NOT MEASUREMENT SENSITIVE

MIL-DTL-32169
30 November 2004

DETAIL SPECIFICATION

WHEEL ASSEMBLIES, POLYURETHANE; FOR THE BRADLEY FIGHTING VEHICLE

This specification is approved for use by all Department and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers roadwheels for use on the Bradley Fighting Vehicle. These are metal wheels with bonded polyurethane tires (see 6.1). For the purpose of this specification polyurethane may be any form of thermoplastic or thermosetting resins. The contractor is held fully responsible for the entire assembly/component including non-elastomeric components and fasteners.

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2 APPLICABLE DOCUMENTS

2.1 General. The document listed in this section are specified in sections 3 and 4 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 documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense index of Specifications and standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Comments, suggestions, or questions on this document should be addressed to Tank-automotive and Armaments Command, 6501 E. 11 Mile Road, Warren, MI 48397-5000 or emailed to standardization@tacom.army.mil Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil

AMSC N/A FSC 2630

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-STD-1916 - DOD Preferred Methods For Acceptance of Product.

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DRAWINGS

ARMY

12497867 - Wheel, Solid Polyurethane Tire.

(Copies of these drawings are available from the U.S. Army Tank-automotive and Armaments Command, AMSRD-TAR-E, Warren, MI 48397-5000.)

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 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).

ASTM INTERNATIONAL

ASTM D412 - Vulcanized Rubber and Thermoplastics Elastomers – Tension, Standard Test Methods (DoD Adopted).

ASTM D429 - Rubber Property – Adhesion to Rigid Substrates, Standard Test Methods (DoD Adopted).

ASTM D624 - Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers, Standard Test Methods (DoD Adopted).

ASTM D792 - Density and Specific Gravity (Relative Density) of Plastics by Displacement, Standard Test Methods (DoD Adopted).

ASTM D2137 - Rubber Property-Brittleness Point of Flexible Polymers and Coated Fabrics, Standard Test Methods (DoD Adopted).

ASTM D2240 - Rubber Property - Durometer Hardness, Standard Test Method (DoD Adopted).

ASTM D4065 - Plastics: Dynamic Mechanical Properties: Determination and Report of Procedures, Standard Practice (DoD Adopted).

(Copies of these documents are available from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959 or website: http://www.astm.org)

2.4 Order of precedence. In the event of a conflict between the text of this document and the reference 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 Pre-production. Roadwheel assemblies furnished under this specification shall be products which have been tested and have passed the pre-production tests specified herein. The Pre-Production process is divided into three phases as defined in section 3 of this specification: Phase I, Plant/Facilities Inspection; 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 approved. Section 4 of this specification establishes the quality control requirements based on section 3 as applicable to Bradley Vehicle polyurethane roadwheel 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 Pre-production process. This plan shall be submitted to the Quality Assurance Representative (QAR) and Procuring 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 polyurethane.

3.1.2 Phase I, plant/facilities inspection. The procuring activity or its authorized agent may conduct plant/facility inspections prior to the start of any pre-production testing. Subcontractors that provide polyurethane materials for processing shall be subjected to the same inspection and test requirements on that portion of the product/process that is within the subcontractor's purview.

3.1.3 Phase II, establishment of contractor's Process Fingerprint Plan. Prior to the start of pre-production hardware fabrication, the contractor shall establish a Process Fingerprint Plan that describes the entire process used to produce the qualification hardware and the compound characteristics. This plan shall identify the target values and ranges (limits/tolerances) the contractor expects during pre-production hardware fabrication. Once pre-production testing approval is granted, the contractor shall document these values/ranges as comparative data. This

data will be maintained during subsequent production and used by the Government as evidence of consistency of materials, formula, and manufacturing process. This plan shall bear the signatures of the Government QAR and an authorized representative of the contractor. This plan shall be proprietary to the contractor and remain at the contractor's facility but be made available for review by the Procuring 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 pre-production testing.

3.1.3.1 Physical and mechanical properties. The physical and mechanical properties to be used by the contractor as comparative data are as follows: Tensile strength, Elongation, tensile stress, specific gravity, tear strength, low temperature flexibility, and accelerated aging. During production, the contractor shall be required to maintain the production values within the tolerances specified in Table I (see 3.1.3).

3.1.4 Pre-production testing hardware fabrication. The fabrication of the pre-production testing hardware shall be in accordance with the approved Process Fingerprint Plan. 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. All records/test results of all lots of polyurethane materials used in 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 pre-production 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 pre-production testing.

3.1.5. 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 the name of the tester. These records must be signed and dated by the Government QAR or an authorized agent. The contractor will identify the method to be used during Pre-Production testing and utilize the same method during subsequent production testing. Compound numbers must be identified to the component being tested 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.

3.1.6. 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 polyurethane wheel submitted for endurance testing.

3.2 First article. When specified (see 6.2), a first article sample shall be subjected to first article inspection in accordance with 4.3.4 and 4.4.

3.3 Materials.

3.3.1 Tires. Solid tires shall consist of intractable thermoplastic, rubbery or thermosetting polymeric materials which are black in color and conform to applicable

specifications and standards. The intractable thermoplastic, rubbery or thermosetting polymeric material shall not contain any metal mesh, webbing or lattice used as a reinforcement of the solid material.

3.3.2 Wheels. Materials used in metal wheels shall conform to applicable drawings, specifications, and standards.

3.3.3 Bonding materials. Adhesives, boding agents, cement, gum compounds, and materials furnished under this specification shall produce bonded rubbery or thermoplastic tires that meet or exceed the requirements of the applicable drawing and this specification.

3.3.4 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.

3.3.5 Construction. Wheel assemblies furnished under this specification shall be in accordance with the applicable drawings (see Drawing 12497867) or as specified by the contracting authority.

3.3.6 Date of origin. Wheel assemblies furnished under this specification shall have been cured and bonded a minimum of 30 days immediately preceding date of submission for acceptance.

3.4 Physical and mechanical properties.

3.4.1 Physical properties of roadwheel compounds. Physical property tests, as a minimum, will be conducted on 5 specimens taken and averaged from each compound used in the roadwheels in accordance with the applicable ASTMs as follows and in accordance with Table I: Tensile Strength (ASTM D412), Elongation (ASTM D412), Tear Strength (ASTM D624) and Tensile Stress (Modulus) (ASTM D412). The production tolerances for the physical property tests, based on the average values established during pre-production testing, shall be ± 15 for tensile strength, elongation, tensile stress and tear strength (see 4.9.3, 4.9.5, 4.9.7 and 4.9.10).

3.4.2 Aged properties. Physical property tests as a minimum, shall be conducted on 5 aged specimens in accordance with ASTM D412 and Table II. Accelerated aging shall be conducted for 166 hours (hr) at 158 degrees Fahrenheit (ºF) within any one specimen. The production tolerance for the change in tensile strength, tear strength, and elongation shall be not more than 15 percent (%) (see 4.9.4, 4.9.6 and 4.9.11).

3.4.3 Hydrolytic stability test. Hydrolytic stability testing shall be performed in accordance with ASTM D412 using Die C dumbbells on samples submitted for pre-production testing. The test shall be performed on cast material. The polyurethane shall retain 75% of the original baseline properties after 14 days and that degradation is stabilized and does not progress any further. This test shall be performed during pre-production testing to establish the values for

the fingerprint plan. Values for follow-on production shall fall within the band established at the time of pre-production testing (see 4.9.8).

3.4.3.1 Procedure. Six specimens shall be immersed in water at 160 ºF for periods of 7 days and 14 days. The contractor may use either of the following methods; (a) the same test specimen for this test or (b) use similar/identical individual test specimens. The same bath water must be used in either method. Tensile strength, tear strength, ultimate elongation, modulus, hardness, and adhesion properties shall be determined for each condition to ascertain any degradation of the material.

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3.4.5 Peel adhesion of wheel to polyurethane material. Special test specimens shall be fabricated consisting of wheel alloy strips bonded to lengths of the polyurethane. The metal alloy strips shall be 15 inches (in.) long and shall be of the same alloy as that used in the wheel. The polyurethane shall be 15 in. long minimum (min) by 2.000 ± 0.050 in. wide, and shall be of the same composition as that used in the roadwheel. The polyurethane shall be uniformly bonded to the alloy metal strip. The bond shall be formed using identical techniques and bonding agents used to bond the polyurethane to the roadwheel and shall be cured identically (time, pressure, temperature, relative humidity, etc.) to the process used in bonding the polyurethane roadwheels (see 4.9.13).

3.4.5.1 Procedure. Specimens shall be tested as per ASTM D429, method B. Five specimens shall be averaged for each water immersion test. The same identical specimen shall be used to determine the initial peel strength and the strength after water immersion and when the computing the percentage of initial adhesion retained after water immersion at 160 ºF for 14 days. At no time should the peel strength fall below 100 pounds (lbs.) per linear in. of width.

3.4.6 Low temperature flexibility (brittleness point). The specimens and test method shall be in accordance with ASTM D2137, method A, with a temperature of -60°F (-51 degrees Celsius (°C)). The specimen shall show no evidence of cracks, fissures, or holes visible to the naked eye or complete separation into two or more pieces (see 4.9.14).

3.4.7 Specific gravity. Specific gravity tests shall be performed in accordance with ASTM D792. Specific gravity tests will be performed on samples from each compound submitted for pre-production testing and all results will be provided to the Government. Five samples shall be taken and averaged. The production tolerance for specific gravity shall be ± .025 from the value established during pre-production testing (see 4.9.9).

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3.4.9 Fourier Transform Infrared Test (FT-IR). The contractor shall furnish FT-IR spectral recordings to the government, taken prior to each delivery of specimens granted first article approval. These readings shall be retained by the Government for future reference (see 4.9.15).

3.4.9.1 Procedure. Samples for FT-IR should be taken from molded, cast urethane test specimens that are created for the tensile testing. Spectral recordings should be performed utilizing an Attenuated Total Reflectance (ATR) sampling accessory. Urethane specimens should be pressed against the ATR crystal so that optimum contact is made. The recording should be taken with a minimum of 64 co-added scans at resolution of 4. A plot of the infrared absorbance over a frequency range 4000-700cm^{-1} shall be provided. Spectra should be placed in a database for future comparisons with samples deemed successful.

3.4.10 Dynamic mechanical analysis. The test will be performed in accordance with ASTM D4065. DMA experiments are to be conducted in the temperature range between -60°C to 200°C. This data shall be provided to the Government for future reference (see 4.9.16).

3.5 Finished wheel testing.

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 Dynamometer (drum) testing. The wheel assembly shall evidence no internal or external failure after rolling. Under the following conditions, however, no one sample shall be required to withstand operation under both conditions in 3.5.2.1 and 3.5.2.2 (see 4.9.17).

3.5.2.1 Forty-eight hour drum test. For 48 continuous hours at not less than 10 miles per hour (mph). The pounds per inch of width shall be 985 at 100% load of 3693. Maximum (max) speed or load shall not exceed the specified values by more than 5% unless agreed to under contractual arrangements.

3.5.2.1.1 Apparatus. The apparatus shall consist of a rotating steel drum having a smooth, flat-faced rim. The wheel assemblies for testing shall be individually mounted so as to apply test loads radially. The wheel assemblies shall turn freely. The steel drum shall have a diameter of 67.23 ± 0.50 in. The width of the drum shall provide full contact with the tire under the loads specified herein. The test shall be conducted in ambient air temperature of 100 ± 5ºF measured at the same height above the floor as the tires being tested. The apparatus shall be equipped with automatic devices to make a permanent record of ambient temperature, speed, applied load and hours (elapsed time) of operation.

3.5.2.1.2 Procedure. The wheel assembly shall be mounted and centered for minimum runout. The tire may be ground, if necessary, to assure a radial run out of not more than 0.031 in. total indicator reading. The wheel shall be loaded radially against the drum, and run continuously for 48 hrs at loads specified in 3.5.2.1.

3.5.2.2 Six-hour drum test. For 6 continuous hours at not less than 30 mph. The pounds per inch of width shall be 435 with a 120% load of 1957. Maximum speed or load shall not exceed the specified values by more than 5% unless agreed to under contractual arrangements.

3.5.2.2.1 Apparatus. The apparatus shall be as specified in 3.5.2.1.1.

3.5.2.2.2 Procedure. The wheel assembly shall be mounted and centered for min. run out. The tire may be ground, if necessary, to assure a radial run out of not more than 0.031 in. total indicator reading. The wheel assembly shall then be loaded radially against the drum and run continuously for six hours at not less than 30 mph in accordance with the specified load (see 3.5.2.2). The test may be stopped for not more than 5 minutes to change loading.

3.5.3 Adhesion. Adhesion tests shall be conducted on the finished product of the item being submitted for pre-production testing. Wheel assemblies shall exhibit complete adhesion of tire to wheel. There shall be no areas of deficient adhesion. The load required to separate the tread from a wheel shall be not less than 400 pounds per inch of width on any line of separation around the circumference (see 4.9.12).

3.5.3.1 Apparatus. A tension testing machine, or apparatus having a power actuated clamp, shall be used to apply, measure and permanently record the amount of force required to strip the tire from the metal wheel to which it is bonded. The clamp shall travel at a rate of not more than six inches per minute max. The machine shall be provided with means for measuring and permanently recording the amount of tension applied. The hub and spindle assembly shall be provided for mounting the tire and permitting it to rotate freely about a fixed axis of rotation.

3.5.3.2 Procedure. The tire shall be prepared for testing by cutting and clamping in accordance with Figures 1 and 2 or other method specified by the Procuring Activity. The tire shall then be mounted on the hub and spindle assembly, and positioned in such a manner that its axis of rotation will remain parallel to the line of separation during testing, and that the applied force will be normal to the wheel at the line of separation. The tire bonded to curved axial surfaces may be cut to not less than the width that is normal to applied force. With the free end of the tire gripped by the machine clamp, the machine shall be started and the tire stripped from the metal base. The tire shall be stripped from not less than 50% of the circumference of the wheel. If, during the test, the tire begins to tear instead of separating wholly from the wheel, the tire shall be cut to the metal base with a cutting tool. Force measurements shall be permanently observed throughout the test. Any force less than 100 pounds per inch of width shall be cause for rejection. The ambient temperature during the test shall be not less than 70°F and not more than 110°F and the actual temperature shall be noted.

3.5.4 Hardness. Hardness tests will be performed (ASTM D2240) utilizing a Shore A type durometer. The average value of 5 samples shall be taken from finished components. Readings shall be taken off the side wall of the tires at different positions at least 50.8 millimeters (mm) (2 in.) apart. The production hardness for tolerance for hardness shall be 90 ± 3 (see 4.9.2).

3.5.5 On-vehicle test requirement. The contractor's roadwheel samples shall be mounted on a Bradley Fighting Vehicle. A minimum of 7500 miles demonstrated track durability at 20%

replacement must be achieved for the roadwheel sample to be considered as approved (see 4.3.2).

3.6 Finish. Unless otherwise specified (see 6.2), portions of the wheel assembly not covered by the elastomer shall be treated and painted in accordance with the manufacturer's standard practice.

3.7 Identification and marking. Unless otherwise specified in the contract order (see 6.2), the wheel assembly shall have the following information molded, branded, or affixed onto the outboard side of the tire:

a. Manufacturer's name or approved symbol.
b. Military assembly part number.
c. National Stock Number.
d. Manufacturer's serial number.
e. Month and year of manufacture.

3.8 Workmanship. Shall be such quality as to assure that solid-tired wheel assemblies furnished under this specification are, and appear to be, free of defects that compromise, limit, or reduce performance in intended use. The molded polyurethane components shall be free from defects as classified on Table III.

4 VERIFICATION

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

a. Pre-production inspection (see 4.3).
b. First article inspection (see 4.4).
c. Conformance examination and tests (see 4.6).

4.2 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed in accordance with conditions specified in applicable drawings, specifications, and standards.

4.3 Pre-production inspection.

4.3.1 Sampling for pre-production inspection. Inspection shall be performed on sample units selected in accordance with Table II which were produced with equipment and procedures normally used in production. The test results and other inspection information shall be submitted to the Government to be used for the establishment of average values for future production control. Established property and tolerances in Table I must be met by pre-production specimens subjected to applicable tests. Upon successful fabrication and testing of the wheel, contractors shall not make any compound formulation changes in either the type or the quantity of ingredients without prior Government approval.

4.3.2 On-vehicle testing. For the on-vehicle test, roadwheels shall be mounted on a Bradley Fighting Vehicle and tested in accordance to the test plan found in Appendix A of this specification.

4.3.3 Pre-Production testing approval. Roadwheel 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 Procuring Activity, that the faults revealed by the inspections have been corrected.

4.3.4 Retention of pre-production testing approval. The Procuring 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 pre-production testing. Any test results that continue to fail to match or exceed the data requirements established during testing may be cause for the Government to remove the contractor as an approved supplier of the item. For those contractors who are approved suppliers, but have been out of production for 1 (one) year or more, the Government reserves the right to require a first article inspection. Further, The Government reserves the right to require a first article inspection whenever a change is made to the manufacturing processes, procedures, or in the manufacturing facility location.

4.4 First article inspection. Unless otherwise specified (see 6.2), the Government shall select roadwheel samples produced under the production contract for the first article inspection. First article samples shall be inspected as specified in Table II. Approval of the first article sample by the Government shall not relive the contractor of his obligation to supply wheel assemblies that are fully representative of those inspected as a first article sample. Any changes or deviations of the production units from the first article samples shall be subject to the approval of the contracting officer. (See 4.3.4)

4.4.1 First article sample. Unless otherwise specified (see 6.2), the Government shall select roadwheel assemblies under the production contract for first article inspection. Inspection results shall be equal to or superior to those obtained during pre-production testing.

4.4.2 First article approval. Approval of the first article sample by the Government shall not relieve the contractor of his obligation to supply roadwheels 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 Procuring Activity.

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.

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 3.1.3). The initial control plan shall be established prior to Pre-production testing and shall reflect the product and process controls used to manufacture the 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 requirement 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 3.1.3). The plan shall reflect the process parameter controls and product characteristic controls 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 Procuring 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.

4.5.2 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.

4.5.3 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, etc), cleanliness of polyurethane and metal to be bonded, complete adhesive coverage, cure time, mold service time, runner temperature, injection time, nozzle temperature, mold temperature, and mold pressure. In addition, the contractor may use any additional parameters to assure production of acceptable wheels. The selected parameters shall be reflected on the control plan (s).

4.5.4 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.

4.5.5 Product characteristic selection. As a minimum, the product characteristics to be controlled or are identified in Quality Assurance Provisions, drawings, and this specification. 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.

4.6 Conformance examination and tests.

4.6.1 Conformance examination. Samples selected for conformance examination shall be randomly selected in accordance with MIL-STD-1916. The sample units shall be examined for the defects specified in Table III. Note that Table III only addresses the visual and physical measurement inspections of cast material. It does not address defects or failures found upon testing (see 4.6.2.1).

4.6.1.2 Conformance examination failure. Any item that fails to conform to any specified requirements shall be rejected and any failure (one or more) of the selected sample for the appropriate inspection lot size shall constitute a failure of the entire lot (see 4.6.6). 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% 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 polyurethane which have not been listed in Table III and are primarily appearance or cosmetic conditions (poor marking, pitting of molds, minor surface contamination) should be resolved by manufactures as these conditions arise.

4.6.2 Conformance tests. Samples selected for conformance tests shall be selected in accordance with Table II. Unless otherwise specified, a minimum of three specimens shall be required for tests.

4.6.2.1 Conformance test failure. Any deficiency in any conformance 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.

4.6.2.2 Additional samples/specimens. In the event of failure of the first specimen selected to pass the test, two additional specimens shall be selected and both shall pass the same tests. If these last two specimens pass the test, then that conformance 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.

4.6.3 Conformance examinations and tests. Conformance examinations and tests listed in Table II shall be performed after molding. This effort will minimize production of large quantities of defective compounds which may result in the production of defective roadwheels.

4.6.4 Casting time, pressure and temperature. The casting time, pressure, temperature and other cure conditions will be those established by the contractor to assure that the polyurethane has 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 maintained by the manufactures to assure production of defect free components that will meet all specification requirements. The values for casting time, pressure and temperature shall be identified in the process Fingerprint Plan (see 3.1.3).

4.6.5 Rework (workaway). Polyurethane compounds that are defective or miscompounded shall not be used for rework (workaway) to fabricate any roadwheel. Rework will consist of compounds being reworked into the same compounds using the lowest practical level in order to avoid process, compounds and finished variation

4.6.6 Lot formation. Unless otherwise specified, 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.

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4.9 Methods of Inspection.

4.9.1 Materials and construction. Conformance to 3.3 through 3.3.6 shall be determined by inspection of contractor records proving proof or certification that materials conform to requirements. Applicable records shall include drawings, specifications, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certification, industry standards, test reports, and rating data.

4.9.2 Hardness. This test shall be performed to meet the requirements of 3.5.4. Hardness measurements shall be taken on the finished product. During production, a minimum of 5 measurements should be taken and averaged. The results from these tests will meet the tolerances established from data acquired during pre-production testing and the tolerances listed in Table I.

4.9.3 Tensile strength. This test shall be performed to meet the requirements of 3.4.1. During production, ASTM test sheets will be cast and evaluated. Sheets will be sampled before or during every 8 hour labor shift. The average value for the 5 specimens shall be taken as the characteristic tensile strength. The results from these tests will meet the tolerances established from data acquired during pre-production testing and the tolerances listed in Table I.

4.9.4 Tensile strength (aged). This test shall be performed to meet the requirements of 3.4.2. During production, ASTM test sheets will be cast and evaluated. The average value for 5 specimens shall be taken as the characteristic aged tensile strength. Sheets will be sampled and tested on a bi-monthly basis or every 1000 wheels, whichever occurs first.

4.9.5 Elongation. This test shall be performed to the requirements of 3.4.1. During production, ASTM test sheets will be cast and evaluated. Sheets will be sampled before or during every 8 hour labor shift. The average value of 5 specimens shall be taken as the characteristic elongation. The results from these tests will meet the tolerances established from data acquired during pre-production testing and the tolerances listed in Table I.

4.9.6 Elongation (aged). This test shall be performed to the requirements of 3.4.2. During production, ASTM test sheets will be cast and evaluated. The average value for 5 specimens shall be taken as the characteristic aged elongation. Sheets shall be sampled and tested on a bi-monthly basis or every 1000 wheels, whichever occurs first.

4.9.7 Tensile stress (modulus). This test shall be performed to the requirements of 3.4.1. During ASTM test, sheets shall be cast and evaluated. The average value for 5 specimens shall be taken as the characteristic tensile stress. Sheets will be sampled before or during every 8 hour shift. The results from these tests shall meet the tolerances established from data acquired during pre-production testing and the tolerances listed in Table I.

4.9.8 Hydrolytic Stability. This test shall be performed to the requirements of 3.4.3. The average value for 6 specimens shall be taken as the characteristic tensile strengths. During production, sheets will be sampled and tested on a bi-monthly basis or every 1000 wheels, whichever occurs first. The Government may perform spot inspections for the purpose of obtaining samples for Hydrolytic Stability testing.

4.9.9 Specific Gravity. This test shall be performed to the requirements of 3.4.7. During production, ASTM test sheets shall be cast and evaluated. The average value of 5 samples will be used for determination of specific gravity. Sheets will be sampled and tested on each lot of pre-polymer. The results from these tests will meet the tolerances established from data acquired during pre-production testing and tolerances listed in Table I.

4.9.10 Tear strength. This test shall be performed to meet the requirements of 3.4.1. During production, ASTM test sheets shall be cast and evaluated. Sheets shall be sampled before or during every 8 hour labor shift. The average value for the 5 specimens shall be taken as the characteristic tensile strength. The results from these tests will meet the tolerances established from data acquired during pre-production testing and the tolerances listed in Table I.

4.9.11 Tear strength (aged). This test shall be performed to meet the requirements of 3.4.2. During production, ASTM test sheets shall be cast and evaluated. The average value for 5 specimens shall be taken as the characteristic aged tensile strength. Sheets shall be sampled and tested on a bi-monthly basis or every 1000 wheels, whichever occurs first.

4.9.12 Adhesion (wheel). This test shall be performed to meet the requirements of 3.5.3. During production, the test shall be performed on one sample of the finished wheel on a bi-monthly basis or every 1000 wheels, whichever occurs first.

4.9.13 Adhesion (peel). This test shall be performed to meet the requirements of 3.4.5. An average value of 5 samples will be used for determination of peel adhesion. During production, one cast test sample shall be taken on a monthly basis or every 500 wheels, whichever occurs first.

4.9.14 Low temperature flexibility (brittleness point). This test shall be performed to the requirements of 3.4.6. The average value of 5 samples will be used for determination of pass or fail at -60 degrees (-51 degrees Celsius). During production, one cast test sample will be taken on a monthly basis or every 1500 wheels, whichever occurs first.

4.9.15 Fourier transform Infrared test. This test shall be performed to the requirements of 3.4.9. During production, ASTM sheets will be cast and evaluated. Sheets will be sampled and tested on a bi-monthly basis or every 1000 wheels, whichever occurs first.

4.9.16 Dynamic Mechanical Analysis (DMA). This test shall be performed to the requirements of 3.4.10. DMA is to be submitted for pre-production and first article testing only. DMA data should be submitted before each individual contract production is started.

4.9.17 Drum test tire inspection. The 6-hour and 48 hour drum test shall be performed to the requirements of 3.5.2. At the conclusion of the test in 3.5.2, the tire shall be removed from the wheel in a way that will allow for the detection of the following defects: cracking, chunking, blowout, separation, blister, delamination, or lack of adhesion. During production, testing shall be performed on 1 (one) sample of the finished wheel for the 6 hour test and 1 (one) sample of the finished wheel for the 48 hour test on a quarterly basis or every 2000 wheels, whichever occurs first.

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 or in-house contractor 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 activities within the Military Service or Defense Agency, or within the military service's system commands. 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 which may be helpful, but is not mandatory).

6.1 Intended use. The wheel assemblies described in this specification are intended for use on the Bradley Fighting Vehicle System or similar military vehicles. These roadwheels are military unique because they are used on tracked military vehicles and have a special 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 2.2.1 and 2.3).
c. When first article is required (see 3.2 and 3.5.1).
d. Drawing number and size of wheel assembly to be furnished (see 3.3.5).
e. If finish is to be other as specified (see 3.6).
f. If marking is to be other as specified (see 3.7).
g. If inspection conditions are other than as specified (see 4.2).
h. If first article inspection is other than specified (see 4.4).
i. If samples are other than as specified (see 4.4.1).
j. Packaging requirements (see 5.1).

6.3 Construction identification. Construction identification (see 3.7) is a contractor generated number or letter, or combination thereof, which completely identifies specific processing, materials and compounds (metal preparations, bonding agents, cements, tie gums and tire compounds), as approved by the Government, used in manufacturing submitted tires. Construction identification will be made available to the Government.

6.4 Recovered materials. Recovered materials means material that have been collected or recovered from solid waste.

6.5 Solid waste. Solid waste means (a) any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; and (b) other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities.

It does not include solid or dissolved material in domestic sewage, or solid or dissolved material in irrigation returns flows or industrial discharges which are point sources subject to permits under section 402 of the Clean Water Act, (33 U.S.C. 1342 et seq.), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) (Source: Federal Acquisition Regulations, section 23.402).

6.6 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. Non-fill. 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. Blowout. Development of holes or chunks in the material due to the explosion of trapped gas.

6.7 Definitions of process control.

a. Process parameter. Process parameters are associated with the process used for the manufacture of material.
b. Product characteristic. Product characteristics include: hardness, length, diameter, specific gravity, tensile strength, 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 Mode 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 characteristics target values and tolerances, in-process materials and process settings, and all other important and relevant information.

6.8 Procuring activity. The military activity which purchases material to the requirements of this document.

6.9 Testing agencies. Contractors may use their own or any other testing agency for performing the tests required under this specification proving it is acceptable to the Procuring Activity and/or the contracting officer. Unless otherwise stated, the Government will perform on-vehicle testing.

6.10 Pre-production approval. With respect to products requiring approval, awards will be made only for products which are, at the time of award of contract, have met all requirements. The attention of the contractors is called to these requirements. Manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested in order that they may be eligible to be awarded contracts or purchase orders for the product covered by this specification. Information pertaining to Pre-Production testing approval may be obtained from the U.S. Army Tank-automotive and Armaments Command, Warren, MI 48397-5000.

6.11 Subject term (key word) listing.

Roadwheels
Thermoplastic resins
Thermosetting resins

TABLE I. Material property tests.

Test Requirement	**ASTM**	**Specification Paragraph**	**Tolerance**
Tensile Strength	ASTM D412	3.4.1	+/- 15
Tensile Strength (Aged)		3.4.1	+/- 15
Tensile Strength (7 – Day Water Immersion)		3.4.3	Pass/Fail
Tensile Strength (14 – Day Water Immersion)		3.4.3	Pass/Fail
Elongation	ASTM D412	3.4.1	+/- 15
Elongation (Aged)		3.4.2	+/- 15
Elongation (7 – Day Water Immersion)		3.4.3	Pass/Fail
Elongation (14 – Day Water Immersion)		3.4.3	Pass/Fail
Tear Strength	ASTM D624	3.4.1	+/- 15
Tear Strength (Aged)		3.4.2	+/- 15
Tear Strength (7 – Day Water Immersion)		3.4.3	Pass/Fail
Tear Strength (14 – Day Water Immersion)		3.4.3	Pass/Fail
Tensile Stress (Modulus)	ASTM D412	3.4.1	+/- 15
Tensile Stress (7 – Day Water Immersion		3.4.3	Pass/Fail
Tensile Stress (14 – Day Water Immersion)		3.4.3	Pass/Fail
Hardness	ASTM D2240	3.5.4	90 +/- 3
Hardness (7 – Day Water Immersion)		3.4.3	Pass/Fail
Hardness (14 – Day Water Immersion)		3.4.3	Pass/Fail
Specific Gravity	ASTM D792	3.4.7	+/- .25
Adhesion (wheel)	ASTM D429	3.5.3	Pass/Fail
Adhesion (Peel)	ASTM D429	3.4.5	Pass/Fail
Adhesion (7 – Day Water Immersion)		3.4.3	Pass/Fail
Adhesion (14 – Day Water Immersion)		3.4.3	Pass/Fail
Low Temperature Flexibility	ASTM D2137	3.4.6	
Fourier Transform Infrared Test (FTIR)		3.4.9	
Dynamic Mechanical Analysis (DMA)	ASTM D4065	3.4.10	

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

TABLE II. Classification of inspection.

Title	Requirement	Inspection	Pre-Production Testing	First Article	Conformance Test	Conformance Examination
Hardness	3.5.4	4.9.2	1/	1/	1/ Shift	
Hardness 7-Day Water Immersion	3.4.3	4.9.8	1/	1/	1/ Bi-monthly	
Hardness 14 Day Water Immersion	3.4.3	4.9.8			1/ Bi-monthly	
Tensile Strength	3.4.1	4.9.3	1/	1/	1/ Shift	
Tensile Strength (aged)	3.4.2	4.9.4	1/	1/	1/ Bi-monthly	
Tensile Strength 7 day Water Immersion	3.4.3	4.9.8	1/	1/	1/ Bi-monthly	
Tensile Strength 14 Day Water Immersion	3.4.3	4.9.8	1/	1/	1/ Bi-monthly	
Elongation	3.4.1	4.9.5	1/	1/	1/ Shift	
Elongation (aged)	3.4.2	4.9.6	1/	1/	1 Bi-monthly	
Elongation 7 Day Water Immersion	3.4.3	4.9.8	1/	1/	1/ Bi-monthly	
Elongation 14 Day Water Immersion	3.4.3	4.9.8	1/	1/	1/ Bi-monthly	
Tear Strength	3.4.1	4.9.10	1/	1/	1/ Shift	
Tear Strength (aged)	3.4.2	4.9.11	1/	1/	1/ Bi-monthly	
Tear Strength 7 Day water Immersion	3.4.3	4.9.8	1/	1/	1/ Bi-monthly	
Tear Strength 14 day Water Immersion	3.4.3	4.9.8	1/	1/	1/ BI-monthly	
Tensile Stress Modulus	3.4.1	4.9.7	1/	1/	1/ Shift	
Tensile Stress 7 Day Water Immersion	3.4.3	4.9.8	1/	1/	1/ Bi-monthly	
Tensile Stress 14 day Water Immersion	3.4.3	4.9.8	1/	1/	1/ Bi-monthly	
Specific Gravity	3.4.7	4.9.9	1/	1/	1/ lot of pre-polymer	
Low Temperature Flexibility	3.4.6	4.9.14	1/	1/	1/ monthly	
Adhesion (wheel)	3.5.3	4.9.12	1/	1/	1/ Bi-monthly	

TABLE II. Classification of inspection – Continued.

Title	Requirement	Inspection	Pre-Production Testing	First Article	Conformance Test	Conformance Examination
Adhesion (Peel)	3.4.5	4.9.13	1/	1/	1/ monthly	
Adhesion 7 Day	3.4.3	4.9.8	1/	1/	1/ Bi-monthly	
Adhesion 14 day	3.4.3	4.9.8	1/	1/	1/ Bi-monthly	
Fourier Transform Infrared Test	3.4.9	4.9.15	1/	1/	1/ Bi-monthly	
DMA	3.4.10	4.9.16	1/	1/		
Workmanship	3.8	4.6.1	2/	2/		2/
Product Marking	3.7	4.6.1	2/	2/		2/
Endurance (48-hour drum test)	3.5.2.1	4.9.16	3/	3/	3/ Quarterly	
Endurance (6-hour drum test)	3.5.2.2	4.9.16	3/	3/	3/ Quarterly	
On-Vehicle Road Test	3.5.5	4.3.4.2	1/			

1/ Samples shall be taken as specified in Sections 3 and 4 and/or as specified by the Procuring Activity. Unless otherwise specified, sample size shall be one.

2/ Sample size shall be taken in accordance with MIL-STD-1916.

3/ Samples shall be required by the Government as specified in section 4.4.1.

NOTES: Conformation tests (definitions)

1/Bi-monthly=indicates one sampling and testing cycle every other month or every 1000 wheel articles produced.

A lot=identified as a full reactor of pre-polymer.

1/Shift=indicates one sample before each 8 hour shift begins.

Quarterly=is defined as every 3 months or 2000 wheel articles produced.

Monthly is defined as once a month

TABLE III. Clarification of defects.

Classification	Defect	Method of inspection
Blister	A void or hole in article which causes protrusion in surface when hot, may not show on surface when cold. Distortion at the mold line in the form of wrinkles, folds, and tears.	SIE 1/
Cracks	Failure of polyurethane to knit together properly. It may also be found in any part of the polyurethane surface and also at the polyurethane base next to the metal.	Visual
Chipped	Polyurethane missing due to chipping, usually during removal from mold or during trimming.	SIE
Cuts/Tears	A slit, nick, or gash caused primarily by trimming of cast components. Tear may be caused during removal of items from molds.	Visual
Folds	A slit, nick, or gash caused primarily by trimming of cast components. Tear may be caused during removal of items from molds.	Visual
Overcure	Casting to the point that physical property (hardness, tensile strength, etc.) requirements are impaired.	SIE
Off-register	Uneven or misaligned molds causing non-conformity to dimensional requirements of the drawing.	SIE
Undercure	Appears as tackiness, softness, porous, low hardness or other inferior physical properties, usually caused by improper cure conditions or defective polyurethane.	SIE
Separation	Separation in the polyurethane or between the polyurethane and adhesives or polyurethane and metals.	Visual
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.	SIE
Dimensional non-compliance	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.	SIE
Improper identification and marking		Visual

1/ SIE = Standard inspection equipment

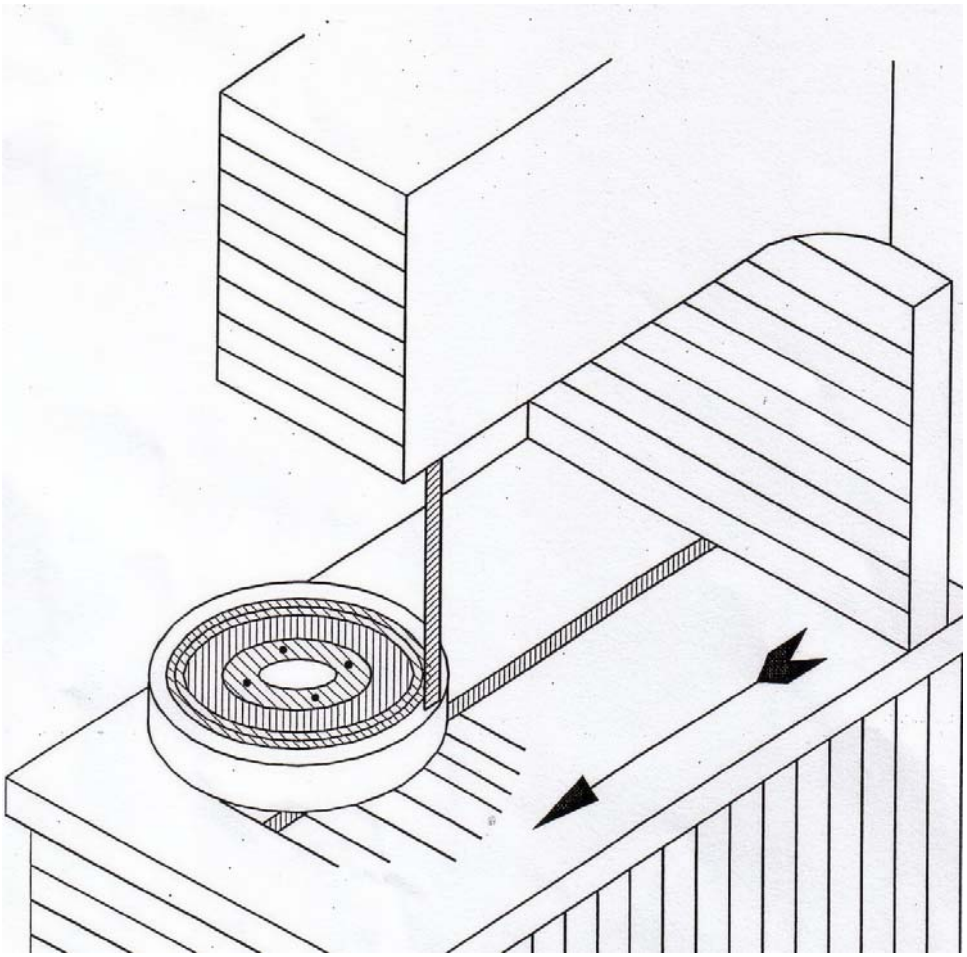

FIGURE 1. Direction of cut for adhesion test.

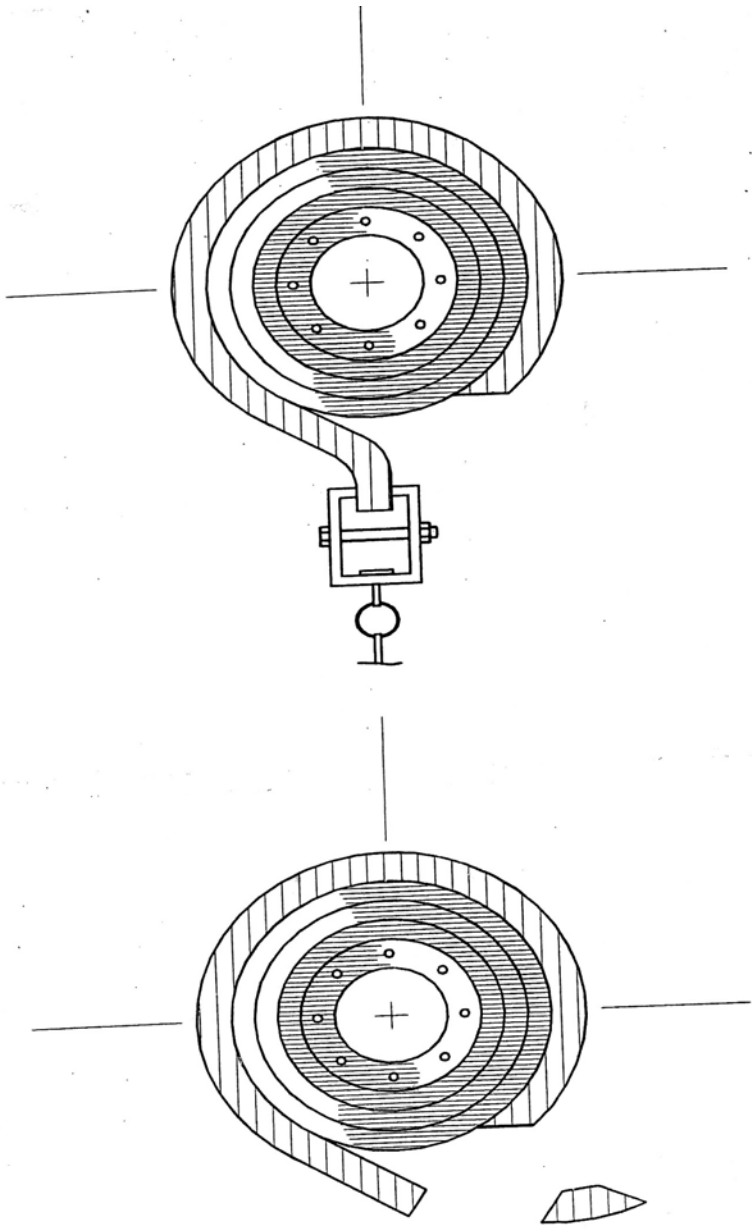

FIGURE 2. Preparation and clamping of tire for adhesion test. Wheel and fixture orientation is optional.

ON-VEHICLE TEST PLAN

BRADLEY FIGHTING VEHICLE POLYURETHANE ROADWHEEL

A.1 SCOPE

A.1.1 Scope. This appendix defines a set of instructions and requirements used for conducting a Polyurethane on-vehicle roadwheel production test. Although this appendix is specific in nature, the Procuring Activity may amend this appendix with a more detailed set of instructions to meet the needs of the particular test.

A.2 ROAD TEST COURSE REQUIREMENTS

A.2.1 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 Procuring Activity.

A.2.2 Test program review. A start of test meeting may be held at the test site on a date and time to be established by the Procuring Activity. Any additional review meetings shall be scheduled only if considered necessary by the Procuring Activity.

A.2.3 Polyurethane roadwheel design characteristics. The Bradley Fighting Vehicle system has a total of 24 roadwheels. They consist of six roadwheel stations on the right side of the vehicle and six roadwheel stations on the left side of the vehicle. Each of the twelve stations has two wheel halves known as an inner wheel and an outer wheel which together form a pair. Each pair is mounted to the roadarm spindle using 10 washers and 10 locknuts. There is no difference in configuration between an inner wheel and an outer wheel (see Figure A-1).

A.2.4 Test course. The Procuring Activity will select the test course for conducting all on-vehicle production 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 testing because of climate, course, and the consistency of the test results. The following standard track vehicle test courses at YPG are designated for testing roadwheels for this specification.

A.2.4.1 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 accuracy surveyed distance markers.

A.2.4.2 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.

A.2.4.3 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.

A.2.4.4 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 a dry soil. One lap is 6.7 miles.

A.2.5 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.

A.2.6 Climatological conditions. In order to expose the wheel 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.

A.2.7 Roadwheel deliver and storage. Roadwheels shall be delivered to the test site by a date as specified by the Procuring Activity. The sample hardware and any spares provided will be inspected to ensure no physical damage has occurred in shipment and that the required number of samples and spares have been provided and the components are properly identified. Adequate time shall 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 samples. Any storage condition that might influence the relative performance of the roadwheels shall be held as uniform as possible.

A.3 HARDWARE REQUIREMENTS

A.3.1 Vehicle.

A.3.1.1 A Bradley Fighting Vehicle shall be utilized for the test. The weight of the vehicle shall be adjusted to 67,000 pounds, plus or minus 500 pounds.

A.3.1.2 The test site shall perform a receiving inspection of the Bradley series vehicle to be used for the test. The basic test vehicle shall be visually and functionally checked with specific attention given to suspension, electrical systems, hydraulic systems, and automotive controls and accessories. Any damage or improper operations will be repaired/corrected to ensure the vehicle will be capable of meeting the test requirements defined by this appendix.

A.3.2 Test sample hardware.

A.3.2.1 Road test. The road test requires 24 (12 stations @ 2 wheels per station) wheel assemblies plus 10 spares.

A.3.2.2 Procurement. The Procuring Activity reserves the right to adjust the test sample size (including spares) based on vehicle availability, the number of contractors attempting test approval, or other circumstances.

A.3.2.3 Roadwheel identification. To aid in failure and part life tracking, all roadwheels, including spares, shall be permanently marked with a sequential number/letter code applied to the metal portion of the wheel. The code shall be identified to reflect the name of the manufacturer, the wheel station number and whether the wheel is an inboard wheel or outboard. The test site shall apply the number/letter codes prior to vehicle installation.

A.3.2.4 Break-in run.

A.3.2.4.1 Purpose. The purpose of the break-in run procedure is to simulate the natural aging process afforded production track and roadwheels during normal transit/storage periods before actual vehicle use. All test samples, excluding 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

A.3.2.4.2 Break-in run roadwheel installation. After the break-in run is completed, the wheels are not to be removed from the vehicle unless they meet the inspection and replacement criteria.

A.3.2.4.3 Vehicle operation. The vehicle shall be operated in both directions for one half-half of the total vehicle distance.

A.3.2.4.4 Track/roadwheel cooling. During the break-in run, the track/roadwheels 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:

A.3.2.4.5 Track roadwheel path surface. The track roadwheel path surface and the roadwheels shall be cooled to the point where the palm of the hand can be held to the surface backing in excess of 10 seconds.

A.3.2.4.6 Measuring device. Cool down between speed changes shall require the use of a device (i.e. thermo gun see Figure A-2.) used to measure the temperature of the track/roadhwheels. Measurements shall be taken from both the roadwheel side and the road side. A reading of 130 degrees ºF or less should be recorded prior to restart of the break-in.

A.3.2.4.7 Visual Inspection of track/roadwheels. Between each division of the break-in run, a visual inspection shall be made of the track/roadwheels. Hardware shall be re-torqued if noticeably loose. After break-in, all hardware shall be torqued 100% to values as specified in applicable technical manuals.

A.3.2.4.8 Break-in failures. Any roadwheel 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. Roadwheels failed during break-in shall be replaced with spares and noted on a Test Incident Report (TIR). Break-in mileage shall be counted toward the production approval mileage requirement.

A.4.1 Test procedure.

A.4.1.1 Break-in run. After completion of the break-in run, endurance testing shall be conducted using a Bradley Fighting Vehicles with an adjusted weight and to the operational mode summary as specified in this test plan.

A.4.1.2 Test mileage. The contractor's test sample set shall be tested to 7500 miles or until the sample set meets the failure criteria whichever occurs first.

A.4.1.3 Failure criteria. Failure of a contractor's roadwheels will be established when 20% of its total roadwheel samples have reached wear-out and/or need replacement (see A.4.1.4). Therefore, based on a sample size of 24 roadwheels, five roadwheels shall reach the wear out/replacement criteria in order for the sample set to be considered failed.

A.4.1.4 Inspection and replacement criteria. As a minimum, YPG personnel are to inspect the roadwheels after every mission scenario or after approximately every 50 miles, whichever occurs first. Check all roadwheels and compensation idler for bent, broken, or missing conditions as required by the Preventative Maintenance Checks and Services (PMCS) portion of the operator's manual. Replacement shall occur, at the Government's discretion, when one of the following criteria is met:

A.4.1.4.1 Chunking. Chunking occurs in excess of 20% or extending more than one-half the width of the wheel.

A.4.1.4.2 Wheel rim. Wheel rim metal surfaces become visually bent, out of round or cracked.

A.4.1.4.3 Wheel mounting holes. Wheel mounting holes become elongated as determined by visual inspection.

A.4.1.5 Scoring Criteria.

A.4.1.5.1 Wheel. When a wheel meets the failure criteria identified in A.4.1.3, the wheel is to be removed from the test and the Government will make a final determination as to the validity of the failure.

A.4.1.5.2 Multiple count replacement. The test site shall not count multiple replacement of the same roadwheel. However, since there are two roadwheels per station, each roadwheel is allowed to fail and be counted. But, for example, if station # 2, outer wheel fails for the second time, it is not counted.

A.4.1.5.3 Roadwheel replacement. Roadwheels shall be replaced in pairs even though only one of the wheels may meet the failure criteria. This is necessary to prevent the premature wear of the newly mounted wheel. Example, if station # 2, inner wheel, fails, the station # 2 outer wheel shall also be replaced and not be counted as a failure. However, during the future conduct of the test, the station # 2 outer replacement wheel would be subject to be counted as a failure since this position had not been previously counted as such. Further, during the conduct of the test, the wheels are not to be moved from one vehicle test location to another. Example; the inner wheel from station six is not to be moved to the outer position of station 6. Once wheels are mounted, they are to remain in this position throughout the duration of the test or until the wheel has reached the failure criteria, whichever occurs first.

A.4.1.5.4 Heat transfer. Heat transfer between the roadwheels and track components shall be measured using an IR temperature/thermo gun or similar type instrument (see Figure A-2). Heat buildup shall be checked after every mission scenario or per the direction of the Procuring Activity. Measurements shall be taken on the inner and outer wheel as well as the backing rubber. Data collectors shall note the time lapse between stoppage of the vehicle and the temperature measurement. Measurements shall be taken in a consistent manner.

A.4.1.5.5 Rubber and polyurethane use. If the circumstances of the test require the use of rubber and polyurethane wheels, the following shall apply: During the conduct of the test, polyurethane roadwheels and rubber roadwheels are not to be paired at the same roadwheel station. Example; for station 2, the test site shall not mount a rubber wheel half at the inner position and a polyurethane wheel half at the outer position. However, mounting full polyurethane roadwheels next to full rubber wheels is acceptable. Example; the wheels at station 6 can both be rubber, but the wheels at Station 5 may be polyurethane rubber.

A.4.2 Documentation/test reporting/photographic coverage:

A.4.2.1 Documentation. Any test incidents related to roadwheel, track, suspension, and/or drive train components shall be documented on a Test Incident Report (TIR) or comparable test reporting document. Each TIR or other test reporting document shall include as a minimum the following:

A.4.2.1.1 Description of failed component/part (noun).

A.4.2.1.2 Mileage roadwheels have endured.

A.4.2.1.3 Date of incident.

A.4.2.1.4 Description of incident. (Description shall be detailed and include cause, if evident).

A.4.2.1.5 Test course where incident occurred (if known).

A.4.2.1.6 Estimated speed of vehicle when incident occurred.

A.4.2.1.7 Test environment at time of incident.

A.4.2.1.8 Disposition of failed part (Hold and tag failed part).

A.4.2.1.9 Test report number.

A.4.2.1.10 Authorized signature.

A.4.2.2 Major suspension incidents. All suspension incidents determined to be major shall be immediately reported to the Procuring Activity.

A.4.2.3 Interim reports. In order to assure that the test sponsor and the manufacturers are kept apprised to the latest information pertaining to the test, the test site may be required to furnish interim status reports on a regular basis. The interim reports shall consist of a summary of test findings and other information pertinent to the test. The test sponsor shall notify the test site regarding the frequency of these reports.

A.4.2.4 Final report. The test site shall prepare a final technical report at the completion of testing. The report shall be completed in a timely matter and shall include as a minimum the following:

A.4.2.4.1 Data collected. Include copies of TIRs or comparable test reporting document for suspension related failures.

A.4.2.4.2 Summary of test findings.

A.4.2.4.3 Photographs, tables, charts to reflect test findings. Photographs shall be captioned to include the name of the manufacturer, miles on wheel at time of photograph, test site unique item identifier (example X 01) and the position of the wheel (example; station number 6, inner wheel). This information is necessary to properly identify the test item in question.

A.4.2.5 Disposition of roadwheel sample hardware.

A.4.2.5.1 Sample hardware. All roadwheel sample hardware, including failed wheels and unused spares, shall be retained at the test site pending disposition instructions. Hardware required for failure analysis shall be provided to the Procuring Activity upon request. Roadwheels that are defective or have completed testing may be stored outdoors while waiting disposition instructions.

A.4.2.5.2 Failed hardware. All failed hardware 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.

A.4.2.6 Distribution of reports and documentation. The distribution of test incident reports and final reports shall be as specified by the Procuring Activity.

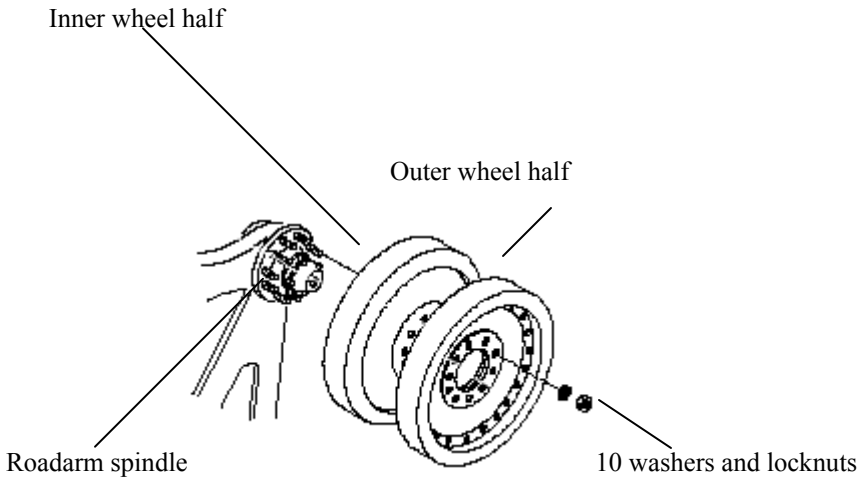

FIGURE A.1. Typical roadwheel station for the Bradley Fighting Vehicle. There are six such stations on each side of the vehicle.

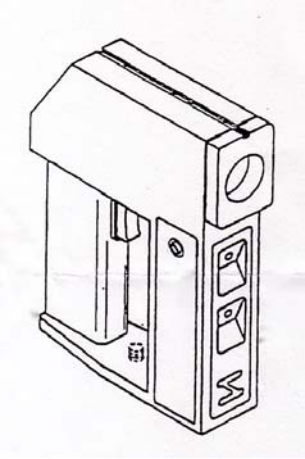

FIGURE A.2. Example of a thermo gun that may be used to measure the heat intensity of the polyurethane material.

Custodians:
Army - AT
Navy - AS
Air Force - 99

Preparing Activity:
Army - AT

(Project 2630-0042)

Review Activities:
Navy – CG, YD
Air Force – 84
GSA - FSS

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil