MILITARY SPECIFICATION

ENGINE, DIESEL, 6 CYLINDER, IN-LINE, LIQUID COOLED, 210 HP

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 covers a 6 cylinder, in-line, liquid cooled, internal-combustion diesel engine.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

SPECIFICATIONS

FEDERAL

O-I-490	- Inhibitor, Corrosion, Liquid Cooling System.
VV-F-800	- Fuel Oil, Diesel.

MILITARY

MIL-P-514	- Plate, Identification, Instruction and Marking, Blank.
MIL-T-740	- Trucks, 5 Ton, 6 x 6, Military Design, M39 Series.

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: DRSTA-GSS, Warren, MI 48090, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

MIL-L-2104	- Lubricating Oil, Internal-Combustion Engine, Tactical Service.
MIL-S-3785	- Starter Engine, Electrical 24 Volt Direct Current.
MIL-A-11755	- Antifreeze, Artic-Type.
MIL-F-46162	- Fuel, Diesel, Referee Grade.
MIL-A-46153	- Antifreeze, Ethylene Glycol, Inhibited, Heavy Duty, Single Package.
MIL-L-46167	- Lubricating Oil, Internal-Combustion Engine, Arctic.
MIL-G-46795	- Generator System, Alternator, Rectifier, 60 Ampere, 28 Volts.
MIL-A-62048	- Air Cleaners, Automotive Heavy Duty, Dry-Type for Internal-Combustion Engines.

STANDARDS
MILITARY

MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-193	- Painting Procedures and Marking for Vehicles, Construction Equipment, and Material Handling Equipment.
MIL-STD-461	- Electromagnetic Emission and Susceptibility Requirements for Control of Electromagnetic Interference.
MIL-STD-1184	- Electrical Components for Automotive Vehicles, Waterproofness Test.
MS 36423	- Cleaning, Compound, High Pressure Cleaner Steam.
MS 53011-1	- Starter, Engine, Electrical; 24 Volt D.C., 5/8 Inch Frame Diameter, Solenoid Actuated, Heavy-Duty, Long Frame.

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

PURCHASE DESCRIPTIONS

ATPD 2056	- Trucks, 5 Ton, 6 x 6, M939 Series.

DRAWINGS
ARMY

10929868	- Rectified AC Generating System.
11604557	- Air Cleaner Assembly, Engine - 550 cfm.
11604558	- Air Cleaner Assembly, Engine - 800 cfm.
11604610	- Air Cleaner Assembly, Engine - 675 cfm.
11664247	- Pump and Pulley Assembly, Steering.
11664451	- Engine Assembly (M809).
11664481	- Steering Pump Assembly.
11669328	- Engine Assembly (M939).

(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.)

ENVIRONMENTAL PROTECTION AGENCY (EPA)

Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines.

(Application for copies should reference "Federal Register Volume 35, Number 108, Part II, dated June 4, 1968" and should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

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

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

J1349 - Engine Power Test Code - Spark Ignition and Diesel, SAE Standard, DoD Adopted.

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

PTC-9-70 - Displacement Compressors, Vacuum Pumps and Blowers.

(Application for copies of ASME publications should be addressed to the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017.)

NATO INTERNATIONAL STAFF - DEFENSE SUPPORT DIVISION

AC/225 (Panel II) D/131 (Part II) NATO Standard Engine Laboratory Test for Diesel and Gasoline Engines.

(Application for copies of NATO publications should be addressed to NATO, Military Agency for Standardization (MAS), 35 Chesham Place, London SWI, England.)

3. REQUIREMENTS

3.1 First article. Unless otherwise specified, the contractor shall furnish diesel engine assemblies which shall be subjected to first article inspection (see 4.4 and 6). First article inspection samples, properly marked with identifying information shall be representative of the unit to be furnished to the Government. All subsequent engines delivered to the Government shall conform to these samples in all of their pertinent physical and performance attributes.

3.2 Reliability. During Government specified vehicle tests, the engine assembly installed in a 5 ton M809 or M939 series cargo truck with specified payload and towed load shall operate in conformance with specified test cycles for 20,000 miles, and shall not exceed the maintenance ratio criteria specified in 3.2.1. There shall be no accessory or component failure which requires maintenance beyond scheduled maintenance normally performed at organizational level. There shall be no failures which require engine replacement. Identical failures of the engine, engine components, or engine accessories which occur twice during the 20,000 mile test whether on one engine or on another engine in a different vehicle which is being concurrently tested shall be considered a failure and the Government shall refuse acceptance of the engines. Successful completion of complete retesting must be accomplished prior to approval by the Government.

3.2.1 Maintenance ratio. During Government specified vehicle test cycles, the time required to perform scheduled (not to include organizational operator daily maintenance) and unscheduled engine maintenance shall not exceed 4 percent of the operating hours, based upon 20 miles equal one hour of operation. The unscheduled engine maintenance shall not exceed 2 percent of the operating hours. Maintenance data so accumulated will be based on active maintenance time; i.e., time for diagnosis, repair, and test of repair, but will not include time for recovering the vehicle, cleaning, securing parts, performing administrative shop functions, obtaining mechanics, etc.

3.2.2 Maintainability. The engine and its installations shall permit accomplishment of maintenance in the field with minimum time. Engine and installation features shall require minimum quantity of special tools, minimum variety and quantity of maintenance tasks, maximum practicable use of sealed assemblies and modules, and maximum accessibility for service and repair. Engine mounted accessories and components; i.e.; starter, alternator, injection pump, and turbocharger (if utilized), shall be installed or mounted so that they may individually be removed, replaced and the installation tested within one hour using normal hand tools and maintenance procedures.

3.3 Materials. Materials shall be as specified herein and in referenced specifications, standards, and drawings. Material shall be free of defects which adversely affect performance or serviceability of the finished product.

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

3.4 Design and construction.

3.4.1 Configuration. The engine assembly shall conform to drawings 11664451 or 11669328 as applicable (see 4.8.2).

3.4.1.1 Interchangeability of parts. Component parts and assemblies of each engine shall be so constructed that any part(s), except assemblies requiring individual select fitting of components, may be installed in a like engine without modification (see 4.8.2.1).

3.4.2 Kits. The engine shall be capable of receiving and providing the necessary functions for the kits listed in 6.3 of MIL-T-740, and ATPD 2056 (see 4.8.3).

3.4.3 Starting aids. Each engine shall be equipped with starting aids as required to insure starting after being cold-soaked for 24 hours down to minus 25 degrees Fahrenheit (°F). Fuel required by the starting aid system shall be obtained from the engine fuel system. Ether starting aids shall not be used (see 4.9.4).

3.4.4 Thermostat. Provision for rapid warm-up shall be provided. Thermostat characteristics shall be based on the use of solutions conforming to coolants specified herein (see 3.5.7 and 4.8.4).

3.4.5 Engine lubrication system. The lubrication system shall be capable of satisfactory operation under intended service, operating, and performance requirements specified herein when serviced with seasonal grades of oils as specified in MIL-L-2104 from minus 10°F to plus 120°F and MIL-L-46167 from minus 65°F to 0°F. The oil pressure shall not fall below minimum recommended by the engine manufacturer. At initial truck assembly, the contractor may utilize an engine oil of his own selection for ambients of minus 10°F to plus 120°F, provided the oil selected is compatible with oil as specified in MIL-L-2104 (see 4.8.5).

3.4.5.1 Oil filters. Suitable oil filters of size and type proper for the engine provided shall be included. Military standard oil filter elements may be used at the discretion of the engine manufacturer. The filter(s) shall be readily accessible and the design shall facilitate hot oil draining and filter changes (see 4.8.5.1).

3.4.5.2 Oil filler and gage. The crankcase oil filler shall be arranged so that oil can be readily poured into the filler opening, without requiring the use of a funnel, from a container conforming to type II, 5-quart size of PPP-C-96, and type II 5-gallon of PPP-P-704. The engine shall be provided with a properly accessible waterproofed bayonet gage that ensures ready and accurate determination of crankcase oil level with engine stopped (see 4.8.5.2).

3.4.6 Air cleaner. Based on the rated engine airflow, the contractor shall select one of the air cleaner assemblies in accordance with 11604557 [550 cubic feet per minute (cfm)], 11604558 (800 cfm), or 11604610 (675 cfm). The air cleaner shall comply with the requirements of MIL-A-62048 (see 4.8.6).

3.4.7 Fuel filters. Filters of a size and type proper for the engine requirements shall be provided. The fuel filters shall have an efficiency equal to the engine manufacturer's best commercial system and adequate capacity to hold and remove contaminants. The fuel system shall include a chassis mounted fuel-water separator to separate entrained water from the fuel. The separator shall include provision for drainage of accumulated water. Provisions for daily drainage of all filters shall be furnished. The drainage provisions shall be within easy reach of an operator or mechanic during normal preoperational vehicle checks, and shall not require the use of tools to operate or the disassembly of any component to gain access. The operation of the drains shall be simple, and the location such that operators will not avoid following prescribed maintenance checks (see 4.8.7).

3.4.8 Accessories and equipment. All electrical accessories and equipment, wiring, and electrical connections shall conform to the applicable requirements of MIL-STD-1184. Unless otherwise specified, all accessories and equipment shall be installed on the engine and properly adjusted (see 4.8.8).

3.4.8.1 Alternator system. The engine shall be equipped with a 60 ampere alternator in accordance with Class B of MIL-G-46795. The alternator assembly shall conform to drawing 10929868. The drive ratio shall be such that at normal engine idle, the electrical output shall be not less than 18 amperes (see 4.8.8.1).

3.4.8.2 Starter system. Starter shall be a 24-volt electric solenoid actuated, waterproofed, corrosion, and fungus resistant unit as specified in MIL-S-3785. The starter assembly shall conform to MS 53011-1 (see 4.8.8.2).

3.4.8.3 Air compressor. The air compressor on the engine with applicable governor shall deliver the following minimum air flows at a pressure of 125 pounds per square inch gage (psig) at the following engine speeds (see 4.8.8.3):

a. 5.4 cfm [0.073 pounds per cubic foot (lbs/ft^3) air density] at engine full load governed speed [2100 revolutions per minute (rpm)].

b. 4.2 cfm (0.073 lbs/ft^3 air density) at 1500 rpm. In addition, the unloading valve shall function properly in conjunction with air compressor governor at normal governing pressure. Air flow performance shall be conducted at (or corrected to) an ambient intake air temperature of 77 ± 5°F and dry barometer pressure of 29.42 ± .50 inches of Hg.

3.4.8.4 Engine governor. An engine governor shall be provided that will limit engine speed to not more than 2450 rpm, no load. The governor shall be sealed or constructed so that any tampering with the setting will be readily apparent. The governor shall be set as specified herein and sealed during the break-in run (see 4.8.8.4).

3.4.8.5 Steering pump. The engine shall be equipped with a steering pump assembly conforming to 11664247. The steering pump shall be filled with oil conforming to grade 10 of MIL-L-2104 in ambient temperatures between minus 10°F and plus 120°F, and oil conforming to MIL-L-10295 in ambient temperatures between minus 65°F and 0°F (see 4.8.8.5).

3.4.9 Engine data plate. Engine date plates shall be installed on the engine block in a location readily visible to personnel performing maintenance on the engine in a vehicle. The data plates shall conform to MIL-P-514 (see 4.8.9).

3.4.10 Engine weight with accessories. The engine with accessories as shown on drawing 11664451 and 11669328 shall weigh not more than 2625 pounds.

3.5 Performance.

3.5.1 Production engine break-in run. A production break-in run is required. The break-in run schedule shall be established by the contractor to assure that each engine, as offered for delivery, is suitable for immediate vehicle drive-away operations. The manufacturer may use oil of his own selection for the engine build up and production break-in run (see 4.9.1).

3.5.2 NATO standard engine test. The engine shall show no evidence of performance degradation when tested in accordance with NATO standard AC/225 (Panel II) D/131 (Part II), section 2-3 (see 4.9.2). During the tests, the engine shall require only specified maintenance.

3.5.2.1 Engine performance requirements. The engine assembly as defined herein with alternator and air compressor operating unloaded, and corrected to standard conditions as established in SAE test code J1349 shall meet the following requirements (see 4.9.3):

a. Net horsepower: 210-225 observed horsepower at 2100 rpm (see figure 1).
b. Peak torque: 590-650 pound feet at 1500 rpm (see figure 1).
c. Fuel consumption: shall not exceed .395 pounds per observed brake horsepower (bhp) hour with engine operating at full load and speed and without fan (see figure 1).
d. Oil consumption: .007 pound per observed bhp hour maximum at full load throughout the speed range of the engine.

3.5.3 NATO endurance test. The engine shall pass the NATO endurance test specified in NATO Standard AC/225 (Panel II) D/131 (Part II) section 2-4. Subsequent to testing, the engine shall be disassembled and examined for abnormal wear (see 4.9.4.1).

3.5.3.1 Fuel requirement (see 4.9.2 and 4.9.4.1).

a. The engine shall be capable of full performance using fuel in accordance with grade DF-2 of VV-F-800 of minimum quality.
b. The engine without adjustment shall complete the 400 hour NATO cycle without damage when using fuel in accordance with MIL-F-46162.

3.5.4 Exhaust smoke density. The engine exhaust smoke number at the engine outlet during operation at elevation up to 500 feet and using specified fuels shall not exceed a reading of 3.5 at full power steady state throughout speed range when using Robert Bosch model #EFAW 68 smoke meter, and sampling pump model EFAW65. Alternate smoke analyzers may be utilized, provided comparative data is supplied by the contractor, and the contractor and Contracting Officer mutually establish an official table indicating comparative readings (see 4.9.5).

3.5.5 Air pollution control. The engine shall comply with the Environmental Protection Agency Regulations governing control of air pollution from new motor vehicles and new motor vehicle engines in effect on the date of award of contract (see 4.9.5.1).

3.5.6 Environmental requirements. The engine shall start within one minute after cranking, and within 15 minutes, shall demonstrate the performance characteristics specified in 3.5.2.1 under any of the following conditions or combination of conditions (see 4.9.6).

a. Temperature conditions. With integral cold starting aids only after being cold-soaked for a 24-hour period without benefit of solar-radiation, to an ambient temperature of minus 25°F.

b. Elevation conditions. At any elevation from sea level to 8000 feet as specified in table I, the engine shall have adequate torque and power characteristics to meet the performance requirements specified herein.

TABLE I. Elevation conditions.

Elevation (feet)	Ambient temperature (°F) (4 to 6 feet above ground)	Solar radiation ($Btu/ft^2 hr$)
Sea level to 3000	120	360
4000	115	364
6000	105	372
8000	95	380

c. Humidity conditions. Under relative humidity conditions as low as 5 percent at temperature of 120°F and as high as 100 percent at all temperatures from minus 25°F to 85°F.

3.5.7 Limiting operating temperatures. The engine shall not exceed the following temperatures when operating at full load throughout the speed range of engine under any conditions specified herein (see 4.9.7).

a. Oil Sump 260°F (measured at the drain plug)
b. Coolant 210°F (measured at engine coolant outlet) without pressurized coolant system

3.5.8 Submersion requirements. The engine and all accessories with intake and exhaust ducted to the atmosphere, shall operate for a period of 30 minutes while submerged to a depth of 18 inches above the valve cover housings in fresh and salt water. While still submerged, the engine shall restart after being stopped for three minutes, then operated for an additional 15 minutes. At the conclusion of operation, a maximum of one percent water contamination by volume in the lubricating oil is permissible (see 4.9.8).

3.5.9 Grades and slopes. The engine shall perform as specified below with the oil at "full" and "add" levels when inclined in either direction, 60 percent longitudinally or 30 percent laterally, or any combination thereof. During an operating period of 30 minutes there shall be no evidence of faulty lubrication, cooling, fuel supply, leakage, or other malfunction.

a. Net horsepower: 210-225 observed horsepower at 2100 rpm (see figure 1).
b. Peak torque: 590-650 pound feet at 1500 rpm (see figure 1).
c. Fuel consumption: shall not exceed .395 pounds per observed brake horsepower (bhp) hour with engine operating at full load and speed and without fan (see figure 1).
d. Oil consumption. .007 pound per observed bhp hour maximum at full load throughout the speed range of the engine.

3.5.10 Steam and water jet cleaning. The engine and all its components shall withstand cleaning with high pressure steam and cleaner conforming to MS36423 and water jet, without deterioration of seals or hoses, water leakage past seals or gaskets, or other defects. Paint removal shall not be a basis for rejection under this requirement (see 4.9.10).

3.5.11 Electromagnetic compatibility. Unless otherwise specified (see 6.2), the engine shall meet the functional suppression requirements of MIL-STD-461 as specified (see 4.9.11).

3.6 Exterior surface treatment. All exposed exterior surfaces of the engine and its components shall be cleaned, primed, and painted for corrosion resistance as specified on the applicable drawings, or if not so specified, in accordance with applicable provisions of MIL-STD-193 (see 4.10).

3.7 Workmanship. The engine assembly shall be constructed and finished thoroughly in a workmanlike manner; particular attention shall be paid to thoroughness of painting, plating, and bolted on assemblies. Electric, fuel, and lubrication lines shall be located in a manner so as to prevent possible damage by rubbing on adjacant lines or appendages. All parts and assemblies shall be free from burrs, sharp edges, or any condition which may present a safety hazard to operating and maintenance personnel (see 4.11).

3.8 Leakage. During dynamometer operation, or when installed in a vehicle, the engine shall show no evidence of leakage greater than class III as defined in 6.3 (see 4.12).

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

4.1.1 Inspection equipment. Unless otherwise specified in the contract, the supplier is responsible for the provision and maintenance of all inspection equipment necessary to assure that supplies and services conform to contract requirements. Commercial, modified commercial, or supplier designed inspection equipment or measuring set-ups must be capable of repetitive measurements to an accuracy of 10 percent of the component tolerance. Calibration of inspection equipment shall be in accordance with MIL-STD-45662.

4.1.2 Materials and construction. To determine conformance to 3.3 through 3.4.12, inspection, test, 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.

4.2 Classification of inspection:

a. First article inspection (see 4.4).
b. Quality conformance inspections (see 4.5).
    1. Examination (see 4.5.2).
    2. Acceptance tests (see 4.6).
    3. Control tests (see 4.7).

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

a. Air temperature 23° ± 10°C
b. Barometric pressure 725 + 50mm Hg
- 75
c. Relative humidity 50 ± 30 percent

4.4 First article inspection. First article inspections are 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 two engine assemblies 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), the preproduction sample shall consist of two diesel engine assemblies. Preproduction inspection shall consist of examination as specified in table III and tests specified in table II.

4.4.2 Initial production inspection. Unless otherwise specified (see 6.2), the Government shall select two units, from the first ten engines produced under the production contract for initial production inspection. Initial production units shall be examined as specified in table III and tested as specified in table II.

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 until corrective action by the contractor has been approved by the Government.

NOTE: Any engine assembly subjected to preproduction or initial production tests shall not be delivered to the Government as an end item of the contract until the engine has been dissasembled and examined for wear and damage. Wear limits shall not exceed those specified for overhaul by the manufacturer. Scuffing, galling, or burning of parts or surfaces shall not be permitted. Subsequent to the inspection, performed above, the engine may be reassembled using all parts that meet new part drawing requirements, or replacing worn or damaged parts with new parts. Following reassembly the engine shall pass the break-in run and acceptance tests as specified herein.

TABLE II. Classification of tests.

Title	Requirement	Test	First article	Quality conformance	
				Acceptance (100%)	Control
Configuration	3.4.1	4.8.2	X		
Interchangeability	3.4.1.1	4.8.2.1	X		
Kits	3.4.2	4.8.3	X		
Starting aid	3.4.3	4.9.4	X		X
Thermostat	3.4.4	4.8.4	X		
Engine lubrication system	3.4.5	4.8.5	X		
Oil filters	3.4.5.1	4.8.5.1	X		
Oil filler and gage	3.4.5.2	4.8.5.2	X		
Air cleaner	3.4.6	4.8.6	X		
Fuel filters	3.4.7	4.8.7	X		
Accessories and equipment	3.4.8	4.8.8	X		
Alternator system	3.4.8.1	4.8.8.1	X		
Starter system	3.4.8.2	4.8.8.2	X		
Air compressor	3.4.8.3	4.8.8.3	X		
Engine governor	3.4.8.4	4.8.8.4	X	X	
Steering pump	3.4.8.5	4.8.8.5	X		
Engine data plate	3.4.9	4.8.9	X		
Engine weight	3.4.10	4.8.10	X		X
Break-in run	3.5.1	4.9.1	X	X	
NATO standard engine test	3.5.2	4.9.2	X		X
Engine requirements	3.5.2.1	4.9.3	X	X	
NATO endurance tests	3.5.3	4.9.4.1	X		X
Fuel requirement	3.5.3.1	4.9.2 & 4.9.4.1	X		X
Exhaust smoke density	3.5.4	4.9.5	X		X
Air pollution control	3.5.5	4.9.5.1	X		X
Environmental requirements	3.5.6	4.9.6	X		X
Limiting operating temperatures	3.5.7	4.9.7	X		X
Submersion requirements	3.5.8	4.9.8	X		X
Grades and slopes	3.5.9	4.9.9	X		X
Steam and water jet cleaning	3.5.10	4.9.10	X		X
Electromagnetic compatibility	3.5.11	4.9.11	X		
Exterior surface treatment	3.6	4.10	X		
Workmanship	3.7	4.11	X		
Leakage	3.8	4.12	X	X	X

4.5 Quality conformance inspection.

4.5.1 Sampling.

4.5.1.1 Lot formation. An inspection lot shall consist of all engines sequentially manufactured and submitted at one time for quality conformance inspection.

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

4.5.2 Quality conformance examinations.

4.5.2.1 Acceptable quality level. Each sample selected in accordance with 4.5.1.2 shall be examined to determine conformance to the following acceptable quality levels (AQL) on the basis of percent defective (see 6.4).

Classification	AQL
Major	2.5
Minor	15.0

4.5.2.2 Classification of defects. For examination purposes, defects shall be classified as listed in table III.

TABLE III. Classification of defects.

Category	Defect	Method of examination
Critical	None	
Major	AQL 2.5% Defective	
101	Incomplete assembly per 11664451 or 11669328.	Visual
102	Valve tappet clearance (each valve): intake and exhaust valves improperly adjusted.	Visual and functional
103	Fuel, oil and coolant leaks: leakage (see 6.3).	Visual
104	Governor: malfunction; not sealed.	Visual and functional
105	Improper torque on accessible cylinder head bolts, intake and exhaust manifold flange bolts that can be reached without breaking seals or removing cover.	Certified torque equipment
106	Crankshaft: excessive or restrictive end play.	Visual and functional
107	Fuel system components: malfunction; damage; leaks (see 6.3).	Visual and functional
108	Fuel injection system timing and components: malfunction; improper adjustment.	Visual and functional

TABLE III. Classification of defects - Continued.

Category	Defect	Method of examination
Minor	AQL 15% Defective	
201	Fuel lines: damaged, rubbing, improper support.	Visual
202	Drive belts, loose.	Visual/belt tension gage
203	Oil dipstick gage, missing.	Visual
204	Oil level, overfilled, below safe operating level.	Visual
205	Bolt on components, loose, nuts or bolts missing, heads rounded or deformed.	Visual/ tactile
206	Threaded holes, correct size, proper depth.	Go and not go thread gages.
207	Cylinder firing order cast on manifold; improper location, distorted numbers, missing, incorrect.	Visual
208	6.00 in. lbs. maximum torque to operate throttle shaft; torque excessive.	Certified torque equipment
209	Engine data plate, missing.	Visual
210	Painting; sags, runs, inadequate or improper coverage, none in threaded holes.	Visual

4.6 Quality conformance tests.

4.6.1 Acceptance tests (100 percent). Each engine assembly shall be subjected to the tests specified in table II.

4.6.1.1 Failure. Engine assemblies that fail to pass any of the acceptance tests specified in table II may be repaired and resubmitted for inspection retest. The retest, as a minimum, shall consist of the failed tests and any other tests as deemed necessary by the Government inspector.

4.7 Control tests. Control test samples shall be selected from a production lot which has passed quality conformance examinations specified in 4.5 and 4.6. Control test samples shall be selected at the rate of one from each lot of 500 engines consecutively produced, except not more than one engine shall be tested in a six-month period, nor less than one in a twelve-month period. The control test engine shall be subjected to the tests specified in table II.

4.7.1 Failure. Failure of a sample to pass control testing shall be cause for Government refusal to accept engine assemblies until corrective action taken by the contractor has been approved by the Government.

NOTE: Any engine assembly subjected to control tests shall not be delivered to the Government as an end item of the contract until the engine has been disassembled and examined for wear and damage. Wear limits shall not exceed those specified for overhaul by the manfuacturer. Scuffing, galling, or burning of parts or surfaces shall not be permitted. Subsequent to the inspection, performed above, the engine may be reassembled using all parts that meet new part drawing requirements, or replacing worn or damaged parts with new parts. Following reassembly the engine shall pass the break-in run and acceptance tests as specified herein.

4.8 Methods of inspection.

4.8.1 Design and construction.

4.8.2 Configuration. The configuration of the engine assembly shall be inspected for conformance to drawings 11664451 and 11669328, as applicable (see 3.4.1).

4.8.2.1 Interchangeability of parts. The manufacturer shall provide a certification attesting that all parts, except assemblies requiring individual select fitting of components, may be installed in a like engine without modification (see 3.4.1.1).

4.8.3 Kits. The manufacturer shall provide a certification attesting that the engine is capable of receiving and providing necessary requirements for the kits listed in MIL-T-470, and ATPD 2056 (see 3.4.2).

4.8.4 Thermostat. During engine tests, verify that the thermostat provided remains closed, restricting coolant flow until minimum operating temperature of the engine as specified by the manufacturer has been reached, and that the thermostat is fully open at 210°F measured at the coolant outlet (see 3.4.4).

4.8.5 Engine lubrication system. To determine conformance to 3.4.5, and using oil specified in MIL-L-2104, the engine shall operate without damage during all testing specified herein at temperatures ranging from minus 10°F to plus 120°F. Using oil specified in MIL-L-46167, the engine shall operate without damage during all testing specified herein at temperatures ranging from minus 65°F to 0°F. During tests specified with each of the oils specified, with oil level at the lowest marked safe operating level on the dipstick and engine running at 600 + 10 rpm, the oil pressure shall not fall below the minimum specified by the manufacturer. Verification of a satisfactory lubrication system shall be determined during tear down inspections following engine tests, and will be evidenced by lack of excessive wear or damaged wear surfaces (see 3.4.5).

4.8.5.1 Oil filters. Verify that oil filters are part of the engine configuration and that they are readily accessible for hot oil draining, and filters can be easily removed and replaced (see 3.4.5.1).

4.8.5.2 Oil filler and gage. Verify that the oil filler opening is in such a position that oil can be poured into the filler opening without the use of a funnel when pouring from a container conforming to type II, 5 quart size of PPP-C-96, and from a type II 5 gallon size of PPP-P-704. Remove the waterproof type bayonet gage oil dipstick and verify that the oil level is in the safe operating zone as identified on the dipstick (see 3.4.5.2).

4.8.6 Air cleaner. Verify that the air cleaner conforms to one of the following: 11604558, 11604557, or 11604610, and that the manufacturer has a certificate of conformance to MIL-A-62048 (see 3.4.6).

4.8.7 Fuel filters. Verify that the fuel filters are the same as, or equal to, the manufacturer's best commercial types. The filter system shall include a fuel-water separator suitable for chassis mounting, and must have provision for easy drainage of accumulated water without the use of hand tools (see 3.4.7).

4.8.8 Accessories and equipment. Verify that electrical accessories and equipment conform to the applicable engine drawings and that the manufacturer has a certificate attesting conformance of electrical components to MIL-STD-1184 (see 3.4.8).

4.8.8.1 Alternator system. Verify that the alternator conforms to drawing 10929868, and that the manufacturer has a certification on file attesting conformance to class B of MIL-S-46795. With the engine mounted on a dynamometer and operating at 600 rpm, the alternator output shall not be less than 18 amperes (see 3.4.8.1).

4.8.8.2 Starter system. Verify that the starter assembly conforms to MS-53011-1, and that the manfuacturer has a certification on file attesting conformance to MIL-S-3785 (see 3.4.8.2).

4.8.8.3 Air compressor. With the engine mounted on an engine dynamometer and operating at the following specified engine speeds, the air compressor shall deliver the following minimum air flows at a pressure of 125 pounds per square inch gage (psig). Air flow performance shall be measured as specified in the ASME, power test code PTC-9-70 (see 3.4.8.3).

a. 5.4 cfm (0.073 pounds per lb/ft^3 air density) at engine full load governed speed (2100 rpm).

b. 4.2 cfm (0.073 lbs/ft^3 air density) at 1500 rpm. In addition, the unloading valve shall function properly in conjunction with air compressor governor at normal governing pressure. Air flow performance shall be conducted at (or corrected to) an ambient intake air temperature of 77 $\pm$ 5°F and dry barometer pressure of 29.42 $\pm$ .50 inches of Hg.

4.8.8.4 Engine governor. During the manufacturer's break-in run, it shall be verified that the engine governor is set and sealed to govern the engine speed at not more than 2450 rpm with no load. The governor shall be sealed in such a manner that any tampering with the setting will be readily observed (see 3.4.8.4).

4.8.8.5 Steering pump. Verify that the steering pump assembly conforms to drawing 11664247, and that the manufacturer has a certification attesting to the performance requirements specified on 11664481 (see 3.4.8.5).

4.8.9 Engine data plate. Verify that an engine data plate conforming to MIL-P-514 is installed on the engine block in a location that will be readily visible to personnel performing maintenance when the engine is installed in a vehicle (see 3.4.9).

4.8.10 Engine weight with accessories. The engine complete with accessories shown on drawings 11664451 or 11669328 shall be weighed on a certified scale and shall not weigh more than 2,625 pounds (see 3.4.10).

4.9 Performance requirements.

4.9.1 Production engine break-in run. Each engine shall be hooked to an engine dynamometer and operated through the break-in run schedule developed by the manufacturer. During the break-in run, the engine shall be observed for oil pressure, overheating, oil or coolant leaks, and unusual noise (see 3.5.1). During the break-in run, the governor shall be adjusted and set to limit the engine speed to 2100 rpm full load and 2450 rpm no load. When the governor is set to the engine speed specified, it shall be sealed in such a manner that if tampered with, it will be readily apparent (see 3.4.8.4). The break-in run shall be conducted on all engines prior to further testing.

4.9.2 NATO performance test. With the engine mounted on an engine dynamometer, and under the environmental conditions specified herein, the tests specified herein, shall be performed in accordance with NATO standard AC/225 (Panel II), D/131 (part II), section 2-3 (see 3.5.2). The performance test is to include curves of power, torque, and specific fuel consumption versus rpm at 100%, 85%, 70%, 50%, and 25% load, which will be measured and calculated at a minimum of five speed settings in both ascending and descending order. The highest speed setting is to be the rated speed. For each setting, the engine should run for 15 minutes to allow the operating parameters to stabilize. The endurance test specified herein shall be conducted using fuel conforming to DF-2 of VV-F-800 of minimum quality (see 3.5.3.1).

4.9.3 Engine performance requirements. The engine assembly shall be mounted and tested as specified in 4.9.2, and with the air compressor, power steering pump, and alternator operating unloaded. The engine assembly shall meet the following requirements with calcualtions corrected to standard conditions established in SAE test code J1349, engine assembly shall meet the following requirements (see 3.5.2.1):

a. Net horsepower: 210-225 observed horsepower at 2100 rpm (see figure 1).
b. Peak torque: 590-650 pound feet at 1500 rpm (see figure 1).
c. Fuel consumption: shall not exceed .395 pounds per observed brake horsepower (bhp) hour with engine operating at full load and speed and without fan (see figure 1).
d. Oil consumption. .007 pound per observed bhp hour maximum at full load throughout the speed range of the engine.

4.9.4 Endurance requirements.

4.9.4.1 NATO endurance test. With the engine mounted on an engine dynamometer, the engine shall be subjected to the endurance test specified in NATO standard AC/225 (Panel II), D/131 (part II), section 2-4 (see 3.5.3 and 4.9.4.2). The engine without adjustment following the break-in run shall meet the endurance tests using fuel conforming to MIL-F-46162 (see 3.5.3.1). The endurance test is to last for 400 hours, divided into four periods of 100 hours each. At the completion of each period, the engine shall be submitted to a full-load performance check. Each 100-hour period is to comprise 10-hour cycles. During the endurance test, the engine shall require only minor repairs, such as replacing belts and filters. At the conclusion of this test, the engine shall conform to the operational and performance requirements specified in paragraph 4.9.3. In addition the engine shall be disassembled and examined for abnormal wear, such as scuffing or galling of cylinder bores, pistons, piston rings, piston pins, bearings, bearing journals, gear teeth, cam surfaces, valves tappets or other parts; burning of valves or pistons; sticking of valves or piston rings; leakage of gaskets or seals, or other malfunctions. Wear limis shall not exceed those specified for overhaul by the manufacturer. Leaks which form class III drops that cannot be correct by retorquing bolts and nuts shall be cause for failure of the test.

4.9.5 Exhaust smoke density. Exhaust smoke conditions for diesel engines during performance and altitude testing shall be measured by the use of a Robert Bosch EFAW 65 sampling pump, and analyzed on an EFAW 68 analyzing instrument. Testing shall be conducted at room temperature (65°F to 80°). The smoke sampling tube shall be located in the exhaust pipe, positioned midway of, and parallel to, the pipe walls, and between 12 and 60 inches of the exhaust manifold. Tubing between the sampling pump and exhaust probe shall not exceed 24 inches in length, and shall have an inside diameter of not more than 1/4 inch. At that location, the exhaust pipe inside area shall not be larger than 125 percent of the exhaust manifold outlet area. Alternate smoke analyzers may be utilized provided comparative data is obtained during initial portions of the test program, and the engine manufacturer and contracting officer mutually establish an official table indicating comparative readings (see 3.5.4).

4.9.5.1 Air pollution control. Engines shall be tested for conformance to Environmental Protection Agency Regulations for compliance with air pollution standards (see 3.5.5).

4.9.6 Environmental requirements. With the engine mounted on an engine dynamometer as specified in 4.9.2, the engine shall meet the performance requirements of this specification under all of the following conditions or combination of conditions. Under any of the following conditions, the engine shall start within one minute of start of cranking and shall demonstrate performance characteristics specified in 4.9.3 following 15 minutes of warm-up (see 3.5.6, a, b, c, and d).

a. Temperature conditions. With integral cold starting aids only after being cold-soaked for a 24-hour period without benefit of solar-radiation, to an ambient temperature of minus 25°F.

b. Elevation conditions. At any elevation from sea level to 8000 feet as specified in table I, the engine shall have adequate torque and power characteristics to meet the performance requirements specified herein.

c. Humidity conditions. Under relative humidity conditions as low as 5 percent at temperature of 120°F and as high as 100 percent at all temperatures from minus 25°F to 85°F.

4.9.7 Limiting operating temperatures. During testing, the following engine fluid temperatures shall not be exceed under any conditions (see 3.5.7).

a. Oil sump 260°F (measured at the drain plug).
b. Coolant 210°F (measured at engine coolant outlet) without pressurized coolant system.

4.9.8 Submersion requirements. The engine with accessories shall be hooked to power sources, and with the intake and exhaust ducted to the atmosphere shall operate for a period of 30 minutes while submerged to a depth of 18 inches above the valve cover housings in fresh and salt water. While still submerged, engine shall restart after being stopped for three minutes, then operated for an additional 15 minutes. At conclusion of operation, a maximum of one percent water contamination by volume in the lubricating oil is permissible (see 3.5.8).

4.9.9 Grades and slopes. With the engine hooked to power sources, the engine shall meet the performance characteristics specified below for not less than 30 minutes in each direction. With the oil level at the full level and at add oil level condition in the sump, and measured while in a level condition, the engine shall perform as specified when raised and lowered to a 60 percent longitudinal grade, when tipped sideways to a 30 percent grade, or in any combination of longitudinal or lateral grades. During operation as specified herein, any evidence of stalling, overheating, or degradation of performance will be cause for rejection. During the specified test, the engine shall be shut off and restarted a minimum of two times in each direction, with a minimum of two minutes during shutdown. Oil pressure shall be carefully monitored during tests, and if the pressure falls below the minimum pressure indicated for safe operation, the test shall be aborted. Any evidence of faulty lubrication, cooling, fuel supply, leakage, or other malfunction during or following tests shall be cause for rejection (see 3.5.9).

a. Net horsepower: 210-225 observed horsepower at 2100 rpm (see figure 1).
b. Peak torque: 590-650 pound feet at 1500 rpm (see figure 1).
c. Fuel consumption: shall not exceed .395 pounds per observed brake horsepower (bhp) hour with engine operating at full load and speed and without fan (see figure 1).
d. Oil consumption. .007 pound per observed bhp hour maximum at full load throughout the speed range of the engine.

4.9.10 Steam and water jet cleaning. To determine conformance to 3.5.10, the engine assembly shall be steam and water-jet cleaned as follows: The jet is applied perpendicular to the surface being cleaned at a distance not more than one foot from the surface for steam cleaning, and not more than five feet from the surface for water-jet cleaning, and cleaned at a rate of one square foot per minute (sq. ft/min). The jet pressure shall be not less than 100 psi and not more than 110 psi. Subsequent to the cleaning operation, the engine and components shall be disassembled to the extent necessary to determine if any deterioration to seals, hose, gaskets, or driving belts exists, and to determine if any entry of water has occurred into the engine or any component. Any evidence of seals, hose gasket, or driving belt deterioration, or any sign of water entry resulting from above testing, shall be cause for rejection.

4.9.11 Electromagnetic compatibility. To determine conformance to 3.5.11, the engine and components shall be tested to meet the functional suppression requirements of MIL-STD-461.

4.10 Exterior surface treatment. To determine conformance to 3.6, the engine assembly shall be examined to assure that there are no exposed bare metal surfaces, except for mating mounting surfaces. Cleaning, priming, and painting shall conform to the requirements of MIL-STD-193.

4.11 Workmanship. To determine conformance to 3.7, the engine assembly shall be visually examined to determine that paint coverage is thorough and does not sag or run, and that plating has completely covered the surface intended and is of uniform quality. Heads of bolts and nuts shall not be damaged or distorted. Electric, fuel, and other external lines shall be located so as to preclude possible damage by rubbing on adjacent lines or appendages. All surfaces shall be free from burrs, sharp edges, gouges, or protrusions which might present a safety hazard or deter from the overall gook look of a quality product.

4.12 Leakage. To determine conformance to 3.8, during all testing the engine assembly shall be closely monitored for evidence of leakage. Any leakage great enough to form drops (class III) as defined in 6.3 shall be casue for rejection.

5. PREPARATION FOR DELIVERY

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

6. NOTES

6.1 Intended use. The engines covered by this specification are intended for the M809 and M939 series 5 ton trucks used by the United States Military Service in transporting personnel or cargo, towing trailers or semitrailer, and recovering disabled equipment during military operations.

6.2 Ordering data. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Drawing number of engine to be furnished (see 3.4.1).
c. Preproduction inspection, if required (see 3.1).
d. Initial production inspection, if not required (see 3.1.1).
e. Additional suppression requirements, if required (see 3.5.11).
f. Selection of applicable levels of preservation, packaging, packing, and marking (see 5.1).

6.3 Definitions. The following definitions shall be used for the classification of defects for leaks:

(1) Class I. Leakage indicated by wetness or discoloration not great enough to form drops.

(2) Class II. Leakage great enough to form drops but not enough to cause drops to drip from item being checked/inspected.

(3) Class III. Leakage great enough to form drops that fall from the item being checked/inspected.

Custodian:
Army - AT

Preparing activity:
Army - AT

Project No. 2815-A147

Horsepower, torque, and fuel consumption curves shown below represent performance at SAE standard J1349 conditions of 500 ft. altitude (29.00 "Hg/736mmHg dry barometer), 85°F (29°C) air intake temperature, and 0.38 "HG" (9.6mm Hg) water vapor pressure.

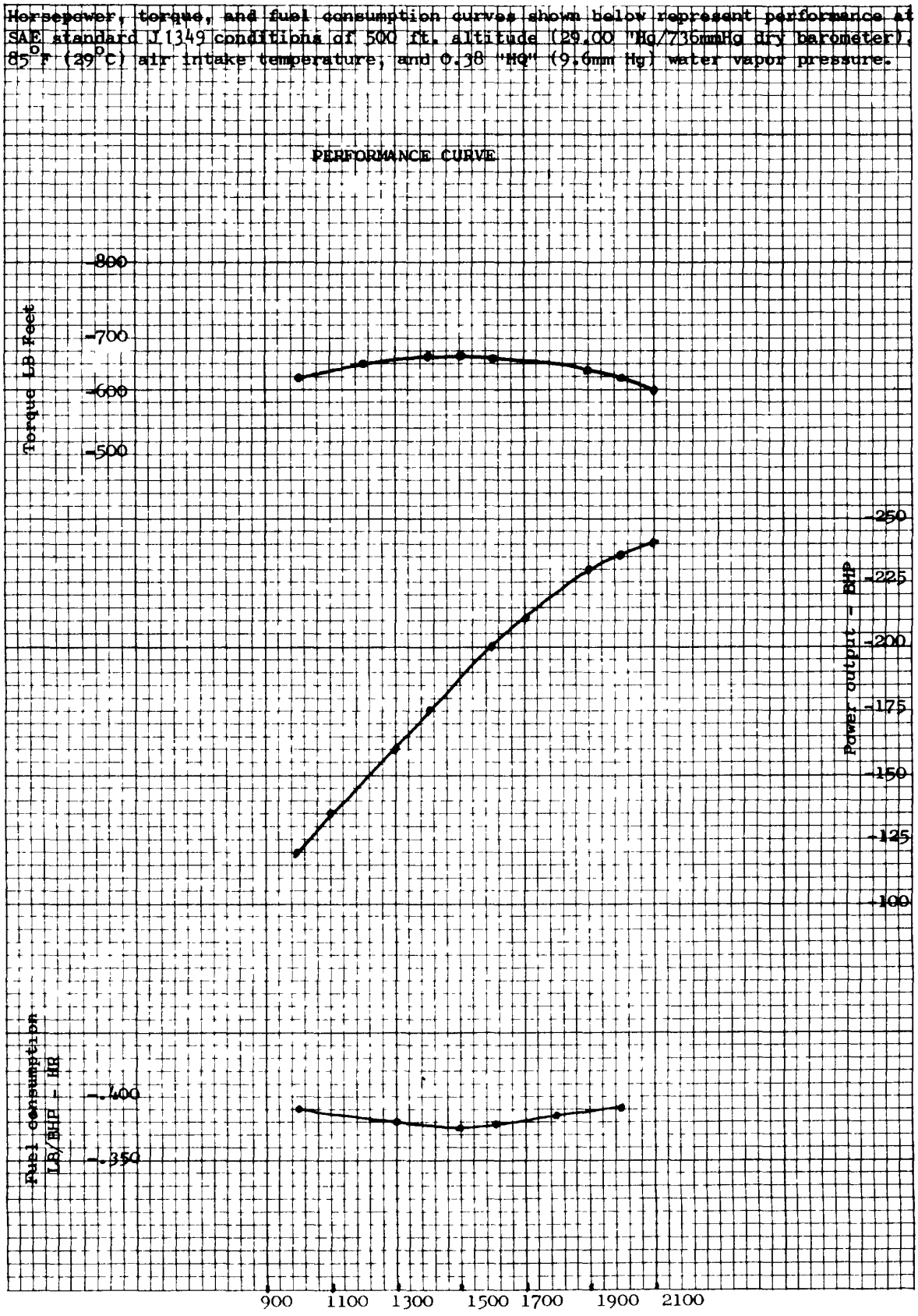

FIGURE 1 Engine speed - RPM.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-E-62483(AT)	Engine, Diesel, 6 Cylinder, In-Line, Liquid Cooled, 210 HP

3a. NAME OF SUBMITTING ORGANIZATION

b. ADDRESS *(Street, City, State, ZIP Code)*

4. TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ OTHER *(Specify)*. _____

5 PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c Reason/Rationale for Recommendation

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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