

INCH-POUND

MIL-DTL-62461E(AT)

1 December 1998

SUPERSEDING

MIL-PRF-62461D(AT)

11 April 1997

DETAIL SPECIFICATION

TRANSMISSION ASSEMBLY

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 covers a transmission with an integral torque converter that consists of the main assembly and a control valve. The transmission assembly will be referred to, herein, by the term 'transmission'. The transmission is a counter-shaft type with external clutches and a six-speed self-contained unit with the necessary gearing, shafting, spacers, bearings and all other parts required for satisfactory operation (see 6.1).

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.

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 2520

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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).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-2104	- Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service.
MIL-PRF-22750	- Coating, Epoxy, High Solids.
MIL-PRF-46167	- Lubricating Oil, Internal Combustion Engine, Arctic.
MIL-C-46168	- Coating, Aliphatic Polyurethane, Chemical Agent Resistant.
MIL-C-53039	- Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant.
MIL-DTL-62462	- Engine, Diesel, Liquid-Cooled, 8 Cylinder: 4 Cycle, V-Type, 220 KW (295 HP).
MIL-V-62468	- Vehicle, Armored Combat Earthmover, M9 ACE.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available 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

DEPARTMENT OF DEFENSE

12331877	- Transmission Assembly.
13214E2449	- Control Valve.

(Copies of these drawings are available from the U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000.)

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NUCLEAR REGULATORY COMMISSION (NRC)

Code of Federal Regulations (CFR) - Title 10, Parts 30 and 40.

(Copies of the Code of Federal Regulations (CFR) are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

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 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.1.1.

3.2 Design and construction. The design and construction of the transmission shall be as specified herein and in accordance with Drawing 12331877. The construction of the control valve shall be in accordance with Drawing 13214E2449. The transmission shall have a single stage three element integral torque converter, shall be designed to accept input power from a diesel engine conforming to MIL-DTL-62462, and shall transmit power and torque commensurate with use in a vehicle conforming to MIL-V-62468.

3.2.1 Accessories and equipment. All accessories and equipment shall be installed and properly adjusted. Electrical accessories and equipment, including wiring and electrical connections, shall be waterproof and shall conform to the applicable drawings (see 3.2).

3.2.2 Weight. The dry weight of the transmission shall be not more than 1350 pounds (lb) (612 kilograms (kg)), and the weight with residual oil shall be not more than 1400 lb (635 kg).

3.3 Materials. Materials used shall be as specified herein and in applicable drawings (see 3.2). Materials not thereby designated shall be in accordance with the manufacturer's material specifications for transmissions meeting the requirements as specified herein.

3.3.1 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.

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3.3.2 Hazardous materials. Asbestos, cadmium, and radioactive materials shall not be used in this item. Radioactive material is defined by CFR, Title 10, Parts 30 and 40, and other radioactive material in which specific activity is greater than 0.002 microcuries per gram or the activity per item equals or exceeds 0.01 microcuries.

3.3.3 Rubber components. Rubber components shall be ozone resistant to the degree specified in the applicable specification or drawing.

3.4 Operating requirements. The transmission shall meet the operating requirements as specified in Drawing 12331877 and 3.4.1 through 3.4.3 when coupled with a power source conforming to MIL-DTL-62462.

3.4.1 Output speed. Minimum output speeds shall be in accordance with table I.

TABLE I. Minimum output speeds.

No load input speed (± 20 rpm)	Gear range	Forward speed (rpm minimum)	Reverse speed (rpm minimum)
1800	1st	320	344
1800	2nd	485	518
1800	3rd	776	
1800	4th	1170	
1800	5th	1999	
1800	6th	3003	

3.4.2 Oil pressure and flow. The transmission, with an input speed of 1800 ± 20 revolutions per minute (rpm), no load at the output, and a converter out temperature of 200 ± 20 degrees Fahrenheit ($^{\circ}\text{F}$) (93 ± 11 degrees Celsius ($^{\circ}\text{C}$)), shall attain the oil pressures and flows as specified in table II without evidence of leakage or any other damage.

TABLE II. Oil pressure and flows.

Direction and range	Input speed, rpm	Clutch pressure, psi (kPa)	Converter-out flow, gal/min (L/min) ^{1/}	Converter-out temperature, $^{\circ}\text{F}$ ($^{\circ}\text{C}$)	Lube temperature, $^{\circ}\text{F}$ ($^{\circ}\text{C}$)	Lube pressure, psi (kPa)
R-1,2	1800 ± 20	180-220 (1240-1517)	17.4 (68)	180-220 (82-104)	180-220 (82-104)	15-40 (103-276)
N	1800 ± 20	180-220 (1240-1517)	20.0 (78) minimum	180-220 (82-104)	180-220 (82-104)	15-40 (103-276)
F-1,2, 3,4,5, 6	1800 ± 20	180-220 (1240-1517)	17.4 (68) minimum	180-220 (82-104)	180-220 (82-104)	15-40 (103-276)

^{1/} gal/min = gallons per minute, L/min = liters per minute

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3.4.3 Seals. Seals shall restrict the entrance of all foreign material into bearings exposed to contamination during transmission operation in any condition. The seals shall prevent lubricant leakage and water contamination of the lubricants.

3.5 Support and ownership requirements. The transmission shall meet the support and ownership requirements as specified in 3.5.1 through 3.5.3.

3.5.1 Durability. The transmission shall have a 50 percent (%) probability of completing the first 600 hours of operation commensurate with operation on the M9 mission profiles as specified in MIL-V-62468, without replacement, rebuilding or overhauling.

3.5.2 Finish. Unless otherwise specified (see 6.2), the transmission shall be cleaned, treated, primed and painted in accordance with standard commercial practice. All parts of the transmission that are exposed to chemical contaminants shall be painted with a coating conforming to MIL-PRF-22750, MIL-C-46168, or MIL-C-53039, as applicable.

3.5.3 Identification marking. The transmission and each major component shall be permanently and legibly marked with an identification plate that includes, as a minimum, the following information:

- a. National stock number (NSN).
- b. Manufacturer's serial number.
- c. Manufacturer's name and CAGE code.
- d. U.S.

3.6 Operating environment requirements. The transmission shall meet the operating environment requirements as specified in 3.6.1 through 3.6.4.

3.6.1 High temperature. The transmission shall operate through all gear ranges at an ambient temperature of 120°F (49°C) without damage or malfunction.

3.6.2 Low temperature. The transmission shall operate through all gear ranges, without benefit of solar radiation, after being cold soaked to an ambient temperature of -26°F (-32°C) without damage or malfunction.

3.6.3 Leakage decay. The transmission components, connections, gaskets, seals, and joints shall be free of leaks when completely submerged in water.

3.6.4 Steam and waterjet cleaning. The transmission shall withstand steam cleaning and high pressure waterjet washing without deterioration of seals, water leakage past seals or gaskets, or other evidence of damage.

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4. VERIFICATION

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

- a. First article inspection (see 4.1.1).
- b. Conformance inspection (CI) (see 4.1.2).

4.1.1 First article inspection. When specified (see 6.2 and 6.3), first article inspection shall be performed on preproduction or initial production samples as specified in 4.1.1.1 and 4.1.1.2.

4.1.1.1 Preproduction inspection. When specified (see 6.2), the preproduction sample shall consist of two transmissions. Preproduction inspection shall consist of the all the verifications as specified in table III.

4.1.1.2 Initial production inspection. Unless otherwise specified (see 6.2), the Government shall select two from the first ten transmissions produced under the production contract for initial production inspection. Initial production inspection shall consist of the all the verifications as specified in table III.

TABLE III. Classification of inspections.

Title	Requirement	Verification	CI (100%)
Design and construction	3.2	4.4.1	
Accessories and equipment	3.2.1	4.4.1	
Weight	3.2.2	4.4.1	
Materials	3.3	4.4.2	
Hazardous materials	3.3.2	4.4.2	
Operating requirements	3.4	4.4.3	
Output speed	3.4.1	4.4.3.1	X
Oil pressure and flow	3.4.2	4.4.3.2	X
Seals	3.4.3	4.4.3.3	
Support and ownership requirements	3.5	4.4.4	
Durability	3.5.1	4.4.4.1	
Finish	3.5.2	4.4.4.2	
Identification marking	3.5.3	4.4.4.3	
Operating environment requirements	3.6	4.4.5	
High temperature	3.6.1	4.4.5.1	
Low temperature	3.6.2	4.4.5.2	
Leakage decay	3.6.3	4.4.5.3	
Steam and waterjet cleaning	3.6.4	4.4.5.4	

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4.1.2 Conformance inspection. Unless otherwise specified (see 6.2 and 6.4), each transmission shall be tested in accordance with the 100% CI verifications as specified in table III. As specified in the contractual sampling plan (see 6.2), select transmissions shall complete and pass the tests as specified in 4.4.1, 4.4.4.2, and 4.4.4.3.

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

- a. Air temperature: $73 \pm 18^{\circ}\text{F}$ ($23 \pm 8^{\circ}\text{C}$).
- b. Barometric pressure: 28.5 (+2, -3) inches mercury (in. Hg)
(725 (+50, -75) millimeters Hg)
- c. Relative humidity: $50 \pm 30\%$.

4.3 Verification methods. The types of verification methods included in this section are visual, measurement, sample tests, full-scale demonstration tests, simulation, modeling, engineering evaluation, component properties analysis, and similarity to previously-approved or previously-qualified designs.

4.3.1 Verification alternatives. The manufacturer may propose alternative test methods, techniques, or equipment, including the application of statistical process control, tool control, or cost-effective sampling procedures, to verify performance. See the contract for alternatives that replace verifications required by this specification.

4.4 Order of inspection. The following tests shall be in any order except that the seals verification (see 4.3.3.3) shall be performed at the conclusion of each test.

4.4.1 Design and construction verifications. Use one or more of the methods outlined in 4.3 to verify the following.

- a. That the transmission, operating with a single stage three element integral torque converter, is built in accordance Drawing 12331877, and the control valves are accordance with Drawing 13214E2449.
- b. That the transmission is designed to accept input power from a diesel engine conforming to MIL-DTL-62462, and transmit power and torque commensurate with its use on a vehicle conforming to MIL-V-62468.
- c. That all accessories and equipment are installed on the transmission, properly adjusted, and in accordance the applicable drawings as specified in (a).
- d. That the dry weight of the transmission is not more than 1350 lb (612 kg), and the weight with residual oil is not more than 1400 lb (635 kg).

4.4.2 Materials verification. Use one or more of the methods outlined in 4.3 to verify that transmission is made with the material requirements as specified in applicable drawings (see 4.4.1(a)), and does not contain asbestos, cadmium, or any other radioactive material.

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4.4.3 Operating requirements verifications. Complete and pass each of the tests as specified in 4.4.3.1 through 4.4.3.3.

4.4.3.1 Output speed. The transmission shall be tested on a test stand and operated under the input speed and gear ranges as specified in table I. The minimum output speeds shall be as specified therein.

4.4.3.2 Oil pressure and flow. The transmission shall be tested on a test stand with provisions for providing the no-load speed, gear shifting, observation of flows and pressures, and oil supply at the temperature indicated in table II. The transmission shall attain the oil pressures and flows as indicated in table II and shall show no evidence of leakage in excess of a seep (see 6.5). When first article inspection is required (see 6.2), the transmission shall be capable of operating with converter output temperatures of up to 250°F (121°C) on a continuous basis, and up to 280°F (138°C) on an intermittent basis during a period of not more than 15 minutes. Normal acceptance testing shall be accomplished with the converter-output temperature in the range of 180-220°F (82-104°C).

4.4.3.3 Seals test. Visually verify that the seals have restricted the entrance of all foreign material into bearings exposed to contamination, and have prevented lubricant leakage and water contamination of lubricants during transmission operation.

4.4.4 Support and ownership requirements verifications. Complete and pass each of the tests as specified in 4.4.4.1 through 4.4.4.3.

4.4.4.1 Durability test. The transmission shall be tested in a way that is commensurate with the mission profiles of the M9 series tanks as specified in MIL-V-62468. The transmission shall demonstrate a 50% probability of completing the first 600 hours of operation without replacement, rebuilding or overhaul, when calculated with the grading scale as specified therein.

4.4.4.2 Finish test. Visually verify that the transmission is cleaned, treated, primed and painted in accordance with acceptable commercial standards, and that all parts exposed to chemical contaminants are painted with coatings conforming to MIL-PRF-22750, MIL-C-46168, and MIL-C-53039, as applicable.

4.4.4.3 Identification marking. Visually verify that the transmission and each major component is permanently and legibly marked with an identification plate that includes the following information:

- a. National stock number (NSN).
- b. Manufacturer's serial number.
- c. Manufacturer's name and CAGE code.
- d. U.S.

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4.4.5 Operating environment requirements verifications. Complete and pass each of the tests as specified in 4.4.5.1 through 4.4.5.4.

4.4.5.1 High temperature. The transmission, without external load and with provisions for oil cooling, shall be tested as follows:

- a. Place the transmission in a test chamber for not less than 6 hours at a temperature of 120°F (49°C).
- b. Raise the chamber temperature to 160°F (71°C) within a time period of 1 hour and maintain at that temperature for an additional 4 hours.
- c. Lower the chamber temperature to 120°F (49°C) within 1 hour.
- d. Repeat steps a, b, and c two additional times (making a total of three 12 hour cycles).
- e. Adjust the chamber temperature to the highest operating temperature under which the transmission is designed to operate and maintain until temperature stabilization of the transmission is reached.
- f. Operate the transmission until it is stabilized through all gear ranges.
- g. Return the transmission, nonoperating, to standard ambient conditions and stabilize.
- h. There shall be no evidence of damage or malfunction during or after the test.

4.4.5.2 Low temperature. The transmission, without external load and with provisions for oil cooling, shall be tested as follows:

- a. Place the transmission in a test chamber for not less than 24 hours at a temperature of -26°F (-32°C).
- b. Raise the chamber temperature to -20°F (-30°C) and maintain until temperature stabilization of the transmission is reached.
- c. Operate the transmission until it is stabilized through all gear ranges.
- d. Return the transmission, nonoperating, to standard ambient conditions and stabilize.
- e. The rate of temperature change (steps a, b, and d) may be the maximum attainable by the chamber but shall not be greater than 18°F (10°C) per minute.
- f. There shall be no evidence of damage or malfunction during or after the test.

4.4.5.3 Leak decay. The transmission, without oil, shall be submerged in water to a depth sufficient to completely cover the assembly for at least 5 minutes. The internal air pressure shall be 3-5 pounds per square inch (psi) (21-35 kilopascals (kPa)). The transmission shall be checked for leaks. No air bubbles shall be permitted.

4.4.5.4 Steam and waterjet cleaning. All transmission interface openings shall be sealed and the transmission shall be steam cleaned using high pressure steam and cleaner. After steam cleaning the transmission shall be waterjet washed and subsequently checked for any deterioration

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of seals or water leakage past seals or gaskets. Following the steam and waterjet cleaning, the oil shall be drained from the transmission and exhibit no evidence of contamination.

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 which may be helpful, but is not mandatory.)

6.1 Intended use. The transmission covered by this specification is intended for use as original, spare, or replacement in the Armored Combat Earthmover M9 ACE. Due to the extreme mission profiles under which the transmission must operate (see 3.5.1), and the detailed design solutions required for use on the M9 ACE (see 3.2), this item is military unique.

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)
- c. If first article inspection is required (see 3.1 and 4.1.1).
- d. If cleaning, treating, priming and painting of the transmission should be other than as specified (see 3.5.2).
- e. If preproduction inspection is required (see 4.1.1.1).
- f. If initial production inspection is other than as specified (see 4.1.1.2).
- g. If conformance inspection is other than as specified (see 4.1.2).
- h. Specification of sampling plan (see 4.1.2).
- i. If inspection conditions are other than as specified (see 4.2).
- j. Packaging requirements (see 5.1).

6.3 First article. When requiring a first article inspection, contracting documents should provide specific guidance to offerors. This guidance should cover whether the first article is a first article sample, a pre production item, a first production item, and the number of test items. These documents should also include specific instructions regarding arrangements for

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examinations, approval of first article test results, and disposition of first articles. Pre-solicitation documents should provide Government waiver rights for samples for first article inspection to bidders offering a previously acquired or tested product. Bidders offering such products who wish to rely on such production testing must furnish evidence with the bid that prior Government approval is appropriate for the pending contract.

6.4 Conformance inspection. Affordable conformance inspection with confidence varies depending upon a number of procurement risk factors. Some of these factors include: Contractor past performance, government schedules and budget, product material and design maturity, manufacturing capital equipment and processes applied, the controlled uniformity of those processes, labor skill and training, and the uniformity of measuring processes and techniques. During the solicitation, contracting documents should indicate those tests desired from table III and their designated frequency based on a risk assessment for the procurement.

6.5 Leakage. The following definitions are established as guidelines governing leaks.

- a. Weep. Any evidence of fluid beyond a seal or joint.
- b. Seep. Any evidence of fluid beyond a seal or joint that does not result in the formation of a droplet.
- c. Leak. Any evidence of fluid beyond a seal or joint that results in the formation of a droplet.
- d. Drip. Any evidence of fluid beyond a seal or joint where droplets form and fall.

6.6 Subject term (key word) listing.

Clutch
 Earthmover
 Gear shifting
 M9
 Power train
 Torque converter

6.7 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.

Custodian:
 Army - AT

Preparing Activity:
 Army - AT

(Project 2520-0019)

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 MIL-DTL-62461E(AT)	2. DOCUMENT DATE (YYMMDD) 981201
3. DOCUMENT TITLE TRANSMISSION ASSEMBLY		
4. NATURE OF CHANGE (<i>Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.</i>)		
5. REASON FOR RECOMMENDATION		
6. SUBMITTER		
a. NAME (<i>Last, First, Middle Initial</i>)	b. ORGANIZATION	
c. ADDRESS (<i>Include Zip Code</i>)	d. TELEPHONE (<i>Include Area Code</i>) (1) Commercial (2) AUTOVON (<i>If applicable</i>)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY		
a. NAME	b. TELEPHONE (<i>Include Area Code</i>) (1) Commercial (810) 574-8745 (2) AUTOVON 786-8745	
c. ADDRESS (<i>Include Zip Code</i>) 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	