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DETAIL SPECIFICATION

TRACK SHOE SETS, TRACK SHOE ASSEMBLIES, TRACK SHOE PADS AND TRACK SHOE BUSHINGS, VEHICULAR: ELASTOMERIZED

This specification is approved for use by U.S. Army Tank-automotive and Armaments 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 identifies the requirements for qualification and production control of track systems supporting U.S. Military Tracked Vehicles. This specification is intended primarily for the qualification of elastomeric compounds used in the fabrication of track and track components and to ensure that the quality and performance established at qualification is maintained throughout production. The contractor is held fully responsible for the entire assembly/component including all non-elastomeric components and fasteners. The qualified products list (QPL) is divided by individual track components (pads, bushings and roadwheel path/shoe body) listing the contractors qualified to produce the various components, the contractor's address, and compound identification. The QPL also identifies contractors qualified to assemble the various track components into full assemblies/systems. This includes bushing insertion, pad installation and connecting component (end connectors, center guides) assembly. The track shoe assemblies may be acquired either as sets, assemblies or as individual components (pin bushing assemblies or pads) as specified by the acquiring activity (see 6.1).

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

AMSC N/A FSC 2530

1.2 Classification. The track shoe assemblies or components to be procured in accordance with this specification are of the following types and styles:

Type I.....Single-pin track shoe
Style A.....Integral pad
Style B.....Replaceable pad

Type II.....Double-pin track shoe
Style A.....Integral pad
Style B.....Replaceable pad

Type III.....Bushing assemblies

1.3 Track systems. Applicable track systems are as follows:

Designation	Type / style	TDP no.
T142 (see note 1)	II / B	11645125
T107	I / A	8705914
T154	II / B	12268550
T136	II / B	10954051
T130E1	I / B	11677988
T138	I / A	10948405
T132E1	I / B	10934639
T144	II / A	10892811
T164	I / B	12352500
T150	II / B	12306600
T157I	I / B	12359466

NOTE: The T142 track block elastomer must be produced in accordance with Drawing 11645127 and is exempt from the requirements of this specification except where noted on the drawing.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirement documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government drawings. Technical data package (TDP) drawings for the track system/component to be procured will be provided as a part of the invitation for bid.

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the (DoDISS) are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D395	- Standard Test Methods for Rubber Property - Compression Set (DoD Adopted).
ASTM D412	- Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension (DoD Adopted).
ASTM D429	- Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates (DoD Adopted).
ASTM D518	- Standard Test Method for Rubber Deterioration - Surface Cracking (DoD Adopted).
ASTM D573	- Standard Test Method for Rubber - Deterioration in an Air Oven (DoD Adopted).
ASTM D792	- Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement (DoD Adopted).
ASTM D1149	- Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber (DoD Adopted).
ASTM D2084	- Standard Test Method for Rubber Property - Vulcanization Using Oscillating Disk Cure Meter (DoD Adopted).
ASTM D2137	- Standard Test Methods for Rubber Property - Brittleness Point of Flexible Polymers and Coated Fabrics (DoD Adopted).
ASTM D2240	- Standard Test Method for Rubber Property - Durometer Hardness (DoD Adopted).
ASTM D3182	- Standard Practice For Rubber - Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets (DoD Adopted).
ASTM D3183	- Standard Practice for Rubber - Preparation of Pieces for Test Purposes from Products (DoD Adopted).

ASTM E1131 - Standard Test Method for Compositional Analysis by Thermogravimetry.

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Track shoe assemblies, track shoe pads, and track shoe bushings furnished under this specification shall be products which have been tested and have passed the qualification tests specified herein. The qualification process is divided into three phases as defined in section 3 of this specification: Phase I, Plant/Facilities Inspections; Phase II, Establishment of Contractor's Control Plan and Compound Characteristics; and Phase III, Endurance Tests. The procedures and requirements of these phases must be successfully completed and all requirements met prior to a contractor becoming qualified for listing on the QPL. Section 4 of this specification establishes the quality control requirements based on section 3 as applicable to all track procurement contracts.

3.1.1 Control plan. The contractor shall provide a control plan (see 4.5.1) addressing the requirements of this specification that identifies how the contractor intends to conform to this specification. This plan will require Government approval and will be included as part of the qualification process. This plan shall be submitted to the Quality Assurance Representative (QAR) and Preparing Activity for review and approval. This control plan should be general in nature, identifying the contractor's capability in conforming to the requirements of this specification and should not contain proprietary information. This plan should identify subcontractor control requirements in compliance to this specification as related to rubber.

3.1.2 Materials. The materials used in the production of shoes, pads, bushings and assemblies shall meet the requirements of this specification and be in accordance with the applicable drawings of the track TDPs.

3.1.3 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.1.4 Qualified products list. Type I and type II track shoe assemblies, track shoe sets, track shoe pads, and type III bushings furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids. Qualification for all systems/components includes the contractor's plan, all materials, processes, tests, facilities, and assembly, as applicable, of these systems or components. The contractor is responsible for the entire component/assembly being submitted for qualification and subsequent production including all metal parts and fasteners.

3.1.5 Approval for the rebuild/overhaul of track components. Contractors/military depots which desire to obtain approval for the rebuild of track or track components covered by this specification must utilize this specification in conjunction with the current Depot Maintenance Work Requirement (DMWR) for single pin and double pin track used on military vehicles. This specification should be used to specify requirements for rubber and rubber processing. The DMWR should address the quality of the rebuilt/overhaul metal components.

3.2 Phase I, plant/facilities inspection. Defense Standardization and Specification Program SD-6, "Provisions Governing Qualification (Qualified Products Lists)" and DOD 4120.3-M, "Defense Standardization Program Policies and Procedures", authorizes the preparing activity or its authorized agent to conduct plant/facility inspections prior to the start of any qualification testing. Subcontractors that provide uncured rubber for processing by the contractor requesting qualification shall be subjected to the same inspection and test requirements on that portion of the product/process that is within the subcontractor's purview.

3.3 Phase II, establishment of contractor's control plan and compound characteristics. Prior to the start of qualification hardware fabrication, the contractor shall establish a Process Fingerprint Plan (see tables I and II, and 4.5.2.4) that describes the entire process used to produce the qualification hardware. This plan shall identify the target values and ranges (limits/tolerances) the contractor expects during qualification hardware fabrication. This plan shall address all the requirements of this specification and adequately describe the process and product supplied for qualification. This plan shall bear the signatures of the Government QAR and an authorized representative of the contractor. This plan shall remain at the contractor's facility but be made available for review by the preparing activity or its authorized agent. This information shall not be disclosed in whole or in part for any purpose other than to evaluate the product submitted for qualification testing.

3.3.1 Qualification hardware fabrication. The fabrication of the qualification hardware shall be in accordance with the approved Process Fingerprint Plan (see 3.3). All testing must be conducted in the presence of a government inspector or its authorized agent, signed off for conformance to the requirements and dated. This plan and test data generated during the fabrication of elastomeric components for qualification will be used by the Government as a measure of conformance/performance in future production contracts (see 3.4.1.2) and will remain proprietary to the contractor. All records/test results of all lots of elastomeric materials used in

the preparation of all qualification hardware shall be made available to the Government QAR upon request . This information shall not be disclosed in whole or in part for any purpose other than to evaluate the product submitted for qualification testing. The Government reserves the right to conduct these tests at any time to ensure compounds in production are in conformance to the data established during qualification.

3.3.2 Test records and compound identification. All test records must contain at a minimum, the compound identification and source, test results, test facility identification, dates of tests, and name of tester. These records must be signed and dated by the Government QAR or authorized agent. The contractor will identify the method to be used during qualification and utilize the same method during subsequent production testing. Compound numbers must be identified to the component being qualified (i.e. bushing compound xxxxx, ground pad compound yyyyy and roadwheel path compound zzzzz) and fully identified on the applicable test records/data sheets. Any record, data sheet or certification lacking proper identification, or one that does not contain clear and concise information will not be considered in compliance to these requirements and rejected.

3.3.3 Track bushing characteristic tests. Table I has been established in order to identify the compound performance characteristics/properties being provided for qualification for future reference and production control purposes, pending successful qualification. Table I identifies the requirements for establishing the characteristics of the bushing compound(s). These tests will be performed during the fabrication of the T130E1 long bushings (P/N 11678029) required for qualification and in accordance with the requirements established in Appendix A.

3.3.3.1 Specimen preparation. Specimens shall be prepared in accordance with the applicable ASTM and shall be of an equivalent state of cure to that of the bushings submitted for endurance testing. The following tests will be performed on samples taken at the final mixing of the compound (see 4.3.1.1) and be of an equivalent state of cure as bushings submitted for qualification: specific gravity, hardness, tensile strength, elongation, tensile stress, aged properties, brittleness point, cure meter, thermogravimetric analysis (TGA), load deflection, compression set and G/C mass spec. The following tests shall be performed on vulcanized samples: hardness, adhesion, and bushing endurance (see 4.3.1.2).

3.3.3.2 Specific gravity. Specific gravity tests will be performed on the bushing compounds subject to qualification test in accordance with ASTM D792. Specific gravity tests will be performed on 3 samples from each compound submitted for qualification and all results will be provided to the Government. Samples shall be taken from unvulcanized compounds at the final mixing stage (see 4.7.1.1).

TABLE I. Bushing property tests.

Test requirements	ASTM	Specification paragraph	Tolerance (see note)
Specified gravity	D792	3.3.3.2	±0.020
Hardness	D2240	3.3.3.3	±5 pts
Tensile strength	D412	3.3.3.4	±16%
Tensile strength (aged)	D573	3.3.3.5	±30 % (Change)
Ultimate elongation	D412	3.3.3.4	±15%
Ultimate elongation (aged)	D573	3.3.3.5	±40% (Change)
Tensile stress (modules) @ 200% strain	D412	3.3.3.4	±17%
Thermogravimetric analysis	E1131	3.3.3.6	3.3.3.6
Vulcanization using oscillating disk cure meter	D2084	3.3.3.7	3.3.3.7
Adhesion	D429	3.3.3.8	3.5.4.2
Compression set	D395	3.3.3.9	0
Brittleness point of flexible polymers:	D2137	3.3.3.10	ACPT/REJ
GC mass spec	None	3.3.3.11	3.5.3

NOTE: The contractor shall provide all test results of all lots of elastomeric materials used in the preparation of all qualification hardware when tested to the requirements of table I. During production, the contractor will be required to maintain the production values within the tolerances specified in table I.

3.3.3.3 Hardness - durometer. Hardness tests will be performed on laboratory specimens from bushing compounds subject to qualification in accordance with ASTM D2240. Hardness tests shall be conducted on 3 samples each of the unvulcanized compounds taken from the final mixing stage as well as 3 samples of the vulcanized finished components. All data generated as the results of these two tests shall be reported to the Government. The production tolerance for hardness will be ±5 from the average value established at qualification (see 4.7.1.2).

3.3.3.4 Physical properties of bushing compounds. Physical property tests will be conducted on each compound submitted for bushing qualification in accordance with ASTM D412. All test results will be reported to the Government. For production of qualified bushing compounds, the adjusted value established following qualification tests (3.4.1.2) , shall be held to the following tolerances: ±16% for tensile strength, ±15% ultimate elongation, ±17% for 200% modulus (see 4.7.1.3, 4.7.1.5 and 4.7.1.7).

3.3.3.5 Aged physical properties. Aged physical property tests will be performed on specimens taken from bushing compounds in accordance with ASTM D573. Accelerated aging shall be conducted for 166 ± 2 hours at 158 ± 3.6 degrees Fahrenheit (°F) or 70 to 72 hours at 212°F ± 3.6°F. All test results will be reported to the Government. The tolerance for the percent change of unaged tensile strength to aged tensile strength will not exceed 30 percent during production. The tolerance for the percent change of the unaged elongation to the aged elongation will not exceed 40 percent during production (see 4.7.1.4 and 4.7.1.6).

3.3.3.6 Thermogravimetric analysis. This test will be performed in accordance with ASTM E1131 during qualification to establish requirements for future reference during process control. All test results will be reported to the Government. The ranges for TGA are as follows (see 4.7.1.8):

Plasticizer + Residue	±3%
Polymer	±5%
Filler	±5%

3.3.3.7 Vulcanization using oscillating disk cure meter. A curing characteristics curve (trace) shall be obtained as outlined in ASTM D2084 on the bushing compound being submitted for qualification. The traces will be provided to the Government. The following tolerances will be used in production when compared to the charts representing traces of compounds used for fabrication of components for qualification. Parameter definitions shall be according to ASTM D2084. Alternative test methods and parameter may be used but must be identified in the control plan and approved by the Preparing Activity (see 4.7.1.9).

Minimum torque (M): ±2 pound-inch (lb-in) [.23 Newton-meter (N-m)]
Maximum torque (M): ±4 lb-in (0.45 N-m)
Time to 60 percent of M: T(60) ± 0.4 minutes
Time to reach 5 lb-in (0.57 N-m) above minimum torque: ±0.4 minutes

3.3.3.8 Bushing adhesion test. Testing apparatus shall conform to ASTM D429, method B. A hub and spindle assembly is required for mounting the bushing insert (P/N 87565l9) that shall permit full rotation about a fixed axis. Three complete bushing assemblies (P/N 11678029) shall be selected as the test samples and be of an equivalent state of cure to that of the bushings submitted for endurance test. Testing shall be conducted on the outer rings of the bushing assembly (see 4.7.1.10).

3.3.3.8.1 Sample preparation. The bushings shall be prepared for testing by cutting the rubber rings transversely down to the metal insert and separating circumferentially for a distance sufficient to permit a firm grip by the free end of the power-actuated clamp. Injection molded bushings shall be cut on the sprue side (injection side) to ensure discontinuity (non-knit) of the elastomer is checked.

3.3.3.8.2 Procedure. The bushing shall be mounted on the pin in the hub and spindle assembly with the free end of the rubber firmly gripped by the machine clamp. The machine shall be started and the rubber pulled circumferentially from the sleeve/insert. In the event the elastomer is about to tear off, specimens should be cut back to the metal. Force measurements shall be recorded and observations made throughout the test to determine the minimum load required to separate the rubber from the metal/adhesive interface or from the rubber itself.

3.3.3.8.3 Acceptance. Successful adhesions will be those that result in a separation in the rubber (rubber tear) without evidence of separation in the rubber-to-metal interface. The bond between metal and all bonding agents/cements shall be higher than the bushing rubber so that separation during adhesion occurs only in the rubber. The load required to separate the rings from the pin shall be not less than that shown in 3.5.4.2. For T130El bushing qualification a minimum of 29 pounds per inch of width is required. The elastomer pulled off the sleeve and that remaining shall be examined for any defects including cracks, blisters, or porosity. Discontinuity (non-knit) of the elastomer resulting in any indication of separation of the elastomer shall be cause for rejection. All test results shall be reported to the Government.

3.3.3.9 Compression set. The bushing laboratory specimen shall be subjected to the compression set test of method B of ASTM D395 for 22 $\pm$ 0.5 hours at a temperature of 158 $\pm$ 3.6°F using type 1 specimens. Five specimens shall be tested with the average results reported in accordance with ASTM D395. The compression set shall not exceed 25 percent and all data shall be reported to the Government (see 4.7.1.11).

3.3.3.10 Brittleness point of flexible polymers. The specimens and test method shall be in accordance with ASTM D2137. Specimens shall be type B of method A and tested at a temperature of -40 $\pm$ 3.6°F in accordance with method A of ASTM D2137. Five specimens shall be tested and inspected showing no evidence of cracks, fissures, or pinholes. In the event one specimen fails, an additional five specimens shall be prepared and tested. Failure of two or more of the initial five specimens, or any of the last five specimens, shall be cause for rejection. Test results shall be reported to the Government (see 4.7.1.12).

3.3.3.11 GC mass spec. The Government may perform spot inspections for the purpose of obtaining samples for pyrolysis-gas chromatography/mass spectrometry analysis. Up to five samples may be taken at any time during a production contract. Samples will be taken from end item cured parts. The initial part of the method will thermally desorb the additives, which are then

analyzed by gas chromatography/mass spectrometry. Following desorption of the additives, the remaining sample will be pyrolyzed and analyzed by gas chromatography/mass spectrometry. A baseline scan will be performed on the material submitted for qualification. Future results will be compared with the baseline to determine that there are no new peaks appearing, no ingredients missing and no substitutions in subsequent production runs (see 4.7.1.13).

3.3.4 Track roadwheel path and ground pad performance tests. All material property tests indicated in table II for the track roadwheel path and ground side pads (integral and/or replaceable) shall be conducted in accordance with the referenced ASTM's, the Process Fingerprint Plan (see 3.3) and in accordance with the requirements of this specification. The following tests will be performed on qualification samples taken on unvulcanized samples at the final mixing of the compound (see 4.3.1.3) and be of an equivalent state of cure as compounds being submitted for qualification: specific gravity, hardness, tensile strength, elongation, tensile stress, aged properties, brittleness point, cure meter; ozone resistance, TGA, GC mass spec. The following tests will be performed on qualification samples taken on vulcanized samples: hardness, tensile strength, elongation, tensile stress, aged properties, ozone resistance, adhesion, and blow-out (see 4.3.1.4).

3.3.4.1 Specific gravity. Specific gravity tests will be performed on the pad (integral and/or replaceable) and roadwheel path compounds subject to qualification test in accordance with ASTM D792. Specific gravity tests will be performed on a minimum of 3 samples from each compound submitted for qualification and all results provided to the Government. Samples shall be taken from unvulcanized compounds at the final mixing stage (see 4.7.2.1).

3.3.4.2 Hardness - durometer. Hardness tests will be performed on laboratory specimens of pads (integral and/or replaceable) and roadwheel path compounds subject to qualification in accordance with ASTM D2240. As a minimum, hardness tests shall be conducted on 3 samples each of the unvulcanized compounds taken from the final mixing stage as well as 3 samples of the finished components. The results of all tests shall be provided to the Government (see 4.7.2.2).

3.3.4.3 Physical properties of pad and roadwheel path compounds. Physical property tests, as a minimum, will be conducted on specimens taken from each compound used in the pads (integral and replaceable) and roadwheel path in accordance with ASTM D412, table II and figures 1, 2, 3 and 4. The three specimens for the style B (Tl54) ground pad shall be taken as shown in figure 1. The three specimens for the style B (TI54) roadwheel path shall be taken as shown in figure 2. The three specimens for the style A (Tl07) ground pad shall be taken as shown in figure 3. The three specimens for the style A (Tl07) roadwheel path shall be taken as shown in figure 4. The three specimens for the style B (T157I) ground pad shall be taken as shown in figure 6. All test results will be reported to the Government. The production tolerance for the physical property tests based on the average values established during qualification tests will be $\pm$15% for tensile strength, $\pm$15% ultimate elongation, and $\pm$15% for 200% modulus (see 4.7.2.3, 4.7.2.5 and 4.7.2.7).

TABLE II. Material property tests.

Test requirement	ASTM test method	Specification paragraph	Tolerance (see note)
Specific gravity	D792	3.3.4.1	±0.020
Hardness	D2240	3.3.4.2	±5 pts
Tensile strength	D412	3.3.4.3	±15%
Tensile strength (aged)	D573	3.3.4.4	±30% (Change)
Ultimate elongation	D412	3.3.4.3	±15%
Ultimate elongation (aged)	D573	3.3.4.4	±40% (Change)
Tensile stress (modulus) @ 200% strain	D412	3.3.4.3	±15%
Thermogravimetric analysis	E1131	3.3.4.5	3.3.4.5
Vulcanization using oscillating disk cure meter	D2084	3.3.4.6	3.3.4.6
Adhesion style A & B ground side pads	D429	3.3.4.7	0
Adhesion type I & II (roadwheel path)	D429	3.3.4.7	0
Ozone resistance	D1149	3.3.4.8	ACPT/REJ
Ozone resistance	None	3.3.4.9	ACPT/REJ
Brittleness point of flexible polymers	D2137	3.3.4.10	ACPT/REJ
GC mass spec	None	3.3.4.11	3.5.3
Blowout test style A	None	3.3.4.12	ACPT/REJ

NOTE: The contractor shall provide all test results of all lots of elastomeric materials used in the preparation of all qualification hardware when tested to the requirements of table II. During production, the contractor will be required to maintain the production values within the tolerances specified in table II.

3.3.4.4 After age physical properties. Physical property tests, as a minimum, will be conducted on 3 aged specimens taken from each compound used in the pads (integral and replaceable) and roadwheel path in accordance with ASTM D573, table II and figures 1, 2, 3, and 4. Three specimens for each test are required and all results will be reported to the Government. Accelerated aging shall be conducted for 166 ± 2 hours at 158 ± 3.60°F or 70 to 72 hours at 212 ± 3.60°F. The production tolerance for the percent change of unaged tensile strength (see 3.3.4.3) to aged tensile strength will not exceed ±30 percent. The tolerance for the percent change of the unaged elongation (see 3.3.4.3) to the aged elongation will not exceed ±40 percent (see 4.7.2.4 and 4.7.2.6).

3.3.4.5 Thermogravimetric analysis. This test will be performed in accordance with ASTM E1131 during qualification to establish requirements for future reference during production. Results of the TGA will be provided to the Government. The ranges for TGA are as follows (see 4.7.2.8):

Plasticizer + Residue.....±3%
Polymer.....±5%
Filler.....±5%

3.3.4.6 Test measurements with oscillating disk cure meter. A curing characteristics curve (trace) shall be obtained as outlined in ASTM D2084 on the compounds used in the pad (integral and/or replaceable) and roadwheel path of the track being submitted for qualification. The traces will be provided to the Government. The following tolerances will be used in production when compared to the charts representing traces of compounds used for fabrication of components for qualification. Parameter definitions shall be according to ASTM D2084. Alternative test methods and parameters may be used but must be identified in the control plan and approved by the Preparing Activity (see 4.7.2.9).

Minimum torque (M): ±2 lb-in (0.23 N-m)
Maximum torque (M): ±4 lb-in (0.45 N-m)
Time to 60 percent of M: T(60) ± 0.4 minutes
Time to reach 5 lb-in (0.57 N-m) above minimum torque: ±0.4 minutes

3.3.4.7 Track pad and roadwheel path adhesion test. Adhesion tests will be conducted on the finished products of the track systems being submitted for qualification. As a minimum, two representative samples of the ground pad (replaceable and/or integral) and two representative samples of the roadwheel path elastomer are required for the adhesion tests. One test specimen from each component shall be prepared for test in accordance with 3.3.4.7.1 using the test apparatus of ASTM D429, method B (see 4.7.2.10).

3.3.4.7.1 Sample preparation. The samples shall be prepared in the location as shown in figures 1, 2, 3 and 4. The elastomer shall be cut down to the base metal along two (2) parallel lines, leaving an elastomer strip 1 ± 1/16 inch in width, 1/2 to 1 inch in thickness, with length extending in the direction of maximum adhesive area. The elastomeric thickness shall be as uniform as practical of the thickness shown in the respective figures for the component under test. When necessary, the portion of the elastomer remaining outside of the 1-inch wide section of the cut strip shall be removed from the metal base to avoid any edge constraint during the test. The elastomer shall be stripped from the metal using a sharp knife for a sufficient distance to permit firm gripping of the tab in the grip of the test machine head.

3.3.4.7.2 Procedure. The metal base of the specimen shall be mounted to one head of the testing machine using care in centering and adjustment so that the tension shall be uniformly distributed across the strip width. The machine shall then be started and, when the applied force causes the elastomer to begin separating from the metal, the recorder shall be started. Force shall continue to be applied and recorded continuously throughout the test. The point of separation of the elastomer from the metal shall be observed carefully throughout the test. In the event that tearing up into the elastomer occurs, the specimen should be cut back to the metal without stopping the machine.

3.3.4.7.3 Acceptance. The roadwheel path adhesion shall be not less than 60 pounds per inch of width and the pad adhesion shall not be less than 120 pounds per inch of width. Successful adhesions will be those that result in a separation in the rubber (rubber tear) without evidence of separation in the rubber-to-metal interface. The bond between metal and all bonding agents/cements shall be higher than the component compound so that separation during adhesion tests occurs only in the rubber. The elastomer pulled off the metal plate/shoe body and that remaining shall be examined for any defects including cracks, blisters, or porosity. Discontinuity (non-knit) of the elastomer resulting in any indication of separation of the elastomer shall be cause for rejection. All data generated during this test will be provided to the Government.

3.3.4.8 Ozone resistance. Prepare specimens in accordance with procedure B of ASTM D518. The specimens shall be smoothly finished in accordance with ASTM D3182 and ASTM D3183 and obtained from either of the following (see 4.7.2.11):

a. Three samples each shall be taken from each compound used on the track roadwheel path and ground pad (integral and/or replaceable) and shall not include any outer surface.
b. Samples may be taken from each uncured compound production molding blanks, prepared in the form of ASTM tensile slabs, and certified as being of an equivalent state of cure as the production molded component (roadwheel path stock and ground pad).

3.3.4.8.1 Procedure. Specimens shall be tested in accordance with ASTM D1149 and mounted 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 chamber. Specimens shall then be placed in the chamber and exposed for 7 days at a temperature of 104 $\pm$ 3.6°F having a partial pressure of ozone of 50 millipascals. The specimens shall show no evidence of cracks when inspected at seven power magnification. Test results will be reported to the Government.

3.3.4.9 Optional ozone test procedure. As an option, the following procedures may be used in place of the above to accommodate the ozone test requirement (see 4.7.2.11).

3.3.4.9.1 Specimen preparation. The size of the specimens shall be in accordance with procedure B of ASTM D518, except the thickness shall be 0.080 ± 0.005 inch. Specimens shall be obtained from either of the following:

a. Three specimens shall be taken from the track block chevron and shall not include any outer surface.
b. Three specimens shall be taken from production molding blanks of uncured rubber compounds, being used to rubberize track components, prepared in the form of ASTM tensile slabs and certified as being of an equivalent state of cure as the production molding.

3.3.4.9.2 Procedure. The specimen 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 chamber. Specimens shall then be placed in the chamber and exposed for 7 days at a temperature of 100 ± 2°F in an air-ozone mixture containing 50 ± 5 parts by volume of ozone per hundred million parts of air. The specimen surfaces shall be finished smoothly and of uniform thickness in accordance with part C of ASTM method D-15. The rubber materials shall have no evidence of cracks when inspected at 7 power magnification at the end of 7 days.

3.3.4.10 Brittleness point of flexible polymers. The specimens and test method shall be in accordance with ASTM D2137. Specimens shall be type B of method A and tested at a temperature of -40 ± 3.6°F in accordance with method A of ASTM D2137. Five specimens shall be tested and inspected showing no evidence of cracks, fissures, or pinholes. In the event one specimen fails, an additional five specimens shall be prepared and tested. Failure of two or more of the initial five specimens, or any of the last five specimens, shall be cause for rejection. Test results shall be reported to the Government (see 4.7.2.12).

3.3.4.11 GC mass spec. The Government may perform spot inspections for the purpose of obtaining samples for pyrolysis-gas chromatography/mass spectrometry analysis. Up to five samples may be taken at any time during a production contract. Samples will be taken from end item cured parts. The initial part of the method will thermally desorb the additives, which are then analyzed by gas chromatography/mass spectrometry. Following desorption of the additives the remaining sample will be pyrolyzed and analyzed by gas chromatography/mass spectrometry. A baseline scan will be performed on the material submitted for qualification. Future results will be compared with the baseline to determine that there are no new peaks appearing, no ingredients missing, and no substitutions in subsequent production runs (see 4.7.2.13).

3.3.4.12 Track blowout test. This test is required for compounds being submitted for qualification for integral pad track systems using the T107 track as the candidate qualification design. Testing shall be conducted at the U.S. Army Tank-automotive and Armaments Command and arrangements can be made by contacting the preparing activity. Testing will be conducted on

a fatigue test machine (see 4.7.2.14) having a static load and a dynamic (oscillating) load as specified in 3.3.4.12a below as applicable. Cyclic loading will be at 1800 cycles per minute with automatic load sensing and compensation capability. Fifteen (15) track block samples of each compound being submitted for qualification will be required with 12 being tested. The highest and lowest cycles to failure will not be counted and the results will be the average of the remaining ten (10) track block samples. All test results will be provided to the submitting contractor indicating acceptance or rejection of the samples (see 4.7.2.14).

a. T107 ground side chevron pads are to be subjected to a dynamic load of 1600 pounds and a static load of 1600 pounds for a total load of 3200 pounds. The minimum average fatigue life (blowout) shall not be less than 50 000 cycles with no individual block of the original twelve (12) samples below 45 000 cycles.

3.3.4.13 Product marking. Unless otherwise specified (see 6.2), each track shoe assembly (roadwheel path elastomer) and track shoe pad (replaceable or integral) shall have the following information permanently and plainly marked on it. Every attempt possible should be made to locate this information in an area that may not get damaged/worn during field use.

a. Manufacturer's name or rubber manufacturer's code number.
b. National stock number of the track shoe assembly and/or track shoe pad kit as applicable.
c. Week of month and year of manufacture.
d. Compound number and mold number.

3.4 Phase III endurance tests.

3.4.1 Bushing endurance. The bushing qualification/endurance testing will be conducted in accordance with the test requirements of Appendix A and results provided to the Government. Compounds that have passed all qualification test requirements and have documented data supporting compliance to all requirements will be listed on the QPL by number and source for all track bushings with the exception of T158 and T158LL track systems.

3.4.1.1 Endurance test requirements. The bushing endurance test for qualification will be conducted in accordance with the requirements of Appendix A. The minimum acceptance criteria for fatigue life-to-failure for all 9 specimens tested is 110 000 compression load cycles simultaneous with 440 000 torsional cycles without exceeding 0.144 inches of radial deflection at the bushing center line. The minimum average of 8 specimens, dropping the highest bushing test cycles, shall not be less than 130 000 cycles.

3.4.1.2 Process Fingerprint Plan. Following qualification and prior to any production, the contractor’s Process Fingerprint Plan (see 3.3) with the predicted and actual target values and ranges shall be reviewed by the contractor with the Government QAR to determine whether any

adjustments are required and the extent of any adjustments. Any and all pertinent and relevant data, historical or otherwise, shall be used as supporting rational for the establishment of these values. This final plan shall be reviewed by the Government and signed by the QAR and an authorized contractor representative. This plan will then be put in place at the contractor's plant/facilities and/or subcontractor's plant/facilities and utilized for the production of all subsequent parts/assemblies as described in the plan.

3.4.2 Replaceable pad track system qualification. Contractors submitting compounds for qualification to produce style B, replaceable pad track systems are responsible for the entire track system to include all metal components and fasteners. All requirements of 3.2 must be met prior to qualification approval and the documented results provided to the Government.

3.4.2.1 Endurance test requirements. Full track assemblies being submitted for qualification must contain a qualified pin/bushing assembly. A report is required containing the information required in 3.3.2 and 3.4.1 as demonstration of bushing qualification. In addition, a report containing the results of 3.3.3 and 3.3.4 of this specification is also required as applicable to replaceable pad track systems. Track system qualification will be conducted in accordance with the requirements established in Appendix B. A minimum of 5000 miles demonstrated track durability at 20 % replacement must be achieved for a track system to be considered qualified and a contractor to be listed on the QPL.

3.4.2.2 Track ground pad qualification. Contractors submitting compounds for pads only on style B track will provide the inspection results in accordance with the requirements of 3.2 and provide a report containing the results of applicable requirements of 3.3.4. Excluding the T157I pad, on-vehicle qualification tests will be conducted in accordance with Appendix B as applicable to ground pads only. A minimum of 1000 miles demonstrated track pad durability at 40% replacement must be achieved for a pad compound/contractor to be considered for listing on the QPL for pads. For the T157I pad, on-vehicle qualification tests will be conducted in accordance with Appendix D. A minimum of 800 miles demonstrated track pad durability at 40% replacement must be achieved for a pad compound/contractor to be considered for listing on the QPL for pads.

3.4.3 Integral pad track system qualification. Contractors submitting compounds for qualification to produce style A, integral pad track systems are responsible for the entire track system to include all metal components and fasteners. All requirements of 3.2 must be met prior to qualification approval and the documented results provided to the Government.

3.4.3.1 Endurance test requirements. Full track assemblies being submitted for qualification must contain a qualified pin/bushing assembly. A report containing the information required in 3.3.2 and 3.4.1 is required as demonstration of bushing qualification. In addition, a report on the results of 3.3.3 and 3.3.4 of this specification is also required as applicable for integral pad track systems. Track system qualification will be conducted in accordance with the

requirements established in Appendix C. A minimum of 1200 miles demonstrated track durability at 20% replacement must be achieved for a track system to be considered qualified and a contractor to be listed on the QPL.

3.5 Production requirements. Following qualification and prior to any production, the contractor's Process Fingerprint Plan (see 3.3) with the predicted and actual target values and ranges shall be reviewed by the contractor with the Government QAR to determine whether any adjustments are required and the extent of any adjustments. All data generated during the qualification of track bushings, track pads, and full track assemblies as required and in accordance with 3.3 shall be used in the assessment of any changes to the contractor's Process Fingerprint Plan. This final plan shall be approved by the Government, signed by the QAR and an authorized contractor representative, and dated. This plan will then be put in place at the contractor's plant/facilities and/or subcontractor's plant/facilities and utilized for the production of all subsequent parts/assemblies as described in the plan. During production, the contractor shall maintain values within the tolerances specified in the Process Fingerprint Plan.

3.5.1 First article. When specified (see 6.2), a sample shall be subjected to first article test/inspection in accordance with 4.4.

3.5.2 Workmanship. Workmanship shall be of such quality as to assure that track pin/bushing assemblies, track shoe pads and track shoe assemblies furnished under this specification are free from defects that compromise, limit or reduce performance in intended use. The bushing holes of the shoes shall be free from foreign substances that will adversely affect bushing installation and endurance. The shoe shall be free from sharp edges, concave roadwheel path surfaces, or other irregularities which may adversely affect operation. Molded elastomeric components shall be free from blisters, cracks, folds, porosity, backrinding, flash, and non-fill (air check), voids, cuts, foreign material, separation, off-register, undercure, overcure, and improper dimensions. Bushing rubber shall be free from installation cuts and tears. Additional information, guidance and a listing of unacceptable defects are shown in table VI. Note that no defects are allowed on bushing assemblies.

3.5.3 GC mass spec. The Government may perform spot inspections for the purpose of obtaining samples for pyrolysis-gas chromatography/mass spectrometry analysis. Up to five samples may be taken at any time during a production contract. Samples will be taken from end item cured parts. The initial part of the method will thermally desorb the additives, which are then analyzed by gas chromatography/mass spectrometry. Following desorption of the additives, the remaining sample will be pyrolyzed and analyzed by gas chromatography/mass spectrometry. A baseline scan will be performed on the material submitted for qualification. Future results will be compared with the baseline to determine that there are no new peaks appearing, no ingredients missing, and no substitutions in subsequent production runs.

3.5.4 Pin/bushing design and construction. Unless otherwise specified (see 6.2), (reference dimensioned bushing drawings) the thickness of the elastomeric sections bonded to the pin shall be such that compression of 35 to 40 percent of the original thickness will result when installed in the intended application. Unless otherwise specified, the width of the sections shall be not less than two and one-half or more than three times their thickness before compression. The contractor shall be responsible for the volume of bushing properly filling the total volume for which it is intended within ±5 percent (95 to 105 percent of available volume). The bushing shall not protrude beyond nor be recessed inside the shoe in which it is assembled beyond the limits shown on applicable drawings. Unless otherwise specified, the bushing bore of the track shoe body shall have a surface roughness height between 63 and 250 microinches (see 4.7.1.14).

3.5.4.1 Concentricity. The pin with the elastomer bushing thereon, assembled in the applicable shoe (or simulated bore), shall be concentric with the bore of the shoe (or simulated bore), so that the elastomer thickness is uniform within ±1/64 inch.

3.5.4.2 Bushing adhesion. When tested in accordance with 4.7.1.10, the load required to separate the elastomeric sections from the pin/sleeve shall be not less than the values shown below. The elastomer pulled off and that remaining on the part shall show no evidence of any defects including cracks, blistering, or porosity at the conclusion of the test. Discontinuity (non-knit) of the elastomer resulting in any indication of separation of the elastomer shall be cause for rejection.

Diameter of pin (inches)	Minimum load (lbs/inch width)
5/8	23
3/4	25
1	29
1-1/8	31
1-1/4	33
1-5/16	34
2	36

NOTE: When exact size of pin/sleeve is not shown above, use the value of load for the next larger pin/sleeve diameter.

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.3)
b. First article inspection (see 4.4)
c. In-process inspections and tests (see 4.5.2)
d. Conformance inspection (CI) (see 4.5.3)
e. Control tests (see 4.6)

4.2 Inspection conditions. All inspections shall be performed in accordance with conditions specified in applicable drawings, specifications, and standards.

4.3 Qualification inspection.

4.3.1 Sampling for qualification inspection. Qualification inspection shall be performed on sample units selected in accordance with table III for bushings and table IV for track roadwheel path and ground pad rubber which were produced with equipment and procedures normally used in production. The test results and other inspection information will be submitted to the Government to be used for the establishment of average values for future production control. Established property and tolerances in tables I and II must be met by qualification specimens subjected to applicable tests. Upon successful fabrication and qualification of all components and tracks, contractors shall not make any compound formulation changes in either the type or the quantity of ingredients without prior Government approval.

4.3.1.1 Bushings (unvulcanized). Samples from unvulcanized bushings shall be taken upon final compound mixing for the performance of the following qualification tests: specific gravity, hardness, tensile strength, elongation, tensile stress, aged properties, brittleness point, cure meter, TGA, compression set, GC mass.

4.3.1.2 Bushings (vulcanized). The following tests will be performed on vulcanized bushings: hardness, adhesions, bushing endurance.

4.3.1.3 Roadwheel path and ground pad (unvulcanized). Samples from unvulcanized roadwheel path and ground pad rubber shall be taken upon final compound mixing for the performance of the following qualification tests: specific gravity, hardness, tensile strength, elongation, tensile stress, aged tensile strength (roadwheel path only), aged elongation (roadwheel path only), brittleness point, cure meter, ozone resistance, TGA, and GC mass.

TABLE III. Classification of inspection and frequencies (bushings).

Title	Require-ment	Inspection	Qualification	First article	In-process inspection	CI	Control test
Specific gravity	3.3.3.2	4.7.1.1	1/	1/	1/ Batch		
Hardness	3.3.3.3	4.7.1.2	1/	1/	1/ Shift		1/Shift
Tensile strength	3.3.3.4	4.7.1.3	1/	1/	1/ Shift		
Tensile strength (aged)	3.3.3.5	4.7.1.4	1/	1/	1/ Month		
Ultimate elongation	3.3.3.4	4.7.1.5	1/	1/	1/ Shift		
Ultimate elongation (aged)	3.3.3.5	4.7.1.6	1/	1/	1/ Month		
Tensile stress	3.3.3.4	4.7.1.7	1/	1/	1/ Shift		
TGA	3.3.3.6	4.7.1.8	1/	1/	1/ Bi-Monthly		
Cure meter	3.3.3.7	4.7.1.9	1/	1/	1/ Batch		
Adhesion	3.3.3.8	4.7.1.10	1/	1/			1/Shift
Compression set	3.3.3.9	4.7.1.11	1/	1/	1/ Month		
Brittleness	3.3.3.10	4.7.1.12	1/	1/	1/ Monthly		
GC mass spec	3.3.3.11	4.7.1.13	1/	1/			4/
Bushing fill	3.5.4	4.7.1.14	1/Mold	1/Mold			1/New Mold
Concentricity	3.5.4.1	4.7.1.15	2/	2/		2/	
Workmanship	3.5.2	4.5.3.1	2/	2/		2/	
Product marking	3.3.4.13	4.5.3.1	2/	2/		2/	
Endurance	3.4.1	4.3.3	1/				3/

NOTES:

1/ Samples shall be taken as specified in section 3. Unless otherwise specified (see 6.2), sample size shall be one.

2/ Sample size shall be in accordance with table V.

3/ Bushing endurance shall be run as specified by the Procuring Activity. During the course of any given contract, no more than three (3) tests shall be required. Requirements and sample size shall be in accordance with 3.4.1.

4/ The Government may require samples as specified in 3.3.3.11.

5/ One batch is identified as a full mixer of rubber compound. 1/batch indicates one sample per batch. 1/bi-monthly indicates one sample every other month.

6/ Samples shall be selected at the location specified in 4.3.1.1 and 4.3.1.2. For in-process tests, samples are picked right after or while batches are being finalized. Control Tests would normally be performed on finished bushings (vulcanized).

TABLE IV. Classification of inspections and frequencies (roadwheel path and ground pad).

Title	Require-ment	Inspection	Qualification	First article	In process Inspection	CI	Control test
Specific gravity	3.3.4.1	4.7.2.1	1/	1/	1/ Batch		
Hardness	3.3.4.2	4.7.2.2	1/	1/	1/Shift		1/Shift
Tensile strength	3.3.4.3	4.7.2.3	1/	1/	1/Shift		1/Week
Tensile strength (aged)	3.3.4.4	4.7.2.4	1/	1/	1/Month		1/Month
Ultimate elongation	3.3.4.3	4.7.2.5	1/	1/	1/Shift		1/Week
Ultimate elongation (aged)	3.3.4.4	4.7.2.6	1/	1/	1/Month		1/Month
Tensile stress	3.3.4.3	4.7.2.7	1/	1/	1/Shift		1/Week
TGA	3.3.4.5	4.7.2.8	1/	1/	1/Bi-Monthly		
Cure meter	3.3.4.6	4.7.2.9	1/	1/	1/Batch		
Adhesion	3.3.4.7	4.7.2.10	1/	1/			1/Shift
Ozone resistance	3.3.4.8 3.3.4.9	4.7.2.11	1/	1/			1/Month
Brittleness	3.3.4.10	4.7.2.12	1/	1/	1/Month		
GC mass spec	3.3.4.11	4.7.2.13	1/	1/			4/
Blowout	3.3.4.12	4.7.2.14	1/	1/			3/
Workmanship	3.5.2	4.5.3.1	2/	2/		2/	
Product marking	3.3.4.13	4.5.3.1	2/	2/		2/	
Road test	3.4.2.1	4.3.2	1/				

NOTES:

1/ Samples shall be taken as specified in section 3. Unless otherwise specified (see 6.2), sample size shall be one.
2/ Sample size shall be taken in accordance with table V.
3/ Samples shall be required by the Government as specified in 3.3.4.12.
4/ Samples may be selected by the Government as specified in 3.3.4.11.
5/ One batch is identified as a full mixer of rubber compound. "1/batch" indicates one sample per batch. "1/bi-monthly" indicates one sample every other month.
6/ Samples for in-process and control testing shall be selected at the locations as specified in 4.3.1.3 and 4.3.1.4. In-process tests shall normally be performed on finished batches. Control tests shall be performed primarily on finished pads and roadwheel path rubber.

4.3.1.4 Roadwheel path and ground pad (vulcanized). The following qualification tests will be performed on vulcanized track roadwheel path rubber and ground pads: hardness, tensile strength (replaceable and integral pads only), elongation (replaceable and integral pads only), tensile stress (replaceable and integral pads only), aged tensile strength (replaceable and integral pads only), aged elongation (replaceable and integral pads only), ozone resistance, adhesion, and blowout.

4.3.1.5 Samples for on-vehicle road test. On-vehicle road test qualification of replaceable pad track systems (T154) requires 74 complete assemblies plus spares in accordance with Appendix B. Excluding the T157I pads, contractors supplying pads only for qualification are required to provide 74 pads plus spares in accordance with Appendix B. Contractors supplying pads for T157I pad qualification are required to submit 164 samples plus spares in accordance with Appendix D. On-vehicle road test qualification of integral pad track systems (Tl07) requires 50 complete assemblies plus spares in accordance with Appendix C. In addition 15 blocks are required for blow-out testing in accordance with 3.3.4.12. All hardware submitted for on-vehicle qualification shall be sent to the test site. Results of all tests listed in tables I and II shall be on file for the on-vehicle test samples. The samples shall be representative of those produced with equipment and procedures normally used in production.

4.3.1.5.1 Qualification sample size. The Government reserves the right to adjust the qualification sample size specified in 4.3.1.5 based on vehicle availability and the number of contractors attempting qualification.

4.3.2 On-vehicle-testing. For the on-vehicle test, replaceable track pad systems shall be qualified on the T154 track configuration mounted on an M109 series vehicles (see Appendix B for the replaceable track pad system test plan). Integral pad track shall be qualified on the T107 track mounted on an M88 series vehicle system (see Appendix C for the integral pad track test plan). Extension of qualification to track models other than those directly tested are listed in 6.7.1. The T157I pads shall be qualified on a Bradley Fighting Vehicle (BFV) System. See Appendix D for the T157I pad test plan.

4.3.3 Qualification approval. Track assemblies shall meet the requirements stated in section 3. Failure to meet minimum requirements specified shall be cause for sample rejection. Failure of any qualification sample to pass the specified inspections may be cause for refusal by the Government to conduct additional inspections until it has been proved, to the satisfaction of the Preparing Activity, that the faults revealed by the inspections have been corrected.

4.3.4 Retention of qualification. The Preparing Activity shall periodically review the contractor's test and inspection data during the life of future production contracts to assure that the results are equal or superior to those obtained during qualification testing. Any test results

that continue to fail to match or exceed the data requirements established during qualification testing may be cause for removal of the contractor from the QPL. For those contractors who are on the QPL, but have been out of production for 1 (one) year or more, the Government reserves the right to require a first article inspection (see 4.4).

4.4 First article inspection.

4.4.1 First article sample. Unless otherwise specified (see 6.2 and 6.10), the Government shall select bushing and roadwheel path and ground pad samples produced under the production contract for first article inspection. For bushings, first article samples shall be inspected as specified in table III. For track roadwheel path and ground path, first article samples shall be inspected to table IV. Inspection results shall be equal or superior to those obtained during qualification testing.

4.4.2 First article sample approval. Approval of the first article sample by the Government shall not relieve the contractor of his obligation to supply bushings, roadwheel path or ground pad items that are fully representative of those inspected as a first article sample. Any changes or deviations of the production units from the first article sample shall be subject to the approval of the contracting officer.

4.4.3 Failure. Deficiencies occurring during or as a result of first article inspection shall be cause for rejection of the products until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiency. The Government will not accept products until first article inspection is completed to the satisfaction of the Government. Further, the Government reserves the right to remove a contractor's name from the QPL pending successful completion of the first article.

4.5 Product and process control.

4.5.1 Control plan. The control plan is basically an outline of how the contractor verifies fulfillment of the requirements of this specification. The control plan shall summarize the control techniques used from receipt of raw materials to shipment of product. Test/inspection characteristic values shall be identified in the Process Fingerprint Plan (see 3.3). The initial control plan shall be established prior to qualification and shall reflect the product and process controls used to manufacture the qualification hardware. The control plan shall be in chart form and shall reflect the following: supplier name, process or product name and/or number, plan revision and revision date, operation number or process step, process parameters and product characteristics, method of control (e.g. gage, test, etc), sample size and frequency, analysis method (e.g. control chart, lot plot, run chart, etc), and other important control information. The control plan shall address the test methods/equipment used to meet the requirements of this specification. The use of alternative test methods/equipment (state-of-the-art) may be utilized provided supporting data/rationale is provided to show equivalency to the test/equipment being

replaced and the contractor receives Government approval (see 3.3). The plans shall reflect the process parameter controls (see 4.5.1.1) and product characteristic controls (see 4.5.1.2) used to assure the quality of the end product. The control plans are intended to be dynamic and may be changed as process improvements are made. The initial plans shall be delivered to the Government QAR and the Preparing Activity for approval. Any changes to the plans shall be provided to the Government QAR for concurrence, prior to implementation. The contractor shall have data available to support any changes to the control plans.

4.5.1.1 Process parameter controls. The quality of the products produced under this specification shall be controlled through process control techniques, such as statistical process control (SPC). Process controls shall be of a type that will provide adequate control of the process. The type and extent of the control is a function of the significance of the parameter being controlled.

4.5.1.1.1 Process parameter selection. The process parameters selected for control shall be identified through one of the following process analysis methods: Design of Experiments (DOE), Regression Analysis, Correlation Studies, Failure Mode Effects Analysis, (FMEA) , or other formal or scientific process analysis technique. The results of the process analysis shall be documented. As a minimum, the contractor shall identify how the following parameters are to be controlled or provide data from the process analysis or other evidence/information that justifies why one of the following are not controlled: raw material properties, material weights, mixing and milling conditions (time, temperature, mill banks, etc.) stock lay down temperatures, extrusion temperatures, booking temperatures, unvulcanized rubber block weights/dimensions, cleanliness of rubber and metal to be bonded, complete adhesive coverage, injection time, cure time, mold service time, runner temperature, nozzle temperature, mold temperature, mold pressure. In addition, the contractor may use any additional parameters to assure production of acceptable track components. The selected parameters shall be reflected on the control plan(s).

4.5.1.2 Product characteristic controls. Product characteristics are identified in the technical data package and in this specification. The product characteristics identified shall be controlled by process control techniques. Adequate process controls are necessary for the reduction and elimination of these product characteristic inspections as described in 4.5.1 of this specification.

4.5.1.2.1 Product characteristic selection. As a minimum, the product characteristics to be controlled or tested are identified in Quality Assurance Provisions, drawings, and this specification (see 4.5.3 and 4.7). At its own discretion, the contractor may control or inspect any additional characteristics. However, elimination of the required characteristics shall be supported by adequate inspection process analysis data. The selected characteristics shall be reflected on the control plan.

4.5.2 In-process inspection. In-process inspections listed in tables III and IV shall be performed on unvulcanized bushing, track roadwheel path and ground pad compound batches as soon as possible after they are final (all ingredients are added to the compounds). This effort will minimize production of large quantities of defective compounds which may result in the production of defective track components.

4.5.2.1 Sampling for in-process inspection.

4.5.2.1.1 Bushings. The samples for in-process inspection shall be selected and tested in accordance with table III.

4.5.2.1.2 Roadwheel path and ground path. The samples for in-process inspection shall be selected and tested in accordance with table IV.

4.5.2.2 Rework (workaway). Rubber track compounds that are defective or miscompounded shall not be used for rework (workaway) to fabricate any track components. Rework will be limited to conforming compounds that are generated during processing. Rework will consist of compounds being reworked into the same compounds using the lowest practical level in order to avoid process, compound and finished product variation. This level shall be established by the contractor and shall not affect the rubber properties or result in processing difficulties. Rubber compounds for rework would normally be limited to the following:

a. Non-defective compounds being worked into themselves at the rate indicated above.
b. Excess rubber left on the mills after extrusion, provided it is sheeted off promptly, identified and kept clean.
c. Extruded rubber that failed to meet dimensions, provided the extruded rubber is milled, cooled and identified.
d. Rubber used to warm up the tuber, but has not been contaminated with other rubber compound or scorched material.

4.5.2.3 Material weight tolerances. The ingredients shall be properly weighed on calibrated scales and controlled by inspections to assure compliance to the tolerances and inspection frequencies established by the contractor. The weights of all ingredients for the master batches, remills (if any), and final batches shall be inspected to assure process control.

4.5.2.4 Vulcanization time, pressure and temperature. The vulcanization time, temperature, pressure and other cure conditions will be those established by contractors to assure that track components have acceptable properties. These established cure conditions and tolerances will continue to produce components with acceptable properties and will meet the

requirements of this specification. The molding pressure will be set and be maintained by the manufacturers to assure production of defect free components that will meet all specification requirements. The values for vulcanization time, pressure and temperature shall be identified in the Process Fingerprint Plan (see 3.3).

4.5.2.5 Failures. Control failures are indicated by a deficiency discovered at any process control point (process parameter controls) , during testing identified in tables III and IV, or during product inspections (product characteristic controls).

4.5.2.5.1 Process control failures. Process control failures are indicated by a deficiency discovered at the process control point during the inspection parameters identified in 4.5.1.1.1. A failure shall require the contractor to take corrective action to eliminate the problem and prevent its recurrence. Contractors shall correct failures or deficiencies to preclude production of defective products.

4.5.2.5.2 Product control failures. Product control failures shall be determined upon performance of inspections/tests listed in tables III and IV. Failures which are discovered in mixed, extruded and vulcanized compounds shall be separated by screening preceding and, if necessary, subsequent runs until all defective materials are found and rejected. Contractors can retest two additional specimens out of the same deficient runs to confirm failure to meet requirements. If these last two specimens pass the test, then that control test is considered to be met. Failure of either of the two additional tests shall result in the rejection of all defective products.

4.5.2.6 Data comparison. Comparative data obtained from both in-process inspections and control tests shall be compared with data submitted in connection with qualification approval. Variations in excess of tolerance (see section 3) shall be evidence of change of materials, formula, or manufacturing procedure, and shall be cause for rejection.

4.5.3 Conformance inspection (CI).

4.5.3.1 Sampling for conformance inspection. The samples for CI examination shall be randomly selected from the inspection lot in accordance with table V.

4.5.3.1.1 Lot formation. Unless otherwise specified (see 6.2), a lot shall consist of all items submitted at one time, of one part number, manufactured under identical conditions from an identifiable production period not to exceed one work shift of a day's production from one manufacturer and from one production facility.

TABLE V. Sampling plan for CI.

CI sampling plan**	
Inspection lot size	Sample size
2 to 8	*
9 to 15	13
16 to 25	13
26 to 50	13
51 to 90	13
91 to 150	13
151 to 280	20
1201 to 3200	29
3201 to 10,000	34
10,000 to 35,000	42
35,000 to 150,000	50
150,000 to 500,000	60
500,001 and over	74
	90
	102

* Indicates entire lot must be inspected (100% inspection).
** Acceptance number is always zero

NOTES:

1. Tightened inspection shall be introduced as soon as 2 out of 5 successive lots have been rejected and shall, as a minimum, impose a 30 percent increase in sample size. Normal inspection sampling may be restored after 5 successive lots have been accepted under tightened inspection.
2. Reduced inspection may be introduced when 10 successive lots have been accepted and shall as a maximum, permit a 30 percent decrease in sample size. Normal inspection sampling shall be restored if a lot is not accepted under reduced inspection.

4.5.3.2 Defects The sample selected in 4.5.3.1 shall be inspected to the requirements of table IV for roadwheel path and ground pads and table III for bushings. The defects shall be classified as specified in table VI. Note that table VI addresses only the visual and physical measurement inspections of vulcanized components. It does not address defects or failures found upon testing.

4.5.3.3 CI failure. Any item that fails to conform to any specified requirement shall be rejected and any failure (one or more) of the selected sample or test for the appropriate inspection lot size shall constitute a failure of the entire lot. The rejected item(s) may be repaired or corrected and resubmitted for inspection. If the contractor utilizes sampling inspection as an

element of his inspection system, rejected inspection lots may be resubmitted for acceptance if the contractor performs 100 percent inspection on the lot for those characteristics which were defective and resulted in rejection of the lot and removes all defective units or obtains procuring activity approval to resample the lot due to the insignificance of the defects. Resubmitted lots shall be kept separate from new lots and shall be clearly identified as resubmitted lots. Blemishes on rubber components which have not been listed in table VI and are primarily appearance or cosmetic conditions (poor markings, pitting of molds, minor surface contamination) should be resolved by manufacturers as these conditions arise.

TABLE VI. Classification of defects.

Classification	Defect	Method of inspection
Blisters	A void or hole in article which causes protrusion on surface when hot, may not show on surface when cold - unacceptable in bushings. Allowable tolerance 1/16 inch max length/depth on pads and wheel-side rubber. Same as backflow or back-flash. Distortion at the mold line in the form of wrinkles, folds, tears.	SIE 1/
Back-rinding	Unacceptable on bushings. Allowable tolerance 1/16 inch deep, 1/16 inch wide, 1/2 inch length along the mold line.	SIE
Cracks	Failure of rubber stock to knit together properly. It may be found in any part of the rubber surface and also at the rubber base next to the metal.	Visual
Chipped	Rubber missing due to chipping, usually during removal from mold or during trimming. Unacceptable on bushings. Allowable tolerance 1/8 inch max in depth/ length, provided there is no cutting beyond this dimension.	SIE
Cuts/Tears	A slit, nick, or gash caused primarily by trimming of vulcanized components. Tear may be caused during removal of items from molds.	Visual
Folds	A crease or pleat, usually appears as overlap of rubber on itself with a relatively weak cohesion.	Visual
Foreign materials	Any extraneous matter such as wood, paper, metal, dirt, etc. penetrating past the rubber surface.	Visual
Wide flash	Thick spew-out rubber during moldings that results in dimensional noncompliance of the vulcanized component.	SIE

TABLE VI. Classification of defects - Continued.

Classification	Defect	Method of inspection
Light/non-fill/ air check	Insufficient material to fill mold, leaving voids or non-fill conditions on component. Trapped air, poorly vented molds, excess mold lubricant can also cause this defect. Unacceptable on bushings. Allowable tolerance 1/16 inch max depth and 1/8 inch max length.	SIE
Separation	Separation in the rubber or between the rubber and adhesives or rubber and metals.	Visual
Off-Register	Uneven or misaligned molds causing non-conformity to dimensional requirements of the drawing.	SIE
Undercure	Appears as tackiness, softness, porous, loginess, low hardness or other inferior physical properties. Usually caused by improper cure conditions or defective rubber.	SIE
Overcure	Vulcanizing to the point that physical property (hardness, tensile strength, etc) requirements are impaired.	SIE
Dimensional non-compliance	Molding that will result in concaveness, convexity or other dimensional irregularities of the components to meet the dimensional requirements of the drawing or result in adverse performance of the products.	SIE

1/ SIE = Standard Inspection Equipment

4.5.3.4 Packaging and packing.

4.5.3.4.1 Lot formation. A lot shall consist of all packs prepared for shipment in accordance with one level (see 6.2), from an identifiable production period, from one manufacturer, submitted at one time for acceptance.

4.5.3.4.2 Sampling for acceptance examination. Sampling for acceptance examination shall be performed in accordance with table V.

4.5.3.4.3 Examination inspection for packaging and packing. Samples selected in 4.5.3.4.2 shall be inspected as specified by the procuring activity (see 5.1 and 6.2).

4.5.3.4.4 Sample failure. Failure of the sample to pass any specified inspection may be cause for the Government to refuse to accept the lot until it has been proved to the satisfaction of the Government that the faults revealed have been corrected.

4.6 Control tests.

4.6.1 Control test samples. Control test samples shall be selected in accordance with the schedule shown in table III for bushings and table IV for roadwheel path and ground pad material.

4.6.2 Control test failure. Any deficiency in any control test component shall be presumed to be present in components subsequently produced after selection of the control test component unless evidence satisfactory to the Procuring Activity is presented by the contractor that such components are not similarly defective. Upon determination that said defects do exist, the Government reserves the right to refuse to accept further production until the contractor demonstrates that corrective action has been taken to eliminate the cause of such defects. For material produced after the last successful control test or for material produced prior to control test failure, the contractor shall provide evidence that the material produced met requirements. Evidence can be in the form of sampling inspection.

4.6.3 Additional specimens. In the event of failure of the first selected specimen to pass the test, two additional specimens shall be selected and both shall pass the same test. If these last two specimens pass the test, then that control test is considered to be met. Failure of the first specimen to pass the test, or failure of either the second or third specimens to pass the test, will be cause for the Government to discontinue acceptance and to return units previously accepted which can be identified with the lot corresponding to the failed sample.

4.7 Methods of inspection.

4.7.1 Bushings.

4.7.1.1 Specific gravity. This test shall be performed to the requirements of 3.3.3.2. During production, this test shall be performed as batches of unvulcanized rubber are finalized (all ingredients have been added and mixed in the compound). Each batch of compound will be identified and tested. The results from these tests will meet the tolerances established from data acquired during qualification and the tolerances listed in table I.

4.7.1.2 Hardness. This test shall be performed to the requirements of 3.3.3.3. During production, one sample will be taken on unvulcanized and vulcanized rubber on a per shift basis. The results from these tests shall meet the tolerances established from data acquired during qualification and the tolerances listed in table I.

4.7.1.3 Tensile strength. This test shall be performed to the requirements of 3.3.3.4. During production one unvulcanized sample will be taken right after mixing. The results from these tests will meet the tolerances established from data acquired during qualification and the tolerances listed in table I.

4.7.1.4 Tensile strength (aged). This test shall be performed to meet the requirements of 3.3.3.5. During production, one unvulcanized sample will be taken right after mixing on a monthly basis.

4.7.1.5 Ultimate elongation. This test shall be performed to the requirements of 3.3.3.4. During production, one unvulcanized sample will be taken on a per shift basis right after mixing. The results from these tests shall meet the tolerances established from data acquired during qualification and the tolerances listed in table I.

4.7.1.6 Ultimate elongation (aged). This test shall be performed to the requirements of 3.3.3.5. During production, one unvulcanized sample will be taken on a monthly basis right after mixing.

4.7.1.7 Tensile stress (modulus). This test shall be performed to the requirements of 3.3.3.4. During production, one unvulcanized sample will be taken right after mixing on a per shift basis. The results from these tests shall meet the tolerances established from data acquired during qualification and the tolerances listed in table I.

4.7.1.8 Thermogravimetric analysis. This test shall be performed to the requirements of 3.3.3.6. During production this test shall be performed on one sample of unvulcanized rubber on a bi-monthly basis. The results will be compared to the established test results obtained at qualification.

4.7.1.9 Vulcanization using oscillating disk cure meter. This test will be performed to the requirements of 3.3.3.7. The test shall be performed as batches of unvulcanized rubber are finalized (all ingredients have been added and mixed in the compound). Each batch of compound will be identified and tested.

4.7.1.10 Adhesion. This test shall be performed to meet the requirements of 3.3.3.8. During production, the test shall be performed on one sample of vulcanized rubber per shift.

4.7.1.11 Compression set. Compression set shall be performed to the requirements of 3.3.3.9. During production, the test shall be performed on unvulcanized rubber sampled at the frequency of one sample monthly.

4.7.1.12 Brittleness point of flexible polymers. This test shall be performed to the requirements of 3.3.3.10. During production, the test shall be performed on unvulcanized rubber sampled at the frequency of one sample monthly.

4.7.1.13 GC mass spec. This test shall be performed to the requirements of 3.3.3.11. During production, the test shall be performed on unvulcanized rubber sampled at the frequency established by the Government. The results will be compared to the established test results obtained at qualification.

4.7.1.14 Bushing fill. To determine conformance to 3.5.4, the contractor shall test each mold cavity as specified herein. Every time a mold is reworked, or a new mold is produced, each cavity shall be tested. Prior to initiation of production, each mold shall have each bushing cavity tested for minimum and maximum fill by use of the approved compound in the following procedure:

a. Mold one set of bushing to pin or sleeve, without bond (do not use bonding agent) for minimum fill in accordance with 4.7.1.14.1, and maximum fill in accordance with 4.7.1.14.2. Another set of bushings which shall be bonded may be used for maximum fill determination in accordance with 4.7.1.14.3 in lieu of 4.7.1.14.2. Record mold position of each bushing. Record the outside diameter of each pin or sleeve of the unbonded set in inches to three decimal places.
b. Ensure skin coating between or beyond rings and flash is not in excess of 0.031 inch.
c. Record from track shoe drawing the following dimensions in inches:
   (1) Maximum and minimum diameter of bore in shoe body.
   (2) Average length of bore in shoe body. NOTE: On the boss and bushing sleeve combination where the bushing sleeve is shorter than its mating boss, use the bushing sleeve length as the determining factor).

4.7.1.14.1 Minimum fill determination. Using the unbonded bushing, the following procedure shall be completed:

a. Slide bushing elastomer off pin or sleeve.
b. Immerse elastomer in graduated cylinder of water. Water and bushing shall be at the same temperature of 80 $\pm$ 20°F. Record volume of water displaced in cubic centimeters.
c. Apply data from drawings and recorded bushing sleeve diameter in the following formula:

$$Vcc = 12.227 (Do^2 - Di^2)L$$

Where:

Do = maximum diameter of bore (inches)
Di = recorded diameter of pin or sleeve (inches)
L = average length of bore or sleeve (inches)
Vcc = volume of cavity for bushing

The constant 12.227 included factors for conversion of inches to centimeters and to reduce to 95% volume. The calculation for each cavity is to be accomplished for minimum fill by using the maximum diameter and average length.

d. The displaced volume recorded from 4.7.1.14.1b is to be compared to and be equal to or greater than the calculated volume of 4.7.1.14.1c.

4.7.1.14.2 Maximum fill determination (unbonded). Using the unbonded bushing, the following procedure shall be completed:

a. Perform steps in 4.7.1.14.1a and 4.7.1.14.1b.
b. Apply data from drawings and recorded sleeve diameters in the following formula:

$V_{max} = 13.515 (D_{min}^2 - Di^2) L$
D_{min} = minimum diameter of bore (inches)
Di = recorded diameter of pin or sleeve
L = average length of bore or sleeve (inches)
V_{max} = volume of cavity for bushing in cubic centimeters.
The constant 13.515 includes factors for conversion of inches to centimeters and to increase to 105 percent volume.

c. The displaced volume recorded from 4.7.1.14.1b is to be compared to and be equal to or equal to or less than the calculated volumes of 4.7.1.14.1b.

4.7.1.14.3 Maximum fill determination (bonded). Using the bonded bushing, the following procedure shall be completed:

a. Provide one or more tubes, either steel or plastic, with a minimum bore diameter and the length equal to 105 percent of the average bore length of the shoe body in which the bushing is to be used.
b. Insert the bonded bushing in the tube.
c. One bushing from each cavity shall be tested.

4.7.1.15 Concentricity. Concentricity shall be measured with a depth gage or steel rule to determine conformance with 3.5.4.1. Samples shall be taken in accordance with table V.

4.7.2 Track roadwheel path and ground pad.

4.7.2.1 Specific gravity. This test shall be performed to the requirements of 3.3.4.1. During production, the test shall be performed on unvulcanized rubber sampled at the frequency of one per batch at the final mixing. The results from these tests shall meet the tolerances established from data acquired during qualification and the tolerances listed in table II.

4.7.2.2 Hardness. This test shall be performed to the requirements of 3.3.4.2. During production, one sample per shift shall be taken from the unvulcanized rubber. In addition, one test shall be performed per shift on a finished component. The results from these tests shall meet the tolerances established from data acquired during qualification, and the tolerances listed in table II.

4.7.2.3 Tensile strength. This test shall be performed to the requirements of 3.3.4.3. During production, one sample per shift shall be taken on unvulcanized rubber after final mixing. In addition, one sample per week shall be taken from the finished component (replaceable and integral pads only). The results from these tests shall meet the tolerances established from data acquired during qualification and the tolerances listed in table II.

4.7.2.4 Tensile strength (aged). This test shall be performed to the requirements of 3.3.4.4. During production, one sample per month shall be taken from the finished component (replaceable and integral pads only). One sample per month shall be taken from the unvulcanized rubber (roadwheel path only).

4.7.2.5 Ultimate elongation. This test shall be performed to the requirements of 3.3.4.3. During production, one sample per shift shall be taken on unvulcanized rubber after final mixing. In addition, one sample per week shall be taken from the finished component(replaceable and integral pads only). The results from these tests shall meet the tolerances established from data acquired during qualification, and the tolerances listed in table II.

4.7.2.6 Ultimate elongation (aged). This test shall be performed to the requirements of 3.3.4.4. During production, one sample per month shall be taken from the finished component (replaceable and integral pads only). One sample per month shall be taken from the unvulcanized rubber (roadwheel path only).

4.7.2.7 Tensile stress (modulus). This test shall be performed to the requirements of 3.3.4.3. During production, one sample per shift shall be taken on the unvulcanized rubber after final mixing. In addition, one sample per week shall be taken from the finished component (replaceable and integral pads only). The results from these tests will meet the tolerances established from data acquired during qualification, and the tolerances listed in table II.

4.7.2.8 Thermogravimetric analysis. This test shall be performed to the requirements of 3.3.4.5. During production, this test shall be performed on unvulcanized rubber sampled at the frequency of one sample bi-monthly.

4.7.2.9 Oscillating disk cure meter. This test shall be performed to the requirements of 3.3.4.6. During production, this test shall be performed on unvulcanized rubber sampled at the frequency of one sample per batch.

4.7.2.10 Adhesion. This test shall be performed to the requirements of 3.3.4.7. During production, one sample per shift shall be taken on vulcanized rubber.

4.7.2.11 Ozone resistance. This test shall be performed at the rate of one sample per month in accordance with the requirements of 3.3.4.8 or 3.3.4.9.

4.7.2.12 Brittleness point of flexible polymers. This test shall be performed to the requirements of 3.3.4.10. During production, one sample shall be taken monthly from unvulcanized final mixed compounds.

4.7.2.13 GC mass spec. This test shall be performed to the requirements of 3.3.4.11. During production, samples shall be taken as required by the Government.

4.7.2.14 Blowout test. This test shall be performed to the requirements of 3.3.4.12. Fifteen (15) track block samples of each compound for each configuration being submitted for qualification shall be required. Up to twelve (12) track block samples may be required by the Government during a production contract for the T107 track systems.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The elastomerized track shoe assemblies, track shoe bushings, and track shoe pads covered by this specification and track shoe sets assembled therefrom are intended for use in track systems on tracked military vehicles. These track shoes are military unique because they are used on tracked military vehicles and have a specific formulation which does not have a commercial application.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of this specification.
b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1 and 2.2.).
c. Type and part number of the track shoe, track shoe pad or track shoe set required.
d. Title, number and date of applicable drawings.
e. Manufacturer's compound number from QPL.
f. Number of shoes to be assembled in a set.
g. If product marking should be other than as specified (see 3.3.4.13).
h. If first article test/inspection is required (see 3.5.1).
i. If pin/bushing design and construction should be other than as specified (see 3.5.4).
j. If first article sample should be selected other than as specified (see 4.4.1).
k. If CI inspection lot should be other than as specified (see 4.5.3.1.1).
l. If sample size should be other than as specified in table III and table IV.
m. Packing requirements (see 5.1).
o. Mileage track pads should be removed from vehicle (see D.3.19.1).
p. Distribution of test incident reports and final reports (see D.3.27).

6.3 Definitions.

6.3.1 Definition of types.

6.3.1.1 Type I assembly. The type I track shoe assembly consists of a single-pin track shoe, bushing, and detachable track shoe pad, as applicable, together with attaching components such as bolts, pins, nuts, and washers.

6.3.1.1.1 Type I set. A type I track shoe set consists of a specified number of type I assemblies (see 6.3.1.1) coupled together with all attaching components.

6.3.1.1.2 Style B detachable pad. The detachable pad for the type I or type II track shoe assembly is the rubber pad intended for assembly on the road side of the track shoe.

6.3.1.2 Type II assembly. The type II track shoe assembly consists of a double-pin track shoe and bushings, together with attaching components such as bolts, pins, nuts, washers, connectors, caps, wedges, and guides and detachable pad as applicable.

6.3.1.2.1 Type II set. A type II track shoe set consists of a specified number of type II assemblies (see 6.3.1.2) coupled together with all attaching components.

6.3.1.3 Style. A style A track shoe does not have a detachable pad and the style B incorporates detachable pad.

6.3.2 Definition of defects.

a. Blister. Void or hole in item; causes protrusion on surface when hot; may not show on surface when cold; may be covered or open.
b. Crack. Failure of material to join together properly.
c. Nonfill. Air checks; depressions due to trapping of air at corners and edges.
d. Light stock. Insufficient material to fill mold.
e. Fold. Lapping or doubling of material resulting in crease or pleat.
f. Backrinding. Distortion at the mold line, usually in the form of wrinkles, folds, tears, or indentations.
g. Flash rubber. Spew-out of material at mold parting line.
h. Porosity. Presence of numerous minute voids in cured material.
i. Non-knit. Weakness where rubber flows together during molding.

6.3.3 Definitions for process control.

a. Process parameter. Process parameters are associated with the process used for the manufacture of material. Typical parameters include; time, temperature, feed rate, pressure, etc.
b. Product characteristic. Product characteristics include: hardness, length, diameter, specific gravity, tensile strength, concentricity, etc.
c. Control techniques. Control techniques are used for either process or product purposes as applicable. Examples of control techniques include: Statistical Process Control, first and last piece verifications, temperature monitoring devices with warnings or auto processing stops, detection inspections, etc.
d. Analysis methods. Analysis methods are used for the identification of process parameters and product characteristics. Typical analysis methods include: Design of Experiments, Regression Analysis, Failure Modes Effect Analysis, Quality Functional Deployment, etc.
e. Process fingerprint. Documented and detailed information that thoroughly describes the entire process used to produce the final product. This documentation includes: test, process parameter and product characteristic target values and tolerances, in-process materials and process settings, and all other important and relevant information.

6.3.3.1 Preparing activity. The military activity responsible for the preparation and maintenance of this document and the associated Qualified Products List. The preparing activity is responsible for qualification, and is the qualifying activity and authority.

6.3.4 Definitions for rubber products. Use ASTM D1566 for rubber terminology and definitions.

6.4 Code numbers. Manufacturer's code numbers should conform to those listed in "Federal Supply Code for Manufacturers Cataloging Handbook", identified as "H-4.1, H-4.2, and Supplement".

6.5 Illustrations. The illustrations shown herein (see figures 1 through 4) are relevant to the preparation of rubber specimens for testing purposes; they are not intended to represent shoe or pad designs.

6.6 Testing agencies. Contractors may use their own or any other testing agency for performing the tests required under this specification providing it is acceptable to the qualifying activity for qualification tests or the contracting officer for any other testing. On-vehicle testing will be performed by the Government.

6.6.1 Subject term (key word) listing.

Military
Tracked
Vehicles

6.7 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 11891 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000.

6.7.1 Extension of qualification. Elastomer compounds used in track models that have been tested and met all qualification requirements of this specification may be extended qualification for use in similar track shoe models as listed.

Track model tested		Qualification extended to:
Track assembly	T107	T107, T138, T144, and all type II, style A tracks.
Track assembly	T154	T154, T164, T150, T130E1, T136, T132E1, and all replaceable pad tracks except T158/T158LL. T142 with First Article Blow-out Test required. T157I with First Article or Qualification Test for pad.
Track pads	T154	All style B tracks except T157I, T158/Tl58LL
Bradley track pad	T157I	None
Bushings	T130El	All track systems except T158/TI58LL

6.8 Track cross reference. The following track shoe assemblies have been assigned model numbers for easy reference:

Army Drawing no.	Nomenclature	Model
12306600	Track, Double Pin	T150
12268550	Track, Double Pin	T154
12352500	Track, Double Pin	T164
8705914	Track, Double Pin	T107
10892811	Track, Double Pin	T144
10934639	Track, Single Pin	T132El
10948405	Track, Single Pin	T138
10954051	Track, Double Pin	T136
11645125	Track, Double Pin	T142
11677988	Track, Single Pin	T130El
12359466	Track, Single Pin	T157I

6.9 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

6.10 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first production items, a standard production item from the contractor's current inventory (see 3.5.1), and the number of items to be tested as specified in 4.4.1. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, finished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

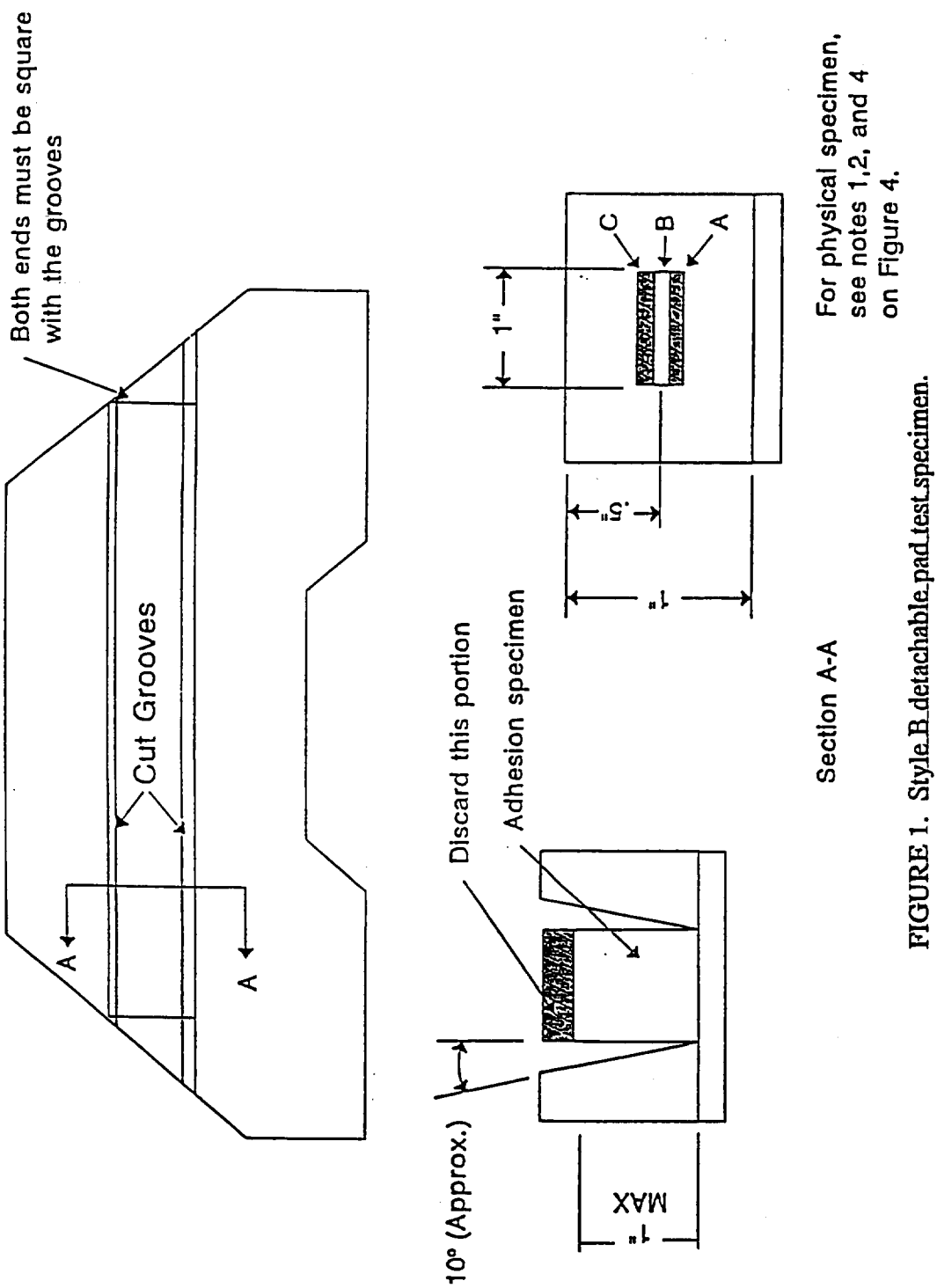


FIGURE 1. Style B detachable pad test specimen.

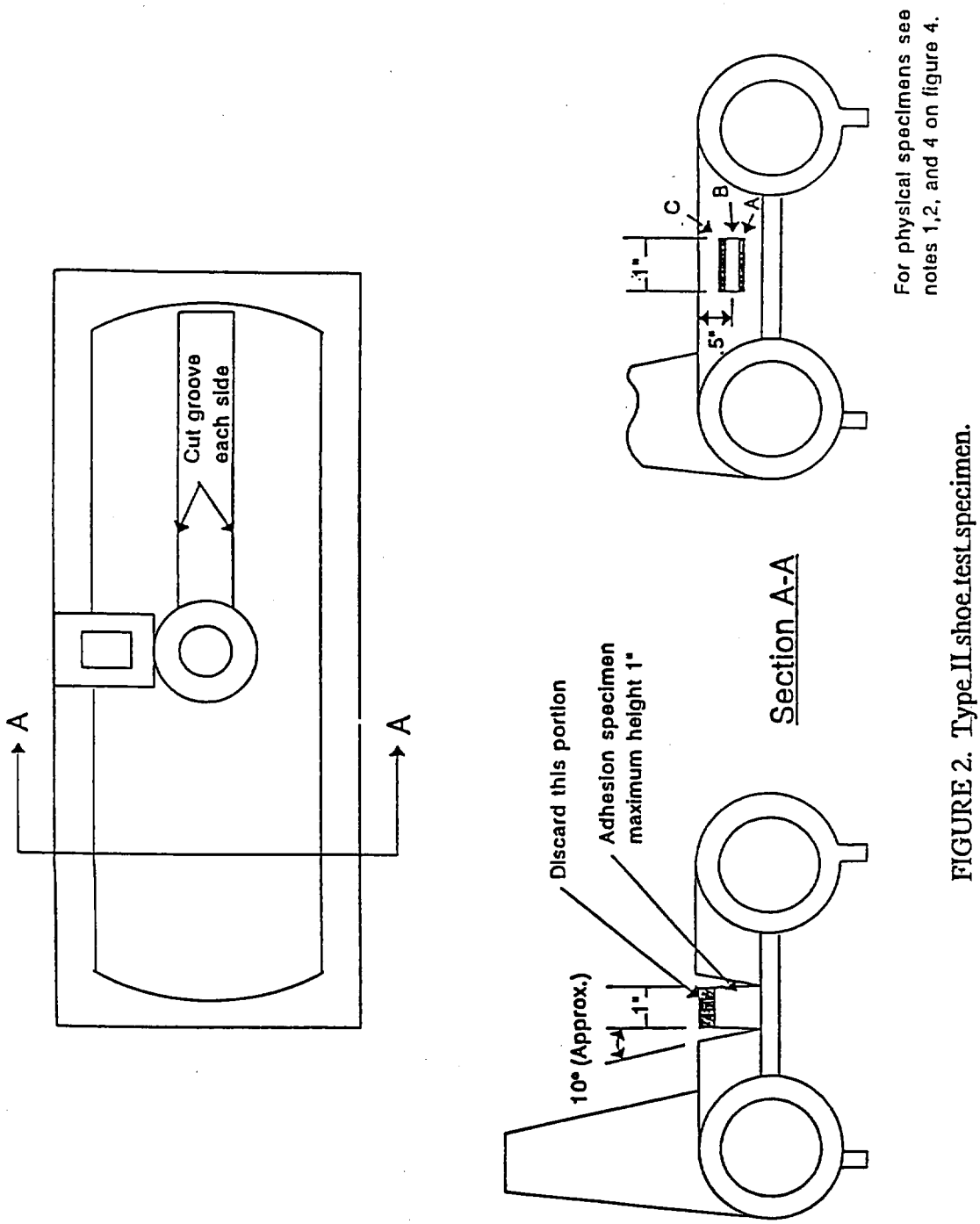
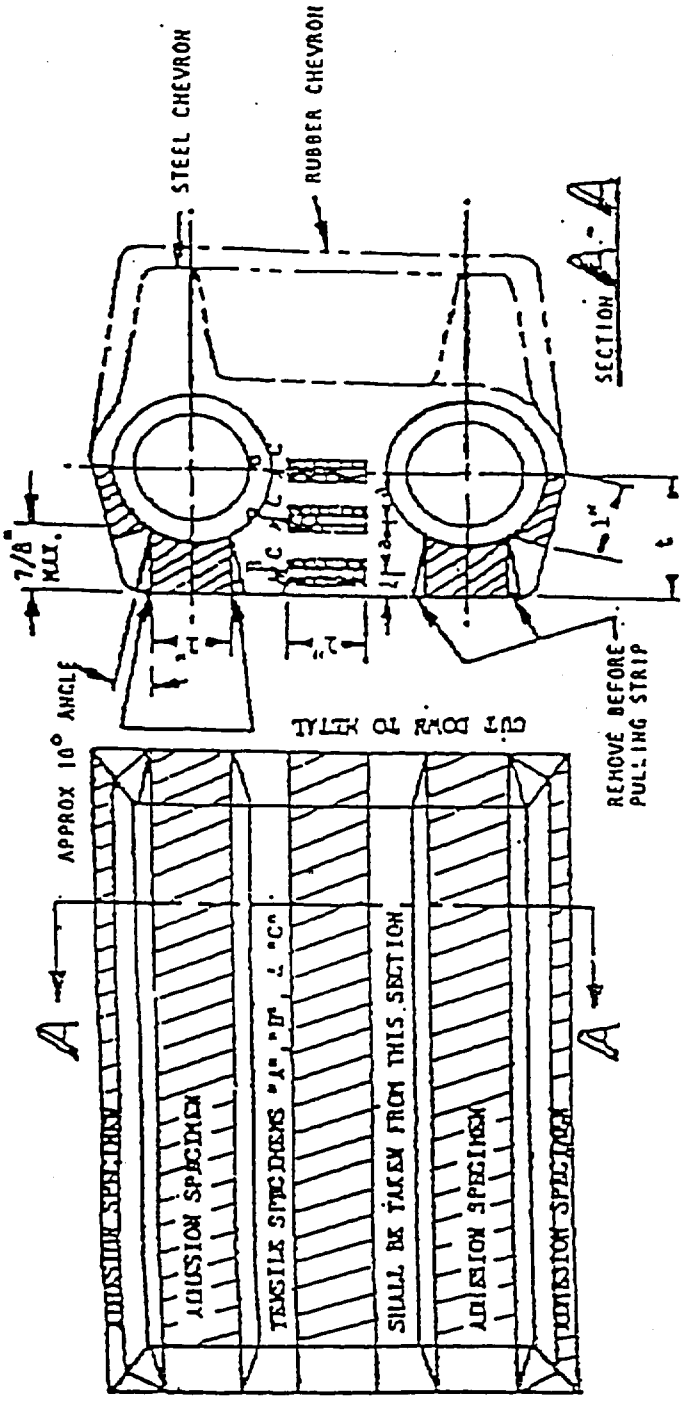


FIGURE 2. Type II shoe test specimen.



NOTES:

1. SPECIMENS "A" FOR MODULUS, TENSILE, & ELONGATION.
   SPECIMENS "B" FOR AGING.
   SPECIMENS "C" FOR ADDITIONAL SPECIMENS IF DESIRED.
2. THICKNESS OF SPECIMENS APPROXIMATELY 0.10 INCH ± 0.025".
3. $a = (t - 1) / 2$
4. STRIPS SHALL BE CUT TO END OF BLOCK ON BOGIE TIRE SIDE.

FIGURE 3. Physical property test sample locations.

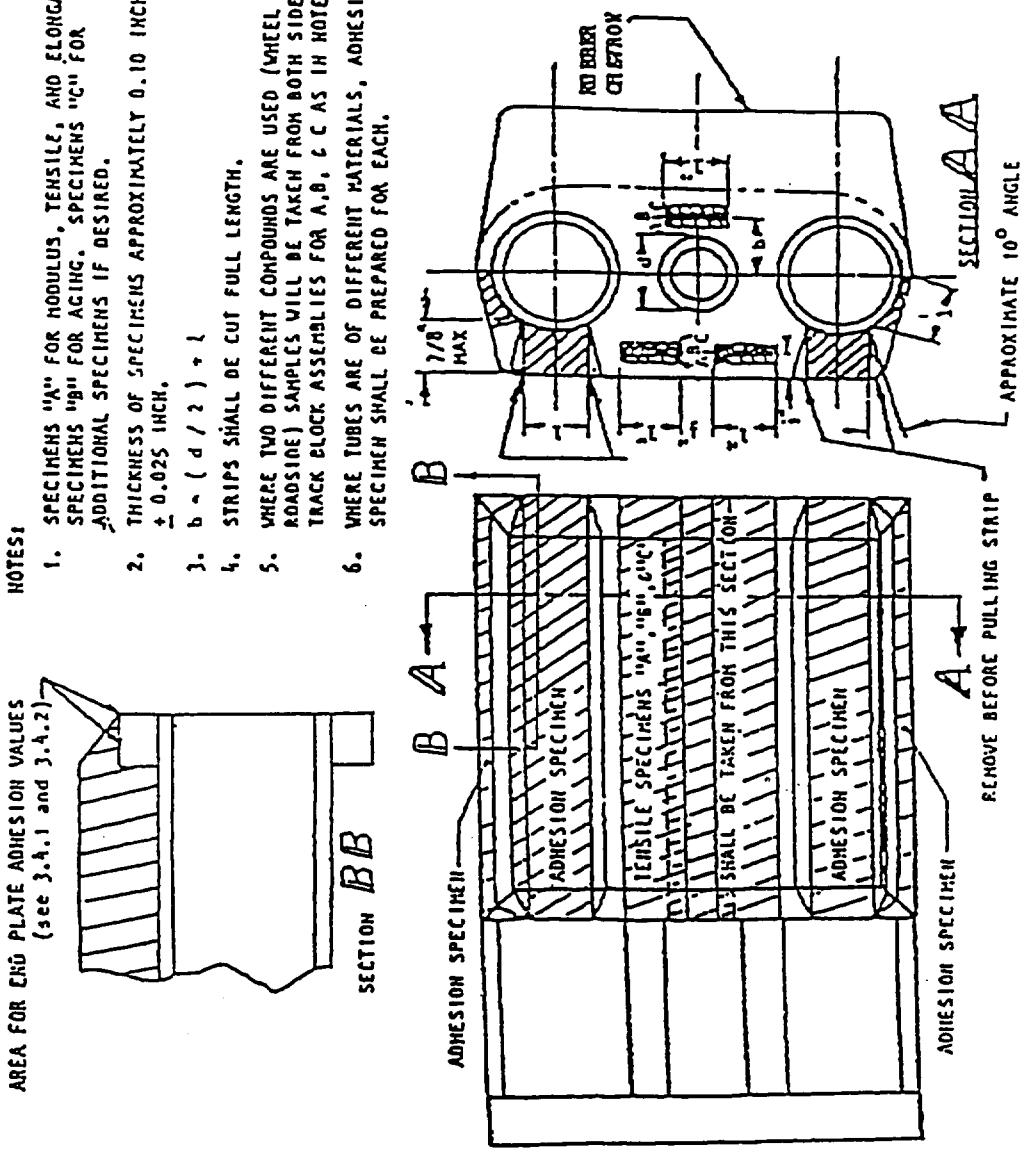


FIGURE 4. Typical location physical property test samples.

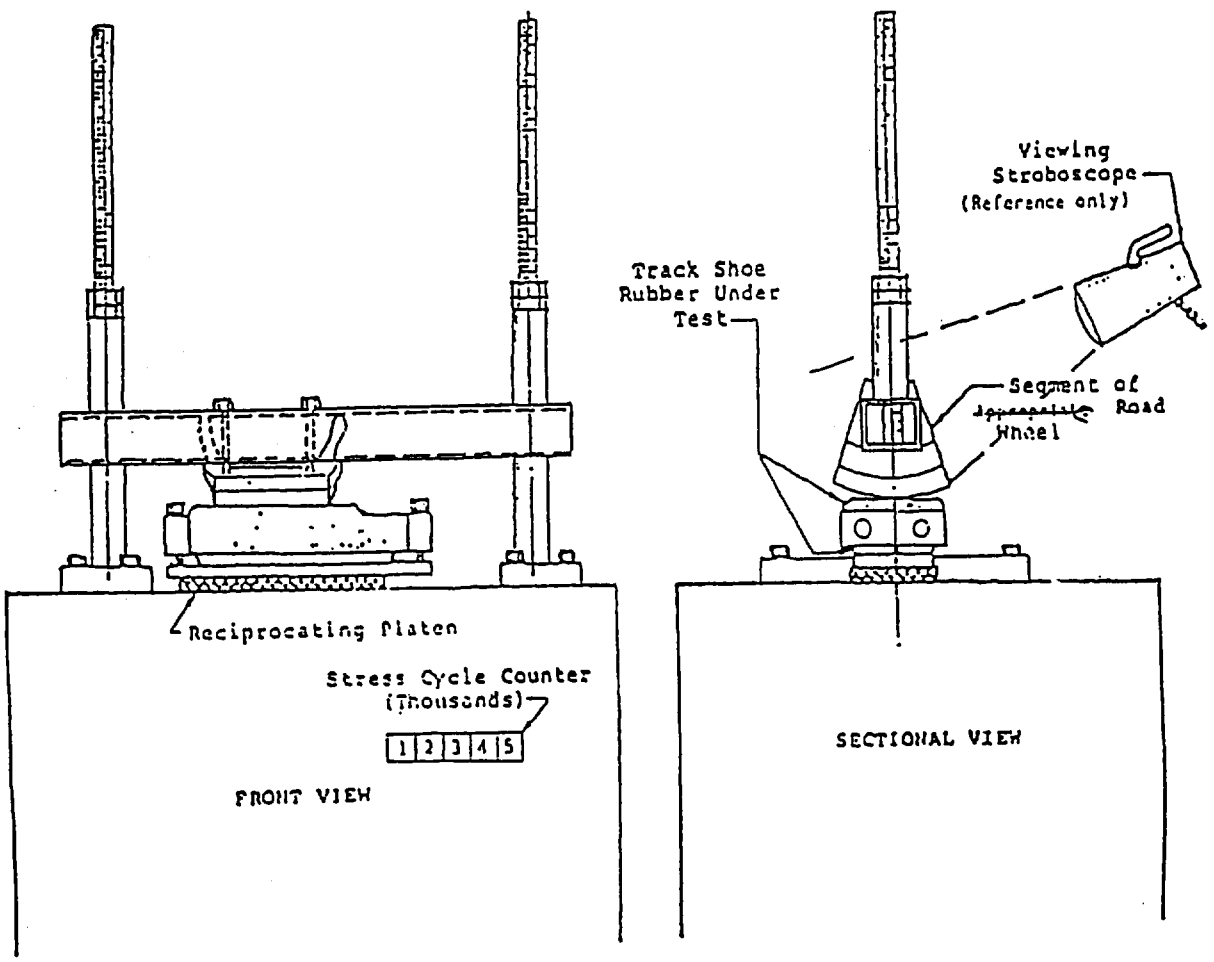


FIGURE 5. Blow-out machine.

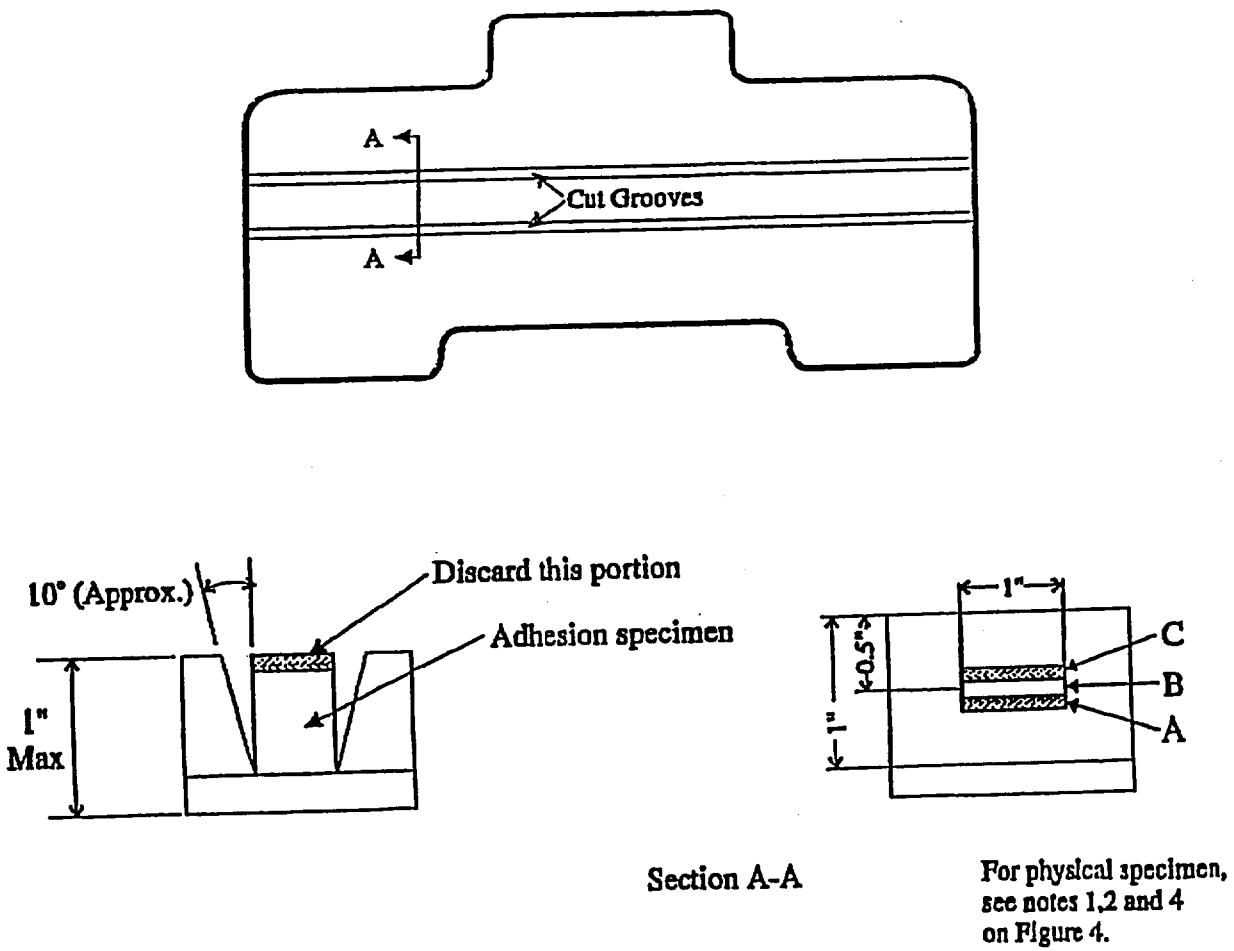
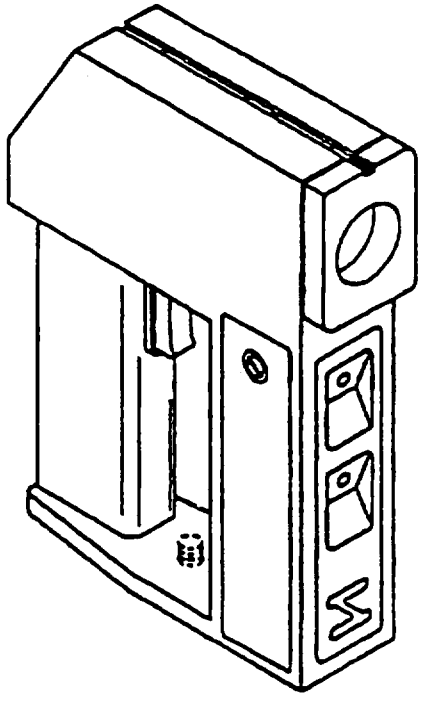


FIGURE 6. T157I detachable pad test specimen.



NOTE: Example of a thermo gun that may be used during break-in testing to measure the heat intensity of the rubber.

FIGURE 7. Thermo gun.

APPENDIX A

BUSHING ENDURANCE TEST PLAN

A.1 SCOPE

A.1.1 Scope. This appendix details the test procedures for testing contractor supplied T130E1 (P/N 11678029) long bushings for qualification. Those compounds successfully meeting these requirements will be listed on the Qualified Products List (QPL-11891) with the source and address. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2 APPLICABLE DOCUMENTS

A.2.1 Drawings.

11678029 - Bushing.

A.3 REQUIREMENTS

A.3.1 Test site. Unless otherwise notified, qualification testing will be conducted at the Michigan Technological University, Keweenaw Research Center (KRC) , Houghton County Airport, Calumet, Michigan 49913, (906) 487-2628.

A.3.2 Hardware requirements. Contractors submitting bushing samples for qualification in accordance with the following procedures are required to provide fifteen (15) T130El long bushings fabricated in accordance with Drawing Number 11678029. In addition, each contractor, at his option, will supply one (1) quart of the insertion lubricant of their choice to be used by the test facility during insertion of the candidate bushings into the simulated bore described below. If no lubricant is provided, Flexon 845 will be used by the test site personnel.

A.3.3 Test procedures.

A.3.3.1 Notification. Upon receipt of contractor supplied bushing samples intended for qualification testing, test site personnel will notify TACOM, AMSTA-TR-E/BLUE, (810) 574-8745. No qualification testing shall begin until AMSTA-TR-E/BLUE provides written authorization for testing to proceed.

A.3.3.2 Inspection of samples. Prior to the start of test, test site personnel will inspect each of the 15 sample bushings to ensure conformance to Drawing Number 11678029 and that no damage has occurred to the samples in shipment. Test site personnel will record the following information:

a. Date received.
b. Source address and code or compound number.
c. Quantity of bushings.
d. Conformance to Drawing No. 11678029.
e. Comments regarding bushing condition.

NOTE: If any nonconformance or unusual condition of the bushings is noted by test site personnel, the information shall be provided to TACOM, AMSTA-TR-E/BLUE, requesting disposition of the test samples.

A.3.3.3 Bushing sample insertion. Following a determination that all bushing samples meet the requirements established in A.3.3.2, test site personnel shall select and insert nine (9) bushings into simulated bores using the lubricant provided by the contractor or Flexon 845. Insertion shall be accomplished using the MTS 321 machine or equivalent.

A.3.3.4 Bushing sample aging. Following insertion, the nine bushing samples shall be aged for a minimum of 96 hours at an ambient room temperature of 75°F $\pm$ 10°F.

A.3.3.5 Thermogravimetric analysis. Test site personnel shall select one (1) bushing sample from the remaining six (6) samples to be submitted to an independent laboratory capable of conducting thermogravimetric analysis (TGA). The results of the TGA must be closely safeguarded and shall be provided with the results of the bushing endurance test for future reference.

A.3.3.6 Bushing test machines. Following the 96 hour aging, the simulated bores shall be placed into the bushing test machine(s). Three test machines are to be used if possible, equally distributing the qualification samples (3 on each machine). The machine(s) will be calibrated and zeroed prior to test initiation.

A.3.3.7 Load profile. The load profile and phase angle relationship of each test machine shall be checked within the first hour of the initial bushing test, to ensure conformance to figures 1 and 2 (attached).

A.3.3.8 Cyclic compression. Cyclic compression load shall be from 0 to 5200 pounds minimum at a frequency of 64 cycles per minute (cpm) $\pm$1 cpm. To ensure conformance to the 5200 pound minimum, the test machine shall be set to provide 5300 pounds of compression load.

A.3.3.9 Cyclic torsional deflection load. Simultaneous cyclic torsional deflection load shall be from +15° to -15° (±l°) at a frequency of 256 cpm ±4 cpm (see figure 9). Cyclic torsional deflection load frequency shall be maintained at four (4) times the cyclic compression load frequency by positive mechanical means.

A.3.3.10 Testing duration. Testing will be continuous (24 hours per day) until bushing failure, defined by the deflection exceeding 0.144 inches (0.145 inches of deflection). Radial load, deflection, ambient temperature, bushing temperature, number of cycles, and time shall be continuously monitored and recorded on a floppy disk using a Daytronic data acquisition system (or equivalent) for future reference as required. A one-time lapse of up to 30 minutes from the requirement of continuous operation of the test machine is permitted.

A.3.3.11 Test machine failure. In the event of a test machine failure, KRC shall discard the bushing undergoing the endurance test and any data pertaining to it, and will randomly select a new bushing specimen for testing.

A.3.3.12 Qualification requirements. Qualification requirements are determined by eliminating the highest bushing test cycle result and averaging the remaining eight (8) bushing test cycles. The average shall be a minimum of 130 000 compression load cycles. No single bushing of the nine (9) tested shall be less than 110 000 cycles. If, at any time during the test, a test sample fails to attain the minimum 110 000 cycles, KRC shall notify TACOM, AMSTA-TR-E/BLUE (810) 574-8745 for disposition and direction.

A.3.3.13 Test completion. Following completion of the test, a report containing all test data shall be provided to TACOM, AMSTA-TR-MTT and AMSTA-TR-E/BLUE. This report shall also include the results of the thermogravimetric analysis. All test information and reports will be released by TACOM personnel only. KRC personnel will not release any test information to manufacturers.

A.3.3.14 Sample disposition. All samples shall be retained by the test site until receipt of official Government approval to release the samples to the contractor. All remaining samples shall then be returned to the contractor supplying parts for qualification.

A.3.4 Monitoring and certification. The test shall be monitored and results certified by the local Government Quality Assurance Representative (QAR) . Monitoring will be conducted to ensure proper machine calibration and that the test is conducted in accordance with the established procedures. At a minimum, the QAR will visit KRC at the beginning of the test of a contractor's supplied bushings (at the installation of the first 3 bushings) and near the mid-point of the test (test initiation of bushing # 5). At the conclusion of all bushing tests, the QAR will make

a final visit to review test results, certify that the test was conducted in accordance with the test plan and machine calibration was maintained throughout the test. In addition, TACOM engineers may, at their option, visit the test site to review procedures and results at any time.

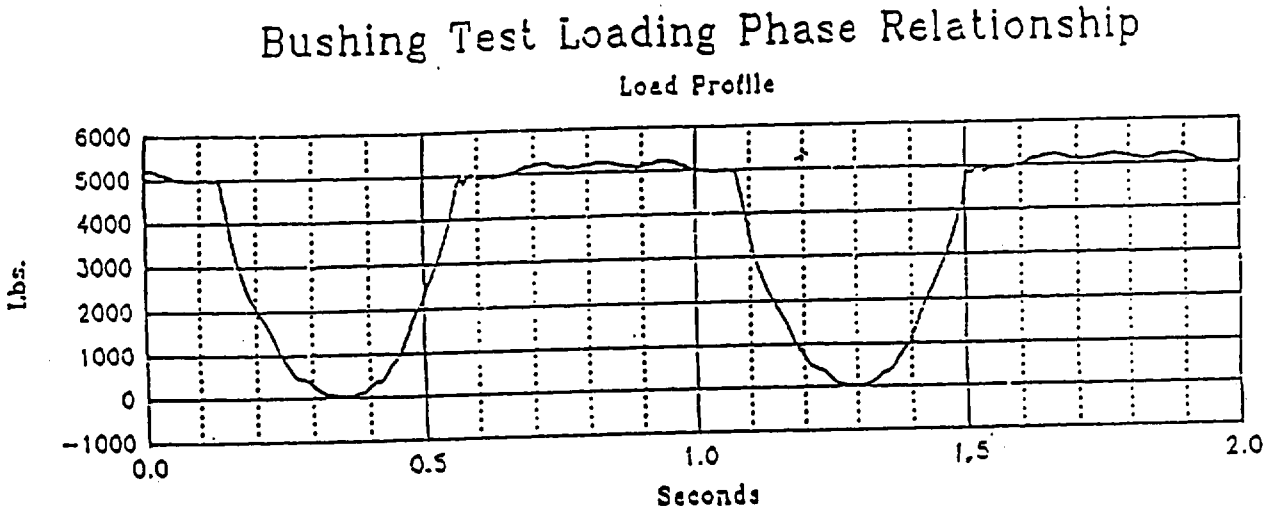


FIGURE 8. Load profile.

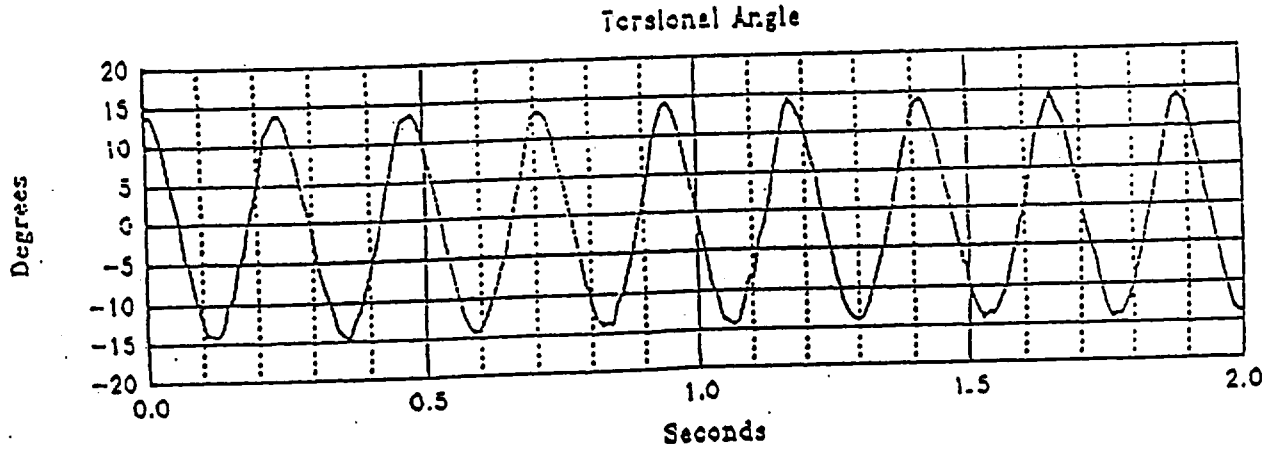


FIGURE 9. Torsional angle.

APPENDIX B

T154 TRACK ON-VEHICLE TEST PLAN

B.1 SCOPE

B.1.1 Scope. This appendix defines a set of instructions and requirements to be used for conducting all replaceable pad track vehicle qualification tests. Although this appendix is specific in nature, the Preparing Activity may amend this appendix with a more detailed set of instructions to meet the needs of the particular test. The requirements of this appendix are not to be changed without prior permission from the Preparing Activity. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

B.2 APPLICABLE DOCUMENTS

B.2.1 Drawings.

12268550	- T-154 Track Shoe Assembly.
12268551	- End Connector.
12268552	- Link Assembly.
12268557	- Molded Pad.
12268561	- Nut, Plain.
12268563	- Screw, Cap.

B.3 REQUIREMENTS

B.3.1 Test program review. A start of test meeting will be held at the test site on a date and time to be established by the Preparing Activity. Any additional review meetings shall be scheduled only if considered necessary by the Preparing Activity.

B.3.2 Test site access. Access to the test site will be required by Government personnel on a continuous basis to conduct their test responsibilities. Contractor personnel shall not be allowed test site access without specific approval from the Preparing Activity.

B.3.3 Test program scope. This test will be accomplished by assembling the manufacturer's T154 track samples on an M-109 series vehicle and operated to the requirements of this appendix.

B.3.4 T154 track design characteristics. The T154 track is a double-pin track with a replaceable track shoe pad. See figure 10 for a T154 track illustration with an associated parts listing.

APPENDIX B

B.3.5 Test course. The test course to be used for conducting all on-vehicle qualification tests will be selected by the Preparing Activity. The preferred course is located at the U.S. Army Proving Ground (YPG), Yuma, Arizona. Yuma has been traditionally selected for on-vehicle track testing because of climate, course, and test result consistency. The following standard track laying vehicle (tank and other tracked vehicles) test courses at YPG are designated for testing track for this specification.

a. Paved course. The dynamometer course is a 2-mile, smooth, near-level (0.8 percent grade) 30-foot wide roadway with 500-foot radius turnarounds at each end, surfaced with a high strength asphalt. The course is located at an elevation of approximately 470 feet above sea level and is staked at 0.1-mile intervals throughout its length with accurately surveyed distance markers.

b. Gravel course. The tank gravel course is a 3.6-mile compacted and graded gravel course and is for testing track laying vehicles under conditions simulating a secondary gravel road. The course consists of short straight sections and curves of varying radii with many moderate and sharp turns.

c. Hilly cross-country course. The tank hilly cross-country B course is 2.7 miles long and has short steep grades (35 percent) with a greater proportion of slopes less than 20 percent. This course has surfaces varying from sand and gravel to exposed bedrock. The loose gravel, sharp stones and rocks present a severe cutting and abrasion problem for tracks and roadwheels.

d. Level-cross country course. The tank level cross-country course traverses areas of level, sandy terrain with many bumps that provide a severe test of track laying vehicles. The dust conditions are typical of cross-country operation on dry soil. One lap is 6.7 miles.

B.3.6 Operational mode summary. The operational mode summary for the test shall consist of 25% paved (concrete, asphalt, or macadam); 50% on gravel composed mostly of small stones; and 25% on cross-country (equal amount of hilly and level). During the test, the vehicle shall not traverse more than 50 continuous miles over any single type of terrain. Vehicle direction around the test courses shall be changed periodically to assure approximately equal clockwise and counterclockwise test operation.

B.3.6.1 Climatological conditions. In order to expose the track test samples to the maximum “hot” weather conditions, vehicle road testing shall be scheduled to start no earlier than 1 March and no later than 1 September of the same calendar year.

APPENDIX B

B.3.7 Track delivery and storage. Track shoe/pad samples are to be delivered to the test site by a date specified by the Preparing Activity. Adequate time must be allowed for test site personnel to inspect, mark, and install the hardware so as not to impact the projected test start date. A secured area must be made available during and after the test for each of the track shoe/pad samples. The samples received will be placed in a shaded area that prevents direct sunlight from shining on the track pads during storage and assembly operations. The reduction of variables such as solar heating of the pads in a stack while other are shaded and, therefore, cooler is mandatory. Any condition that might influence the relative performance of the track shoes/pads are to be held as uniform as possible.

B.3.8 Contractor hardware requirements. For the qualification road test, the contractor test sample shall consist of 74 complete T154 track shoe assemblies (see B.3.11 for strand configuration). In addition, the following spare hardware shall be required: (a) 86 complete T154 track shoe assemblies, to include all pads and connecting components. (b) 70 track shoe pad assemblies (to include pad nut P/N 12268561).

B.3.8.1 Sample size. For a contractor attempting qualification of T154 pad assemblies only, the sample size shall be 74 pads. In addition the contractor shall be required to provide 76 complete spare pad assemblies to include the pad nut.

B.3.9 Initial inspection/preparation for test. The test site shall perform a receiving inspection of the M109 series vehicle(s) to be used for the test. The basic test vehicle(s) will be visually and functionally checked with specific attention given to suspension, electrical systems, hydraulic systems, and automotive controls and accessories. Any damage or improper operation will be repaired/corrected to ensure the vehicle(s) will be capable of meeting the test requirements defined by this appendix.

B.3.9.1 Inspection of track samples. Contractor supplied track qualification samples will be inspected to ensure no physical damage has occurred in shipment, that the required number of samples and spares have been provided and that all components are properly identified.

B.3.10 Track identification. To aid in failure and part life tracking, all track shoes, including spares, shall be identified to a manufacturer by permanent sequential number/letter codes applied to the metal portion of the shoe body. The test site shall apply the number/letter codes to the test track shoes prior to vehicle installation.

B.3.10.1 Track assembly marking. All 160 contractor supplied track assemblies shall be stamped with a lead designator alpha character only, prior to track break-in (see B.3.17). Following break-in, any failed shoes shall be removed and the remaining shoes shall be sequentially numbered. The track shoes shall be marked on both the inboard and outboard faces,

in the recessed area between the track pins as illustrated in figure 11. An example of the coding system to be used is as follows: X0l, X02.... X160 (X for Contractor ABC and 1, 2, 3, etc. for numeric shoe designation). The test site shall contact the Preparing Activity to request a code letter identification upon receipt of a contractors supplied hardware.

B.3.10.2 Serial pad marking. Serial marking of pads may be required as specified by the Preparing Activity.

B.3.10.3 Pad installation and coding. Pads supplied for pad qualification only will be installed on Government furnished T154 track assemblies. The Government furnished track shall be coded using the alpha code letter "G" followed by a contractor code letter corresponding to the contractor furnishing the pads for qualification. The code letters shall be located as illustrated in figure 11.

B.3.11 Track shoe installation pattern. Each vehicle shall have the capacity to test two contractors supplied samples. Each strand will consist of 39 assemblies from each of two contractors and two Government furnished T154 assemblies. The Government furnished assemblies will be removed, as required, to maintain track tension. Two transition shoes (one of each of two different contractors) at the connection points will not be considered in the qualification sample, making the qualification sample size 37 in each of two strands. The track shoe installation pattern on the M109 series vehicle shall be provided to the test site by the Preparing Activity. Track installation shall be accomplished in accordance with the appropriate technical manuals.

B.3.12 Load condition. For the test, the weight of the M109 vehicle shall be adjusted to 58 500 pounds, plus or minus 400 pounds. The load shall be distributed approximately equal on each track when on a level surface.

B.3.13 Pivoting of vehicles. Pivot steering of vehicles during break-in and qualification testing is to be kept at a minimum. Sudden braking action shall also be avoided to the extent possible.

B.3.14 Track tension adjustments. All tension adjustments shall be made prior to the start of the test as well as during test operations. As a minimum, track tension shall be checked on a daily basis. These adjustments shall be made after inspection faults have been corrected. Track tension requirements can be found in the latest technical manuals for the M109 series vehicle. NOTE: Low track tension will cause thrown tracks, broken or bent pins, and broken

end connectors and center guides. High track tension shall also be avoided. Track pins will break and tracks will be thrown, the track adjuster or grease gun shall be kept from contacting the track shoe rubber parts. Any grease or oil accidentally contacting the shoe shall be immediately wiped off.

B.3.15 Track component replacement. Track shoe assembly replacements are required based on meeting the failure criteria for any number of component parts (bushing, roadwheel path rubber, center guide, or shoe body damage). The component failure criteria is detailed in the table VII. The individual shoe replacements shall be made in the same strand location as the respective failed shoes. In addition, if the pads meet the acceptance criteria, the pads from the original track shoe shall be reinstalled on the replacement shoe.

B.3.15.1 Hardware torque. When track shoes, pads or end connectors are replaced, the new hardware must be torqued checked after the first 50 miles of operation.

B.3.16 Torque values. All T154 track hardware shall be torqued to the following values and in accordance with proper maintenance procedures:

Clamp type end connector	400 ±20 wet lb-ft.
Track shoe pad nuts	110 - 150 dry lb-ft.

B.3.17 Break-In run. The purpose of the break-in run procedure is to simulate the natural aging process afforded production/spare track during normal transit/storage periods before actual vehicle use. All test samples (to include spares and all pads provided for qualification) shall be broken in prior to the road test by having the vehicle on which they are installed, continuously operated for 45 miles on a paved road (concrete, asphalt, or macadam) as follows:

Division of Break-in run	Speed m.p.h. (max)	Distance miles (min)
a	10	15
b	15	15
c	20	15

B.3.17.1 Vehicle operation. The vehicle shall be operated in both directions for one-half of the total vehicle distance.

B.3.17.2 Track cooling. During the break-in run, the track shall be allowed to cool between each phase of testing. This cooling of the track can be verified through one of the following two procedures.

B.3.17.2.1 Track roadwheel path surface. The track roadwheel path surface shall be cooled to the point where the palm of the hand can be held to the surface backing in excess of 10 seconds.

B.3.17.2.2 Cool down. Cool down between speed changes shall require the use of a device used to measure the temperature of the rubber pads (see figure 7 for a diagrammed example of this type of device). Measurements should be taken from both the roadwheel side and the road side. A reading of 130 degrees or less should be recorded prior to restart of the break-in.

B.3.17.3 Visual inspection of track. Between each division of the break-in run, a visual inspection shall be made of the track and the component parts. The inspection shall be in accordance with the inspection and replacement criteria found in the table VII. Hardware shall be re-torqued if noticeably loose. After break in, all hardware shall be torqued 100% to values specified in B.3.16.

B.3.17.4 Track or pad failures. Any track or pad failures which occur during break-in do not count towards the failure criteria. Further, any failures during break-in do not reduce the original sample sizes. Track shoes/pads failed during break-in shall be replaced with spares and noted on a Test Incident Report (TIR). The track shoes comprising a strand after break-in (including the recorded spares inserted for any failures during break-in) shall be denoted as the original strand sample at the start of test. Break-in mileage shall be counted toward the qualification mileage requirement.

B.3.17.5 Spare track. All spare track shall be installed on a vehicle and broken in before test start up. The break-in shall be performed in accordance with B.3.17. After completion of the break-in run, the track shall be removed from the vehicle and stored for future use during the qualification test.

B.3.18 Test procedure. After completion of the break-in run, the vehicle shall be run to the operational mode summary found in 30.6 until the track and/or pads being tested for qualification have met the failure criteria (see B.3.20) or have exceeded the qualification requirements of 5000 miles track life and/or 1000 miles pad life. Testing may be stopped at any time at the discretion of the test director.

B.3.18.1 Fifty mile scenario. During the test, operators are to run one 50 mile scenario at a time in accordance with the mission profile requirements stated below. A mission profile requirement will consist of the following:

Secondary road.....25 miles
Paved road.....12.5 miles
Combined X country.....12.5 miles

B.3.18.2 Track switching. Upon completion of the first 500-mile mission scenario, the track strands shall be removed from the vehicle, inspected for overall condition, and switched to the opposite side. At 1000 miles, the track strands shall be removed from the vehicle, inspected for overall condition, and switched to the opposite side. Repeat this switching procedure for every 500 miles of testing.

B.3.19 Inspection and replacement criteria. Inspection and replacement criteria during the on-vehicle test shall be in accordance with the table VII.

B.3.20 Failure criteria. Failure of a contractor's track will be established when 20% of its total shoe samples have reached wearout and/or need replacement. See table VII.

B.3.20.1 Pad sample failure. The contractor's pad sample shall be considered failed when 40% of the pads reach wear-out and/or need replacement. See table VII.

B.3.20.2 Track or pad failures (break-in). Any track or pad failures which occur during break-in or are damaged as a result of the following incidents will not be counted against qualification requirements:

a. Mechanical failure of non track parts resulting in track damage.
b. Sprocket damaged shoes.

B.3.21 Disposition of track test hardware. All track test hardware shall be retained at the test site pending disposal instructions, including failed track components. Track that is defective or has completed testing may be stored outdoors while waiting for disposition instructions. It is essential that each manufacturer's track samples are not commingled with samples from another manufacturer.

B.3.21.1 Failed track component marking. All failed track components shall be tagged and marked so as to identify accumulated test miles and cross reference to daily logs or test reports, as appropriate to provide for traceable component failure history.

B.3.21.2 Hardware. Hardware required for failure analysis shall be provided to the Preparing Activity upon request.

B.3.22 Vehicle disposition. Upon completion of the test and inspections, the vehicle shall be returned to the original pretest condition. Vehicle disposition instructions will be issued by the Preparing Activity.

B.3.23 Documentation/test reporting/photographic coverage. Any test incidents related to track, suspension and/or drive train components shall be documented on AMC Form 2134, Test Incident Report (TIR) or comparable test reporting document. The test site shall provide these reports to the Preparing Activity as they are generated. Each TIR or other test reporting document shall include as a minimum the following:

a. Description of failed component/part (noun).
b. Mileage track has endured.
c. Code/Serial number identification of failed component and code/serial number of replacement component.
d. Vehicle registration number.
e. Date of incident.
f. Description of incident. Description shall be detailed and include cause, if evident.
g. Test course where incident occurred, if known.
h. Estimated speed of vehicle when incident occurred.
i. Test environment at time of incident.
j. Disposition of failed part. Hold and tag failed part.
k. Test report number (beginning with number 1, continuing in chronological order.) Supplements to a specific number shall be identified with a letter (i.e., T0001A).
l. Authorized signature.

B.3.23.1 Track incidents. All track incidents determined to be major (that is, track throws, misguides, etc.) shall be immediately reported to the Preparing Activity.

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B.3.24 Final report. The test site shall prepare a final technical report at the completion of testing. The report shall include as a minimum the following:

a. Data collected. Include copies of TIRs for track related failures.
b. Summary of test findings and conclusions.
c. Photographs, tables, and charts to reflect test findings and conclusions.
d. If more than one contractor is attempting qualification testing at one time, test results shall be grouped by contractor.

TABLE VII. T154 track hardware inspection and replacement criteria.

ITEM	ACTIVITY	INSPECTION OR ACTION	REFERENCE
Track Strand	1. Inspect Daily	Visual observation of overall condition with specific attention to the road/grouser interface.	
	2. Replace	When 20% of the original track shoes have been replaced (or now require replacement) due to wearout.	
Track Pin	1. Inspect Daily	Visually check for cracked, broken or bent pins.	
	2. Replace Shoe*	When pin broken, bent or cracked.	
Bushing	1. Inspect Daily	Visually check for dead blocks or extruded bushing.	
	2. Replace Shoe*	When dead blocks are found or a bushing is completely extruded (pin to shoe body contact).	Fig. 12
Roadwheel Path Rubber	1. Inspect Daily	Visually check for (1) cracks, chunks or cuts. (2) Obvious lack of roadwheel support due to blowout, or chunking.	
	2. Replace Shoe*	When more than 50% of rubber is lost on one or both sides of the grouser.	Fig. 13
Track shoe Body	1. Inspect Daily	Visually check for cracked shoes, crushed binocular tubes, and loose or lost backing rubber.	
	2. Replace	When shoe body cracked, binocular tube crushed, or pad mounting hole enlarged, or unable to remove defective pad.	

TABLE VII. T154 track hardware inspection and replacement criteria - Continued.

ITEM	ACTIVITY	INSPECTION OR ACTION	REFERENCE
End Connector	1. Inspect Daily	Visually check for cracked, broken or missing bolts or connector.	
	2. Replace	When cracked, broken or worn to less than 3/16 to 1/8 inch thick or retorqued if noticeably loose.	Fig. 14
Center Guide	1. Inspect Daily	Visually check for cracked, broken bent, loose or worn center guides.	
	2. Replace Shoe	When missing, cracked, broken, or worn to less than 5/16 inch thick, as measured 1 inch below top of the center guide	Fig. 15
Track Pad	1. Inspect Daily	Visually check for loose, missing or damaged pads and pad wear.	
	2. Replace	(1) Individually, if grouser marks a paved surface. Pad blowout or chunking does not meet criteria for replacement given that grouser is not marking the road. Replace whole assembly if pad mount is damaged or unable to remove pad. Note: Replacement pad height must be within 1/4 inch (plus or minus) of neighboring pads. Either use a worn pad or shave down a spare pad. (2) Strand set replacement considers the overall general condition of all pads on strand. Pad wear should be representative for all the other pads on the strand. When 40% of the original pads have been replaced or require replacement (do not count multiple replacement of the same pad location), then all pads on the strand shall be replaced with new pads. The pad strand set may be replaced before reaching the 40% criteria at the test director's discretion due to local restrictions on road damage.	

*NOTE: Pads from original shoe must be removed and reinstalled on the replacement shoe.

B.3.25 Photographic coverage. The test site shall furnish color photographic coverage of all significant test events to include, as a minimum, track throw or misguide damage (vehicle and track system); broken or bent center guides; sprocket damaged shoes; and broken pins.

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B.3.25.1 Applicable information. Together with the photographic coverage, applicable information (manufacturer, serial number, test course, mileage sustained, etc.) shall be recorded and accompany the photographs. This data is to be included in the final report.

B.3.26 Distribution of reports. The distribution of test incident reports and final reports shall be as specified by the Preparing Activity.

T154 Track Shoe Assembly

P/N 12268550-1

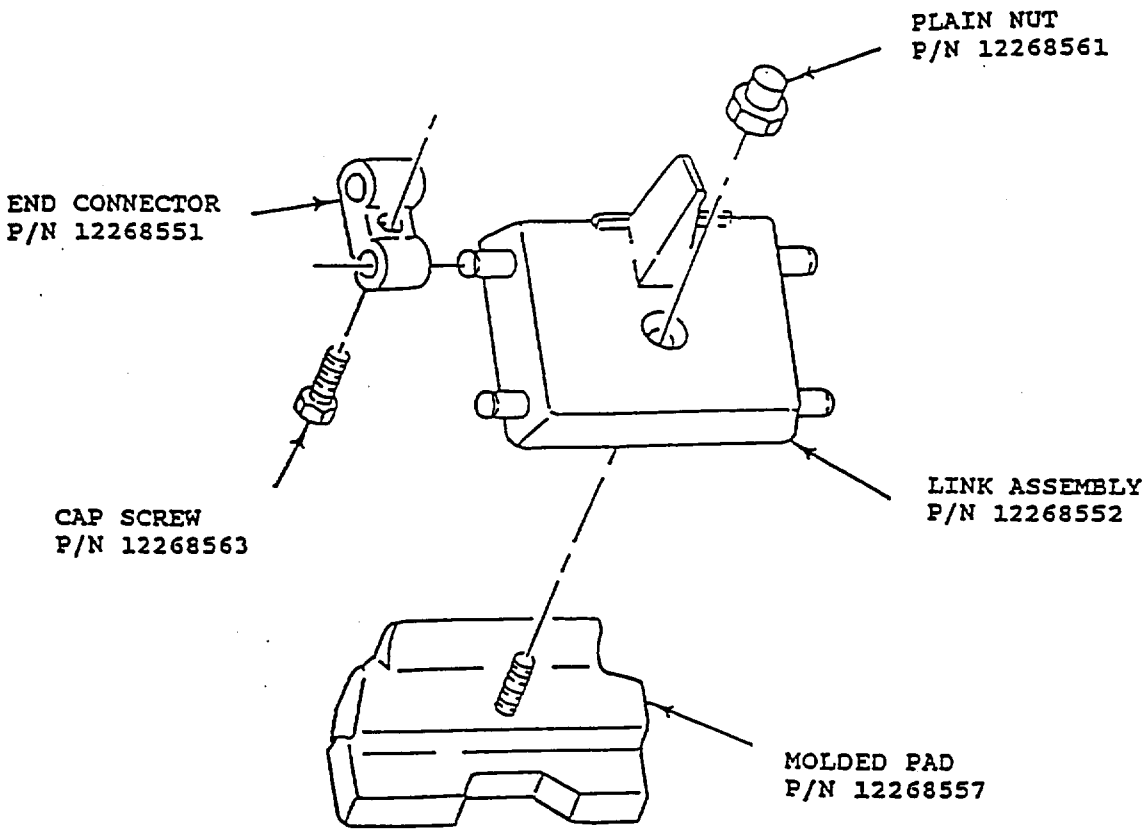

FIGURE 10. T154 Track hardware illustration.

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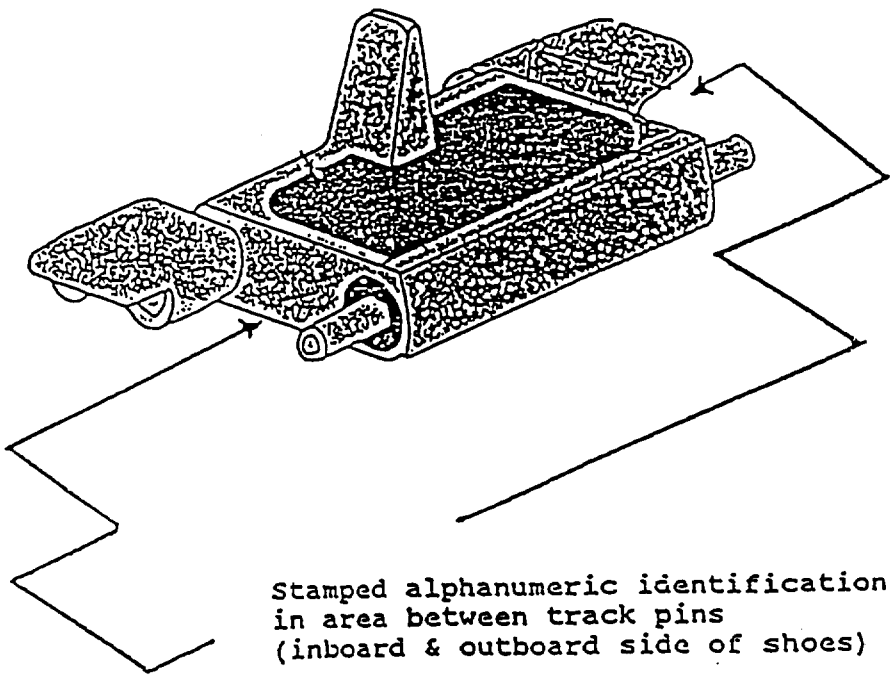

FIGURE 11. Track shoe marking.

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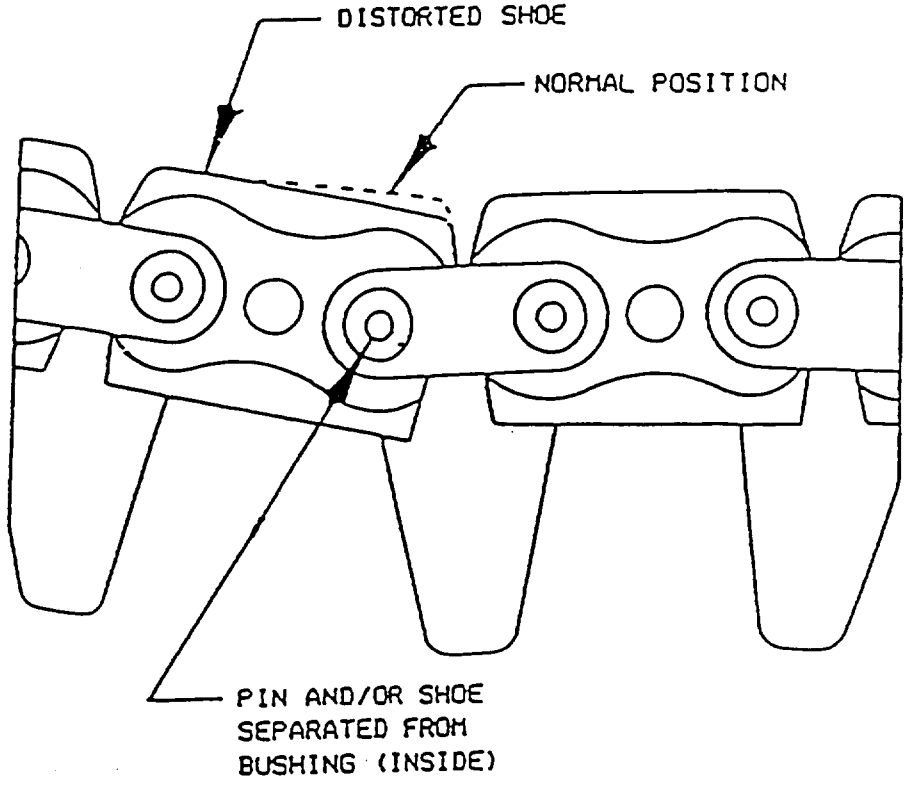

FIGURE 12. "Dead Track Block" bushing check.

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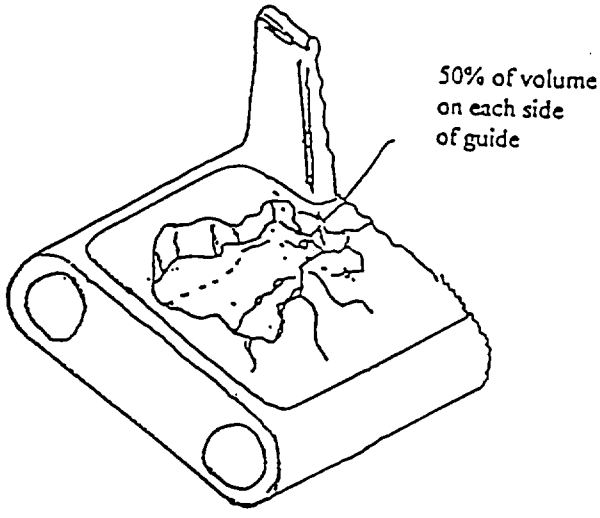

FIGURE 13. Roadwheel path rubber inspection criteria.

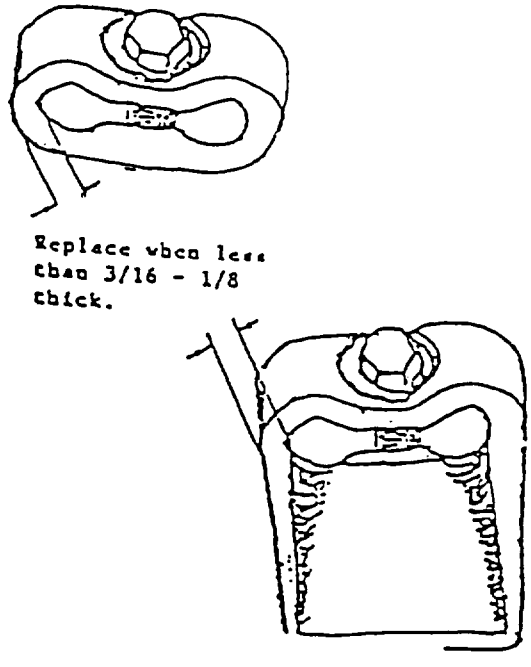

FIGURE 14. End connector inspection criteria.

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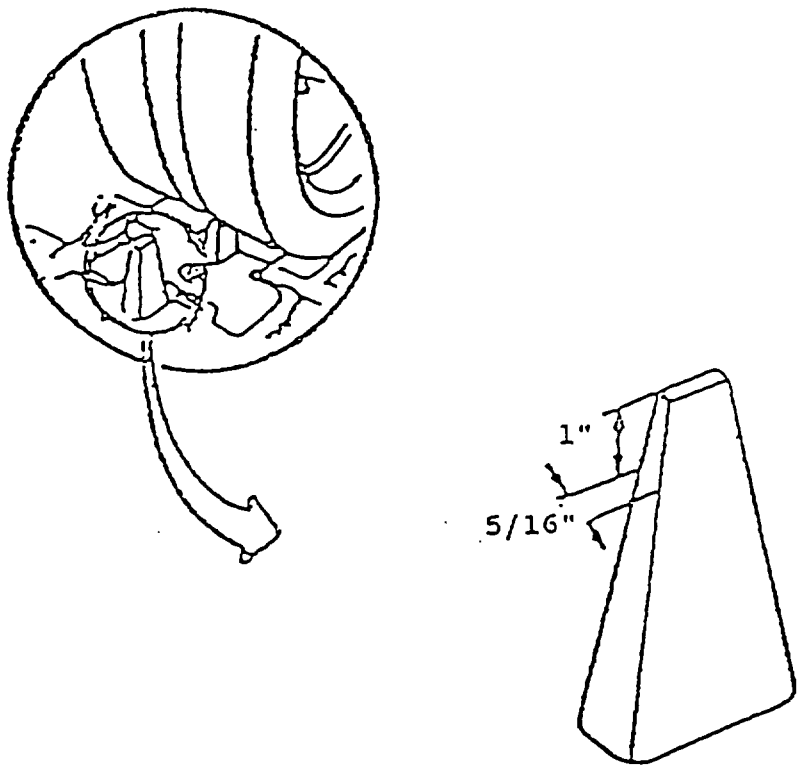

NOTE: Check track center guide thickness on ten track shoes from each side. Measure 1 inch down from top of center guide. At that point, measure center guide thickness. If center guide thickness is less than 5/16 inch thick, or if it is broken, or cracked, replace the track shoe.

FIGURE 15. Center guide inspection criteria.

APPENDIX C

T107 TRACK ON-VEHICLE TEST PLAN

C.1 SCOPE

C.1.1 Scope. This appendix defines a set of instructions and requirements to be used for conducting all integral pad track vehicle qualification tests. Although this appendix is specific in nature, the Preparing Activity may amend this appendix with a more detailed set of instructions to meet the needs of the particular test. The requirements of this appendix are not to be changed without prior permission from the Preparing Activity. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

C.2 APPLICABLE DOCUMENTS

C.2.1 Drawings.

7069543	- Bolt.
8382359	- Wedge.
8382360	- Bolt.
8705894	- Cap.
8705897	- Guide.
8705899	- Link Assembly.
8705914	- T-107 Track.
8705919	- Connector.

C.2.2 Standards.

MS51943	- Nut, Self-Locking, Hexagon-Prevailing Torque, For Critical Installations, 250°F, UNC-3B and UNF-3B.

C.3 REQUIREMENTS

C.3.1 Test program review. A start of test meeting will be held at the test site on a date and time to be established by the Preparing Activity. Any additional review meetings shall be scheduled only if considered necessary by the Preparing Activity.

C.3.2 Test site access. Access to the test site will be required by Government personnel on a continuous basis to conduct their test responsibilities. Contractor personnel shall not be allowed test site access without specific approval from the Preparing Activity.

APPENDIX C

C.3.3 Test program scope. This test will be accomplished by assembling the manufacturer's T107 track samples on an M88 series vehicle and operated to the requirements of this appendix.

C.3.4 T107 Track design characteristics. The T107 track is a double-pin track with an integral pad. See figure 16 for a T107 track illustration with an associated parts listing.

C.3.5 Test course. The test course to be used for conducting all on-vehicle qualification tests will be selected by the Preparing Activity. The preferred course is located at the U.S. Army Proving Ground (YPG), Yuma, Arizona. Yuma has been traditionally selected for on-vehicle track testing because of climate, course, and test result consistency. The following standard track laying vehicle (tank and other tracked vehicles) test courses at YPG are designated for testing track for this specification.

a. Paved course. The dynamometer course is a 2-mile, smooth, near-level (0.8 percent grade) 30-foot wide roadway with 500-foot radius turnarounds at each end, surfaced with a high strength asphalt. The course is located at an elevation of approximately 470 feet above sea level and is staked at 0.1-mile intervals throughout its length with accurately surveyed distance markers.

b. Gravel course. The tank gravel course is a 3.6-mile compacted and graded gravel course and is for testing track laying vehicles under conditions simulating a secondary gravel road. The course consists of short straight sections and curves of varying radii with many moderate and sharp turns.

c. Hilly cross-country course. The tank hilly cross-country B course is 2.7 miles long and has short steep grades (35 percent) with a greater proportion of slopes less than 20 percent. This course has surfaces varying from sand and gravel to exposed bedrock. The loose gravel, sharp stones and rocks present a severe cutting and abrasion problem for tracks and roadwheels.

d. Level-cross country course. The tank level cross-country course traverses areas of level, sandy terrain with many bumps that provide a severe test of track laying vehicles. The dust conditions are typical of cross-country operation on dry soil. One lap is 6.7 miles.

e. Hilly cross- country course (with a vehicle in tow). When towing a vehicle of equal weight, the recommended course is the "Truck Hilly Course". This course is 2.2 miles long in one complete scenario. One mile of the course is in the form of rolling hills with the second mile a number of steep but controllable hills. The course consists of mostly gravel surfaces with the lower portion having sandy soil.

It is operated in both clockwise and counterclockwise directions. The turns allow for safe operation when towing a vehicle of equal weight.

C.3.5.1 Operational mode summary. The vehicle shall perform to the requirements as specified in table VIII. When towing, towed load shall be a vehicle of equal weight to the test vehicle.

Table VIII. Road test.

Course	Mileage and speeds	Vehicle loading
Hard/gravel surface	240 miles at varying speeds up to maximum.	Simulated combat payload towed load for 30% of specified test mileage.
Level cross-country	480 miles at varying speeds up to maximum.	Simulated combat payload towed load for 35% of specified test mileage.
Hilly cross-country	336 miles at varying speeds up to maximum.	Simulated combat payload.
Hilly cross-country (with a vehicle in tow)	144 miles at varying speeds up to maximum.	Simulated combat payload and towed load.

C.3.5.2 Climatological conditions. In order to expose the track test samples to the maximum "hot" weather conditions, vehicle road testing shall be scheduled to start no earlier than 1 March and no later than 1 September of the same calendar year.

APPENDIX C

C.3.6 Track delivery and storage. Track shoe/pad samples are to be delivered to the test site by a date specified by the Preparing Activity. Adequate time must be allowed for test site personnel to inspect, mark, and install the hardware so as not to impact the projected test start date. A secured area must be made available during and after the test for each of the track shoe/pad samples. The samples received will be placed in a shaded area that prevents direct sunlight from shining on the track pads during storage and assembly operations. The reduction of variables such as solar heating of the pads in a stack while other are shaded and, therefore, cooler is mandatory. Any condition that might influence the relative performance of the track shoes/pads are to be held as uniform as possible.

C.3.7 Contractor hardware requirements. For the qualification road test, the contractor test sample shall consist of 50 complete T107 track shoe assemblies (see C.3.10 for strand configuration). In addition, the following spare hardware shall be required: (a) 45 complete T107 assemblies, to include all connecting components. (b) The contractor shall ship 15 track blocks for laboratory testing. Interested parties should contact the preparing activity for a specific address for shipment of the 15 track blocks.

C.3.8 Initial inspection/preparation for test. The test site shall perform a receiving inspection of the M88 series vehicle(s) to be used for the test. The basic test vehicle(s) will be visually and functionally checked with specific attention given to suspension, electrical systems, hydraulic systems, and automotive controls and accessories. Any damage or improper operation will be repaired/corrected to ensure the vehicle(s) will be capable of meeting the test requirements defined by this appendix.

C.3.8.1 Track qualification samples. Contractor supplied track qualification samples will be inspected to ensure no physical damage has occurred in shipment, that the required number of samples and spares have been provided and that all components are properly identified.

C.3.9 Track identification. To aid in failure and part life tracking, all track shoes, including spares, shall be identified to a manufacturer by permanent sequential number/letter codes applied to the metal portion of the shoe body. The test site shall apply the number/letter codes to the test track shoes prior to vehicle installation.

C.3.9.1 Track assembly marking. All contractor supplied track assemblies shall be stamped with a lead designator alpha character only, prior to track break-in (see C.3.16). Following break-in, any failed shoes shall be removed and the remaining shoes shall be sequentially numbered. The track shoes shall be marked on both the inboard and outboard faces,

in the recessed area between the track pins as illustrated in figure 17. An example of the coding system to be used is as follows: X01, X02 .... X160 (X for Contractor ABC and 1,2,3 etc. for numeric shoe designation). The test site shall contact the Preparing Activity to request a code letter identification upon receipt of a contractors supplied hardware.

C.3.10 Track shoe installation pattern. Each vehicle will have the capacity to test three contractors samples. Each strand will consist of 27 assemblies from each of three contractors and three Government furnished T107 assemblies. The Government furnished assemblies will be removed, as required, to maintain track tension. Two transition shoes (one of each of two different contractors) at the connection points will not be considered in the qualification sample, making the qualification sample size 25 in each of two strands. The track shoe installation pattern on the M88 series vehicle shall be provided to the test site by the Preparing Activity. Track installation shall be accomplished in accordance with the appropriate technical manuals.

C.3.11 Load condition. For the test, the weight of the M88 vehicle shall be adjusted to 112,000 pounds, plus or minus 400 pounds. The load shall be distributed approximately equal on each track when on a level surface.

C.3.12 Pivoting of vehicles. Pivot steering of vehicles during break-in and qualification testing is to be-kept at a minimum. Sudden braking action shall also be avoided to the extent possible.

C.3.13 Track tension adjustments. All tension adjustments shall be made prior to the start of the test as well as during test operations. As a minimum, track tension shall be checked on a daily basis. These adjustments shall be made after inspection faults have been corrected. Track tension requirements can be found in the latest technical manuals for the M88 series vehicle.

NOTE: Low track tension will cause thrown tracks, broken or bent pins, and broken end connectors and center guides. High track tension shall also be avoided. Track pins will break and tracks will be thrown, the track adjuster or grease gun shall be kept from contacting the track shoe rubber parts. Any grease or oil accidentally contacting the shoe shall be immediately wiped off.

C.3.14 Track component replacement. Track shoe assembly replacements are required based on meeting the failure criteria for any number of component parts (bushing, roadwheel path rubber, center guide, or shoe body damage). The component failure criteria is detailed in table IX. The individual shoe replacements shall be made in the same strand location as the respective failed shoes.

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C.3.14.1 Hardware torque check. When track shoes, center guides, or end connectors are replaced, the new hardware must be torqued checked after the first 50 miles of operation.

C.3.15 Torque values. All T107 track hardware shall be torqued to the following values and in accordance with proper maintenance procedures:

Connector wedge bolt	180 - 200 lb-ft.
Center guide nuts	300 - 320 lb-ft.

C.3.l6 Break-in run. The purpose of the break-in run procedure is to simulate the natural aging process afforded production/spare track during normal transit/storage periods before actual vehicle use. All test samples (to include spares) shall be broken in prior to the road test by having the vehicle on which they are installed, continuously operated for 45 miles on a paved road (concrete, asphalt, or macadam) as follows:

Division of break-in run	Speed m.p.h. (max)	Distance miles (min)
a	10	15
b	15	15
c	20	15

C.3.16.1 Vehicle operation. The vehicle shall be operated in both directions for one-half of the total vehicle distance.

C.3.16.2 Track cooling. During the break-in run, the track shall be allowed to cool between each phase of testing. This cooling of the track can be verified through one of the following two procedures.

C.3.16.2.1 Track roadwheel path surface. The track roadwheel path surface shall be cooled to the point where the palm of the hand can be held to the surface in excess of 10 seconds.

C.3.16.2.2 Speed change cool down. Cool down between speed changes shall require the use of a device used to measure the temperature of the rubber pads (see figure 7 for a diagrammed example of this type of device). Measurements should be taken from both the roadwheel side and the road side. A reading of 130 degrees or less should be recorded prior to restart of the break-in.

C.3.16.3 Visual inspection. Between each division of the break-in run, a visual inspection shall be made of the track and the component parts. The inspection shall be in accordance with the inspection and replacement criteria found in the table IX. Hardware shall be re-torqued if noticeably loose. After break-in, all hardware shall be torqued 100% to values specified in C.3.15.

C.3.16.4 Track failures. Any track failures which occur during break-in do not count towards the failure criteria. Further, any failures during break-in do not reduce the original sample sizes. Track shoes failed during break-in shall be replaced with spares and noted on a Test Incident Report (TIR). The track shoes comprising a strand after break-in (including the recorded spares inserted for any failures during break-in) shall be denoted as the original strand sample at the start of test. Break-in mileage shall be counted toward the qualification mileage requirement.

C.3.16.5 Spare track. All spare track shall be installed on a vehicle and broken in before test start up. The break-in shall be performed in accordance with C.3.16. After completion of the break-in run, the track shall be removed from the vehicle and stored for future use during the qualification test.

C.3.17 Test procedure. After completion of the break-in run, the vehicle shall run to the operational mode summary found in C.3.5.1 until the track being tested for qualification has met the failure criteria (see C.3.19) or the 1200 mile requirement is exceeded. Testing may be stopped at any time at the discretion of the test director.

C.3.17.1 Mission scenarios. During the test, operators are to run mission scenarios as specified by the Preparing Activity.

C.3.17.2 Track switching. Upon completion of the first 500-mile mission scenario, the track strands shall be removed from the vehicle, inspected for overall condition, and switched to the opposite side. At 1000 miles, the track strands shall be removed from the vehicle, inspected for overall condition, and switched to the opposite side. Repeat this switching procedure for every 500 miles of testing.

C.3.18 Inspection and replacement criteria. Inspection and replacement criteria during the on-vehicle test shall be in accordance with the table IX.

C.3.19 Failure criteria. Failure of a contractor's track will be established when 20% of its total shoe samples have reached wearout and/or need replacement (see table IX).

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C.3.19.1 Track failure (break-in). Any track failures which occur during break-in or are damaged as a result of the following incidents will not be counted against qualification requirements:

a. Mechanical failure of non track parts resulting in track damage.
b. Sprocket damaged shoes.

C.3.20 Disposition of track test hardware. All track test hardware shall be retained at the test site pending disposal instructions, including failed track components. Track that is defective or has completed testing may be stored outdoors while waiting for disposition instructions. It is essential that each manufacturer's track samples are not commingled with samples from another manufacturer.

C.3.20.1 Failed track components. All failed track components shall be tagged and marked so as to identify accumulated test miles and cross reference to daily logs or test reports, as appropriate to provide for traceable component failure history.

C.3.20.2 Hardware (failure analysis). Hardware required for failure analysis shall be provided to the Preparing Activity upon request.

C.3.21 Vehicle disposition. Upon completion of the test and inspections, the vehicle shall be returned to the original pretest condition. Vehicle disposition instructions will be issued by the Preparing Activity.

C.3.22 Documentation/test reporting/photographic coverage. Any test incidents related to track, suspension and /or drive train components shall be documented on AMC Form 2134, Test Incident Report (TIR) or comparable test reporting document. The test site shall provide these reports to the Preparing Activity as they are generated. Each TIR or other test reporting document shall include as a minimum the following:

a. Description of failed component/part (noun).
b. Mileage track has endured.
c. Code/Serial number identification of failed component and code/serial number of replacement component.
d. Vehicle registration number.
e. Date of incident.
f. Description of incident. Description shall be detailed and include cause, if evident.
g. Test course where incident occurred, if known.
h. Estimated speed of vehicle when incident occurred.

i. Test environment at time of incident.
j. Disposition of failed part. Hold and tag failed part.
k. Test report number (beginning with number 1, continuing in chronological order). Supplements to a specific number shall be identified with a letter (i.e., T0001A).
l. Authorized signature.

C.3.22.1 Track incidents. All track incidents determined to be major (that is, track throws, misguides, etc.) shall be immediately reported to the Preparing Activity.

C.3.23 Final report. The test site shall prepare a final technical report at the completion of testing. The report shall include as a minimum the following:

a. Data collected. Include copies of TIRs for track related failures.
b. Summary of test findings and conclusions.
c. Photographs, tables, and charts to reflect test findings and conclusions.
d. If more than one contractor is attempting qualification testing at one time, test results shall be grouped by contractor.

C.3.24 Photographic coverage. The test site shall furnish color photographic coverage of all significant test events to include, as a minimum, track throw or misguide damage (vehicle and track system), broken or bent center guides, sprocket damaged shoes, and broken pins.

C.3.24.1 Applicable information. Together with the photographic coverage, applicable information (manufacturer, serial number, test course, mileage sustained, etc.) shall be recorded and accompany the photographs. This data is to be included in the final report.

C.3.25 Distribution of reports. The distribution of test incident reports and final reports shall be as specified by the Preparing Activity.

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TABLE IX. T107 track hardware inspection and replacement criteria.

ITEM	ACTIVITY	INSPECTION OR ACTION	REFERENCE
Track Strand	1. Inspect Daily	Visual observation of overall condition with specific attention to the road/grouser interface.	
	2. Replace	When 20% of the original track shoes have been replaced (or now require replacement) due to wearout.	Fig. 20
Track Pin	1. Inspect Daily	Visually check for cracked, broken or bent pins.	
	2. 500 miles	Hammer-Ring check at site discretion.	Fig. 18
	3. Replace Shoe	When pin broken, bent or cracked.	
Bushing	1. Inspect Daily	Visually check for dead blocks or extruded bushing.	
	2. Replace Shoe	When dead blocks are found or a bushing is completely extruded (pin to shoe body contact).	Fig. 19
Roadwheel Path Rubber	1. Inspect Daily	Visually check for (1) cracks, chunks or cuts. (2) Obvious lack of roadwheel support due to blowout, or chunking.	
	2. Replace Shoe	When more than 50% of rubber is lost.	Fig. 20
Track Shoe Body	1. Inspect Daily	Visually check for cracked shoes. Daily crushed binocular tubes, and loose or lost backing rubber.	
	2. Replace	When shoe body cracked, binocular tube crushed.	

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TABLE IX. T107 track hardware inspection and replacement criteria - Continued.

ITEM	ACTIVITY	INSPECTION OR ACTION	REFERENCE
End Connector	1. Inspect Daily	Visually check for cracked, broken or missing bolts or connector.	
	2. Replace	When checked, broken or worn. to less than 1/8 inch thick.	Fig. 21
Center Guide	1. Inspect Daily	Visually check for cracked, broken, bent loose or worn center guides.	Fig. 22
	2. Replace Shoe	When missing, cracked, broken, or worn to less than 1/2 inch thick as measured 1 inch below top to the center guide.	
Roadside Rubber	1. Inspect Daily	Visually check for rubber wear or loss of rubber.	
	2. Replace Shoe	Chevron is less than 1/2 inch* or the metal is exposed.	Figs. 20 and 23

*NOTE: At the test site discretion, chevron wear can be measured by a “Go/No/-Go” device having one leg sitting on top of one end plate of a block and a second leg sitting on top of the other end plate, the legs joined with a straight strip running parallel to the rubber surface of the ground side of the shoe. If both legs of the measuring device touch, at the same time, the two high points of the end plates, the wear on the ground side will be considered worn out.

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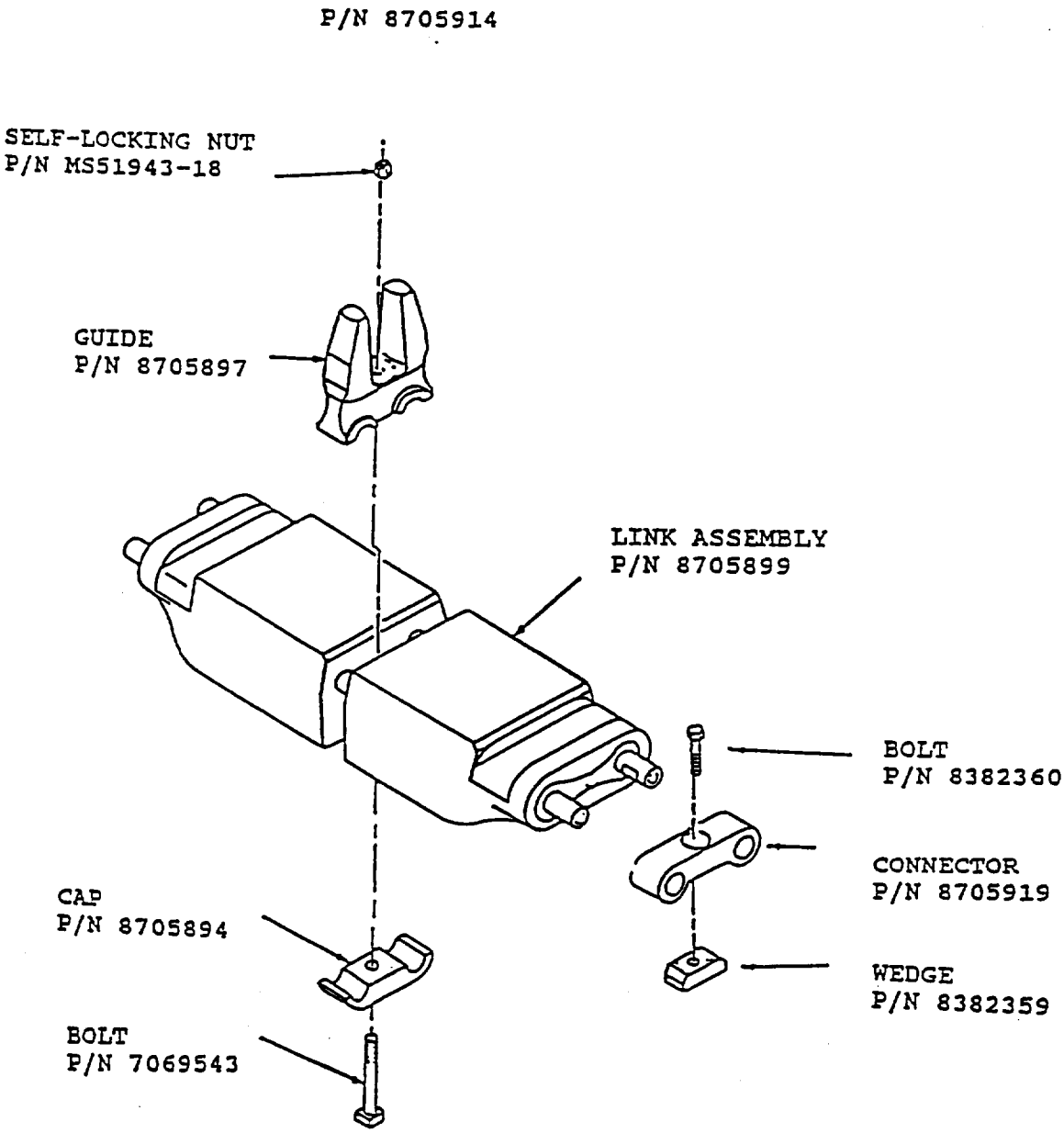

FIGURE 16. T107 track hardware illustration.

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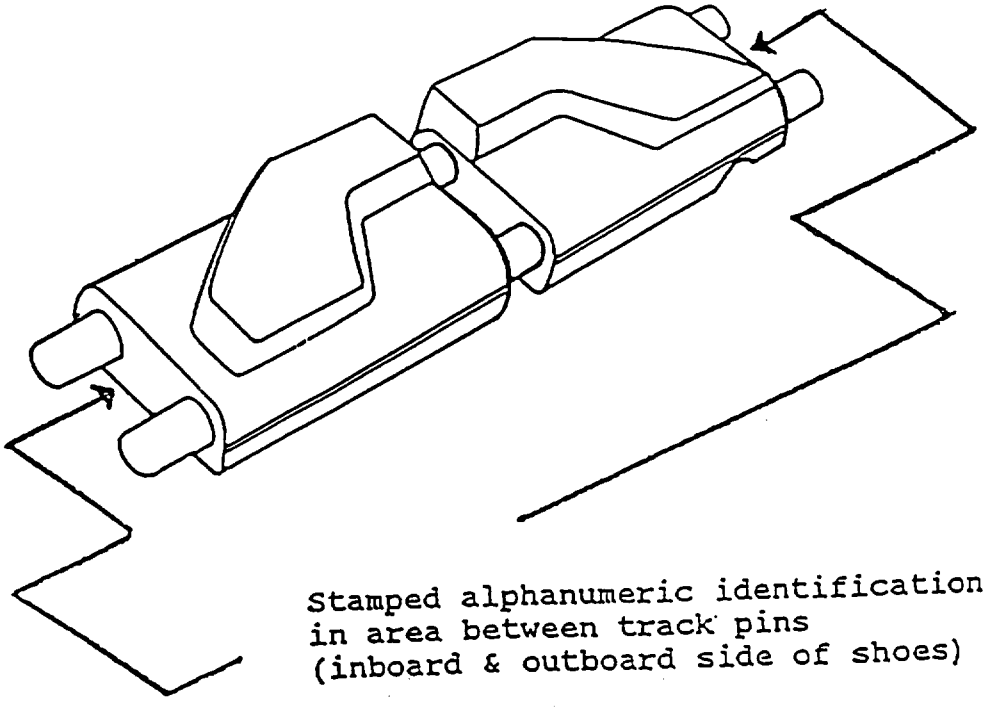

FIGURE 17. Track shoe marking.

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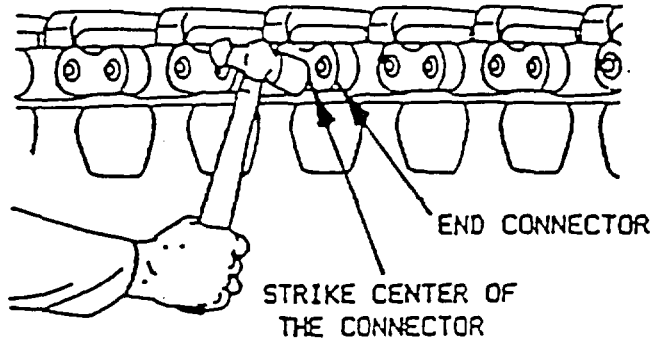
STEP 1.

TAP END CONNECTOR WITH BALL PEEN HAMMER:

- IF RING TONE IS HEARD, THE BOLT AND WEDGE IS TIGHT ON BOTH ENDS, AND BOTH TRACK PINS ARE GOOD.
- IF A DULL TONE IS HEARD, TAP THE TWO TRACK PIN ENDS ALTERNATELY WITH THE HAMMER (SEE STEP 2).



STEP 2.

TAP TRACK PINS WITH BALL PEEN HAMMER:

- A RING TONE MEANS THE PINS ARE GOOD, BUT WEDGE AND BOLTS ARE LOOSE OR END CONNECTOR IS CRACKED.
- A DULL TONE MEANS THE PIN MAY BE CRACKED OR BROKEN.

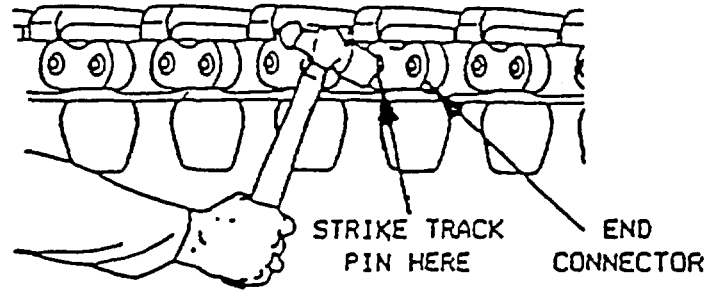


FIGURE 18. "Hammer Ring" check test.

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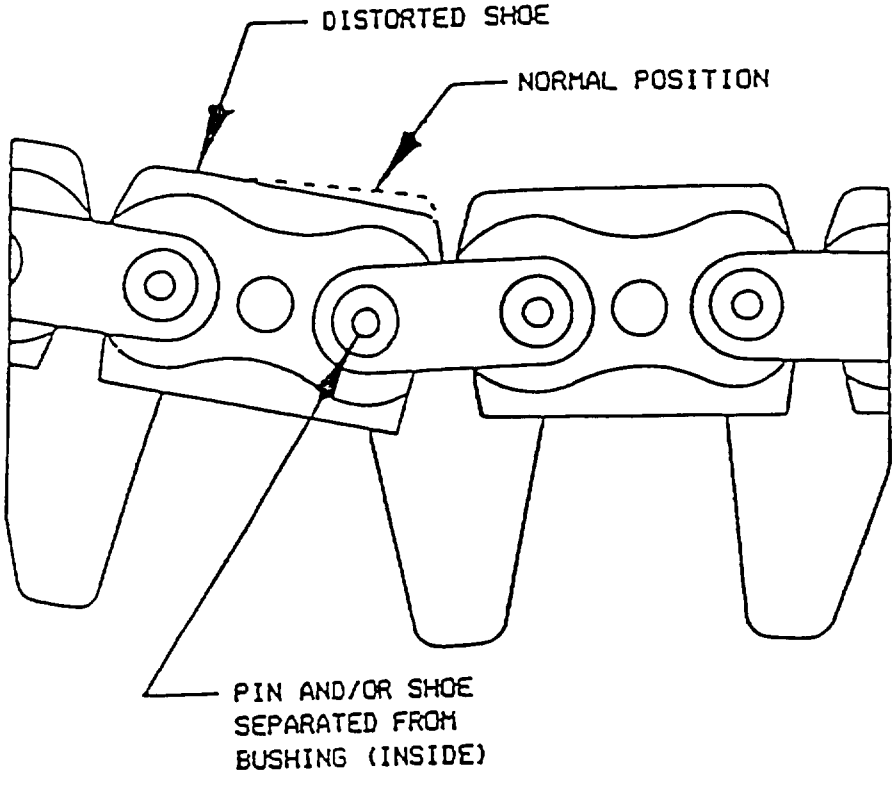

FIGURE 19. "Dead Track Block" bushing check.

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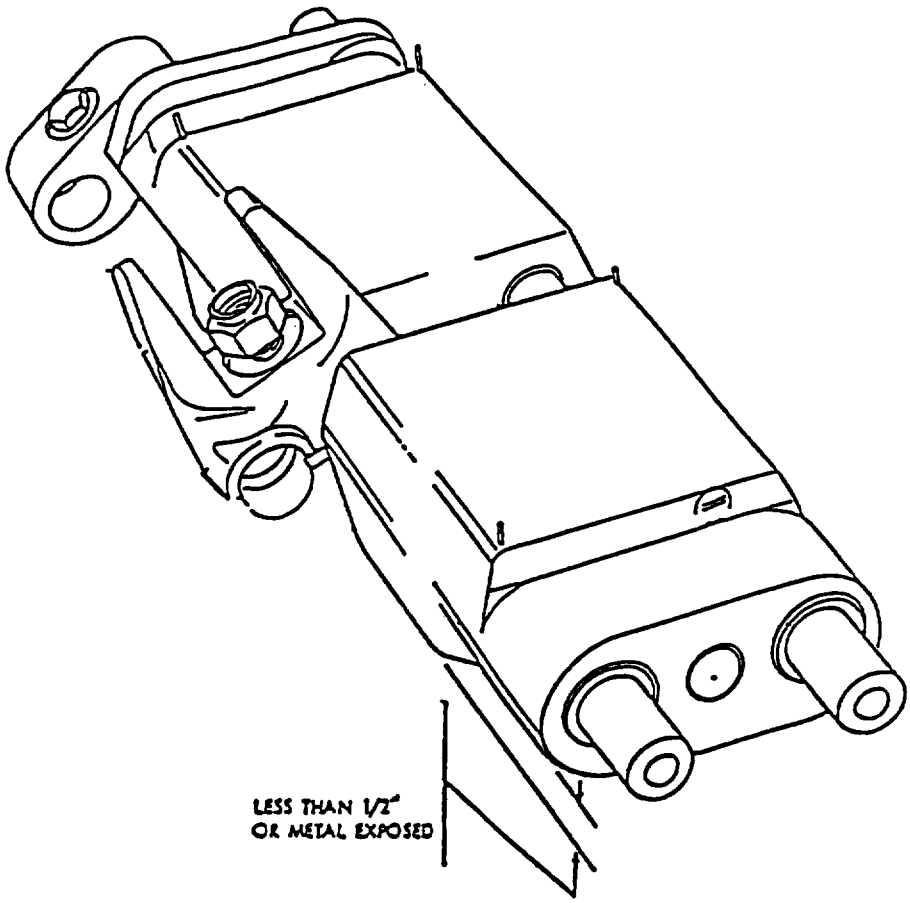

FIGURE 20. Track shoe assembly.

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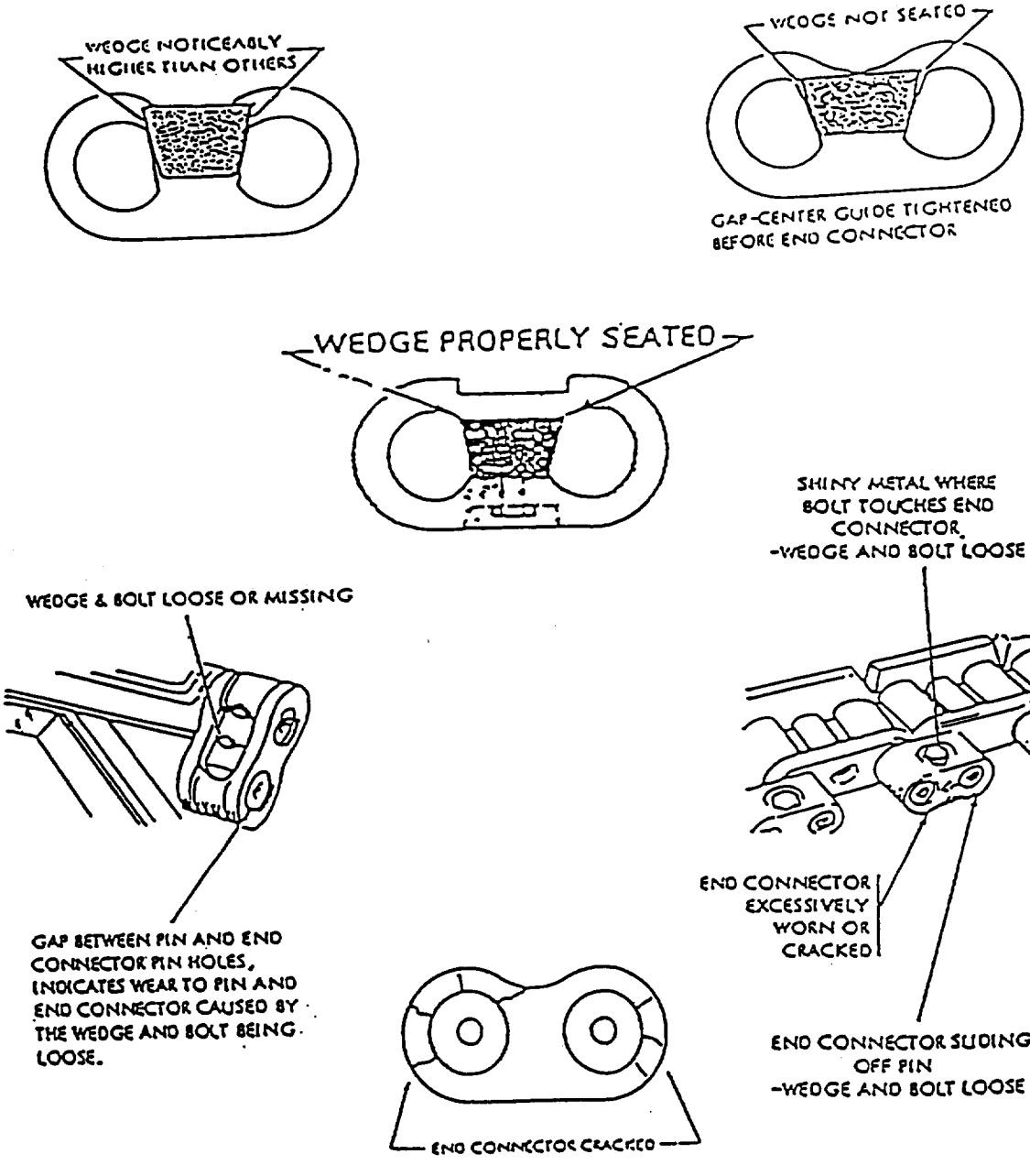

FIGURE 21. End connector.

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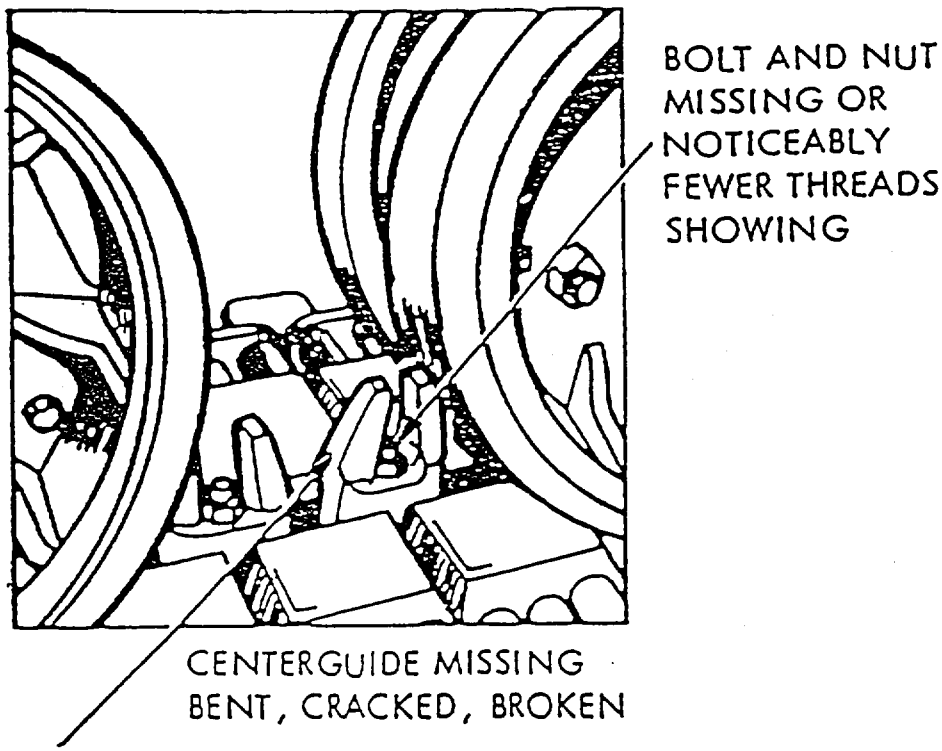

FIGURE 22. Center guide.

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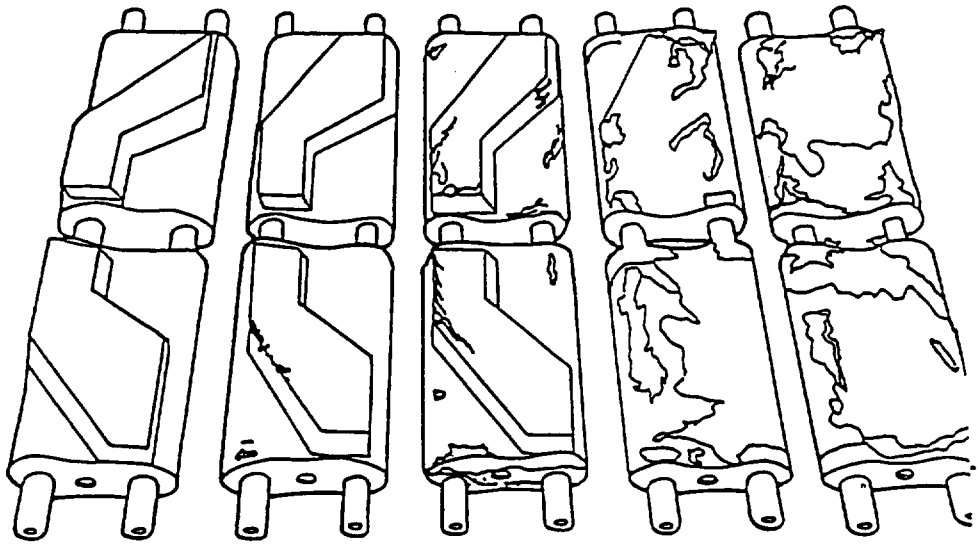

NOTE: Replace shoes that are excessively chunked or cut including rubber on the roadside that has been penetrated to the tube (binoculars).

FIGURE 23. Typical stages of rubber wear on the T107 track.

APPENDIX D

T157I PAD ON-VEHICLE TEST PLAN

D.1 SCOPE

D.1.1 Scope. This appendix defines a set of instructions and requirements used for conducting the T157I pad vehicle qualification test. Although this appendix is specific in nature, the Preparing Activity may amend this appendix with a more detailed set of instructions to meet the needs of the particular test. This appendix will not be changed without prior permission from the Preparing Activity. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

D.2 APPLICABLE DOCUMENTS

D.2.1 Drawings.

12359469	- Pad, Track Shoe.
12359510	- Parts Kit, Pad, Aluminum Backing Plate.
12466485	- Parts Kit, Pad, Steel Backing Plate.

D.2.2 Standards.

MS51943	- Nut, Self-Locking, Hexagon-Prevailing Torque, For Critical Installations, 250°F, UNC-3B and UNF-3B.

D.3 REQUIREMENTS

D.3.1 Test program review. A start of test meeting will be held at the test site on a date and time to be established by the Preparing Activity. Any additional review meetings shall be scheduled only if considered necessary by the Preparing Activity.

D.3.2 Test site access. Access to the test site will be required by Government personnel on a continuous basis to conduct their test responsibilities. Contractor personnel shall not be allowed test site access without specific approval from the Preparing Activity.

D.3.3 Test program scope. This test will be accomplished by assembling the manufacturer’s T157I track pad samples on a Bradley Fighting Vehicle and operated to the requirements of this appendix.

D.3.4 T157I design characteristics. The T157I pad is part of a single pin track. See figure 24 for a T157I track illustration.

D.3.5 Test course. The Preparing Activity will select the test course for conducting all on-vehicle qualification tests. The preferred course is located at the U.S. Army Yuma Proving Ground (YPG), Yuma, Arizona. Yuma has been traditionally selected for on-vehicle track testing because of climate, course, and test result consistency. The following standard track laying vehicle (tank and other tracked vehicles) test courses at YPG are designated for testing track for this specification.

a. Paved course. The dynamometer course is a 2 mile, smooth, near level (0.8 percent grade), 30 foot wide roadway with 500 foot radius turnarounds at each end, surfaced with a high strength asphalt. The course is located at an elevation of approximately 470 feet above sea level and is staked at 0.1 mile intervals throughout its length with accurately surveyed distance markers.

b. Gravel course. The tank gravel course is a 3.6 mile compacted and graded gravel course and is for testing track laying vehicles under conditions simulating a secondary gravel road. The course consists of short straight sections and curves of varying radii with many moderate and sharp turns.

c. Hilly cross-country course. The tank hilly cross-country B course is 2.7 miles long and has short steep grades (35 percent) with a greater proportion of slopes less than 20 percent. This course has surfaces varying from sand and gravel to exposed bedrock. The loose gravel, sharp stones, and rocks present a severe cutting and abrasion problem for tracks and roadwheels.

d. Level cross-country course. The tank level cross-country course traverses areas of level, sandy terrain with many bumps that provide a severe test of track laying vehicles. The dust conditions are typical of cross-country operation on dry soil. One lap is 6.7 miles.

D.3.6 Operational mode summary. The operational mode summary for the test shall consist of 21% paved (concrete, asphalt, or macadam), 45% on gravel composed mostly of small stones, and 34% on cross-country (equal amount of hilly and level). During the test, the vehicle shall not traverse more than 50 continuous miles over any type of terrain. Vehicle direction around the test courses shall be changed periodically to assure approximately equal clockwise and counterclockwise test operation.

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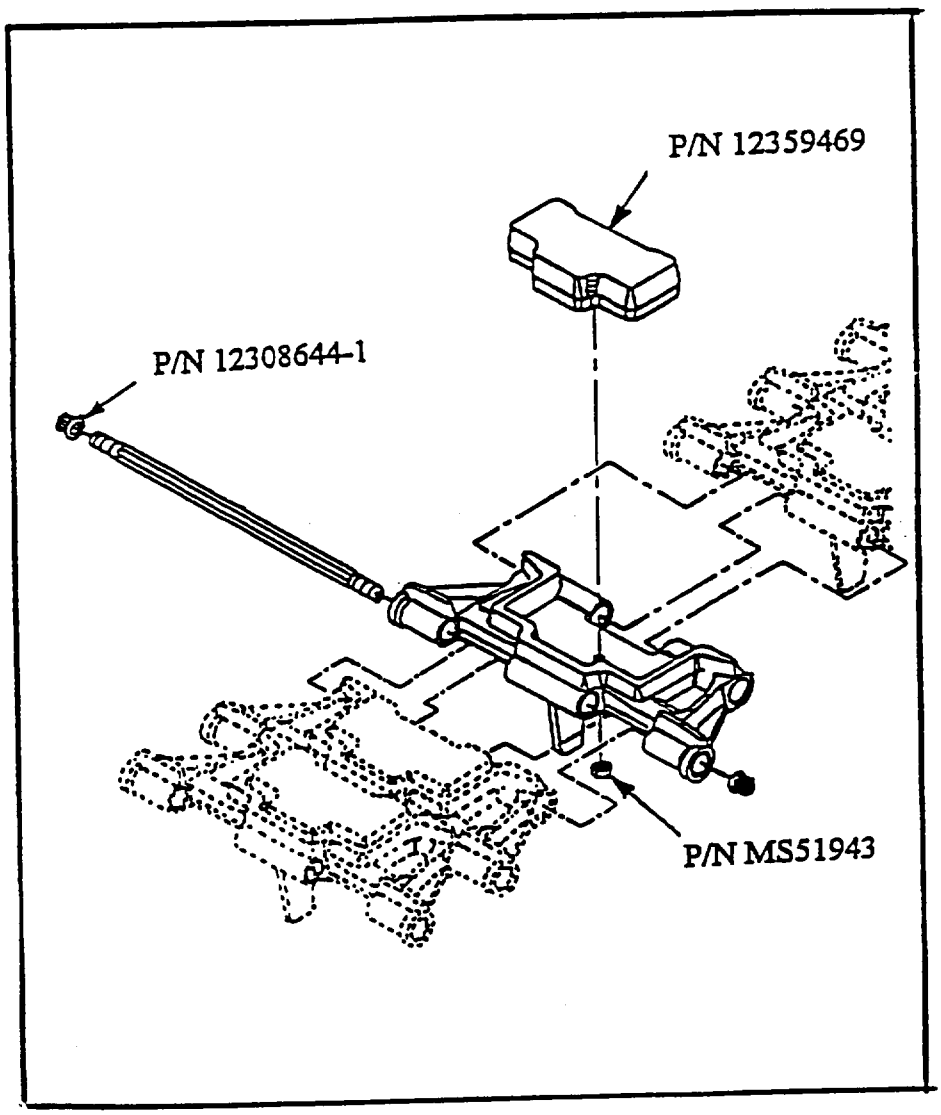

FIGURE 24. T157I track hardware illustration.

D.3.6.1 Fifty mile scenario. During the test, operators are to run one 50 mile scenario at a time in accordance with the mission profile requirements stated below. A mission profile requirement will consist of the following:

Secondary road……..22.5 miles
Paved road…….10.5 miles
Combined X Country…….17 miles

D.3.7 Climatological conditions. In order to expose the track test samples to the maximum "hot" weather conditions, vehicle road testing shall be selected to start no earlier than 1 March and no later than 1 September of the same calendar year.

D.3.8 Pad delivery and storage. Pad samples shall be delivered to the test site by a date as specified by the Preparing Activity. Adequate time must be allowed for test site personnel to inspect, mark, and install the hardware so as not to impact the projected test start date. A secured area must be made available during and after the test for each of the track pad samples. The samples received will be placed in a shaded area that prevents direct sunlight from shining on the track pads during storage and assembly operations. The reduction of variables such as solar heating of the pads in a stack while others are shaded and, therefore, cooler is mandatory. Any condition that might influence the relative performance of the track pads shall be held as uniform as possible.

D.3.9 Contractor hardware requirements. For the qualification road test, the contractor test samples shall consist of 164 complete pad assemblies (to include self-locking nut, P/N MS51943). In addition, 136 spare pads (with self-locking nut, P/N MS51943) shall be required.

D.3.10 Initial inspection/preparation for test. The test site shall perform a receiving inspection of the Bradley series vehicle to be used for the test. The basic test vehicle will be visually and functionally checked with specific attention given to suspension, electrical systems, hydraulic systems, and automotive controls and accessories. Any damage or improper operation will be repaired/corrected to ensure the vehicle will be capable of meeting the test requirements defined by this appendix.

D.3.10.1 Qualification sample inspection. Contractor supplied track pad qualification samples will be inspected to ensure no physical damage has occurred in shipment, that the required number of samples and spares have been provided, and that all components are properly identified.

APPENDIX D

D.3.11 Serial marking. Serial marking of pads may be required as specified by the Preparing Activity.

D.3.12 Pad installation (qualification). Pads supplied for pad qualification only will be installed on Government furnished T157I track assemblies.

D.3.13 Load condition of the vehicle. For the test, the weight of the Bradley vehicle shall be adjusted to 64 375 pounds, plus or minus 500 pounds. The load shall be distributed approximately equal on each track when on a level surface.

D.3.14 Pivoting of vehicle. Pivot steering of the vehicle during break-in and qualification testing is to be kept at a minimum. Sudden braking action shall also be avoided to the extent possible.

D.3.15 Track tension adjustments. All tension adjustments shall be made prior to the start of the test as well as during test operations. As a minimum, track tension shall be checked on a daily basis. These adjustments shall be made after inspection faults have been corrected. Track tension requirements can be found in the latest technical manuals for the Bradley vehicle. NOTE: Low track tension will cause thrown tracks, broken or bent pins, and broken end connectors and center guides. High track tension shall also be avoided. Track pins will break and tracks will be thrown. The track adjuster or grease gun shall be kept from contacting the track rubber parts. Any grease or oil accidentally contacting the shoes shall be immediately wiped off.

D.3.16 Track component replacement. Track shoe assembly replacements are required based on meeting the failure criteria for any number of component parts (bushing, roadwheel path rubber, center guide, or shoe body damage). The individual shoe replacements shall be made in the same strand location as the respective failed shoes. In addition, if the pads meet the acceptance criteria, the pads from the original track shoe shall be reinstalled on the replacement shoe.

D.3.17 New hardware. When track shoes and pads are replaced, the new hardware must be torque checked after the first 50 miles of operation.

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D.3.17.1 Torque values. All T157I track hardware shall be torqued to the following values and in accordance with proper maintenance procedures:

Pad nut - MS51943	135-155 lb-ft
Nut, self-locking - P/N 12308644-1 (used on track shoe rod, see figure 24)	299-325 lb-ft

D.3.18 Break-in run. The purpose of the break-in run procedure is to simulate the natural aging process afforded production/spare pads during normal transit/storage periods before actual vehicle use. All test samples (to include spares and all pads provided for qualification) shall be broken in prior to the road test by having the vehicle on which they are installed, continuously operated for 45 miles on a paved road (concrete, asphalt, or macadam) as follows:

Division break-in run	Speed m.p.h. (max)	Distance miles (min)
a	10	15
b	15	15
c	20	15

D.3.18.1 Vehicle operation. The vehicle shall be operated in both directions for one-half of the total vehicle distance.

D.3.18.2 Track cooling (break-in). During the break-in run, the track shall be allowed to cool between each phase of testing. The cooling of the track can be verified through one of the following two procedures.

D.3.18.2.1 Track roadwheel cooling. The track roadwheel path surface shall be cooled to the point where the palm of the hand can be held to the surface backing in excess of 10 seconds.

D.3.18.2.2 Cool down between speed changes. Cool down between speed changes shall require the use of a device used to measure the temperature of the rubber pads (see figure 7 for a diagrammed example of this type of device). Measurements should be taken from both the roadwheel side and the roadside. A reading of 130 degrees or less should be recorded prior to restart of the break-in.

D.3.18.3 Visual inspection (break-in). Between each division of the break-in run, a visual inspection shall be made of the track and the components parts. The inspection shall be in accordance with the inspection and replacement criteria found in the table X. Hardware shall be re-torqued if noticeably loose. After break-in, all hardware shall be torqued 100% to values as specified in D.3.17.1.

D.3.18.4 Track pad failure (break-in). Any track pad failures which occur during break-in do not count towards the failure criteria. Further, any failures during break-in do not reduce the original sample size. Pads failed during break-in shall be replaced with spares and noted on a Test Incident Report (TIR) or similar document. The pad assemblies comprising a strand after break-in shall be denoted as the original strand sample at the start of test. Break-in mileage shall be counted toward the qualification mileage requirement.

D.3.18.5 Spare pads. All spare pads shall be installed on a vehicle and broken in before test start up. The break-in shall be performed in accordance with D.3.17. After completion of the break-in run, the pads shall be removed from the vehicle and stored for future use during the qualification test.

D.3.19 Test procedure. After completion of the break-in run, the vehicle shall be run to the operational mode summary found in D.3.6 until the pads being tested for qualification have met the failure criteria (see D.3.20) or have exceeded the qualification requirement of 800 miles pad life.

D.3.19.1 Track switching. Upon completion of the first 500 mile mission scenario, the track strands shall be removed from the vehicle, inspected for overall condition, and switched to the opposite side. Unless otherwise specified by the Preparing Activity (see 6.2), the track pads shall be removed from the vehicle at 800 miles.

D.3.20 Failure criteria. Failure of a contractor’s pads will be established when 40% of the original pad samples have reached wear-out and/or need replacement. For scoring purposes, the test site shall not count multiple replacement of the same pad location.

D.3.20.1 Pad failure (break-in). Any pad failures which occur during break-in or start damaged as a result of the following incidents will not be counted against qualification requirements:

a. Mechanical failure of non-track parts resulting in track pad damage.
b. Sprocket damaged shoes.

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TABLE X. T157I track hardware inspection and replacement criteria.

ITEM	ACTIVITY	INSPECTION OR ACTION
Track strand	1. Inspect daily.	Visual observation of overall condition with specific attention to the road/grouser interface.
	2. Replace.	When 20% of the original track shoes have been replaced (or now require replacement due to wearout).
Track pin	1. Inspect daily.	Visually check for cracked, broken or bent pins.
	2. Replace shoe*.	When pin broken, bent or cracked.
Bushing	1. Inspect daily.	Visually check for dead blocks or extruded bushing.
	2. Replace shoe*.	When dead blocks are found or a bushing is completely extruded (pin to shoe body contact).
Roadwheel path rubber	1. Inspect daily.	Visually check for (1) cracks, chunks, or cuts. (2) Obvious lack of roadwheel support due to blowout or chunking.
	2. Replace shoe*.	When more than 50% of rubber is lost.
Track shoe body	1. Inspect daily.	Visually check for cracked shoes, crushed binocular tubes, and loose or lost backing rubber.
	2. Replace.	When shoe body cracked, binocular tube crushed, or pad mounting hole enlarged, or unable to remove defective pad.
Center guide	1. Inspect daily.	Visually check for cracked, broken, bent, loose or worn center guides.
	2. Replace shoe*.	When missing, cracked, broken or worn to less than 3/8 inch thick as measured 1 inch below top to the center guide.
Track pad		See D.3.20 and D.3.21.

*NOTE: Pads from original shoe must be removed and reinstalled on the replacement shoe.

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D.3.21 Inspection and replacement criteria. The track pad shall be replaced if the grouser marks a paved surface. Pad blowout or chunking does not meet criteria for replacement given that the grouser is not marking the road. The whole assembly shall be replaced if the pad mount is damaged or unable to remove pad. Replacement pad height must be within 1/4 inch (plus or minus) of neighboring pads. The test site shall use either a worn pad or shave down a spare pad.

D.3.21.1 Pad inspection. As a minimum, test site personnel shall inspect the pads on a daily basis or after approximately every 50 miles, whichever occurs first. During break-in, a visual inspection shall be made between each division of the break-in run.

D.3.22 Disposition of pad test hardware. All pad test hardware shall be retained at the test site pending disposal instructions, including failed track pad components. Pads that are defective or have completed testing may be stored outdoors while waiting for disposition instructions. It is essential that each manufacturer's pad samples are not commingled with samples from another manufacturer or other compound sample.

D.3.22.1 Failed track pad marking. All failed track pads shall be tagged and marked so as to identify accumulated test miles and cross reference to daily logs or reports, as appropriate to provide for traceable component failure history.

D.3.22.2 Hardware (failure analysis). Hardware required for failure analysis shall be provided to the Preparing Activity upon request.

D.3.23 Vehicle disposition. Upon completion of the test and inspections, the vehicle shall be returned to the original pretest condition. Vehicle disposition instructions will be issued by the Preparing Activity.

D.3.24 Documentation/test reporting/photographic coverage. Any test incidents related to track, suspension, and/or drive train components shall be documented on AMC Form 2134, Test Incident Report (TIR) or comparable test reporting document. The test site shall provide these reports to the Preparing Activity as they are generated. Each TIR or other test reporting document shall include as a minimum the following:

a. Description of failed component/part (noun).
b. Mileage pads have endured.
c. Date of incident.
d. Description of incident. Description shall be detailed and shall include cause, if evident.
e. Test course where incident occurred (if known).
f. Estimated vehicle speed when incident occurred.

g. Test environment at time of incident.
h. Disposition of failed part. Hold and tag failed part.
i. Test report number.
j. Vehicle registration number.
k. `Code/serial number identification of failed component and code/serial number of replacement component.
l. Authorized signature.

D.3.24.1 Major track incidents. All track incidents determined to be major, that is, track throws, misguides, etc., shall be immediately reported to AMSTA-TR-E/BFV.

D.3.25 Final report. The test site shall prepare a final technical report at the completion of testing. The report shall include as a minimum the following:

a. Data collected. Include copies of TIRs for track related failures.
b. Summary of test findings.
c. Photographs, tables, and charts to reflect test findings.
d. If more than one contractor is attempting qualification testing at one time, test results shall be grouped by contractor.

D.3.26 Photographic coverage. The test site shall furnish color photographic coverage of all significant test events to include, as a minimum, track throw or misguide damage (vehicle and track system), broken or bent center guides, sprocket damaged shoes, and broken pins, representative sampling of pad failures, and a representative sampling of pads which have not met the failure criteria.

D.3.26.1 Applicable information. Together with the photographic coverage, applicable information (manufacturer, serial number, test course, mileage sustained, etc.) shall be recorded and accompany the photographs. This data is to be included in the final report.

D.3.27 Distribution of reports. The distribution of test incident reports and final reports shall be as specified by the Preparing Activity (see 6.2).

Custodian:
Army - AT

Preparing Activity:
Army - AT

(Project 2530-0402)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of 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.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE *(YYMMDD)*
	MIL-DTL-11891G(AT)	980225

3. DOCUMENT TITLE
TRACK SHOE SETS, TRACK SHOE ASSEMBLIES, TRACK SHOE PADS AND TRACK SHOE BUSHINGS, VEHICULAR:

4. NATURE OF CHANGE ***(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)***

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(If applicable)*	7. DATE SUBMITTED *(YYMMDD)*

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE *(Include Area Code)*
	(1) Commercial (810) 574-8745 (2) AUTOVON 786-8745
c. ADDRESS *(Include Zip Code)* Commander U.S. Army Tank-automotive and Armaments Command ATTN: AMSTA-TR-E/BLUE Warren, MI 48397-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403 Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340