparation of roadwheel specimen. Elastomer shall be processed onto metal wheels by the Government.

4.7 Methods of inspection.

4.7.1 Physical properties. To determine conformance to 3.5.1, physical properties specified in table III shall be determined on specimens cut from the platen press sheets specified in 4.6.1. Tests shall be in accordance with ASTM methods specified in table VII. Curing tests may be substituted with a certification from the contractor that any elastomer failing to meet the requirements of 3.5.5 will be replaced at no cost to the Government.

MIL-T-45301D

TABLE VII. Test methods for physical properties.

Physical property	Method number
Hardness	ASTM D1415 or ASTM D2240
Tensile strength	ASTM D412
Elongation, ultimate	ASTM D412
Tensile stress, (modulus)	ASTM D412
Accelerated aging of tensile and elongation (air heat test, air heating medium)	ASTM D573
Specific gravity	ASTM D792
Ozone resistance test (resistance to surface cracking of stretched elastomer compounds)	ASTM D518 and ASTM D1149
Low temperature flexibility test	ASTM D2137, Method A
Mooney viscometer test (Viscosity and curing characteristics of elastomer by shearing disk viscometer)	ASTM D1646

4.7.2 Adhesion.

4.7.2.1 Apparatus. To determine conformance to 3.5.2, a tension testing machine having a power-actuated clamp shall be used to apply and measure the force required to strip the tire from the metal wheel or-rim to which it is adhered. The clamp shall travel at a rate of 6 inches (152 mm) per minute. The machine shall be provided with means for accurately measuring the applied tension. A hub and spindle assembly shall be provided for mounting the tire and permitting it to rotate fully about a fixed axis.

4.7.2.2 Procedure. The tire shall be prepared for testing by cutting down to the metal wheel or rim circumferentially along its edges on both sides to minimize tearing. The tire shall also be cut transversely down to the metal base and separated circumferentially, by hand or by using a knife, for a sufficient distance to permit a firm gripping of this free end of the tire by the power actuated clamp. Solvents shall not be used to facilitate this initial separation or any time during actual stripping. The tire shall be mounted on the hub and spindle assembly and positioned in such a manner that its axis of rotation will remain parallel to the line of separation during testing and that the applied force will be normal to the tangent of the wheel or rim at the line of separation. With the free end of the tire firmly gripped by the machine clamp, the machine clamp shall be started and the tire completely stripped from the metal base. If during the test the tire begins to tear instead of separating wholly from the wheel, or rim, the machine shall be stopped and the tire shall be cut with a knife to the metal base and the test started again. Force measurements shall be recorded and observation made throughout the test to determine the actual adhesion value. The ambient air temperature during the test shall be between 70°F (21°C) and 110°F (43°C). Loads to be applied shall be as specified in 3.5.2.

MIL-T-45301D

4.7.3 Blowout (drum) (see 6.5).

4.7.3.1 Apparatus. To determine conformance to 3.5.3, the testing apparatus shall consist of a rotating steel wheel drum having a smooth flat-faced rim, against which one or more test tires, individually mounted on hub and spindle assemblies permitting free tire rotation, are radially loaded. The steel drum shall have a diameter of 67.23 inches \pm 0.50 inches (1707 \pm 12.7 mm) (1/300 mile circumference) with a rim width providing full support to the tire under the loads specified herein. During the test, the apparatus shall be located in an air space controlled at a temperature of 100 \pm 5°F (38 \pm 3°C).

4.7.3.2 Procedure. The tire shall be mounted on the hub and spindle assembly specified in 4.7.3.1, and ground if necessary, to assure a radial runout of not more than 0.031 in (.8 mm) total indicator reading. The tire shall be loaded radially against the drum. The drum test load shall be determined by multiplying the value obtained from table VIII by the nominal tire width. The tire shall then be run continuously for 6 hours at 30 mph (48 km/h), under the following load conditions:

<u>Time</u>	<u>Percentage of load as determined above</u>
Two hours	100 percent
Two hours	110 percent
Two hours	120 percent

At the conclusion of "the test operation, the tire shall be examined externally and then internally by removal of tire from the metal-base and subsequent sectioning of the tire to determine conformance to 3.5.3.

4.7.4 Separation (drum) test (see 6.5).

4.7.4.1 Apparatus. To determine conformance to 3.5.4, the testing apparatus shall be the same as that specified in 4.7.3.1.

4.7.4.2 Procedure. The tire, mounted on a hub and spindle assembly shall be loaded against the drum (see 4.7.3.2) and run continuously for 48 hours at 10 mph (16 km/h) and at 100 percent rated load capacity, as determined from table VIII for 10 mph (16 km/h). At the conclusion of the test operation, the tire shall be examined externally and then internally, by removal from the metal base and subsequent sectioning of the tire, to determine conformance to 3.5.4.

MIL-T-45301D

TABLE VIII. Load application ratings. 1/

Nominal OD tire size (inches)	Speed	
	10 mph (16 Km/h)	30 mph (48 Km/h)
	Load - lb/in (N/m) of nominal tire width	Load - lb/in (N/m) of nominal tire width
9	305 (53410)	120 (21015)
10	345 (60415)	140 (24515)
11	385 (67420)	155 (27145)
12	430 (75300)	175 (30645)
13	475 (83180)	195 (34150)
13 7/16	475 (83180)	195 (34150)
13 1/2	495 (86685)	205 (35900)
20	790 (138345)	340 (59540)
21	840 (148000)	365 (63920)
22	885 (155000)	385 (67420)
23	935 (163735)	410 (71800)
24	985 (172490)	435 (76175)
25	1035 (181245)	455 (79680)
26	1085 (190000)	480 (84055)
27	1135 (198760)	505 (88435)
28	1185 (207515)	530 (92815)
29	1235 (216270)	555 (97190)
30	1285 (225025)	580 (101570)
31	1340 (234660)	605 (105945)
32	1390 (243415)	630 (110325)

1/ Tire load is found by multiplying the value given in the table by the nominal tire width. Interpolation of table values is allowed.

4.7.5 Storage life.

4.7.5.1 Classes 1, 2, 3 and 5. Conformance to 3.5.5.1 shall be confirmed by review of contractor records in accordance with 4.1.3 to determine that the requirements of table III can be met after proper processing and a 6 month storage period.

4.7.5.2 Classes 4 and 6. Conformance to 3.5.5.2 shall be confirmed by review of contractor records in accordance with 4.1.3 to determine that the requirements of table III can be met after proper processing and a 2 year storage period.

4.7.6 Accelerated aging for classes 1, 2, 3 and 5 tread elastomer. To determine conformance to 3.5.6, unvulcanized tread elastomer shall be subjected to accelerated oven aging for 166 + 2 hours at 158 + 3°F (70 + 2°C) then meet the after aging Mooney requirements specified in table IV. Tests shall be in accordance with ASTM methods specified in table VII.

MIL-T-45301D

4.7.7 Accelerated aging tests for classes 4 and 6 elastomer. To determine conformance to 3.5.7, tread rubber elastomer shall be subjected to accelerated oven aging for 166 ± 2 hours at $158 \pm 3^\circ\text{F}$ ($70 \pm 2^\circ\text{C}$) then after being mixed shall meet the after aging Mooney requirements specified in table IV. Tests shall be in accordance with ASTM methods specified in table VII.

4.7.8 Ozone resistance test.

4.7.8.1 Specimens. To determine conformance to 3.5.1 and 3.5.8, the specimen shall be in accordance with procedure B of ASTM D518 and shall be prepared from tread elastomer, be finished smoothly, and shall be of uniform thickness in accordance with ASTM D3183, or shall be prepared from ASTM tensile slabs of certified equivalent cure prepared from production molding blanks of tread elastomer in accordance with ASTM D3182.

4.7.8.2 Procedure. To determine conformance to 3.5.8, the specimens shall be tested in accordance with procedure B of ASTM D518, except the length of the clamping strips shall be such as to facilitate placement within the ozone test chamber. Specimens shall be placed in the chamber and exposed for 7 days at a temperature of $104 \pm 3^\circ\text{F}$ ($40 \pm 2^\circ\text{C}$) in an air-ozone mixture having an ozone partial pressure of approximately 50 millipascals (MPa) per ASTM D1149.

4.7.9 Low temperature flexibility test. To determine conformance to 3.5.9, the specimens shall be subjected to the tests specified in ASTM D2137, method A. Five specimens shall be tested and inspected. In the event one specimen fails, an additional five specimens shall be prepared and tested. If two or more of the initial five specimens fail, or any of the last five specimens fail, it shall be cause for rejection.

4.7.10 Infrared (IR) absorption spectra test. To determine conformance to 3.5.10, a spectra shall be prepared as a chart showing the attenuated total reflectance spectrum for a range from approximately 2.5 to approximately 15 microns wavelength as a function of absorbance. The following recommended equipment and procedure may be deviated from if the complete procedure and equipment used is furnished at the time of submittal of the spectral graph (see ASTM D2702). Prepare the infrared spectrophotometer automatic recording double beam instrument for operation. Prepare an elastomer sample at 1652°F (900°C) for ten (10) seconds under a pressure of 3.98 to 5.30 kPa of mercury, collecting the condensate on a 2 mm KRS-5 (thallium-bromide-iodide) crystal, 45 degrees face angle, utilizing an Attenuated Total Reflectance (ATR) condensate cell. The crystal with condensate is then placed in a variable angle accessory, the spectrophotometer beams actuated, and the sample absorption spectrum recorded. This spectra is a record of the absorption of IR for the specific compound submitted.

4.7.11 Measuring curing characteristics with the oscillating disk cure meter. To determine conformance to 3.5.11, the cure curve shall be obtained from samples of tread compound tested as specified in ASTM D2084. Test conditions shall be as follows:

MIL-T-45301D

Temperature	$370 \pm 2^{\circ}\text{F}$ ($188 \pm 1^{\circ}\text{C}$)
Disk oscillation	100 cycles/minute
Disk oscillation amplitude	$1 \pm .03$ degrees
Chart speed	Full scale in 6 minutes
Test duration	6 minutes
Torque range	0 to 50 lb-in (0 to 5.7 N m)

A minimum of two curves shall be made on tread compound from each sample selected. Changes in excess of the curve tolerances specified in 3.5.11 shall require re-verification of the physical properties, or performance testing to determine if any degradation in composition has occurred. A lack of change in the curing curve does not negate the requirement for continued testing.

4.8 Workmanship. Conformance to 3.6 shall be determined by examination in accordance with 4.5.2.

4.9 Inspection of packaging.

4.9.1 Materials and processes. The Government inspector shall, at unscheduled intervals, inspect all materials and processes involved in the preparation for delivery, to determine conformance to requirements of section 5 and specifications referenced therein. Any evidence of deviation from specified requirements shall be cause for refusal to conduct further inspection, until objective evidence has been provided by the contractor that corrective action has been taken.

5. PACKAGING

5.1 Preservation, packaging, packing, and marking. Preservation, packaging, packing, and marking for the desired level of protection shall be in accordance with the applicable packaging standard or packaging data sheet specified by the acquisitioning authority (see 6.2).

5.2 Marking. Containers shall specify MIL-T-45301, class, storage conditions, lot and batch numbers.

6. NOTES

6.1 Intended use. The tread elastomer covered by this specification is intended to be used for replacement of the tread in rebuilding of roadwheels and track support rollers for military track laying vehicles.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. If first article sample is not required (see 3.1).
- c. If die sizes shall be other than as specified, when several die sizes of class 1 and class 2 tread elastomer are ordered (see 3.1).
- d. If tie gum is required (see 3.2.2 and 3.3.1).
- e. If classes 1 or 2 tread elastomers shall be furnished with backing other than as specified (see 3.3.1).

MIL-T-45301D

- f. If classes 3, 4, 5, and 6 tread elastomers shall be furnished without anti-stick material (see 3.3.2).
- g. If class 1 and class 2 elastomer die size and length shall be other than as specified (see 3.4.1 and 3.4.2).
- h. If class 1 elastomer shall be cut other than as specified (see 3.4.1).
- i. If class 3 tread elastomer shall be furnished other than in sheet form as specified (see 3.4.3).
- j. If responsibility for inspection shall be other than as specified (see 4.1).
- k. If responsibility for inspection equipment shall be other than as specified (see 4.1.1).
- l. If inspection conditions shall be other than as specified (see 4.3).
- m. If first article inspection is not required (see 4.4).
- n. If lot formation shall be other than as specified (see 4.5.1.1).
- o. Selection of applicable levels of packaging and packing (see 5.1).

6.3 Wheel application. The tire size and corresponding Army drawing numbers for wheels are:

<u>Tire size</u>	<u>Army drawing number</u>
9 x 6	5638473
10 x 3	5621440
10 x 5	5635856
11 x 3	5636637
12 x 3	8674928
12 x 4-1/8	6548131
13-7/16 x 1-11/16	10891645
13-1/2 x 3-1/2	8763030
13-1/2 X 3-3/4	8706067
	5635849
18 x 2-1/2 (X 3 3/4)	10866037
20 x 6 x 16	5607928
20-1/2 X 6-1/4	5635844
22 x 1-11/16 (was 22 x 2)	10891655
22 x 1-3/4	10925778
	10954177
22 X 6-1/4	5635861
23 X 1-1/4	9092158
24 x 2.12 (wide) (AL)	11678270 and 12269415
24 X 2-1/8	8763350
24 x 2.38 (steel)	12313083

MIL-T-45301D

<u>Tire size</u>	<u>Army drawing number</u>
24 X 3-3/4	10919004
(was 24 x 5)	11636140
25-1/2 X 4-1/2	6576489
25 X 5.59	12274482
26 X 4-1/2	5621441
26 X 5-3/4	10887252
	8762739
26 x 6	7013976
28 x 2-3/4	10954693
28 X 4-1/2	7764921
32-1/4 X 3-1/2	10891631

6.4 First article. When first article inspection is required, the item to be tested should be a first article sample of the various classes of tread elastomers, produced prior to the manufacture of tread elastomers in production quantity. The contracting officer should include specific instructions in all acquisition instruments regarding arrangements for examination, and test approval of the documents first article.

6.5 Adequacy of physical property requirements. This specification is not intended to be used without conducting the drum tests specified in 4.7.3 and 4.7.4. The physical properties specified herein do not-fully describe all of the tread elastomer characteristics necessary to meet the wheel performance requirements of this specification.

6.6 Changes from previous issue. Asterisks are not used in this revisions to identify changes with respect to previous issue, due to the extensiveness of the changes.

6.7 Definitions. Terminology employed in this specification is in accordance with definitions in ASTM D1566.

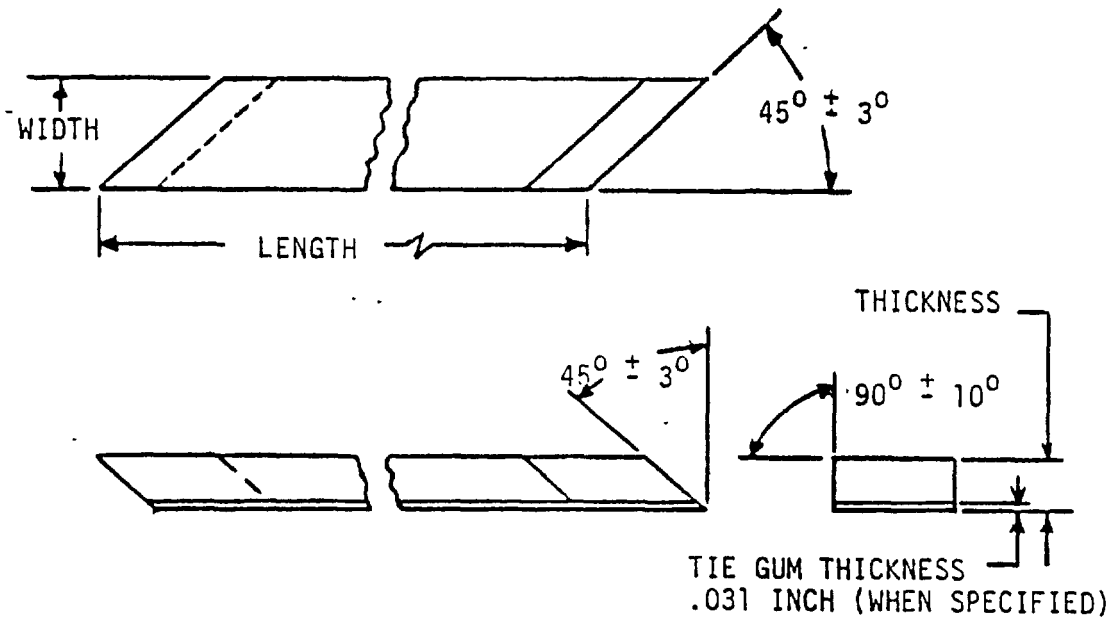
6.7.1 Recovered materials. 'Recovered materials' means materials that have been collected or recovered from solid waste (see 6.7.2) to become a source of new materials, as distinguished from virgin raw materials.

6.7.2 Solid waste. For definition of 'solid waste', refer to section 23.402 of the Federal Acquisition Regulations.

6.8 Subject term (key word) listing.

Elastomer tread, solid tire, for track laying vehicles
Solid tire, tread elastomer, for track laying vehicles
Track laying vehicles solid tire, elastomer tread

MIL-T-45301D



NOTE: FOR DIMENSIONS, SEE TABLE II

FIGURE 1. Tread Rubber

MIL-T-45301D

Custodian:
Army - AT
Air Force - 99

Preparing activity:
Army - AT

User activity:
Navy - MC

Project No. 2640-0192

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE. This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

(Fold along this line)

(Fold along this line)

DEPARTMENT OF THE ARMY



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO 12062 WASHINGTON D C

POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE ARMY

Commander
US Army-Automotive Tank Command
Attn:AMSTA_GDS
Warren, MI 48397-5000



STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER		2. DOCUMENT TITLE					
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one)					
b. ADDRESS (Street, City, State, ZIP Code)		<input type="checkbox"/> VENDOR					
		<input type="checkbox"/> USER					
		<input type="checkbox"/> MANUFACTURER					
		<input type="checkbox"/> OTHER (Specify) _____					
5. PROBLEM AREAS							
a. Paragraph Number and Wording:							
				b. Recommended Wording:			
				c. Reason/Rationale for Recommendation:			
6. REMARKS							
7a. NAME OF SUBMITTER (Last, First, MI) - Optional		b. WORK TELEPHONE NUMBER (Include Area Code) - Optional					
c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional		8. DATE OF SUBMISSION (YYMMDD)					

(TO DETACH THIS FORM, CUT ALONG THIS LINE)