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PERFORMANCE SPECIFICATION

MOTOR, HYDRAULIC, CONSTANT DISPLACEMENT

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

1. SCOPE

1.1 Scope. This specification describes one type of hydraulic motor used in a launcher erection drive system on a military ground vehicle.

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

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

AMSC N/A FSC 2590

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2.2 Government documents.

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

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-6083 - Hydraulic Fluid, Petroleum Base, For Preservation and Operation.

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-810 - Environmental Test Methods and Engineering Guidelines.

(Unless otherwise indicated, copies of the above specifications and standards are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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

DRAWINGS

DEPARTMENT OF DEFENSE

12265504 - Motor Assembly, Hydraulic, Erection Drive (Interface).

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

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SAE AS478 - Identification and Marking Methods (DoD Adopted).

(Application for copies may be obtained from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel (DoD Adopted).

ASTM B650 - Standard Specification for Electrodeposited Engineering Chromium Coating for Ferrous Substrates (DoD Adopted).

(Application for copies may be obtained from the American Society for Testing and Materials, 100 Bar Harbor Drive, West Conshohocken, PA 19428-2959.)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE AS1933 - Age Controls for Hose Containing Age-Sensitive Elastomeric Materials (DoD Adopted).

(Application for copies may be obtained from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

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

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.3.

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3.2 Materials. Materials used shall be in accordance with applicable Government specifications or the manufacturer's materials specifications for hydraulic motors. The materials shall be capable of meeting all the operational and environmental requirements specified herein. Recovered materials shall be used to the maximum extent practicable (see 4.4.2).

3.2.1 Metals. All metals used in the construction of the hydraulic motor shall have corrosion resistance at least equivalent to anodized aluminum. There shall be no contact between dissimilar metals (see 4.4.2).

3.2.2 Age sensitive materials. The use of age sensitive materials shall be controlled in accordance with SAE AS1933 (see 4.4.2).

3.2.3 Plating. Steel parts in contact with aluminum alloy parts shall be either zinc plated in accordance with ASTM B633, or chromium plate equivalent in accordance with ASTM B650 class I. Zinc plating and tin plating shall not be permitted on parts which come in contact with hydraulic fluid (see 4.4.2).

3.2.4 Anodizing. All aluminum-alloy parts shall be anodized in accordance with commercial practice and shall meet all the performance and environmental requirements of this specification (see 4.4.2).

3.3 Design and construction.

3.3.1 Fluid. The hydraulic motor shall be designed to meet all requirements of this specification when supplied with the hydraulic fluids conforming to MIL-PRF-6083 (see 4.2.4 and 4.4.2).

3.3.2 Cleanliness. The fluid drawn from the motor test circuit at the completion of testing shall have a contamination level of not greater than that of table I (see 4.4.2 and 4.5.1).

TABLE I. Maximum contamination limit (100 mL sample).

Particle size range (micrometers)	Number of particles
5 to 15	64 000
15 to 25	11 400
25 to 50	2025
50 to 100	360
Over 100	64

3.3.3 Lubrication. The hydraulic motor shall be self-lubricating with no provision other than the circulating oil (see 4.4.2).

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3.3.4 Operation. The motor shall be capable of continuous, intermittent, reversing, and stalled operation in either direction of rotation. The nominal volumetric displacement of the motor shall be 0.12 cubic inches (in^3) (1.96 milliliters (mL) per revolution (see 4.4.2 and 4.5.3.10).

3.3.5 Rated speed. The motor shall be capable of continuous operation in either direction at speeds up to 6960 rpm (see 4.4.2).

3.3.6 Rated pressure. The motor shall be designed to operate continuously at the rated temperature and rated speed at a pressure of 3000 pounds per square inch (psi) (20 700 kiloPascals (kPa)) (see 4.4.2).

3.3.7 Rated temperature. The motor shall be designed to operate at a rated temperature of 130 degrees Fahrenheit (°F) (54 degrees Celsius (°C)), with a fluid temperature at the inlet port of 160°F (71°C) (see 4.4.2).

3.3.8 Interchangeability. All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance (see 4.4.2 and 4.5.1).

3.3.9 Safety. The motor shall be designed to completely contain all internal parts in the event of a failure due to an overspeed condition. No external loss of fluid from the motor shall occur as a result of the failure (see 4.4.2).

3.3.10 Direction of rotation marking. The corresponding inlet port for each direction of rotation shall be clearly and permanently marked on the motor housing as indicated on Drawing 12265504 (see 4.5.1).

3.3.11 Configuration. The motor’s external configuration shall be within the envelope dimensions shown on Drawing 12265504. The motor’s next assembly mounting requirements including the output shaft configuration and the exterior hydraulic port locations and dimensions shall be in accordance with Drawing 12265504 (see 4.4.2 and 4.5.1).

3.3.12 Weight. The weight of the motor shall not exceed 10 pounds (lb) (4.5 kilograms (kg)) (see 4.5.1).

3.4 Performance.

3.4.1 Starting torque. The motor shall develop not less than 30 pound-inches (lb-in) (3.4 Newton meters (N-m)) of starting torque when fluid is supplied at a differential pressure of not more than 2300 psi (15 850 kPa) (see 4.5.3.1).

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3.4.2 Running torque. The torque developed by the motor at any speed up to 3000 revolutions per minute (rpm) in either direction of rotation with a differential pressure of 2300 psi, shall not be less than 30 lb-in (3.4 N-m) (see 4.5.3.2).

3.4.3 Friction torque. The torque required to rotate the motor shaft at speeds less than 6 rpm at rated temperature, with no differential pressure or case pressure applied, shall not exceed 2.5 lb-in (0.28 N-m) (see 4.5.3.3).

3.4.4 Holding torque. The motor, acting as a pump, shall provide holding torque against a gravity induced load torque which varies from 8 lb-in (0.9 N-m) to 24 lb-in (2.7 N-m) when tested in accordance with 4.5.3.4.

3.4.5 Intermittent torque. The performance of the motor shall not be impaired by repeated torque loading impulses sufficient to raise the differential pressure across the motor to 2700 psi (18 600 kPa). The duration of the loading shall not exceed one second and the torque shall be in one direction only (see 4.5.3.5).

3.4.6 Attitude. The motor shall meet all requirements of this specification when mounted in any attitude with a 20 psi (140 kPa) check valve installed in the drain line (see 4.5.3.6).

3.4.7 Resisting load. Pressure differential shall not exceed 2300 psi when the motor is tested in accordance with 4.5.3.7.

3.4.8 Cylinder block lift. There shall be no cylinder block lift, as evidenced by the absence of excessive case drain flow, when the motor is operated at 9000 rpm for 10 seconds in each direction with no load on the shaft (see 4.5.3.8).

3.4.9 Volumetric efficiency. The volumetric efficiency of the motor shall not be less than 95 percent at speeds between 1500 and 6000 rpm (see 4.5.3.9).

3.4.10 Intermittent speed/endurance. The hydraulic motor shall not be damaged nor its performance impaired by 5000 intermittent operation cycles as designated in table II, half in each direction, at speeds up to 5000 rpm. The differential pressure across the motor shall be between 100 and 1700 psi (690 and 11 700 kPa) during the test cycle. The motor case drain pressure shall not exceed 25 psi (170 kPa) (see 4.2.2 and 4.5.3.10).

TABLE II. Operational cycle.

Number of test cycles		Temperature of fluid at motor inlet
Resistive load	Overhauling load	
500	500	100 ± 20°F (38 ± 10°C)
1500	1500	150 ± 20°F (66 ± 10°C)
500	500	170 ± 20°F (77 ± 10°C)

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3.4.11 Leakage. The motor shall meet all requirements for leakage when supplied with fluid per 4.5.3.11.

3.4.11.1 Running leakage. The shaft leakage shall not exceed 5 drops in ten minutes when tested in conformance with 4.5.3.11.1.

3.4.11.2 Shaft seal leakage. When the inlet and outlet ports of the motor are blocked, the shaft is locked, leakage around the motor shaft seal shall not exceed 5 drops in 10 minutes when tested in conformance with 4.5.3.11.2. There shall be no visible leakage at any other point.

3.4.12 Idling loss. The differential pressure between the motor inlet and outlet ports shall maintain the motor in smooth rotation when tested in conformance with 4.5.3.12.

3.4.13 Consumption. The rate of inlet flow required to drive the motor at 6960 rpm shall not exceed 4 gallons per minute (gal/min) (15 liters per minute (L/min)) when tested in accordance with 4.5.3.13.

3.4.14 Direction of rotation. The hydraulic motor shall operate satisfactorily in either direction of rotation. It shall not be necessary to alter the motor to effect a change in the direction of rotation, but merely to reverse the direction of flow (see 4.2.6).

3.4.15 Break-in run. The motor shall not overheat or leak excessively during break-in run (see 4.2.1).

3.5 Environmental conditions. The motor shall meet the performance requirements of 3.4 during and after exposure to those environments designated as operating. The motor shall not be damaged, and it shall meet the performance requirements of 3.4 after exposure to those environment conditions designated as non-operating (see 4.5.4).

3.5.1 High temperature (operating). The motor shall operate normally in ambient temperatures up to 140°F (60°C) (see 4.5.4.1).

3.5.1.1 High temperature (nonoperating). The motor shall not be damaged nor its performance impaired after extended exposure to an ambient temperature of 155°F (68°C) (see 4.5.4.1.1).

3.5.2 Low temperature (operating). The motor shall operate normally in ambient temperatures down to -25°F (-32°C) (see 4.5.4.2).

3.5.3 Salt fog. The motor shall not be damaged nor its performance impaired after exposure to a salt laden environment (see 4.5.4.3).

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3.5.4 Fungus. Materials which are nonnutrients shall be used where possible. Fungus growth shall not cause performance degradation (see 4.5.4.4).

3.5.5 Shock (nonoperating). The motor shall not show evidence of physical damage or degradation of performance impaired after exposure to shock waves when exposed to tests of 4.5.4.5.

3.5.6 Vibration (nonoperating). The motor shall not be damaged nor its performance impaired after being exposed to vibration in 4.5.4.6.

3.5.7 Proof pressure. The motor shall not be damaged nor its performance impaired after being exposed to a proof pressure in accordance with 4.5.4.7.

3.5.8 Burst pressure. The motor shall not be damaged nor its performance impaired after being exposed to a burst pressure in accordance with 4.5.4.8.

3.6 Identification marking plates. Motor assemblies shall be identified as specified in Drawing 12265504. Identification markings, shall meet the requirements of ANSI/AS478 and shall include the following information as a minimum (see 4.5.1):

a. Motor hydraulic: type I, class 3000
b. Constant displacement: 0.12 cu in per revolution
c. Manufacturer's name and FSCM number
d. Fluid: MIL-PRF-6083
e. Serial number
f. Military part number: 12265504
g. Federal stock number
h. Manufacturer's part number
i. Date of manufacture
j. Contract number (month/year)
k. Cage code: 19207.

3.7 Workmanship. All parts shall be fabricated and assembled in a thorough and workmanship like manner. They shall be free of burns. chips, sharp edges, cracks, unblended radii, surface defects, dirt, grease, corrosion, process residue and other foreign matter. Exposed surfaces shall not have chipped, scratched, peeling, or incorrect finishes. The unit shall contain no rust or corrosion. Screw threads shall be clean and to the full depth required (see 4.5.1).

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4. VERIFICATION

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

a. First article inspection (see 4.3).
b. Conformance inspections (see 4.4).

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

a. Air temperature: 73 ±18°F (23 ±10°C)
b. Barometric pressure: 28.5 (+2, -3) in. of mercury (Hg) (96.5 (+7, -10) kPa)
c. Relative humidity: 50 ±30 percent.

4.2.1 Break-in run. The motor shall be operated for a duration of 2 hours at a minimum of 3000 rpm, while the shaft is loaded to impose a minimum 1500 psi (10 300 kPa) inlet pressure (see 3.4.15).

4.2.2 Operating pressure. The motor shall meet all operating requirements when supplied with fluid at a pressure difference between the inlet and outlet ports (differential pressure) of 2250 psig (15 500 kPa).

4.2.3 Ambient conditions. Measurements and tests shall be made at standard ambient conditions. Standard ambient conditions are the same as listed for inspection conditions (see 4.2).

4.2.4 Test fluid. Test fluid shall conform to MIL-PRF-6083. The fluid shall be filtered through a 10 µm (25 µm absolute) filter before application to the motor.

4.2.5 Case pressure. Motor case pressure shall be maintained between 20 and 75 psi (138 and 510 kPa) during the tests listed in table III.

4.2.6 Rotation. Performance tests shall be run in both directions of motor rotation. These tests shall verify conformance to 3.4.14 by visual examination.

4.2.7 Test equipment. Appropriate test equipment shall be used in the performance of the tests and inspections that have the following capabilities:

a. An external hydraulic power source capable of providing hydraulic oil at pressures up to 12 000 psi.

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b. A hydraulic test facility capable of permitting motor operation at all mounting attitudes; continuous, intermittent, reversing and stalled operation in either direction of rotating and application of loads on the motor shaft up to 30 lb-in.
c. Instrumentation necessary for measuring, motor rpm, motor torque, oil pressure, oil flow rates, oil temperature, and leakage.
d. All gages and measuring devices shall be accurate within ±5% of full scale.

4.3 First article inspection. First article inspection shall be performed on preproduction or initial production samples as specified in table III (see 3.1).

4.3.1 Preproduction inspection. When specified (see 6.2), the preproduction sample shall consist of two hydraulic motors. Preproduction inspection shall consist of examination as specified in 4.4.1.3 and tests specified in table III.

4.3.2 Initial production inspection. Unless otherwise specified (see 6.2), the Government shall select two samples, from the first 10 hydraulic motors produced under the production contract for initial production inspection. Initial production units shall be examined as specified in 4.4.1.3 and tested as specified in table III.

4.4 Conformance inspection.

4.4.1 Sampling. Sampling for inspection lots and sampling for examination of conformance, see 6.5.

4.4.2 Materials and design. Conformance to 3.2 thru 3.3.12 shall be determined by inspection of contractor records providing proof of certification that materials and design conform to requirements. Applicable records shall include drawings, specifications, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certifications, industry standards, test reports, and rating data.

TABLE III. Classification of inspections.

Title	Requirement	Inspection	Conformance	
			First article	Test 100%
Materials and finish	3.2 thru 3.2.4	4.4.1.3	X	
Design and construction	3.3 thru 3.3.12			
	3.3.1	4.4.1.3	X	
Fluid	3.3.2	4.2.4	X	X
Cleanliness 1/	3.3.3	4.4.1.3	X	
Lubrication	3.3.8	4.4.1.3	X	
Interchangeability		4.5.1	X	

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TABLE III. Classification of inspections - Continued.

Title	Requirement	Inspection	Conformance	
			First article	Test 100%
Direction of rotation 1/	3.3.10	4.2.6	X	
Configuration	3.3.11	4.5.1	X	
Weight	3.3.12	4.5.1	X	
Starting torque	3.4.1	4.5.3.1	X	X
Running torque	3.4.2	4.5.3.2	X	
Friction torque	3.4.3	4.5.3.3	X	X
Holding torque	3.4.4	4.5.3.4	X	X
Intermittent torque	3.4.5	4.5.3.5	X	
Attitude	3.4.6	4.5.3.6	X	
Resisting load	3.4.7	4.5.3.7	X	X
Cylinder block lift	3.4.8	4.5.3.8	X	X
Volumetric efficiency	3.4.9	4.5.3.9	X	
Intermittent speed endurance	3.4.10	4.5.3.10	X	
Running leakage	3.4.11.1	4.5.3.11.1	X	
Shaft seal leakage	3.4.11.2	4.5.3.11.2	X	X
Idling loss	3.4.12	4.5.3.12	X	X
Consumption	3.4.13	4.5.3.13	X	X
Direction of rotation	3.4.14	4.2.6	X	
Break-in run	3.4.15	4.2.1	X	X
High temperature (operating)	3.5.1	4.5.4.1	X	
High temperature (nonoperating)	3.5.1.1	4.5.4.1.1	X	
Low temperature (operating)	3.5.2	4.5.4.2	X	
Salt fog	3.5.3	4.5.4.3	X	
Fungus	3.5.4	4.5.4.4	X	
Shock (nonoperating)	3.5.5	4.5.4.5	X	
Vibration (nonoperating)	3.5.6	4.5.4.6	X	
Proof pressure	3.5.7	4.5.4.7	X	
Burst pressure	3.5.8	4.5.4.8	X	
Marking 1/	3.6	4.5.2	X	
Workmanship 1/	3.7	4.5.2	X	

1/ See 4.5.1 and table IV.

4.5 Method of inspection.

4.5.1 Defects. Conformance to 3.3.8, 3.3.11 and 3.6 shall be determined by examination for the defects listed in table IV. Examination shall be visual, tactile, or by measurement by SIE.

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TABLE IV. Classification of defects.

Category	Defect	Method of inspection
Major:		
101	Dimensions affecting interchangeability not within tolerance (see 3.3.8 and 3.3.11).	SIE 1/
102	Direction of rotation marking not as specified (see 3.3.10).	Visual
103	Weight not as specified (see 3.3.12).	SIE
Minor:		
201	Dimensions not affecting interchangeability not within tolerance (see 3.3.8 and 3.3.11).	SIE
202	Improper marking (see 3.3.10 and 3.6).	Visual
203	Improper workmanship (see 3.7).	Visual
204	Cleanliness (see 3.3.2).	SIE

1/ SIE = Standard Inspection Equipment.

4.5.2 Tests. Each hydraulic motor assembly shall be subjected to the tests specified in table III.

4.5.3 Performance.

4.5.3.1 Starting torque. To determine conformance to 3.4.1, the motor shaft shall be externally rotated through one revolution at a rate less than one rpm. The differential pressure across the motor ports shall be maintained at a value not to exceed 2300 psi. The torque measured at any point in the rotation shall not be less than 30 lb-in.

4.5.3.2 Running torque. To determine conformance to 3.4.2, the torque shall be measured at the output shaft of the motor, running at a speed of 3000 rpm with a differential pressure of 2300 psi. The torque shall be not less than 30 lb-in.

4.5.3.3 Friction torque. To determine conformance to 3.4.3, the torque required to rotate the unit at a speed of 6 rpm shall be measured at the output shaft. The torque required shall not exceed 2.5 lb-in (0.28 N-m).

4.5.3.4 Holding torque. To determine conformance to 3.4.4, apply an overhauling torque of 24 lb-in to the motor shaft. Connect the drain port to the inlet port thru a 10 psi check valve and block the outlet port. Fill all hydraulic lines with hydraulic fluid. The motor shaft shall not rotate more than 200 revolutions in 10 minutes with a 24 lb-in (2.7 N-m) torque applied.

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4.5.3.5 Intermittent torque. To determine conformance to 3.4.5, the outlet port of the motor shall be connected to the drain through a 2700 psi relief valve. The inlet port shall be supplied hydraulic fluid through an anti-cavitation check valve from the drain. The case drain shall be connected to drain through a 20 psi (6.9 kPa) check valve. The torque shall be sufficient to cause flow through the 2700 psi relief valve. Repeat for a total of 3000 cycles. The motor shall be capable of meeting the performance requirements of 3.4 after the test.

4.5.3.6 Attitude. Conformance to 3.4.6 shall be verified by tests on a motor with the mounting flange in at least 3 positions: horizontal; vertical, up; and vertical, down.

4.5.3.7 Resisting load. To determine conformance to 3.4.7, a load of 30 lb-in shall be applied to the motor shaft tending to turn the motor shaft in opposition to the direction established by the hydraulic flow (resisting load). The motor shall be run at 3000 rpm. The pressure differential shall not exceed 2300 psi (see 3.4.2).

4.5.3.8 Cylinder block lift. To determine conformance to 3.4.8, the motor shall be operated at 9000 rpm for 10 seconds in each direction with no load on the shaft. There shall be no cylinder block lift as evidenced by the absence of excessive case drain flow.

4.5.3.9 Volumetric efficiency. To determine conformance to 3.4.9, the shaft shall be loaded to impose an operating pressure on the inlet port, the motor speed shall be varied between 1500 and 6000 rpm and the volumetric efficiency shall not be less than 95%.

4.5.3.10 Intermittent speed/endurance. To determine conformance to 3.3.4 and 3.4.10, the motor shall be started with a resistive load of 22 lb-in (2.5 N-m) applied to the output shaft. The motor shall be operated at this load for 6 seconds at 5000 rpm and then stopped. The time required to change direction of motor rotation shall not be less than 1 second nor more than 10 seconds. A sequence of 5 periods of operation in each direction followed by a nonoperating period of not less than 2 minutes shall comprise one test cycle, with a resistive load. The motor shall be acted upon by an overhauling load in the identical manner as the resistive load. The overhauling load test cycle shall be the same as for the resistive load test cycle. Perform at least 5000 cycles in accordance with table II (see 6.3).

4.5.3.11 Leakage. Operating fluid for leakage tests shall be supplied at a temperature of 130°F (54°C) (see 3.4.11).

4.5.3.11.1 Running leakage test. To determine conformance to 3.4.11.1, with the motor shaft free to rotate, apply 1000 $\pm$25 psi (6900 $\pm$170 kPa) to one port and throttle the output to achieve approximately 10 rpm motor shaft speed. Apply 100 $\pm$10 psi (689.5 $\pm$69 kPa) to the case drain.

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4.5.3.11.2 Shaft seal leakage test. To determine conformance to 3.4.11.2, apply no less than 70 psi (483 kPa) to the case drain connection, with the motor shaft locked, the inlet and outlet ports blocked and the hydraulic fluid at rated temperature.

4.5.3.12 Idling loss. To determine conformance to 3.4.12, operate the motor at 6960 rpm in either direction with no load on the shaft. The differential pressure measured across the motor shall not exceed 400 psi (2757.9 kPa).

4.5.3.13 Consumption. To determine conformance to 3.4.13, the shaft shall be loaded to impose an operating pressure of 2250 psi (15 000 kPa) on the inlet port and the motor operating at 6960 rpm measure the inlet flow. The inlet flow shall not exceed 4 gal/min.

4.5.4 Environmental tests.

4.5.4.1 High temperature (operating). To determine conformance to 3.5.1, the motor body and hydraulic fluid shall be stabilized at a temperature of 140°F for at least 24 hours. While the ambient temperature is maintained at 140°F, the motor shall then be started 5 times in each direction with a resisting load of 30 lb-in applied to the motor shaft. The differential pressure across the inlet ports shall not exceed 2250 psi (15 513 kPa). After each start the motor shall be operated for two minutes at 5000 rpm with a resisting load of 28 lb-in (3.2 N-m). Sufficient heating of the motor and fluid shall be provided to maintain 140°F temperature at the beginning of each start.

4.5.4.1.1 High temperature (nonoperating). To determine conformance to 3.5.1.1, the motor shall be tested in accordance with MIL-STD-810, method 501.2, procedure 1, at a temperature of 155°F.

4.5.4.2 Low temperature (operating). To determine conformance to 3.5.2, the motor body and hydraulic fluid shall be stabilized at a temperature of -25°F for no less than 24 hours. The motor shall then be started 5 times in each direction with a resisting load of 30 lb-in applied to the motor shaft. The differential pressure across the motor ports shall not exceed 2300 psi. After each start the motor shall be operated for two minutes at 5000 rpm with a resisting load of 28 lb-in, sufficient cooling of the motor and fluid shall be provided such that the temperature of the fluid or the motor body is not higher than -20°F (-29°C) at the beginning of each attempted start.

4.5.4.3 Salt fog. To determine conformance to 3.5.3, the motor shall be tested in accordance with procedure 1, method 509.2 of MIL-STD-810.

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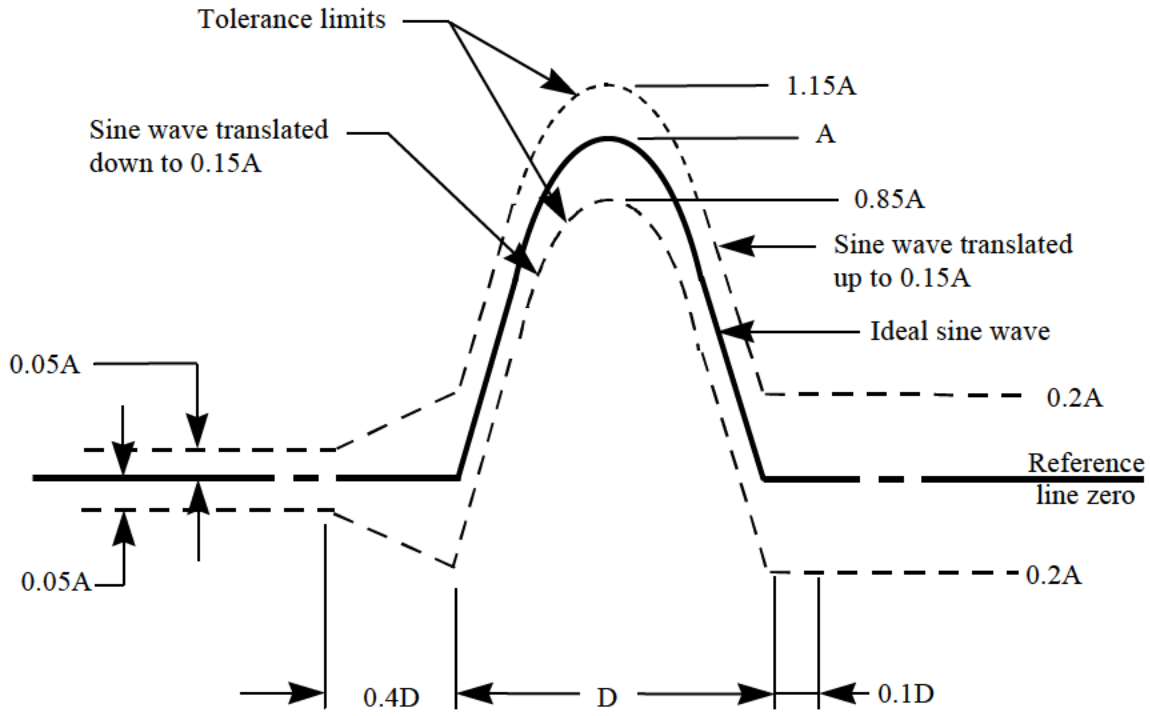
4.5.4.4 Fungus. The assembly shall be tested in accordance with MIL-STD-810, method 508.3, to verify conformance to 3.5.4. In lieu of the performance of the MIL-STD-810 test, certification of compliance, with supporting data, may be provided attesting that the assembly is constructed of materials that will not support fungus growth.

4.5.4.5 Shock (nonoperating). To determine conformance to 3.5.5, the motor shall fall within the tolerance envelope of figure 1 when exposure to the half-sine shock waves of 25 g for 11 milliseconds (ms) duration applied along three mutually perpendicular directions.

4.5.4.5.1 Frequency response. The frequency response of the complete measuring system, including the transducer through the readout instrument shall be as specified in figure 2.



$V_i = 2AD/\pi$

$V = V_i \pm 10\%$

NOTE: The oscillogram should include a time about 3D long with pulse located approximately in the center. The integration to determine velocity change should extend from 0.4D before the pulse to 0.1D beyond the pulse. The acceleration amplitude of the ideal half-sine pulse is A and its duration is D. Any measured acceleration pulse which can be contained between the broken line boundaries is a nominal half-sine pulse of nominal amplitude A and nominal duration D. The velocity-change associated with the measured acceleration pulse is V.

FIGURE 1. Tolerances for half-sine shock pulse.

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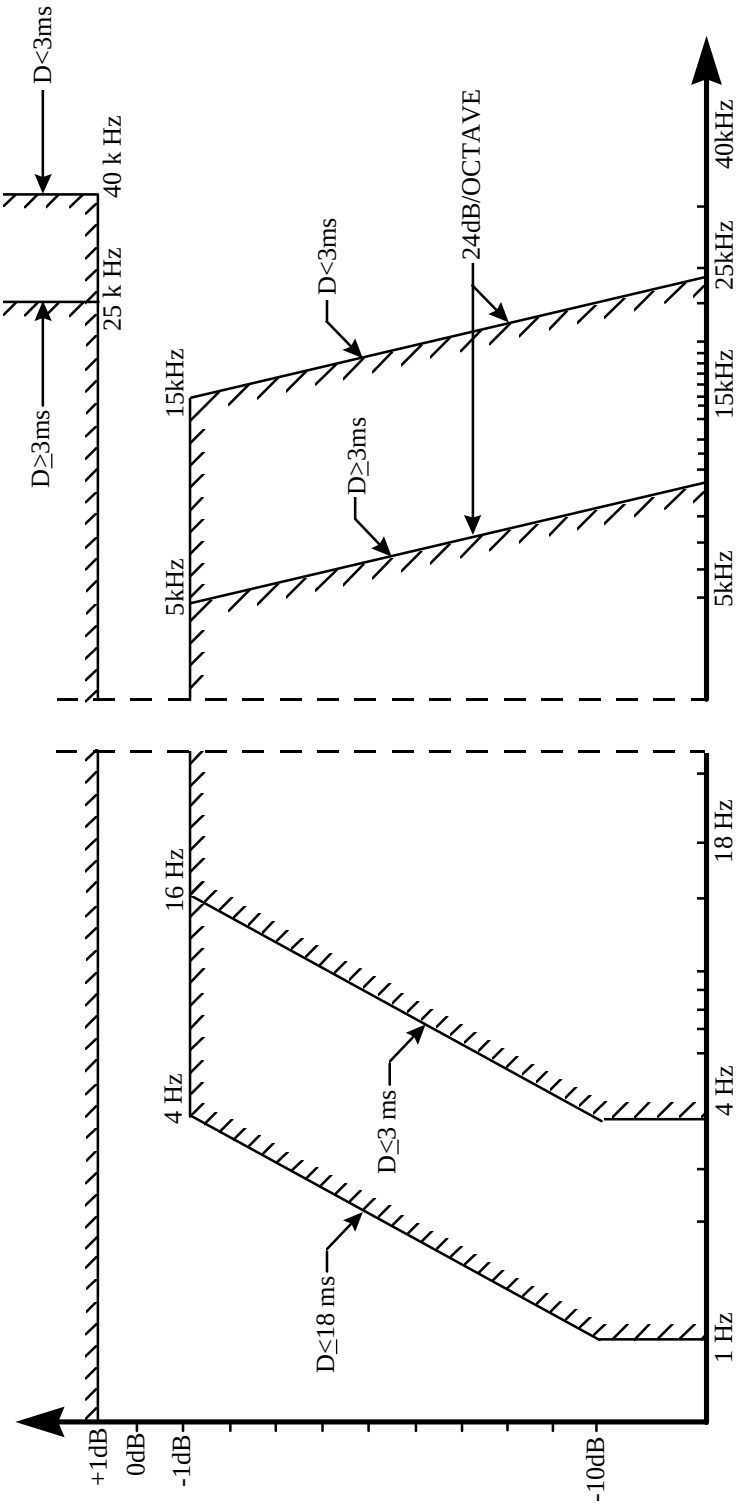

Duration of pulse (ms)	Low-frequency cut-off (Hz)		High-frequency cut-off (kHz)	Frequency beyond which the response may rise above + 1dB (kHz)
	-1dB	-10dB	-1dB	
3	16	4	15	40
<3	16	4	5	25
>3	4	1	5	25

FIGURE 2. Tolerance limits for measuring system frequency response.

dB=20 LOG READOUT VOLTS (AT ANY FREQUENCY)
READOUT VOLTS (AT 100 HERTZ)

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4.5.4.6 Vibration (nonoperating). To determine conformance to 3.5.6, the motor shall be tested in accordance with vibration in the form of simple harmonic motion, in three mutually perpendicular axes, and consisting of twelve 15 minute logarithmic sweeps along each axis for a total of 9 hours.

4.5.4.6.1 Test condition (10 g peak). The motor while deenergized or operating under load shall be subjected to the following frequencies and amplitudes.

Frequency	Amplitude
5 to 6.2 hertz (Hz)	0.5 in (12.7 millimeters (mm) double amplitude
6.2 to 25 Hz	±1 gravity unit (g)
25 to 200 Hz	± 0.5 g

4.5.4.7 Proof pressure. To determine conformance to 3.5.7 the motor shaft shall be clamped to prevent rotation and the outlet port connected to the drain. Apply not less than 6000 psi (41 000 kPa) to the inlet port. The motor shall be capable of meeting the performance requirements of 3.4 after the test.

4.5.4.8 Burst pressure. To determine conformance to 3.5.8 the motor shaft shall be clamped to prevent rotation and the outlet port connected to the drain. Apply not less than 12 000 psi (82 800 kPa) to the inlet port. The motor shall be capable of meeting the performance requirements of 3.4 after the test.

5. PACKAGING

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

6. NOTES

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

6.1 Intended use. The hydraulic motor will be utilized in the M901A1 improved tow vehicle launcher erection drive system.

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6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number. and date of this specification.
b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
c. If first article is required (see 3.1).
d. If inspection conditions are other than as specified (see 4.2).
e. If preproduction inspection is required (see 4.3.1).
f. If initial production inspection is not required (see 4.3.2).
g. Packaging requirements (see 5.1).

6.3 Subject term (key word) listing.

Differential pressure
Displacement per revolution
Fixed displacement
M901A1
Volumetric displacement

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

6.5 Sampling. Sampling, if required, should be specified in the contract.

Custodian:
Army - AT

Preparing Activity:
Army - AT

(Project 2590-A023)

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3. DOCUMENT TITLE

MOTOR, HYDRAULIC, CONSTANT DISPLACEMENT

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

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