INCH-POUND

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MILITARY SPECIFICATION

VEHICLE, ARMORED COMBAT EARTHMOVER, M9 ACE

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

1. SCOPE

1.1 Scope. This specification establishes the requirements for the manufacture and acceptance of full tracked, high speed, dozer/scraper combination, armored combat earthmover. The Armored Combat Earthmover M9 ACE is an 18 ton [16,330 kilogram (kg)], full-tracked, aluminum-hulled vehicle developed to provide highly mobile earthmoving capability to combat engineer platoons placed in support of mechanized and armored battalion task forces. This mobility is obtained by the vehicle characteristics of 30 miles per hour (mph) [48 kilometers per hour (km/h)] speed, air transportability and air drop capability, and the ability to swim inland waterways.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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
MILITARY

MIL-P-514 - Plates, Indentification, Instruction and Marking, Blank.

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

AMSC N/A FSC 2350

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

MIL-F-14072	- Finishes for Ground Electronic Equipment.
MIL-C-62122	- Cable Assembly, Intervehicle Power, Plug and Receptacle.
MIL-E-62484	- Earthmover, Armored Combat, M9 ACE, Processing for Shipment and Storage of .

STANDARDS
MILITARY

MIL-STD-130	- Identification Marking of US Military Property.
MIL-STD-202	- Test Methods for Electronic and Electrical Components.
MIL-STD-209	- Slinging and Tiedown Provisions for Lifting and Tying Down Military Equipment.
MIL-STD-461	- Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference.
MIL-STD-462	- Electromagnetic Interference Characteristics Measurement of .
MIL-STD-642	- Identification Marking of Combat and Tactical Transport Vehicles.
MIL-STD-810	- Enviromental Test Methods and Engineering Guidelines.
MIL-STD-1473	- Standard General Requirements for Color and Marking of Army Material.
MIL-STD-1474	- Noise Limits for Army Material.

2.1.2 Other Govenment documents, drawings, and publications. The following documents, drawings, and publications form a part of this specification to the extent specified herein.

DRAWINGS
ARMY

11682336-1	- Cable Assembly.
11682379	- Intervehicle Power Cable Kit.
12297759	- Marker, Instruction, Hearing Protection.
13211E8600	- Earthmover, Armored Combat, M9.
13211E9558	- Chart Production Lubrication.

PUBLICATIONS

TM5-2350-262-10	- Operators Manual.
TM9-4910-571-12&P	- STE/ICE-R Operators Manual.

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

2.2 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the which are DoD adopted are those listed in the issue of DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B93.28 - American National Standard Method for Calibration of Liquid Automatic Particle Counters Using "AC" Fine Test Dust (NFP T2.9.6).

(Applications for copies should be addressed to the American National Standards Institute, 254 N. W. 7th Street, Miami, FL 33125.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J1165 - Reporting Cleanliness Levels of Hydraulic Fluids.

(Applications for copies should be addressed to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096).

(Industry association specifications and standards are generally available for reference from libraries or other informational services.)

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 Preproduction vehicle. When specified (see 6.2), a preproduction vehicle(s) shall be produced prior to the manufacture or fabrication of vehicles in quantity. The vehicle(s) when completed shall be submitted to the Government for first article examination and tests to determine conformance with the requirements of this specification (see 4.4 and 6.2). Vehicle(s) submitted by the contractor shall be fully representative of vehicles proposed to be supplied under the contract from production facilities and toolings.

3.2 First article. Unless otherwise specified, the contractor shall furnish an initial production vehicle (see 6.2) which shall be subjected to first article inspection (see 4.4). First article inspection samples, properly marked with identifying information shall be representative of the unit to be furnished to the Government. All subsequent vehicles delivered to the Government shall conform to these samples in all of their pertinent physical and performance attributes.

3.3 Qualification of components. No deviation from the vendor items specified on the source control drawings is permissible without prior approval of the contracting officer or his designated technical representative (COTR) in accordance with (IAW) procurement documentation.

3.4 Materials. Materials shall be as specified herein and in referenced specifications, standards and drawings. Materials shall be free of defects which adversely affect performance or serviceability of the finished product. All materials shall be new and rubber products shall not be more than 8 calender quarters in age from date of cure of the rubber to date of acceptance of the M9 ACE by the Government.

3.5 Qualified products. The contractor shall be responsible for using parts and assemblies from Qualified Products Lists (QPLs) where applicable. Contractor's inspection records shall specifically list all QPL items by number and date of the QPL, name of supplier and part or drawing number(s). When parts and assemblies are approved as qualified products, but not yet listed on the QPL, the contractor shall list the products by number and date of the approved document and name of supplier(s).

3.6 Basic issue items. Each M9 ACE shall be provided with basic issue items as stipulated in drawings and contracts (see 4.6.1).

3.7 Government-furnished property. When specified (see 6.2), the Government will provide the following items to the contractor for test and/or installation.

3.7.1 STE/ICE VTM/XDCR Kit Assembly, NSN 4901-01-222-6589, with manual, TM9-4910-571-12 and P.

3.7.2 M8A3 gas particulate filter unit (GPFU) assembly components. (Air Purifier, M2A2, NSN 4240-00-868-7906; Heater, Air, M3, NSN 4240-00-807-6856; Frame Assembly, NSN 4240-00-565-6059; Switch Assembly, NSN 1015-01-027-0980).

3.7.3 Radio harness, NSN 5820-01-299-5870 for AN/VRC-87 Radio Set.

3.7.4 Additional authorized list (AAL) items. One set only for fit up and test.

3.7.5 Basic issue items (BII).

3.8 Design and construction.

3.8.1 Parts, assemblies, and processes. The M9 ACE shall be fabricated and assembled in accordance with drawings, parts lists, and other documents listed on Drawing 13211E8600.

3.8.2 Fuels, lubricants, and coolants. The M9 ACE shall be tested with the standard service products of the type and grade for the applicab

ambient temperature range specified in table I and for the products given on drawing 13211E9558. The M9 ACE shall be furnished with the product for use in the temperature range at the shipping destination and DD Form 2258 shall be completed and attached in accordance with MIL-E-62484 (see 4.3.1).

3.8.3 Installation and stowage.

3.8.3.1 Installation. The M9 ACE shall have mounting surfaces, brackets, and 24-volt electrical connectors as required by applicable drawings for installation and/or connection of the items listed herein for the M9 ACE (see 4.6.2.1):

a. T/SEC KY57 Speech Secure Unit.
b. Gas particulate filter unit.
c. Launcher grenade, smoke: M259.
d. Radio harness.
e. Radio set, AN/VRC-87.
f. Slave Power and Cable Assembly 11682336-1.
g. Trailer Electrical Cable.
h. STE/ICE-R VTM/XDCR kit assembly.

3.8.3.2 Stowage. In accordance with the engineering drawing, all items to be stowed in the M9 ACE shall be capable of being stowed in the space provided (see 4.6.2.2).

3.8.4 Treatment and painting. The vehicles/components shall be cleaned, treated, and painted in accordance with contractual and/or drawing requirements (see 4.6.3).

3.8.5 Engine air intake system. The air cleaner assembly shall be securely installed and the air induction system shall have no leaks or loose connections (see 4.6.4).

3.8.6 Exhaust system. The manifolds, muffler, and exhaust pipes shall show no evidence of exhaust leakage during operations. The exhaust system shall be mounted securely as specified on the drawings. The exhaust connections shall be aligned and fastened securely (see 4.6.5).

3.8.7 Fuel system. The fuel system shall store, vent, filter, and supply fuel to and from the engine, without leakage (see 4.6.6).

3.8.8 Valves. The fuel drain, air bleed, and trailer brake valves shall open and close without binding or sticking and shall not leak when in the closed position (see 4.6.7).

3.8.9 Cooling system. The cooling system shall operate without leakage of coolant under all operating conditions specified herein. The cooling system lines shall be installed to clear adjacent components and be free of twists, kinks, or collapsed sections (see 4.6.8).

3.8.10 Welds. The weld types, materials, sizes, and quality of

soundness shall be in accordance with the weld requirements specified on the applicable drawings (see 4.6.9).

3.8.11 Fasteners. Nuts, bolts, and other threaded fasteners shall be securely tightened. Specific torque values shall be complied with where specified on drawings. Lock tabs, lock wires, and similiar locking devices shall be properly installed (see 4.6.10).

3.8.12 Adjustable mechanism. Prior to operation and testing, tracks, controls, parking brake, wheel bearings, and all other adjustable mechanisms shall be properly adjusted as required for proper operation (see 4.6.11).

3.8.13 Sliding surfaces. All sliding parts and operating contact surfaces shall be free of paint and properly lubricated (see 4.6.12).

3.8.14 Bearing seals. Bearing seals shall be properly installed to prevent entrance of foreign matter into bearings, and prevent leakage of lubricants from bearings (see 4.6.13).

3.8.15 Fluid levels. Hydraulic system, transmission/steer unit system, and engine crankcase fluid levels shall be at proper levels as indicated on the respective dipsticks (see 4.6.14).

3.8.16 Electrical system.

3.8.16.1 Alternator. Alternator voltage shall be set to the limits specified on the Engine Assembly drawing (see 4.6.15.1).

3.8.16.2 Lights. The internal and external lights as specified on applicable drawings shall operate properly, in accordance with switch settings throughout all vehicle operating conditions (see 4.6.15.2).

3.8.16.2.1 Warning lights and buzzers. The appropriate warning light on the instrument panel shall light for the following(see 4.6.15.2.1):

Low engine oil pressure.
Low transmission oil pressure.
Low air pressure.
When in reverse gear while in "unsprung" mode.
When parking brake is on.
When headlights are on high-beam.
When bilge pump is on.

The warning buzzer shall sound under the following conditions:

Low transmission oil pressure.
When in reverse gear while in "unsprung" mode.
When transmission is in gear and parking brake is set.

3.8.16.3 Electrical connector for launcher grenade, smoke, M259. The eletrical cable for plugging into the grenade launcher shall be installed on the M9 ACE and the connector shall be supplied with

electrical power when in the firing mode. Holes for mounting the launcher shall be in the hull in accordance with the applicable drawing (see 4.6.15.3).

3.8.16.4 Radio harness. The radio harness for the AN/VRC-87 radio shall be installed on the M9 ACE and shall be functional (see 4.6.15.4).

3.8.16.5 Gas particulate filter unit. The unit asssembly components shall be installed in the M9 ACE in accordance with drawings and the fan and air heater shall operate properly according to the switch setting (see 4.6.15.5).

3.8.16.6 NATO connector for slave power. The connector for slave power shall at all times have an open circuit terminal voltage equal to the vehicle source power supply voltage and shall meet the requirements of MIL-C-62122 (see 4.6.15.6).

3.8.16.7 Connector for trailer electrical cable. The connector for the trailer electrical cable shall be installed on the M9 ACE and shall be supplied with electrical power (see 4.6.15.7).

3.8.16.8 Ventilation fan. The driver's ventilation fan assembly shall be installed on the M9 ACE in accordance with drawing requirements and shall be functional (see 4.6.15.8).

3.8.16.9 Interface resistor box. The interface resistor box shall be installed on the M9 ACE, shall be supplied with electrical power, and shall be functional (see 4.6.15.9).

3.8.16.10 Simplified Test Equipment/Internal Combustion Engine (STE/ICE-R). The vehicle shall be compatible with STE/ICE-R Test Set 19207-12256266 (see 4.6.15.10).

3.8.17 Fire extinguisher. Fire extinguishers shall be installed and fully charged in accordance with drawing requirements (see 4.6.16).

3.8.18 Ejector adjustment. The ejector shall be adjusted to provide smooth travel on sides and bottom of vehicle bowl (see 4.6.17).

3.8.19 Relief valves. The hydraulic system relief valves on the directional control valve assembly shall be adjusted to the pressure settings specified on the drawing prior to installation on the vehicle and as required after installation to maintain the settings (see 4.6.18).

3.8.20 Variable displacement pump. The hydraulic variable displacement pump shall be adjusted to the pressure setting specified on the hydraulic assembly drawing, after installation in vehicle (see 4.6.19).

3.8.21 Accumulators. All accumulators shall be charged with nitrogen to the pressures specified on the assembly drawings. The accumulators shall function without gas or oil leakage (see 4.6.20).

3.8.22 Hydraulic system. The hydraulic system shall be assembled, installed, serviced with the specified fluid, and adjusted in accordance with the drawings to assure acceptable performance of each hydraulic function. The hydraulic circuitry shall transmit hydraulic power, in accordance with the drawings, to all hydraulic functions and withstand the relief valve pressure setting of each circuit without evidence of permanent deformation or external leakage except a weep or seep (see 6.3.3) is permitted at seals and joints. The hydraulic system shall operate with smooth positive control of all functions (winch, bilge pump, apron, ejector, and suspension) (see 4.6.21).

3.8.23 Hydraulic system cleanliness. Prior to their installation into the M9 ACE, the interior surfaces of all hydraulic components shall be flushed throughout to remove all contaminants, particles, and foreign elements. Openings of the hydraulic components shall be immediately capped to prevent the entry of contaminants and shall remain capped until installation. Prior to initial start-up, the assembled hydraulic system, less pumps and reservoirs, shall be flushed throughout utilizing an auxiliary pump, reservoir, and filtration arrangement. After flushing and after installation of the remaining components the contamination level of the hydraulic oil shall be checked and must meet the cleanliness requirements of ISO code 19/16 as defined in SAE J1165. The contamination level of the hydraulic oil shall meet the above requirements at the termination of flushing and at any time thereafter. See 4.6.22.1 for calibration of the particle counter (see 4.6.22).

3.8.24 Hoses and tubing. All hoses and tubing shall be installed without twists, kinks, or collapsed sections. Tubing bends shall be in accordance with the drawing requirements. Tubing shall not be reformed. Tubing assemblies shall be correctly formed to prevent prestress at installation due to misalignment. Tube flares shall be as specified on the drawings and shall not show evidence of cracks, tool or pit marks, or other defects. In conjunction, with the basic routing and clamping shown on the installation drawings, hoses shall be positioned in such a manner as to avoid interference and chaffing against other hoses, components, and structures (see 4.6.23).

3.8.25 Engine adjustments. The engine assembly, controls, and instruments shall be assembled, installed, and adjusted to assure specified performance. The engine shall operate in accordance with the engine manufacturer's recommendation and without leakage of fuel or coolant. There shall be no leakage of engine oil except weeps and seeps are permitted. The belt tension of all belt-driven components shall be properly adjusted (see 4.6.24).

3.8.25.1 Engine idle speed. The engine shall be adjusted to maintain

an idle speed of 800 ± 50 RPM at normal engine operating temperatures and stabilized no-load (sprung mode) vehicle conditions (see 4.6.24.1).

3.8.26 Lifting and tiedown attachments. Lifting and tiedown attachments shall be provided in accordance with MIL-STD-209 and the drawings (see 4.6.25).

3.8.27 Safety. The vehicle shall comply with personnel safety devices according to the drawings (see 4.6.26).

3.8.27.1 Fuel, oil, and pneumatic lines and electrical conductors. Fuel, oil, and pneumatic lines shall not be routed through battery enclosures or other areas subject to electrical sparking or corrosion. All lines and electrical conductors shall be routed so that they cannot be stepped upon or utilized for hand holds and shall be protected at all points of passage through partitions (see 4.6.26.1).

3.8.27.2 Electrical conductors. Unprotected electrical conductors or components shall not be mounted under fuel tanks (see 4.6.26.2).

3.8.27.3 Driver's seat. The seat shall be adjustable in height, horizontal and back positions in accordance with applicable drawings (nominal height adjustment 13.42 inches [341 millimeters(mm)], horizontal position 4.0 inches (102 mm) and back tilt +5 center . position of top) (see 4.6.27).

3.8.27.4 Driver's hatch cover (see 4.6.28).

a. With the hatch cover closed, the force required to unlatch the latch shall not exceed 30 pounds (13.6 kg).

b. With the hatch cover closed and unlatched, the force required to fully open the hatch cover shall not exceed 50 pounds (22.7 kg).

c. With the hatch cover open, the force required to place the cover in position to latch it open shall not exceed 50 pounds (22.7 kg).

d. With the hatch cover open the force required to unlatch lock from locked position shall not exceed 30 pounds (13.6 kg).

e. The force required to pull the open hatch cover into the closed position shall not exceed 50 pounds (22.7 kg).

f. With the hatch pulled into the closed position, the force required to latch the hatch shall not exceed 30 pounds (13.6 kg).

3.8.27.5 Communications. External communications shall be via an

AN/VRC-87 Radio Set which shall operate through a CVC helmet headset-microphone (see 4.6.29).

3.8.27.6 Heater. Heat shall be supplied by a hot water heater with a two speed fan control and on-off water control (see 4.6.30).

3.8.27.7 Towing. The M9 ACE shall be capable of being towed and of towing standard military trailers (see 4.6.31).

3.9 Performance. The M9 ACE shall perform all tests as specified herein without malfunction, damage, or permanent deformation. There shall be no leakage of lubricants except weeps and seeps are permitted at seals and joints. During operation and immediately after close down, a drip not to exceed one drop in five minutes is permitted from the outer seal of the final drive's sprocket shaft.

3.9.1 Drawbar pull. The M9 ACE shall exert a minimum drawbar pull of 31,000 pounds (138,000 Newtons) when loaded with 18,000 pounds (8160 kg) of ballast or load and traveling 1.5 miles per hour (mph) (2.4 km/h) on normal, dry, level terrain (see 4.6.32 and 6.3.1).

3.9.2 Cruising range. The M9 ACE on one tank of fuel and unballasted shall have a cruising range of 200 miles [322 kilometers (km)] of travel on secondary roads over rolling terrain (see 4.6.33).

3.9.3 Winch. The winch shall be capable of 25,000 $\pm$ 1,500 pounds (111,000 $\pm$ 6,700 N) line pull with bare drum and shall have a minimum spooling rate of 10 feet per min (ft/min)[3.0 meters per minute (m/min)] at 2,200 revolutions per minute (rpm) engine speed (see 4.6.34).

3.9.4 Land speed. The M9 ACE shall be capable of 30 mph (48 km/h) minimum top speed on normal, dry, level paved roads when unballasted (see 4.6.35 and 6.3.1).

3.9.5 Braking. When service brakes are applied while traveling on dry level paved roads at the speeds and loads specified, the M9 ACE shall come to a safe smooth stop within the distances specified below (see 4.6.36):

a. 28 mph (45 km/h) with no load; 65 feet (19.8 m) maximum.

b. 20 mph (32 km/h) with a 4000 pound (1814 kg) load; 35 feet (10.7 m) maximum.

c. 15 mph (24 km/h) with an 18,000 pound (8160) load; 25 feet (7.6 m) maximum.

3.9.6 Bilge pump. The bilge pump shall be in accordance with the drawings, and shall be capable of exhausting water from the hull at a minimum rate of 200 gallons per minute (gpm) [757 Liters per minute (L/min)] during swimming operation, with and without winch operating (see 4.6.37).

3.9.7 Seals.

3.9.7.1 Hull seals. Access cover and door seals shall be properly installed to prevent entrance of water into the hull during swimming operations. Apron/hull seals when installed, shall allow less than 65 gpm (246 L/min) of water to enter the hull while swimming (see 4.6.38.1).

3.9.7.2 Hatch seals. Hatch seals shall prevent leakage of water into the driver's compartment (see 4.6.38.2).

3.9.7.3 Final drive seals. Water contamination of the final drive lubricant is permitted as a result of fording and/or swimming operations (see 4.6.38.3).

3.9.8 Water speed and freeboard. The M9 ACE shall be able to propel and maneuver itself in still water at a speed of 3 mph (4.8 km/h), and shall float with a minimum of 11 inches (280 mm) freeboard (dynamic), when prepared for swimming in accordance with instructions contained in the Operator's Manual TM5-2350-262-10 (see 4.6.39).

3.9.9 Side slopes. The M9 ACE shall be able to traverse in both the left and right direction, slopes (on firm ground) of 20 percent when unballasted, and 40 percent when ballasted with 18,000 pounds (8160 kg) without stalling or damage to the vehicle and components (see 4.6.40).

3.9.10 Climbing. The M9 ACE shall be able to safely climb the following grades in forward and reverse gear, without stalling or damage to powerplant and powertrain (see 4.6.41):

a. 20 percent when unballasted.

b. 30 percent when ballasted with 4,000 pounds (1814 kg) in the bowl.

c. 60 percent when loaded with 18,000 pounds (8160 kg) in the bowl.

3.9.11 Holding. When ballasted with 18,000 pounds (8160 kg) and standing on a 60 percent grade the vehicle shall perform the following (see 4.6.42):

a. With service brakes applied, the M9 ACE shall be held stationary when headed up and headed down grade.

b. With parking brake engaged and all other holding devices not engaged, the M9 ACE shall be held stationary when headed up and down grade.

3.9.12 Engine starting on grades and slopes. Engine starting time shall not exceed 1 minute with the M9 ACE headed up and down a 60 percent grade, after engine had been shut off for 4 + 2 minutes

following 4 ± 2 minutes of no load running at 750 to 1000 rpm. This requirement also applies to 40 percent left and right side slopes (see 4.6.43).

3.9.13 Suspension sprung. When the engine is restarted after being shut-off for 10 minutes, and sprung-unsprung control is in "sprung" position, the vehicle shall smoothly raise to the normal level position within 30 seconds with engine at no more than 1,500 rpm (see 4.6.44).

3.9.14 Suspension unsprung. The rear of the vehicle shall remain at its normal sprung height when operator fully lowers the front of the vehicle (see 4.6.45).

3.9.15 Bump stops. The forward bump stops shall immediately extend or retract when sprung-unsprung control is shifted to "sprung" or "unsprung" positions, respectively (see 4.6.46).

3.9.16 Powertrain. The powertrain and associated controls shall function throughout all gear, steering and speed ranges without binding of linkages, grabbing, chattering, or slippage, and with correct steering responses (see 4.6.47). The joints and seals may weep or seep but no drips are allowed except the outer seal of the final drive's sprocket shaft may drip not to exceed one drop in five minutes during operation and immediately after shutdown (see 4.6.47).

3.9.17 Electromagnetic interference (EMI).

3.9.17.1 Electromagnetic interference (EMI). The vehicle shall meet the requirements of MIL-STD-461, Notice 4(EL), Methods RE05 and CE07 (see 4.6.48.1).

3.9.17.2 Bonds and grounds. Bonding of grounds for equipment current paths, electromagnetic interference, electromagnetic pulse and shock hazards shall be so installed that expansion, contraction or movement incident to normal service use and maintenance will not break or loosen the connection. Surface preparation for bonds and grounds shall be accomplished by removing all anodic film, grease, paint, lacquer or other high resistance coatings from the immediate areas of contact. The equipment finish shall be restored to its original condition in accordance with MIL-F-14072. The DC resistance across each electrical bond junction shall not exceed 2.5 milliohms when measured with interfacing harnesses disconnected (see 4.6.48.2).

3.9.18 Noise. The M9 ACE shall meet noise limits in accordance with MIL-STD-1474, Category A when measured at the unprotected driver's ear. A caution plate, in accordance with drawing 12297759, shall be located in the operator's comparment stating the following: "CAUTION: HEARING PROTECTION REQUIRED, wear both headphones and earplugs", in conformance to figure 4 of MIL-STD-1474, MIL-STD-1473 and MIL-P-514, as applicable (see 4.6.49).

3.9.19 Enviromental. The M9 ACE shall be capable of operation and storage under the extreme climatic conditions described in table I. The vehicle shall be capable of operation under Basic Cold(A2), -25°F (-32°C), conditions without a cold weather kit. When prepared for storage, the complete vehicle shall withstand temperature extremes of 160°F to -50°F (71°C to -46°C) without deterioration of any component that may cause failure of the system and/or subsystem (see 4.6.50).

3.9.19.1 Cooling system. The cooling system shall be capable of maintaining engine, transmission, steer unit and hydraulic system operating temperatures within the limits of table II while operating continuously at maximum loads at 0.75 tractive effort to weight (TE/WT) ratio and all road speeds from maximum drawbar pull to maximum rated speed (see 4.6.50.1). This criteria shall be conformed to under hot-dry (A1) cycle conditions as described in table I. Extrapolation for high ambient temperatures may be made by assuming a one degree rise in fluid temperature for each one degree rise in ambient temperature. The cooling system shall be capable of operation after a drawdown of 15% of engine coolant. The cooling system shall be capable of retention and recovery of 6% coolant overflow or have 6% expansion reserve capacity. The cooling system shall be capable of continuous deaeration with 0.1 cubic feet per minute (cfm) (0.003 m3/min) of air per engine cylinder with no degradation of cooling capacity. The cooling system shall fill completely with an automatic deaeration feature to preclude air captivation at a coolant fill rate up to the maximum fill rate. Fluid temperatures shall not exceed the values listed in table II with water as the coolant. The intermittent temperatures shall not exceed 15 minutes duration (see 4.6.50).

3.9.20 Vehicle break-in. Each vehicle shall be started, and operated for 50 miles (80 km) and serviced by the contractor as a final processing of the vehicle for acceptance. The vehicle shall be completely assembled and all adjustments completed. All controls and attachments shall be manipulated and the vehicle shall meet the requirements of 3.8.5, 3.8.6, 3.8.7, 3.8.9 and 3.8.25 (see 4.6.51).

3.9.20.1 General. The vehicle break-in described below when specified by table IV shall be performed prior to any other road testing. In cases where a particular test procedure is actually followed during the specified course of the break-in, that performance test can be considered as having been completed.

3.9.20.2 Preparation. Prior to vehicle break-in, the M9 ACE shall be completely assembled, all initial adjustments made, and all lubrication performed.

TABLE I Summary of temperature, solar radiation and relative humidity cycles.

Operational Conditions					Storage and Transit Conditions	
Climatic Design Type	Daily Cycle (QSTAG 360 Equivalents)[1]	Ambient Air Temperature °F (°C)	Solar Radiation BPH (W/m^2)	Ambient Relative Humidity %	Induced Air Temperature °F (°C)	Induced relative Humidity
Hot	Hot-Dry (A1)	90 to 120 (32 to 49)	0 to 355 (0 to 1120)	3 to 8	91 to 160 (33 to 71)	1 to 7
	Hot-Humid (B3)	88 to 105 (31 to 41)	0 to 243 (0 to 1080)	59 to 88	91 to 160 (33 to 71)	14 to 80
Basic	Constant High Humidity (B1)	Nearly Constant 75 (24)	Negligible	95 to 100	Nearly Constant 80 (27)	95 to 100
	Variable High Humidity (B2)	78 to 95 (26 to 35)	0 to 37 (0 to 970)	74 to 100	86 to 145 (30 to 63)	19 to 75
	Basic Hot (A2)	86 to 110 (30 to 43)	0 to 355 (0 to 1120)	14 to 44	86 to 145 (30 to 63)	5 to 44
	Basic Cold (C1)	-5 to -25 (-21 to -32)	Negligible	Tending Toward Saturation	-13 to -28 (-25 to -33)	Tending Toward Saturation
	COLD (C2)	-35 to -51 (-37 to -46)	Negligible	Tending Toward Saturation	-35 to -51 (-37 to -46)	Tending Toward Saturation

[1] Designations in parenthesis refer to corresponding climatic categories in Quadripartite Standardization Agreement 360 Climatic Environmental Conditions Affecting the design of military Materials.

TABLE II. Maximum fluid temperatures.

Fluid	Intermittent	Continuous
Engine Coolant (Top Tank)	230°F (110°C)	220°F (104°C)
Engine Oil Sump	275°F (135°C)	275°F (135°C)
Transmission Oil	280°F (138°C)	250°F (121°C)
Hydraulic System	250°F (121°C)	250°F (121°C)
Steer Unit	325°F (163°C)	300°F (149°C)

Intermittent temperatures not to exceed 15 minutes duration.

3.9.20.3 Powertrain. The contractor shall comply with the procedures and precautions specified in the technical manuals for engine break-in and engine/powertrain operations. These procedures and precautions include (but are not limited to) the following:

3.9.20.3.1 General.

a. Long periods of engine idling shall be avoided.

b. Throttle and engine loads to be maintained at 50 percent to 75 percent of maximum as much as possible.

c. Application of maximum horsepower shall not exceed 5 minute periods.

d. Fluid levels shall be checked prior to and after break-in.

3.9.20.3.2 Engine start-up. The following conditions shall occur within 5-10 seconds after each engine start-up, or engine must be shut down and corrective action taken:

a. Low transmission pressure warning light and low air pressure warning light shall go out.

b. Engine oil pressure shall rise to at least 5 pounds per square inch (psi) [34.5 kilopascals (kPa)]. The low pressure light shall go out.

3.9.20.4 Engine warm-up. After start-up, engine shall be operated between 750 and 1000 rpm for 5 minutes before operation.

3.9.20.5 Engine speed. Engine speed shall not exceed 2,150 rpm until coolant has reached 160°F (71°C).

3.9.20.6 Variations from normal pressures and temperatures. If "normal" pressures or temperatures vary from the values specified below, break-in shall be suspended until corrections are made, or until continuation is approved by the Government:

a. Normal coolant temperatures -- 160°F to 200°F (71°C to 93°C).

b. Normal transmission oil temperature -- 200°F (93°C) maximum.

c. Normal engine oil pressure shall not exceed 85 psi (586 Kpa).

d. Normal hydraulic oil temperature -- 225°F (107°C) maximum.

3.9.20.7 Engine shutdown. After reaching normal operating temperatures, the engine shall be idled for 3-5 minutes to allow for proper cooling prior to engine shutdown.

3.9.20.8 Inspection. During the vehicle break-in, the vehicle shall be inspected for leaks, loose nuts and bolts, evidence of damage or evidence of malfunction, etc. Any problems or faults found during this inpsection shall be corrected.

3.9.20.9 Operations. The vehicle shall be operated in the sequence specified below.

3.9.20.9.1 Actuator exercise.

a. Move the selector to the "unsprung" mode then lower front of vehicle to the ground.

b. Fully raise right side and then lower.

c. Fully raise left side and then lower.

d. Fully raise and lower both sides simultaneously.

e. Move the selector to the "sprung" mode and allow the vehicle to level from front to rear.

f. Move the selector to the unsprung mode and raise both sides simultaneously.

g. Move the selector to the sprung mode and allow the vehicle to level from front to rear.

h. Move the apron control lever to the up position and raise the apron to full height.

i. Turn the ejector stop to unlock the ejector lever. Move the ejector control lever to the forward position and fully extend the ejector.

j. Move the ejector control lever to the back position and fully retract the ejector. The ejector stop must lock.

k. Move the apron control lever to down and fully lower the apron.

3.9.20.9.2 Break-in run and distance. The break-in run shall be conducted as specified in table III on a smooth hard surfaced road (or track) except a section of the road shall be as shown in figure 1. The vehicle shall be driven over the undulating portion of the road one time in each direction during divisions b and c (see table III). Speed over the undulating section shall be 5 to 10 mph (8 to 16 km/h) during the division "b" run and 10 to 15 mph (16 to 24 km/h) during the division "c" run. One-half of the miles in each division shall be driven in opposite directions on the road (clockwise and counterclockwise oval track). During the break-in run, the vehicle shall be driven in each of the six forward gears at a speed appropriate to each gear. Prior to, during, and after the break-in run, the vehicle shall be driven in each of the two reverse gears for a minimum of 90 feet (27.4 m) each. Either during or separately from the break-in run, the vehicle must demonstrate satisfactory operation in full left steer, full right steer, and while executing both a 360 degrees left and right pivot in clutch brake operation.

TABLE III. Speeds and distances for break-in run.

Division of run	Speed mph 1/ (km/h)	Distance miles (km)	Test condition
a	0- 5 (0- 8)	1 (1.6) 1/	road (track)
b	0-10 (0-16)	5.5 (8.9) 1/	road (track)
c	10-20 (16-32)	15 (24.1)	road (track)
d	20-29 (32-47)	20 (32.2)	road (track)
e	30 minimum (48) 2/	8.5 (13.7) 2/	road (track) 2/

1/ May include distance run to and from test track.
2/ May be demonstrated on oval track, if suitable road is not available, by running full throttle in 6th gear for 17 minutes and verifying that vehicle consistently reaches 30 mph (48 km/h) on the straightaway.

3.9.20.9.3 Actuator exercise. Park the vehicle on a level plane with provision to lower the dozer blade below the track surface with a clearance. The vehicle actuator shall be operated, and must respond normally, for a minimum of three cycles in the sequence established in 3.9.20.9.1.

3.9.20.10 Conditions after vehicle break-in. After completion of the break-in run, all systems shall function properly and there shall be no evidence of damaged components. There shall be no leakage except weeps and seeps are permitted at seals and joints and a drip not to exceed one drop in five minutes is permitted at the outer seal of the final drive's sprocket shaft during operation adn immediately after shut down.

3.9.20.11 Filter systems. At conclusion of vehicle break-in, all filters shall be serviced (elements cleaned or replaced) as specified on lubricant chart.

3.9.21 Reliability. The M9 ACE shall have a minimum acceptable value (MAV) of reliability of an 80% probability of completing ten hour mission without a mission failure when operated to the mission profiles of 3.9.21.1.1. This equates to a MAV of Mean-Time-Between-Failures (MTBF) of 45 hours. A hardware Failure Definition and Scoring Criteria (FD/SC) will be used to assess M9 ACE R & M (see 4.6.52, and 6.2).

3.9.21.1 M9 missions. The M9 ACE shall be capable of completing mobility, countermobility, survivability and general engineering missions as defined below (see 4.6.52.1):

3.9.21.1.1 Mission profiles. The mode sequencing and duration of the two missions listed below is representative of the support the M9 ACE shall be capable of providing in a combined arms team scenario (see 4.6.52.1.1):

Mission profiles*

Mission A (74)**		Mission B (4)**	
Mode	Minutes	Mode	Minutes
Travel	35	Travel	30
Doze (heavy)	120	Doze	60
Travel	30	Swim	180
Scrape	25	Doze	30
Haul	38	Travel	30
Scrape	24	Winch	45
Haul	30	Travel	30
Grade	34	Winch	45
Tow	24	Travel	30
Doze (Grub)	60	Idle	7.5
Travel	35		
Idle	5		
Total	460 min/ 7 2/3 hrs	Total	487 1/2 min/ 8 1/8 hrs

* The time listed for each mission plus preoperations check, post operations check and scheduled breaks/meals equates to one 10 hour mission (see 4.6.52.1.1, Mission A and Mission B).

** Number of times mission is conducted.

3.9.21.1.2 Performance tasks. During the execution of the mission profiles, the M9 ACE shall demonstrate the capability of performing the operations discussed in 3.9.21.1.2.1 through 3.9.21.1.2.6.

3.9.21.1.2.1 Dozing. The following tasks are representatives of the dozing capability that the M9 ACE shall possess:

-Constructing a U-shaped anti-tank ditch at least 10 meters long, 3.3 meters wide and 1.5 meters deep.

-Constructing a weapons systems firing position 7 meters long, 4.2 meters wide and 1.8 meters deep.
-Constructing an artillery firing position 21 meters long, 5.4 meters wide and 1.5 meters deep (21 meters length includes 9.5 meters or 9 degrees slope into the emplacement).
-Clearing/leveling sites for helicopters, petroleum tanks, communication centers, etc.
-Clearing and stripping fields (does not include tree removal).
-Excavating access and egress approaches to and from steep (two meters above river line) river beds.

3.9.21.1.2.2 Scraping, self-loading, hauling and self-unloading. The M9 ACE shall be capable of scraping earth, self-loading the bowl [8 cubic yards (yd) (6.1 cubic meters (m))], hauling the earth for short and long distances and unloading the earth (see 4.6.52.1.1). During these activities, the M9 ACE shall be capable of using the load to construct or repair roads and neutralize craters/ditches by filling with the transported earth (see 4.6.52.1.1).

3.9.21.1.2.3 Rough grading. After initial dozing or excavating, the M9 ACE shall be capable of rapid rough grading so that after one pass, there are no deviations from a plane surface greater than plus or minus six inches (152 mm) for a distance of 10 feet (3m) longitudinally or laterally measured from any point on the graded surface.

3.9.21.1.2.4 Winching an immobilized vehicle. The M9 ACE shall be capable of recovering an immobilized vehicle weighing 20,000 pounds (9072 kg). Length of recovery demonstrated shall be 95 feet (29 m) minimum (see 4.6.52.1.1, mission B, W1).

3.9.21.1.2.5 Swimming. During performing the mission profiles, the M9 ACE shall meet the swimming requirements of 3.9.8.

3.9.21.1.2.6 Neutralizing obstacles, constructing and repairing routes. In conjunction with the activities of 3.9.21.1.2.2, the M9 ACE shall be capable of filling craters and ditches and compacting the fill.

3.9.21.2 Maintainability. The M9 ACE shall have a maintenance ratio for scheduled and unscheduled maintenance (exclusive of daily operator services and inspections, and manhours for off-system repairs of replaced components) not to exceed an average of 0.45 maintenance manhours per hour of operation.

3.9.21.3 Maintainability, remove/replace. The M9 ACE shall be designed so that the maximum time to repair or replace components is 8 manhours or 4 clockhours at Unit Maintenance and 24 manhours or 12 clockhours at Intermediate Maintenance 95% of the time (MaxTTR 95%). The maximum time for diagnosing failures shall be 1 hour at Unit Maintenance and 2 hours at Intermediate Maintenance 95% of the time.

3.10 Identification and markings. The vehicle shall be identified in accordance with MIL-STD-130 and marked in accordance with MIL-STD-642 on plates furnished and mounted by the contractor (see 4.7).

3.10.1 Instruction plates. The vehicle shall be equipped with instruction warning plates, in compliance with applicable drawings (see 4.7.1).

3.10.2 Plate for transportation data. The first produced M9 ACE shall be weighed, measured, and the center of gravity located to provide the data required for the transportation data plate (see 4.7.2).

3.11 Workmanship. The M9 ACE shall be assembled in accordance with the requirements specified on the drawings. Components of the various systems and their controls shall be installed and adjusted in accordance with the drawings to assure proper operation. No damage shall be imparted to any component during assembly, installation, or adjustment. All parts, components, and assemblies shall be clean and free from sand, dirt, pits, scale, flux, and other harmful, extraneous material. External surfaces shall be free of burrs, sharp edges, and corners except where sharp edges and corners are permitted (see 4.8).

3.12 Quality conformance inspection/tests. Quality conformance inpections and tests shall be conducted as specified in section 4 to determine conformance of vehicles to drawings and specifications.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specifiaction shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Materials and construction. To determine conformance to 3.3 through 3.8.1, inspection and material certification records shall be maintained by the contractor. Records shall be subject to review by the Government and shall include date, part, or characteristic identification, inspection results, and disposition of lot (accepted or rejected). Corrective action taken on noted defects shall be subject to approval by the Government.

4.1.3 Government verification. All quality assurance operations performed by the contractor will be subject to Government verification at random intervals. Verification will consist of: (a) surveillance of the operations to determine that practices, methods, and procedures of the written inspection plan are being properly applied and (b) Government product inspection to determine quality of product offered for acceptance. Deviation from the prescribed or agreed upon procedures, or instances of poor practices which might have an effect upon the quality of the product, will immediately be called to the attention of the contractor. Failure of the contractor to promptly correct deficiencies discovered shall be cause for suspensions of acceptance until corrective action has been made or until conformance of product to specified criteria has been demonstrated.

4.1.4 Quality assurance provisions. In the conduct of inspection, the contractor shall adhere to the Quality Assurance Provisions (QAPs) and General Quality Assurance Provisions (STA Form 458) as applicable and as required by the documents forming part of this specification.

4.2 Classification of inspection:

a. First article inspection (see 4.4).
b. Quality conformance inspections (see 4.5)
   1. (intentionally left blank).
   2. Acceptance tests (see 4.5.3.1).
   3. Control tests (see 4.5.3.2).
c. Comparison tests (see 4.5.4).

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions as specified in 4.6 of this specification.

4.3.1 Fuels, lubricants, and coolants. The contractor shall certify that the proper fuels, lubricants and coolants are used in the vehicle for operation under the conditions specified in 3.8.2.

4.3.2 Qualified products. In the event that a document referenced in the M9 ACE technical data package list (TDPL) has a Qualified Product List (QPL), the production contractor shall utilize items only from vendors specified in the applicable QPL for the manufacture of vehicles. The production contractor shall document the acquisition of all QPL items with listing of suppliers, quantity, and date of QPL in addition to purchase orders. Such QPL documentation shall be made available to the Government upon request.

4.4 First article inspection. First article inspection shall be categorized as preproduction inspection and initial production inspection. Approval of the first article sample by the Government shall not relieve the contractor of the obligation to supply vehicles that are fully representative of those inspected as a first article sample. Any changes or deviation of the production units from the first article sample shall be subject to the approval of the contracting officer.

4.4.1 Preproduction inspection. When specified (see 6.2), a preproduction vehicle(s) shall be subjected to the tests specified under "First Article" in table IV.

4.4.2 Initial production inspection. Unless otherwise specified (see 6.2), a vehicle(s) shall be randomly selected from early production vehicles produced under the production contract for initial production inspection. Initial production unit(s) shall be tested as specified under "First Article" in table IV.

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

4.4.4 Final approval and acceptance. Final approval and acceptance by the Government of the first production vehicle(s) shall be withheld until the Initial Production Test has been completed and a final determination has been made regarding conformity of the vehicle(s) to contractual/specification requirements including, but not limited to, workmanship and materials.

4.4.5 Corrective action. Corrections deemed necessary as a result of above inspection and tests shall be accomlished by the contractor at no cost to the Government. Failure of the contractor to promptly correct defects shall be cause for suspension of acceptance of production vehicles until corrective action has been accomplished.

4.5 Quality conformance inspection (QCI). Unless otherwise specified (see 6.2), QCI shall be performed on each vehicle (100% inspection) and in the following sequence utilizing an approved Final Inspection Record (FIR). Noncompliance with any of the specified requirements in sections 3 and 5 shall be cause for rejection of the vehicle.

a. Examination for characteristics as specified in the FIR.
b. An (X)-mile road test (see 4.6.51).
c. Tests as specified in table IV.

4.5.1 Sampling. Each vehicle shall be submitted for quality conformance examination.

TABLE IV. Classification of inspections.

	Requirement	Method	First Article	QCI		Comparison
				Acceptance	Control	
Performance						
Drawbar pull	3.9.1	4.6.32	X			X
Cruising range	3.9.2	4.6.33	X			X
Winch	3.9.3	4.6.34	X		X	X
Land speed	3.9.4	4.6.35	X	X		X
Braking	3.9.5	4.6.36	X	X		X
Bilge pump	3.9.6	4.6.37	X		X	X
Hull seals	3.9.7.1	4.6.38.1	X		X	X
Hatch seals	3.9.7.2	4.6.38.2	X	X		X
Final drive seals	3.9.7.3	4.6.38.3	X		X	X
Water speed and freeboard	3.9.8	4.6.39	X		X	X
Side slopes	3.9.9	4.6.40	X	X		X
Climbing	3.9.10	4.6.41	X	X		X
Holding	3.9.11	4.6.42	X	X		X
Engine starting on grades and slopes	3.9.12	4.6.43	X	X		X
Suspension sprung	3.9.13	4.6.44	X	X		X
Suspension unsprung	3.9.14	4.6.45	X	X		X
Bump stops	3.9.15	4.6.46	X	X		X
Powertrain	3.9.16	4.6.47	X	X		X
Electromagnetic Interference	3.9.17	4.6.48	X			X
Noise	3.9.18	4.6.49	X			X
Environmental	3.9.19	4.6.50	X			X
Cooling	3.9.19.1	4.6.50.1	X			X
Vehicle break-in	3.9.20	4.6.51	X	X		X
Reliability	3.9.21	4.6.52	X			X
Missions	3.9.21.1	4.6.52.1	X			X

4.5.2 (Intentionally left blank).

4.5.3 Quality conformance tests.

4.5.3.1 Acceptance tests (100 percent). Each vehicle shall be subjected to the tests specified in table IV.

4.5.3.2 Control tests. Control tests shall be conducted on one vehicle from each 20 units consecutively produced, except that not more than two tests shall be performed in a one month period, nor less than one test in a 30 calendar day period. The vehicles shall be subjected to the tests specified in table IV.

4.5.4 Comparison tests. The Government at its option may randomly select vehicles at anytime during the production contract and subject these vehicles to all applicable tests specified in table IV.

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

4.5.6 Correction of defects. Correction of defects found as a result of the foregoing inspections shall be accomplished by the contractor at no cost to the Government. Failure of the contractor to correct defects promptly shall be cause for suspension of acceptanc of vehicles until corrective action has been accomplished and approved by the Government.

4.6 Methods of examination and test. The examinations and tests depicted in paragrah 4.6 (inclusive) are the minimum required to determine conformance to the requirements delineated in section 3 of this specification. Additional examinations and tests by the contractor may be required to determine conformance to specification requirements. The Government reserves the authority to conduct the inspections/tests depicted in paragraph 4.6 (inclusive) and additional inspections/tests at the discretion of the Government to determine conformance of end items or components to specification requirements. Unless otherwise specified, all tests specified herein shall be conducted at the contractor's facility.

4.6.1 Basic issue items. To determine conformance to 3.6, the vehicle shall be checked to insure the presence of all Basic Issue Items (BII) as stipulated on all applicable drawings.

4.6.2 Installation and stowage.

4.6.2.1 Installation. To determine conformance to 3.8.3, all M9 ACE vehicles shall be visually inspected to assure that mounting surfaces, brackets and 24 volt electrical connectors comply with the engineering drawings for the item specified (see 3.8.3.1).

4.6.2.2 Stowage. All stowed equipment shall be installed on a vehicle (selected by the Government) in the spaces provided and visually inspected to verify that each piece of stowed equipment fits in the space provided (see 3.8.3.2).

4.6.3 Treatment and painting. To determine conformance to 3.8.4, components shall be examined for proper cleaning, treatment and painting.

4.6.4 Engine air intake system. To determine conformance to 3.8.5, visually inspect the air induction system for leaks or loose connections.

4.6.5 Exhaust system. To determine conformance to 3.8.6, visually inspect the manifolds, muffler, and exhaust pipe for evidence of exhaust leakage during operations.

4.6.6 Fuel system. To determine conformance to 3.8.7, visually inspect to verify that the fuel system supplies fuel to and from the engine without leakage.

4.6.7 Valves. To determine conformance to 3.8.8, functionally operate the fuel drain valve, air bleed valve, and the trailer brake valves prior to any road testing.

4.6.8 Cooling system. To determine conformance to 3.8.9, visually inspect the cooling system for twists, kinks, or collapsed sections.

4.6.9 Welds. To determine conformance to 3.8.10, verify that weld types, and quality of soundness are in accordance with weld requirements and specifications specified on the engineering drawing.

4.6.10 Fasteners. To determine conformance to 3.8.11, verify that specific torque values are as specified on drawings and that lock wires and tabs and similiar locking devices are properly installed.

4.6.11 Adjustable mechanisms. To determine conformance to 3.8.12, all adjustable mechanisms shall be inspected to assure that proper adjustments are as required for proper operation.

4.6.12 Sliding surfaces. To determine conformance to 3.8.13, visually inspect to verify that all sliding and operating surfaces are free of paint.

4.6.13 Bearing seals. To determine conformance to 3.8.14, visually inspect to verify that bearing seals have no leakage of lubricants from bearings except weeps and seeps are permitted and a drip not to exceed one drop in five minutes at the outer seal of the final drive's sprocket shaft during operation and immediately after shutdown.

4.6.14 Fluid levels. To determine conformance to 3.8.15, visually verify that fluid levels are at the proper level as indicated on the respective dipsticks.

4.6.15 Electrical system.

4.6.15.1 Alternator. To determine conformance to 3.8.16.1, verify by measurement the alternator output voltage as specified on the Engine Assembly drawing for all electrical load conditions of vehicle operation.

4.6.15.2 Lights. To determine ocnformance to 3.8.16.2, all lights shall be operated prior to and after the 50-mile (80 km) vehicle break-in and visually inspected to verify that they operate in accordance with the switch setting.

4.6.15.2.1 Warning lights and buzzer. To determine conformance to 3.8.16.2.1, verify that lights and buzzer function as specified.

4.6.15.3 Electrical connectors for launcher grenade, smoke M259. To determine conformance to 3.8.16.3, the vehicle grenade launcher cable shall be checked for proper operation and installed in accordance with applicable drawings.

4.6.15.4 Radio harness. To determine conformance to 3.8.16.4, radio electrical harnesses shall be checked for proper function in the vehicle.

4.6.15.5 Gas particulate filter unit. To determine conformance to 3.8.16.5, gas particulate filter unit shall be checked for proper function in the vehicle.

4.6.15.6 NATO connector for slave power. To determine conformance to 3.8.16.6, the vehicle slave receptacle shall be checked for compatibility with the specified slave cable and to verify the open terminal voltage at the vehicle slave receptacle.

4.6.15.7 Connector for trailer electrical cable. To determine conformance to 3.8.16.7, the vehicle trailer electrical cable shall be checked for proper function in the vehicle.

4.6.15.8 Ventilation fan. To determine conformance to 3.8.16.8, the driver's ventilation fan assembly shall be checked for proper operation and air flow.

4.6.15.9 Interface resistor box (STE/ICE-R). Installation of the interface resistor box and STE/ICE circuitry shall be in accordance with drawings and a status check conducted using a DCA tester (see 3.8.16.9).

4.6.15.10 STE/ICE-R. To determine conformance to 3.8.16.10, compatibility of the vehicle with the specified equipment shall be demonstrated and performance verification tests shall be performed. Function and proper electrical and mechanical interface of STE/ICE-R with vehicle shall be verified.

4.6.16 Fire extinguishers. To determine conformance to 3.8.17, the portable fire extinguisher and engine compartment extinguisher system shall be checked for charge and readied for use prior to any vehicle operation.

4.6.17 Ejector adjustment. To determine conformance to 3.8.18, verify by operating and visually inspecting that the ejector provides smooth travel and is adjusted to allow the passage of the minimum amount of soil past the ejector.

4.6.18 Relief valves. To determine conformance to 3.8.19, verify that the hydraulic system relief valves are adjusted to pressure settings specified on the directional control valve assembly drawing.

4.6.19 Variable displacement pump. To determine conformance to 3.8.20, verify the adjustment of the pump pressure setting is as specified on the hydraulic assembly drawing.

4.6.20 Accumulators. To determine conformance to 3.8.21, verify by pressure measurement and visual examination that all accumulators are charged with nitrogen and function without gas or oil leakage.

4.6.21 Hydraulic system. To determine conformance with 3.8.22, the hydraulic system shall be examined, prior to and after vehicle break-in, to assure proper installation, leakage, location of hydraulic lines, proper relief valve pressure setting and smooth positive operation for all vehicle functions.

4.6.22 Hydraulic system cleanliness. To determine conformance to 3.8.23 prior to and after vehicle break-in, the hydraulic system cleanliness requirements shall be verified. The hydraulic system shall be tested in accordance with the hydraulic system cleanliness test specified herein during which the requirements of 3.8.22, 3.8.23, 3.9.13, 3.9.14, and 3.9.15 shall be verified and that there is no evidence of contamination, malfunction, or binding of any cylinder. There shall be no leakage except weeps and seeps are permitted are permitted at seals and joints and a drip not to exceed one drop in five minutes at the outer seal of the final drive's sprocket shaft during operation and immediately after shut down. After the vehicle break-in, an oil analysis will be made. Nonconformance to the contamination levels in 3.8.23 shall be cause for rejection.

4.6.22.1 Hydraulic system cleanliness test. Testing sequence of operations and conditions are provided:

a. Install new filter elements in the system.

b. Run the engine at no-load governed speed pumping with the oil at a temperature of 150°F ±20°F (66°C ±11°C), through each circuit for not less than 5 minutes in one direction for each

function. Repeat the above, reversing the flow of each function. Repeat with controls in the center position. Performthe particle count as described below.

c. The procedure for determining contamination shall be as follows:

1. Determine the contamination level by particle counts. The particle counter used for evaluation of the samples shall be calibrated in accordance with ANSI B93.28. The required counts shall be the average of not less than three consecutive counts. Samples may be taken from the reservoir or upstream of the filter(s) used for clean-up.

2. Use any combination of on-the-vehicle and off-the-vehicle filtration for clean up.

4.6.23 Hoses and tubing. To determine conformance to 3.8.24, visually verify that all hoses and tubing are installed without twists, kinks, or collapsed sections.

4.6.24 Engine adjustments. To determine conformance to 3.8.25, visually verify that the engine operates without leakage of fuel, coolant, or lubricants except weep or seep of oil is permitted at seals and joints (see 6.3.3).

4.6.24.1 Engine idle speed. To determine conformance to 3.8.25.1, verify by measurement the engine idle speed to be 800 ± 50 rpm at normal engine operating temperatures and stabilized no-load vehicle conditions.

4.6.25 Lifting and tiedown attachments. To determine conformance to 3.8.26, verify that attachments are in accordance with drawing requirements and MIL-STD-209.

4.6.26 Safety. To determine conformance to 3.8.27, verify by examination that personnel safety devices are provided in accordance with drawings.

4.6.26.1 Fuel, oil, and pneumatic lines and electrical conductors. To determine conformance to 3.8.27.1, visually inspect to verify correct routing of lines and conductors.

4.6.26.2 Electrical conductors. To determine conformance to 3.8.27.2, visually inspect t verify that unprotected electrical conductors or components are not mounted below fuel tanks.

4.6.27 Driver's seat. To determine conformance to 3.8.27.3, driver's seat shall be adjusted to each position throughout its vertical and horizontal range.

4.6.28 Driver's hatch cover. To determine conformance to 3.8.27.4, driver's hatch cover shall be inspected to assure force required to unlatch, open, close and latch cover are not exceeded.

4.6.29 Communications. To determine conformance to 3.8.27.5, one combination of the specified radio set shall be installed in vehicle and checked for proper fit and function. At the conclusion of tests, the set shall be removed from the vehicle.

4.6.30 Personnel heater. To determine conformance to 3.8.27.6, the personnel heater shall be tested for motor fan operation, flow of hot water, proper installation, conditions and location of hoses.

4.6.31 Towing. To determine conformance to 3.8.27.7, verify that the M9 ACE vehicle is capable of towing standard military 1 1/2 ton trailer with maximum load.

4.6.32 Drawbar pull. To determine conformance to 3.9.1, the M9 ACE drawbar pull capacity shall be measured and recorded.

4.6.33 Cruising range. To determine conformance to 3.9.2, the vehicle shall be driven on the standard fuel course at Aberdeen Proving Ground (APG), or equivalent, at a speed of 11 miles per hour and fuel consumption and usable fuel measured. Fifty miles (80 km) may be run and the fuel usage extrapolated to 200 miles (322 km).

4.6.34 Winch. To determine conformance to 3.9.3, line pull and spooling will be measured.

4.6.35 Land speed. To determine conformance to 3.9.4, measure the vehicle speed under the test conditions specified in table III, division of run "e" with note 2.

4.6.36 Braking. To determine conformance to 3.9.5, stopping distances shall be measured.

4.6.37 Bilge pump. To determine conformance to 3.9.6, (for control test) measure the capacity of the bilge pump for the conditions as specified. For acceptance testing the pump shall demonstrate ability to pump water from the vehicle without sign of restricted flow.

4.6.38 Seals.

4.6.38.1 Hull seals. To determine conformance to 3.9.7.1 with seals installed, while swimming, measure the amount of water entering the vehicle over the specified period.

4.6.38.2 Hatch seals. To determine conformance to 3.9.7.2, the hatch shall be closed and locked and 3 gallons of water spray directed at the hatch seals over a 3 minute period. The hatch shall be checked for leakage. Leakage shall not be permitted into the vehicle.

4.6.38.3 Final drive seals. Final drive lubricant shall be completely drained and replaced following fording and swimming operations (see 3.9.7.3).

4.6.39 Water speed and freeboard. To determine conformance to 3.9.8, operate the vehicle under the conditions specified. Record the vehicle's maximum speed and dynamic freeboard.

4.6.40 Side slopes. To determine conformance to 3.9.9, the vehicle shall be tested on firm ground.

4.6.41 Climbing. To determine conformance to 3.9.10, verify that the vehicle does not stall or sustain damage to powerplant and powertrain.

4.6.42 Holding. To determine conformance to 3.9.11, verify that the vehicle operates on a 60-percent grade with no slippage.

4.6.43 Engine starting on grades and slopes. To determine conformance to 3.9.12, test will be performed on a 60-percent grade and 40 percent left and right side slopes and times recorded.

4.6.44 Suspension sprung. To determine conformance to 3.9.13, verify that the vehicle smoothly raises to the normal level position within 3 seconds with engine at no more than 1,500 rpm.

4.6.45 Suspension unsprung. To determine conformance to 3.9.14, verif that the rear of the vehicle remains at normal sprung height when operator fully lowers front of vehicle.

4.6.46 Bump stops. To determine conformance to 3.9.15, verify that the forward bump stops immediately extend or retract when sprung-unsprung control is shifted to "sprung" or "unsprung" positions, respectively.

4.6.47 Powertrain. To determine conformance to 3.9.16, observe the function of the powertrain and associated controls for correct operation during all testing.

4.6.48 Electromagnetic interference/compatibility (EMI/EMC).

4.6.48.1 System (EMI/EMC). The vehicle shall be tested in accordance with MIL-STD-462, Notice 3 (EL) (see 3.9.17.1).

4.6.48.2 Bonds and grounds. Verify visually that bonding grounds conform to the requirements of 3.9.17.2. Test the DC resistance across each electrical bond junction as specified in MIL-STD-202, method 303.

4.6.49 Noise. To determine conformance to 3.9.18, measure the noise at the operator's ear under vehicle break-in and performance conditions. Measurement is to be made with hatch open and closed, driver in both lowest and highest seat position with all ventilation and vehicle systems operating.

4.6.50 Enviromental. To determine conformance to 3.9.19, perform enviromental tests in accordance with MIL-STD-810, Methods 501 and 502, as specified herein (see 3.9.19 and 3.9.19.1).

4.6.50.1 Cooling system. To determine conformance to 3.9.19.1, verify that temperatures do not exceed values in table II.

4.6.50.2 High temperature. To determine conformance to 3.9.19 and 3.9.19.1, the completed vehicle, properly serviced and equipped, shall be subjected to the high temperatures specified herein and observed for performance heating conditions and cooling system operation. During high temperature performance checks, the engine oil temperature shall be monitored at the oil cooler inlet. Oil temperatures shall not exceed that specified in table II with the vehicle operating in an ambient air temperture of 120°F the vehicle shall meet the performance requirements. When specified (see 6.2), storage tests shall be performed at induced air temperatures of 160°F (71°C) for Hot-Dry (A1) Storage and transit conditions given in table I.

4.6.50.3 Low temperature. To determine conformance to 3.9.19, the vehicle, properly serviced and equipped, shall be subjected to ambient air temperatures of -25°F (-32°C) operational conditions for Basic Cold (C1) given in table I. When specified (see 6.2), operational and/or storage test shall be performed at -50°F (-46°C) ambient or induced air conditions for cold (C2) given in table I.

4.6.51 Vehicle break-in. Prior to performing acceptance tests, each vehicle shall be prepared as specified in 3.9.20 and given a break-in run. The break-in shall be run on smooth, level, hard-surfaced roads for the distance and speeds specified in table III and over and undulating section of road as shown in figure 1. After the break-in, each vehicle shall be inspected to determine conformance to 3.9.20.8. Either during or separately from the break-in run, verify operation in full left steer, full right steer and while performing both a 360 degree left and right pivot in clutch/brake operation.

4.6.52 Reliability and maintainability test. To determine conformance to 3.9.21, 3.9.21.2, and 3.9.21.3, reliability and maintainability indices shall be demonstrated when used and operated IAW the mission profiles of 3.9.21.1.1, and scored IAW the FD/SC.

4.6.52.1 M9 ACE missions. To determine conformance to 3.9.21.1, the M9 ACE shall demonstrate capability to perform mobility, countermobility, survivability and general engineering missions during testing specified in table IV.

4.6.52.1.1 Mission profiles. To determine conformance to 3.9.21.1.1 and 3.9.21.1.2, the following mission profiles are to be utilized:

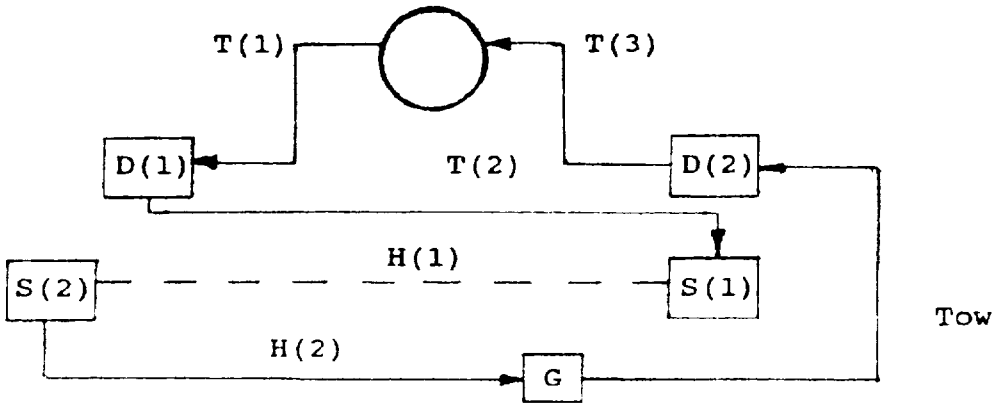
MISSION A

Mode	Task (Mission Performance Criteria)	Duration (Min)
Pre Ops CK	Before starting mission	30
Travel(1)	Move from start point to work site(s) (D1)**	35
Doze(1)	Construct a U-shape ditch (2 M9s)* An effective tank ditch is at least 3.3 meters wide and 1.5 meters deep (71m per hr).	120
	Construct weapons systems firing positions* Both primary and alternative firing positons for the M1 tank and M2 IFV. (7m x 4.2m x 1.8m) (25 min - per).	
	Construct artillery firing positions* Standard dimensions of (21m x 5.4m x 1.5m) will accomodate both 155mm and 8-inch (50 min.- per) 21m length does include 9.5m (9 degrees) slope into the emplacement.	
Travel(2)	Move from worksite(s) (D1) to Scrape Site (S1)**	30
Scrape(1)	Fill bowl and neutralize abstacles - (craters/ ditches) [8 cu yds (6.1 m3)].	25
Haul(1)	Repetitive short hauls between crater/ditch sites and ejection of partial load for fill at each of 3 sites.	38
Scrape(2)	Fill bowl to use as fill material in route construction and repair [8 cu yds (6.1 m3)]	24
Haul(2)	Long haul from S(2) site to grade site and eject	30
Grade	Enhance mobility by leveling and ditching fill material on designated route (25 meters).	34
Tow	Tow a standard 1 1/2 ton trailer (loaded) from site G to site D(2). (This could be substituted with equivalent compaction equipment.)	24
Doze(2)	Clear/level sites for helicopters/support facilities. Examples would be helipads, petroleum tanks, communication centers, etc. (dependent on terrain)	60
	Clear fields of fire through limited land clearing, grubbing, and stripping minus tree removal. (dependent on terrain)	
	Construct a U-shape tank ditch (2 M9s)(same criteria as Doze(1))	
	Construct artillery firing positions (same criteria as Doze(1))	
Travel(3)	Return from D(2) to start point **	35
Idle	Through mission	5
Post OPS CK	After mission is complete	30
Scheduled breaks/meals throughout mission		80
	TOTAL	600 min/ 10 hrs

* Excavation times will vary (+or-) depending on weather conditions, operator experience, and type/condition of soil.
** Standard convoy speed of 20-25 mph (32-40 km/h)will be the rate of travel of the M9 in the travel mode for hard surfaced and secondary roads. As feasible, 20 percent of travel mode should be cross country

Summation and graphic portrayal (Mission A)

Travel	Doze	Scrape	Haul	Grade	Misc	Ops Cks	Breaks Meals	Total
100	180	49	68	34	29	60	80	600 min/10 hr



MISSION B

Mode	Task (Mission performance criteria)	Duration (min)
Pre Ops Ck	Before starting mission	30
Travel(1)	Move from start point to work site (D1)**	30
Doze(1)	Excavate access approach * Work consists of cutting single-lane approach through steep bank to provide access into a river bed. Steep banks are two meters above river line. Approach is 20m long with 10% slope. Bottom width is 6 meters, top width is 10 meters. Approximately 163 bank cubic yards (BCY) (124.6m3) (30 min.)	60
Swim	Prepare M9 ACE vehicle for swimming (60 min) armor/seals). Swim M9 vehicle - propel and maneuver itself in still water at a speed of 3 mph (4.8 km/h). Will float with a minimum of 11 inch (280 mm) freeboard when loaded with an aggregate weight of 4000 pounds (1814 kg). (30 min) Deprocess M9 vehicle from amphibious operations. 90 min (armor/ seals) after exiting water.	180
Doze(2)	Excavate egress bank. Same criteria as D(1)*	30
Travel(2)	Move from site D(2) to winch site W(1)**	30
Winch(1)	Recover immobilized vehicle (weighing approximately 20,000 lbs)(9172 kg). Length of recovery should approximate 95 feet (29 m).	35
Travel(3)	Move from winch site W(1) to winch site W(2)**	30
Winch(2)	Same task as winch(1)	55

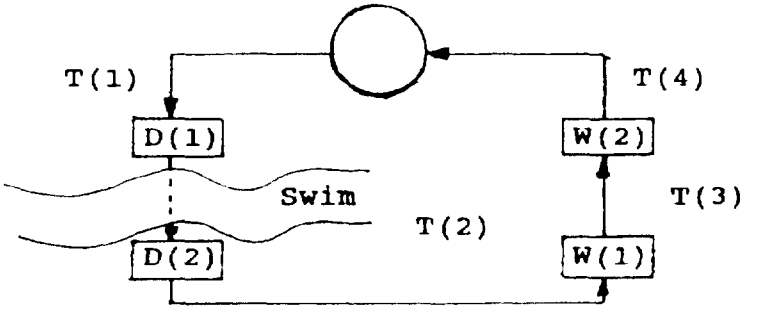
Travel(4)	Move from winch (W(2)) to start point **	30
Idle	Throughout mission	7.5
Post Ops Ck	After mission is completed	30
Scheduled breaks/meals throughout mission		52.5
	TOTAL	600 min/ 10 hrs

* Excavation times will vary (+or-) depending on weather conditions, operator experience, and type/condition of soil.
** Standard convoy speed of 20-25 mph (32-40 km/h) will be the rate of travel of the M9 in the travel mode for hard surfaced and secondary roads. As feasible, 20% of travel mode should be cross country.

MISSION B

Summation and graphic portrayal (Mission B)

Travel	Doze	Swim	Winch	Misc	Ops Cks	Breaks/ Meals	Totals
120	90	180	90	7.5	60	52.5	600 min/ 10 hrs



4.6.52.2 Reliability. To determine conformance to 3.9.21, the MTBF value shall be demonstrated at a point estimate when using the following formula:

$$MTBF = \frac{\text{Operating hours}}{\text{Number of Mission Failures}}$$

4.6.52.2.1 Maintainability. To determine conformance to 3.9.21.2, an average Maintenance Ratio (MR) of 0.45 manhours per operating shall be demonstrated for the vehicle system during IPT. The MR shall be calculated using the following formula:

$$MR = \frac{\text{Scheduled and Unscheduled Maintenance Manhours}}{\text{Operating Hours}}$$

4.6.52.2.2 Maintainability, remove/replace. Compliance with 3.9.21.3 shall be determined at the IPT Scoring Conference by evaluating the generated Equipment Performance Reports (EPR) diagnostic/repair/remove times Unit and Intermediate Maintenance.

4.7 Identification and marking. The vehicle identification and markings shall be visually inspected to determine conformance with 3.10.

4.7.1 Instruction plates. To determine conformance to 3.10.1, verify that the vehicle is equipped with instruction plates described on applicable engineering drawings.

4.7.2 Plate for transportation data. To conform to 3.10.2, the first M9 ACE shall provide data required for transportation data plate.

4.8 Workmanship. To determine conformance to 3.11, the M9 ACE shall be inspected for correct fabrication and assembly in accordance with all applicable drawings.

4.9 Inspection of packaging. The vehicle shall be inspected to determine conformance of the packaging requirements of section 5 of this specification.

5. PREPARATION FOR DELIVERY

5.1 Vehicle processing for shipment and storage. Each complete vehicle shall be processed for shipment and storage in accordance with MIL-E-62484(AT) (see 6.2).

6. NOTES

6.1 Intended use. The M9 ACE will employed by divisional and nondivisional combat engineers to perform the essential combat engineering tasks of bulldozing, rough grading, excavation, and limited hauling to facilitate movement of friendly forces and impede the enemy. The M9 ACE will be employed both in peacetime and wartime and under any climatic weather and visibility conditions in which combat engineering tasks are required to be performed. The M9 ACE is a multipurpose, tracked, armored, amphibious, combat engineer vehicle capable of performing dozing, scraping, rough grading, and hauling. It has a limited swim capability, is airdroppable, and provides light armor protection. The vehicle features a front-loaded scraper bowl (ballast compartment) and a hydraulically operated apron and a positive-load ejector. Dozing and scraping are accomplished by raising and lowering the entire front of the vehicle by means of the hydropneumatic suspension system.

6.2 Ordering data. Acquisition documents must specify the following:

a. Title, number, and date of this specification.
b. Initial production vehicle not required (see 3.2).
c. If preproduction vehicles shall be furnished (see 4.4.1).
d. If more than one initial production vehicle shall be furnished (see 4.4.2).

e. Selection of the applicable level of processing (see 5.1).
f. When Government furnished property will be provided and date available (see 3.7).
g. M9 ACE hardware fails definition and scoring criteria (see 3.9.21).
h. If storage tests are required (see 4.6.50.2 and 4.6.50.3).
i. If -50°F (-46°C) performance tests are required (see 4.6.50.3).

6.2.1 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a first article sample, a first production item, or a standard production item from the contractor's current inventory and the number of items to be tested as specified in 4.4. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.3 Definitions.

6.3.1 Vehicle ballasted and unballasted.

a. Unballasted: The vehicle shall be considered unballasted or unloaded when all Basic Issue Items, GFE, fuel, ammunition and driver are on board.

b. Ballasted: The vehicle shall be considered ballasted or loaded when the vehicle's gross weight includes the normal bowl load of 18,000 pounds (8165 kg).

6.3.2 Leakage.

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.

6.3 Subject term (key word) listing.

Airdroppable
Bulldozing
Combat engineering
Excavation
Light armor
Rough grading

6.4 AMC policy on AQLs/LTPDs. This specification is certified to be in compliance with current Army Materiel Command (AMC) policy for the elimination of AQLs/LTPDs (Acceptable Quality Levels/Lot Tolerance Percent Defectives) from military specifications.

Custodian:
Army - AT

Preparing Activity:
Army - AT

(Project No. 2350-A462)