



AEROSPACE STANDARD	AS7997™	REV. A
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Motors, Aircraft Hydraulic, Constant Displacement General Specification For		
FSC 1650		

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

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NOTICE

This document has been taken directly from U.S. Military Specification MIL-M-7997C and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-M-7997C. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this SAE technical document.

1. SCOPE:

1.1 Scope:

This Specification covers constant displacement hydraulic motors, generally remotely mounted, using hydraulic fluid under pressure as the energy transfer medium for driving various accessories. Hydraulic motors shall be suitable for use in aircraft hydraulic systems conforming to and as defined in MIL-H-5440 and MIL-H-8891 as applicable.

1.2 Classification:

Aircraft constant displacement hydraulic motors shall be of the following types and classes, as specified (see 6.2):

	Range	Rated
Type I.	-65°F (-54°C) to +160°F (71°C)	110°F (43°C)
Type II.	-65°F (-54°C) to +275°F (135°C)	225°F (107°C)
Type III.	-65°F (-54°C) to +390°F (200°C)	350°F (178°C)
Class 1500.	1500 psi (103 Bar) rated inlet pressure	
Class 3000.	3000 psi (207 Bar) rated inlet pressure	
Class 4000.	4000 psi (276 Bar) rated inlet pressure	
Category A.	Secondary. Secondary flight controls, winches, gun drives, constant speed drives, transfer packages, etc.	
Category B.	Primary. Primary flight controls, modulating slats, etc. See Para 4.6.15 for utility and primary motor endurance test requirements.	

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

NN-P-530	Plywood - Flat Panel
QQ-C-320	Chromium Plating (Electrodeposited)
QQ-N-290	Nickel Plating (Electrodeposited)
QQ-P-416	Plating, Cadmium (Electrodeposited)
QQ-S-365	Silver Plating (Electrodeposited)
QQ-Z-325	Zinc Coating, Electrodeposited, Requirements for
PPP-B-566	Boxes, Folding, Paperboard
PPP-B-585	Boxes, Wood, Wirebound
PPP-B-591	Boxes, Fiberboard, Wood-Cleated
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-621	Boxes, Wood, Nailed and Lock-Corner
PPP-B-636	Box, Fiberboard
PPP-B-676	Boxes, Set-Up
PPP-T-60	Tape: Pressure-Sensitive Adhesive, Waterproof, for Packaging

MILITARY

MIL-P-116	Preservation, Methods of
MIL-B-121	Barrier Material, Greaseproofed, Waterproofed, Flexible
MIL-C-5501	Caps and Plugs, Protective, Dust and Moisture Seal
MIL-C-5541	Chemical Films and Chemical Film for Aluminum and Aluminum Alloys
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance
MIL-H-6083	Hydraulic Fluid, Petroleum Base, Preservation and Testing
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-H-8775	Hydraulic System Components, Aircraft and Missiles, General Specification for
MIL-F-8815	Filter and Filter Elements, Fluid Pressure, Hydraulic Line, 15 Micron Absolute and 5 Micron Absolute Type II Systems
MIL-S-8879	Screw Threads, Controlled Radius Root With Increased Minor Diameter; General Specification for

2.1.1 (Continued):

MIL-H-8890	Hydraulic Components, Type III (-65° to 450°F), General Specification for
MIL-L-10547	Liners, Case, and Sheet, Overwrap, Water-Vaporproof or Waterproof, Flexible
MIL-T-10727	Tin Plating; Electrodeposited or Hot Dipped, for Ferrous and Nonferrous Metals
MIL-C-11796	Corrosion Preventive Compound, Petrolatum, Hot Application
MIL-P-15024	Plate, Identification - Information and Markings
MIL-C-16173	Corrosion Preventive Compound, Solvent Cutback, Cold Application
MIL-F-25682	Filter and Filter Element, Fluid Pressure, Hydraulic, absolute, 25 Micron, -65° to +450° and +600°F
MIL-C-26074	Coating, Nickel-Phosphorus, Electroless Nickel, Requirements for
MIL-H-83282	Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft
MIL-P-83461	Packings, Preformed-Petroleum Hydraulic Fluid Resistant Improved Performance @ 275°F (135°C)

STANDARDS

MILITARY

DOD-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-143	Specifications and Standards, Order of Precedence for the Selection of
MIL-STD-276	Impregnation of Porous Nonferrous Metal Castings
MIL-STD-280	Definitions of Item Levels, Item Exchangeability Models, and Related Terms
MIL-STD-781	Reliability Tests: Exponential Distribution
MIL-STD-810	Environmental Test Methods
MIL-STD-889	Dissimilar Metals
MS3332	Flange - Accessory, 5,000 B.C. Round, Design Standard for
MS3335	Spline Details, Accessory Drives and Flanges
MS21344	Fitting, Installation of Flared Tube, Straight Threaded Connectors Design Standard for
MS28773	Retainer, Packing Backup, Tetrafluoroethylene, Thread Tube Fitting Boss
MS28774	Retainer, Packing Backup, Single Turn, Tetrafluoroethylene
MS28775	Packing, Preformed, Hydraulic Plus 275 Deg. F (O-Ring)
MS28782	Retainer, Packing, Backup, Teflon
MS28783	Ring, Gasket, Backup, Teflon
MS33649	Boss, Fluid Connection, Internal Straight Thread

AIR FORCE-NAVY AERONAUTICAL

AND10260	Flange, Type X Accessory Mounting
AND10261	Flange, Type XI Accessory Mounting
AND10262	Flange, Type XII Accessory Mounting

2.1.1 (Continued):

(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 Other publications:

The following document forms 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

AIR-1362 Physical Properties of Fluids

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

2.3 Order of precedence:

In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS:

3.1 First article/qualification:

The motors furnished under this specification shall be a product which has been tested and passed the first article or qualification as specified in the detail specification.

3.2 Precedence:

The requirements of MIL-H-8775 or MIL-H-8890, as applicable apply as requirements of this specification with the exceptions and additions specified herein. In case of conflict between the requirements of this specification and the detail specification the requirements of the detail specification shall take precedence.

3.3 Selection of specifications and standards:

Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.4 Materials:

Materials used in the manufacture of hydraulic motors shall be of high quality, suitable for the purpose, and shall conform to the applicable Government specifications. Materials conforming to the motor manufacturer's specifications may be used provided the specifications are acceptable to the procuring activity and contain provisions for adequate tests. The use of motor manufacturer's specifications shall not constitute waiver of other applicable specifications.

3.4.1 Metals: All metals used in the construction of hydraulic motors, except those which are in constant contact with the hydraulic fluid, shall be of a corrosion-resistant type or shall be suitably protected to resist corrosion. The use of dissimilar metals, especially brass, copper, or steel in intimate metal-to-metal contact with aluminum alloy, shall be avoided wherever practicable. Dissimilar metals are defined in MIL-STD-889.

3.4.1.1 Type I system motors: Except for internal surfaces in constant contact with hydraulic fluid, ferrous alloys shall have a chromium content of not less than 12 percent or shall be suitably protected against corrosion as specified in 3.4.2.1. In addition, tin, cadmium and zinc platings shall not be used for internal parts or on internal surfaces in contact with hydraulic fluid or exposed to its vapors. O-ring grooves for external seals shall not be considered as internal surfaces in constant contact with hydraulic fluid. Magnesium shall not be used.

3.4.1.2 Type II and type III system motors: Ferrous alloys shall have a chromium content of not less than 12 percent or shall be suitably protected against corrosion as specified in 3.4.2.1. In addition, tin, cadmium and zinc platings shall not be used for internal parts or on internal surfaces in contact with hydraulic fluid or exposed to its vapors. Magnesium shall not be used. Where performance or reliability of the motor will be jeopardized by the use of materials and processes as specified in 3.4.1 and 3.4.2, alternate materials or processes may be used, subject to the approval of the procuring activity. Such materials or processes shall be selected so as to provide the maximum degree of corrosion resistance consistent with the performance requirements.

3.4.2 Corrosion protection: Metals which do not inherently possess adequate corrosion-resisting characteristics shall be suitably protected, in accordance with the following subparagraphs, to resist corrosion which may result from such conditions as dissimilar metal combinations, moisture, salt spray, and high temperature deterioration as applicable.

3.4.2.1 Ferrous and copper alloys: Ferrous alloys requiring corrosion preventive treatment, and all copper alloys, except for parts having bearing surfaces, shall have a suitable electrodeposited metallic coating selected from Table I. Cadmium and zinc plating shall not be used for internal parts or on internal surfaces in contact with hydraulic fluid or exposed to its vapors and not where subject to abrasion. Where not indicated, class and type are at the option of the manufacturer.

TABLE I. Metallic coatings.

Cadmium Plating	QQ-P-416, Type II, Class 2
Zinc Plating	QQ-Z-325, Type II, Class 2
Chromium Plating	QQ-C-320
Nickel Plating	QQ-N-290
Silver Plating	QQ-S-365
Tin Plating	MIL-T-10727, Type I
Electroless Nickel	MIL-C-26074

3.4.2.1 (Continued):

Other metallic coatings, the use of which has been demonstrated to be satisfactory to the purchaser, such as electrodeposited 85 percent tin, 15 percent cadmium alloy may be used.

- 3.4.3 Anodizing: Unless otherwise authorized, all aluminum alloys shall be anodized in accordance with MIL-A-8625, except that in the absence of abrasive conditions they may be coated with chemical film in accordance with MIL-C-5541. The exceptions noted will be subject to the approval of the procuring activity.
- 3.4.4 Castings: Castings shall be of high quality, clean, sound, and free from cracks, blow holes, and excessive porosity and other defects. Defects not materially affecting the suitability of the castings may be repaired at the foundry or during machining by peening, impregnation, welding, or other methods acceptable to the procuring activity. Inspection and repair of castings shall be governed by quality control techniques and standards satisfactory to the procuring activity. When impregnation castings are used, they shall be in accordance with impregnation procedures and inspections requirements of MIL-STD-276.
- 3.4.5 Seals: For Type I system motors, static and dynamic seals where practicable, shall be in accordance with MS28775. For Type II system motors, static and dynamic seals, where practicable, shall be in accordance with MIL-P-83461 (improved performance at +275°F). Back up seals shall be in accordance with MS28773, MS28774, MS28782, or MS28783. Nonstandard seals necessary to demonstrate compliance with the requirements of this specification, may be used subject to the approval of the procuring activity. For Type III system motors, seals and back-up rings used shall be subject to approval of the procuring activity.

3.5 Design and construction:

- 3.5.1 Direction of rotation: Unless otherwise specified in the detail specification, the hydraulic motors 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.
- 3.5.2 Rated speed: The rated speed of a motor shall be the maximum speed at which the motor is designed to operate continuously at rated temperature and rated differential pressure. The rated speed shall be measured and stated as RPM of the motor output shaft and shall be specified in the detail specification.
 - 3.5.2.1 Overspeed: Motor performance and integrity shall not be impaired after driven at intermittent speeds up to 125 percent of rated RPM, for 30 minutes.
- 3.5.3 Shaft seal: The hydraulic motor shall be provided with a suitable seal for the motor shaft. No changes of the shaft seal shall be required for operation in either direction of rotation. The shaft seal shall be capable of meeting the tests and environments specified in Section 4.
- 3.5.4 Drains: The motor body shall be provided with case drain and seepage drain connections and plugs as specified in the detail specification.
- 3.5.5 Lubrication: The hydraulic motor shall be self-lubricating with no provision other than the circulating fluid.
- 3.5.6 Balance: The moving parts of the hydraulic motor shall be inherently balanced, and the motor shall not emit abnormal vibrations under conditions of operation at all speeds up to, and including the maximum speed. The self induced vibration limitations at the operating conditions shall be as specified in the detail specification.
- 3.5.7 Torque pulsations: The motor shall be designed to deliver continuous torque without excessive amplitude ripple (over $\pm 10\%$) when the motor is operated within the rated speed range under any of the conditions specified in Section 4 or as detailed in the detail specification.
- 3.5.8 Dimensions: The external envelope dimensions of the hydraulic motors shall conform to applicable drawings as specified in the detail specification.
- 3.5.9 Weight: The dry weight of the completely assembled motor shall not exceed the value specified in the detail specification and shall be specified on the installation drawing. When required by the detail specification, the wet weight shall also be specified on the installation drawing.
- 3.5.10 Ports: Unless otherwise specified in the detail specification, the port bosses shall conform to MS33649.