

MIL - P - 7858**4 APRIL 1952**

Superseding

AN-P-11b

17 June 1948

MILITARY SPECIFICATION**PUMP, HYDRAULIC, POWER DRIVEN, FIXED DISPLACEMENT**

This specification was approved by the Departments of the Army, the Navy, and the Air Force for use of procurement services of the respective Departments.

1. SCOPE

1.1 Scope.- This specification covers the requirements for 1,500 and 3,000 psi fixed displacement power-driven hydraulic pumps.

1.2 Classification.- Hydraulic pumps shall be of the following capacities as designated by the following part numbers:

<u>AN Part No.</u>	<u>Nominal Capacity</u> <u>(at 1,500 rpm, 1,500 psi)</u>
AN6250-1	1 gpm
AN6250-2	1 gpm
AN6251-1	2 gpm
AN6252-1	3 gpm
AN6253-2	5 gpm

<u>AN Part No.</u>	<u>Nominal Capacity</u> <u>(at 1,500 rpm, 3,000 psi)</u>
AN4146	1/2 gpm
AN4147	1 gpm
AN4148	2 gpm
AN4149	3 gpm
AN4150	4 gpm
AN4151	5 gpm

2. APPLICABLE SPECIFICATIONS, OTHER PUBLICATIONS, AND DRAWINGS

2.1 The following publications, of the issue in effect on date of invitation for bids, shall form a part of this specification to the extent specified herein:

2.1.1 Specifications.-Federal

QQ-P-416 Plating, Cadmium, (Electrodeposited)

Military

MIL-A-140 Adhesive, Water-Resistant, Waterproof
Barrier-Material
MIL-C-5501 Closure, Aircraft Tubing Protective
MIL-D-5028 Drawings and Data Lists; Preparation of
(For Engines, Accessories, and Other
Auxiliary Equipment)

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MIL-F-5504	Filters; Hydraulic
MIL-H-5440	Hydraulic Systems; Design, Installation and Tests of Aircraft (General Specification For)
MIL-O-5606	Oil; Hydraulic, Aircraft Petroleum Base
MIL-O-6083	Oil; Preservative, Hydraulic Equipment
MIL-P-6871	Plating, Chromium
MIL-P-6906	Plates, Information and Identification
MIL-S-7742	Screw Threads, Standard, Aeronautical
JAN-B-121	Barrier-Materials, Greaseproof
JAN-P-105	Packaging and Packing for Overseas Shipment - Boxes, Wood, Cleated, Plywood
JAN-P-106	Packaging and Packing for Overseas Shipment - Boxes, Wood, Nailed
JAN-P-108	Packaging and Packing for Overseas Shipment - Boxes, Fiberboard (V-Board and W-Board), Exterior and Interior
JAN-P-120	Packaging and Packing for Overseas Shipment - Cartons, Folding, Paperboard
JAN-P-125	Packaging and Packing for Overseas Shipment - Barrier-Materials, Waterproof Flexible
JAN-P-127	Packaging and Packing for Overseas Shipment - Tape, Adhesive, Pressure-Sensitive, Water Resistant
JAN-P-133	Packaging and Packing for Overseas Shipment - Boxes, Set-Up, Paperboard
JAN-P-139	Packaging and Packing for Overseas Shipment - Plywood, Container Grade

Air Force-Navy Aeronautical

AN-QQ-A-696	Anodic Films; Corrosion-Protective (for) Aluminum Alloys
AN-C-124	Compound; Soft-Film Corrosion-Preventive
AN-P-32	Plating; Zinc

2.1.2 Other Publications.-

Military Standard (Book)

MIL-STD-129	Marking of Shipments
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Air Force-Navy Aeronautical Bulletin

No. 143	Specifications and Standards; Use of
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National Advisory Committee for Aeronautics

Technical Report No. 218	Altitude Tables
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(Copies of this report may be obtained from the National Advisory Committee for Aeronautics, 1724 F Street, N. W., Washington, D. C.)

2.1.3 Drawings.-

Air Force-Navy Aeronautical Standard Drawings

AN4044	Gasket - Type XI Engine Accessory Drive
AN4045	Gasket - Type X or XV Engine Accessory Drive
AN4047	Gasket - Type XII or Type XIV A and B Engine Accessory Drive

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AN4146	Pump - 1/2 GPM at 3000 PSI Power Driven Hydraulic
AN4147	Pump - 1 GPM at 3000 PSI Power Driven Hydraulic
AN4148	Pump - 2 GPM at 3000 PSI Power Driven Hydraulic
AN4149	Pump - 3 GPM at 3000 PSI Power Driven Hydraulic
AN4150	Pump - 4 GPM at 3000 PSI Power Driven Hydraulic
AN4151	Pump - 5 GPM at 3000 PSI Power Driven Hydraulic
AN6207	Valve - 1500 PSI Hydraulic Check
AN6249	Valve - 3000 PSI Hydraulic Check
AN6250	Pump - 1 GPM at 1500 PSI Power Driven Hydraulic
AN6251	Pump - 2 GPM at 1500 PSI Power Driven Hydraulic
AN6252	Pump - 3 GPM at 1500 PSI Power Driven Hydraulic
AN6253	Pump - 5 GPM at 1500 PSI Power Driven Hydraulic
AND10050	Bosses - Standard Dimensions For Straight Thread Gasket Seal
AND10260	Flange - Type I Accessory Drive
AND10261	Flange - Type XI Accessory Drive
AND10262	Flange - Type XII Accessory Drive
AND10398	Metals - Definition of Dissimilar

(Copies of specifications, standards, and drawings required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Materials.- Materials shall conform to applicable specifications and shall be as specified herein. Materials which are not covered by applicable specifications, or which are not specifically described herein, shall be of the best quality, of the lightest practicable weight, and suitable for the purpose intended.

3.1.1 Metals.- Metals, except metal which is in constant contact with the hydraulic fluid during use or storage, shall be of a corrosion-resisting type or shall be adequately protected to resist corrosion during the normal service life of the component.

3.1.1.1 Dissimilar Metals.- Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined in Drawing AND10398.

3.1.2 Plastic Parts.- The use of plastic parts shall be subject to the approval of the Services for the specific application involved.

3.1.3 Selection of Materials.- Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with ANA Bulletin No. 143, except as provided in the following paragraph.

3.1.3.1 AN or JAN Standard Parts.- AN or JAN Standard parts shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part numbers. Commercial utility parts such as screws, bolts, nuts, cotter pins, etc., may be used, provided they possess suitable properties and are replaceable by the AN or JAN Standard parts without alteration, and provided the corresponding AN or JAN part numbers are referenced in the parts list and, if practicable, on the contractor's drawings. In the event there is no suitable corresponding AN or JAN Standard part in effect on date of invitation for bids, commercial parts may be used provided they conform to all requirements of this specification.

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3.2 Design and Construction.

3.2.1 Direction of Rotation. The hydraulic pumps shall operate satisfactorily in either direction of rotation. It shall not be necessary to disassemble the pump to effect the change in rotation except that detailed parts may be changed provided the change can be made without disturbing the high pressure internal parts.

3.2.2 Rated Speed. The rated speed of the pumps shall be 3,750 rpm.

3.2.3 Rated Pressure. The rated pressure of the pumps shall be either 1,500 psi or 3,000 psi.

3.2.4 Shaft Seal. The hydraulic pump shall be provided with a suitable seal for the pump shaft. No changes to the shaft seal shall be required for operation in either direction of rotation. The shaft seal shall be of such design as to be capable of sealing both a positive and a negative pressure as specified in Section 4.

3.2.5 Drains. Drain holes and plugs as specified on the applicable AN or AND drawings referenced in this specification shall be provided for external drainage of the oil leakage around the pump shaft.

3.2.6 Lubrication. The hydraulic pump shall be self-lubricating with no provisions other than the circulating oil.

3.2.7 Balance. The moving parts of the hydraulic pump shall not cause destructive vibrations under any conditions of operation at all speeds up to and including 120 percent of rated speed.

3.2.8 Screw Threads. All screw threads shall be in accordance with Specification MIL-S-7742.

3.2.9 Threaded Parts. All internal or external threaded parts shall be positively locked.

3.2.10 Mounting Flange. The pump shall incorporate a mounting flange as specified in table I. Pump operation shall not be impaired by mounting the pump in any of the possible positions on the drive, with the face of the flange in any plane, except that the centerline at the port end of the pump shall not be below the centerline at the drive end of the pump.

3.2.10.1 Drive Coupling. The drive coupling shall be made from material that will resist fatigue from vibration and reverse stresses set up by torsional vibration of the driven shaft in the engine. The engine drive shaft vibration may vary in magnitude up to ± 2 degrees and may occur at frequencies above 50 cycles per second. The drive shall be removable without disturbing the high-pressure internal parts.

3.2.10.1.1 Shearing Section. The drive shall incorporate a shearing section to prevent damage to the engine in case of pump seizure. The shearing section torque shall fall within the maximum and minimum limits listed in table I.

3.3 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. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of Specification MIL-D-5028.

3.4 Dimensions. The dimensions of the hydraulic pumps shall conform to the applicable AN drawings.

TABLE I
Detail Requirements

Part Number	: Nominal Capacity		: Driving Torque Pound-Inches Max		: Shearing Section Torque Pound- Inches	: Weight Pounds (max)	: Gasket AN Part No.	: Mounting Flange
	: gpm (min) 1/ at 1,500:		: at Rated Pressure					
	: rpm, Rated psi		: at 750 \pm 25 rpm : at 3,750 \pm 25 rpm					
	: Delivery Pressure		: and 29 In. Hg abs : and 18 In. Hg abs					
	: 28 In. Hg abs		: Inlet Pressure : Inlet Pressure					
	: Inlet Pressure		:					
AN6250-1	1	70	70	400 to 725	3.5	AN4045-1	AND10260	
AN6250-2	1	70	70	900 to 1,500	4.0	AN4044-1	AND10261	
AN6251-1	2	130	130	900 to 1,500	6.5	AN4044-1	AND10261	
AN6252-1	3	190	190	900 to 1,500	7.5	AN4044-1	AND10261	
AN6253-2	5	250	250	900 to 1,500	11.0	AN4044-1	AND10261	
AN4146	1/2	65	65	900 to 1,500	4.5	AN4044-1	AND10261	
AN4147	1	115	115	900 to 1,500	4.5	AN4044-1	AND10261	
AN4148	2	215	215	900 to 1,500	6.5	AN4044-1	AND10261	
AN4149	3	320	320	1,200 to 2,400	9.5	AN4047-1	AND10262 - XIIJ	
AN4150	4	410	410	1,200 to 2,400	12.5	AN4047-1	AND10262 - XIIJ	
AN4151	5	500	500	1,200 to 2,400	12.5	AN4047-1	AND10262 - XIIJ	

1/ For allowable capacity-speed variation, see figure 1

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3.5 Weight.- The weights shall not exceed those specified in table I.

3.6 Ports.- The size of the pump ports shall be as specified on the applicable AN drawings. The port bosses shall conform to Drawing AND10050.

3.7 Gasket.- Each pump shall be provided with a mounting flange gasket as specified in table I.

3.8 Finish.-

3.8.1 Plating.- Unless otherwise specified, all steel parts in contact with aluminum or aluminum-alloy shall be cadmium-plated in accordance with Specification QQ-P-416, type I, class B, or zinc-plated in accordance with Specification AN-P-32, or hard chrome-plated in accordance with Specification MIL-P-6871. Cadmium- or zinc-plating may be used in contact with hydraulic fluid, provided there is no rubbing or abrasion on the surface to which it is applied. Surfaces in sliding contact with each other may be chrome-plated.

3.8.2 Anodizing.- All aluminum-alloy parts shall be anodized in accordance with Specification AN-QQ-A-696.

3.9 Performance.- The pumps shall satisfy the performance requirements of the tests listed in Section 4.

3.10 Markings.- All markings shall be durable to prevent effacing or obliteration resulting from service usage.

3.10.1 Direction of Rotation.- The corresponding inlet port for each direction of rotation shall be clearly and permanently marked on the pump housing as indicated on the applicable AN drawings.

3.11 Identification of Product.-

3.11.1 Nameplate.- A nameplate conforming to Specification MIL-P-6906 and containing the following information legibly filled in shall be securely attached to the pump:

PUMP, HYDRAULIC, POWER DRIVEN, FIXED DISPLACEMENT
AN Part No.
Specification MIL-P-7858
Capacity
Rated Pressure
Stock No.
Manufacturer's Part No.
Manufacturer's Serial No.
Contract or Order No.
Manufacturer's Name or Trade-Mark
U S Property

3.11.2 Use of AN or MIL Designations.- AN or MIL designations shall not be applied to a product, except for Qualification test samples, nor referred to in correspondence or sales matter, until notification has been received from the qualifying agency that the product has been approved for aeronautical use.

3.12 Workmanship.- All details of workmanship shall be in accordance with high-grade aircraft hydraulic pump manufacturing practice.

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4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 Classification of Tests.- The inspection and testing of hydraulic pumps shall be classified as follows:

- (a) Qualification tests: Qualification tests are those tests accomplished on samples submitted for qualification as a satisfactory product.
- (b) Inspection tests: Inspection tests are those tests accomplished on hydraulic pumps manufactured and submitted for acceptance under contract.

4.2 Qualification Tests.-

4.2.1 Sampling Instructions.- The Qualification test samples of each manufacturer's part number for which qualification is desired shall consist of two hydraulic pumps, one of which has been tested by the manufacturer in accordance with the specification. These pumps accompanied by one complete set of detail and assembly drawings and a complete test report to each service showing results of the manufacturer's tests, shall be identified as required and forwarded to the agency designated in the Letter of Authorization from the qualifying agency. These pumps shall be plainly identified by securely attached durable tags marked with the following information:

Sample for Qualification Test
PUMP, HYDRAULIC, POWER DRIVEN, FIXED DISPLACEMENT
GPM Rated Pressure _____
AN Part No.
Manufacturer's Part No.
Name of Manufacturer
Submitted by (name) (date) for Qualification test in
accordance with the requirements of Specification
MIL-P-7858 under authorization (reference authorizing
letter).

Assembly drawing shall show a cutaway section showing all details in their normal assembly position and shall carry part numbers of all details and subassemblies. The following data shall be furnished on or together with all assembly drawings:

- (a) Mounting dimensions
- (b) Port dimensions
- (c) Over-all dimensions
- (d) Materials of construction, treatment and finish
- (e) Rated capacity
- (f) Maximum torque
- (g) Weight
- (h) Complete dismantling procedure and description of tools needed
- (i) Any special installation or operating instructions considered necessary

4.2.2 Tests.- The Qualification tests shall consist of the following tests as described under "Test Methods," conducted in the following sequence:

- (a) Examination of Product
- (b) Break-In Run
- (c) Rated Speed Run
- (d) Proof Pressure Run
- (e) Capacity and Shaft Seal Leakage - Individual test (paragraph 4.5.5.1)

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- (f) Torque - Qualification test (Paragraph 4.5.6.3)
- (g) Operation
- (h) Low Temperature Starting
- (i) Shaft Seal Leakage - Sampling test - (Paragraph 4.5.5.2)
- (j) Capacity - Sampling test (Paragraph 4.5.5.3)
- (k) Torque - Sampling test (Paragraph 4.5.6.2)
- (l) Endurance
- (m) Recalibration
- (n) Shearing Section Strength

The Qualification tests may, at the option of the procuring agency, be supplemented with tests under actual service conditions.

4.3 Inspection Tests.- The contractor shall furnish all samples and shall be responsible for accomplishing the required tests. When inspection is conducted at the contractor's plant, all inspection and testing shall be under the supervision of the Government Inspector. Contractors not having laboratory testing facilities satisfactory to the Government shall engage the services of a commercial testing laboratory acceptable to the procuring agency. The contractor shall furnish test reports, in duplicate, showing quantitative results for all tests required by this specification, and signed by an authorized representative of the contractor or laboratory, as applicable. Acceptance or approval of material during course of manufacture shall in no case be construed as a guaranty of the acceptance of the finished product.

4.3.1 Individual Tests.- Each hydraulic pump submitted for acceptance under contract shall be subjected, in the order listed, to the tests described herein. In addition, each pump shall be subject to any other tests specified herein which the Inspector considers necessary to determine conformance with the requirements of this specification.

- (a) Examination of Product
- (b) Break-In Run
- (c) Rated Speed Run
- (d) Proof Pressure Run
- (e) Capacity and Shaft Seal Leakage - Individual Test
(Paragraph 4.5.5.1)
- (f) Torque - Individual Test (Paragraph 4.5.6.1)

4.3.2 Sampling Tests.-

4.3.2.1 Sampling.- One hydraulic pump from the first 50, in addition, one from the first 500, and also one from every 5,000 after the first 500 pumps which have passed the required Individual tests, shall be selected at random by the Inspector and subjected to the Sampling tests. Except for the Shearing Section Strength test, the basis for pump sampling shall be the total continuous production run of any given model. For the Shearing Section Strength test, a number of shafts not to exceed approximately 1 percent of each heat-treatment batch shall be selected at random by the Inspector.

4.3.2.2 Tests.- Each representative sample shall be subjected, in the order listed, to the following tests, as described under "Test Methods":

- (a) Low Temperature Starting
- (b) Shaft Seal Leakage - Sampling Test (Paragraph 4.5.5.2)
- (c) Capacity - Sampling Test (Paragraph 4.5.5.3)
- (d) Torque - Sampling Test (Paragraph 4.5.6.2)
- (e) Endurance
- (f) Recalibration
- (g) Shearing Section Strength

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4.3.3 Rejection and Retest.- When any representative sample fails to meet the requirements of the Sampling tests, 10 other pumps shall be selected at random from the lot represented and subjected to all the tests specified. If any pump of the group fails to meet these tests, the entire lot shall be rejected and returned at the contractor's expense. Any pump failing to meet the requirements of the Individual tests shall be rejected and returned at the contractor's expense. Pumps which have been rejected may be replaced or repaired to correct the defects and resubmitted for all the specified tests. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the original defects shall be furnished the Inspector. Pumps rejected after retest shall not be resubmitted without the specific approval of the Inspector.

4.4 Test Conditions.-

4.4.1 Cleaning.- All oil and grease or other corrosion-resisting compounds shall be removed from the interior and exterior parts of the hydraulic pump.

4.4.2 Direction of Rotation.- Unless otherwise specified, each pump shall be installed and tested with clockwise rotation, when viewed from the anti-drive end.

4.4.3 Oil.- Unless otherwise specified, all tests shall be conducted using hydraulic oil conforming to Specification MIL-O-5606.

4.4.4 Measurements and Apparatus.-

4.4.4.1 Inlet Pressure.- The inlet pressure shall be measured with a calibrated manometer or equally accurate pressure gage as close to the inlet port as practicable.

4.4.4.2 Outlet Pressure.- The outlet pressure shall be measured with a calibrated pressure gage located as close to the discharge port as practicable.

4.4.4.3 Oil Flow.- The oil flow shall be measured by any method which will give results to an accuracy of 2 percent.

4.4.4.4 Pump Speed.- The pump speed shall be measured at a shaft directly connected to the pump shaft or positively driven from that shaft.

4.4.4.5 Torque.- The torque required to drive the pump shall be measured in any suitable manner, such as with a dynamometer, or by running the pump with a calibrated motor and determining the torque from electrical measurements.

4.4.5 Pressure Pulsation.- Pressure pick-up equipment shall be capable of static calibration with repetitive accuracy of 5 percent of rated pressure and readability within 3 percent of rated pressure. The natural frequency of the pick-up shall be at least four times the fundamental pulsation frequency of the pumping mechanism, defined as:

- (a) The number of teeth in the driving gear of gear pumps multiplied by pump rpm
- (b) The number of pistons multiplied by pump rpm for piston pumps having an even number of pistons
- (c) Twice the number of pistons multiplied by pump rpm for piston pumps having an odd number of pistons.

4.4.6 Altitude Operation.- Altitude operation of the pump shall be simulated by maintaining the test altitude pressure in the reservoir and the air pressure surrounding the pump shaft seal. Altitude pressures shall be determined from NACA Altitude Tables, Technical Report No. 218. Unless otherwise specified, it can be assumed that the pump inlet will be supercharged so that the pump inlet pressure will be between 14 in. Hg abs and 12 psi gage.

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4.4.7 Oil Temperature.- Unless otherwise specified, the oil inlet temperature shall be $150^{\circ} \pm 5^{\circ}\text{F}$.

4.4.8 Filtration.- For all tests, a filter may be installed except in break-in run where filter is mandatory. The filter shall be in accordance with Specification MIL-F-5504.

4.4.9 Pump Mounting.- During all of the tests, including individual tests, the pump shall be installed on the laboratory mounting pad and a shim shall be so placed under the pump mounting flange that the included angle between the base of the pump mounting flange and the laboratory mounting flange shall be $1/4$ degree.

4.5 Test Methods.-

4.5.1 Examination of Product.- The pump shall be examined to determine conformance with the applicable drawings and all requirements of this specification for which there are no specific tests.

4.5.2 Break-In Run.- The break-in run shall be made with any desired restriction in the inlet and outlet line and shall consist of 1 hour at 1,700 to 2,750 rpm and 1 hour at 3,400 to 4,000 rpm. At the option of the procuring agency, the break-in run may be reduced to not less than $1/2$ hour.

4.5.3 Rated Speed Run.- Each pump shall be operated at 3,400 - 4,000 rpm and rated pressure ± 3 percent.

- (a) One-half hour at 30 to 27 inches Hg abs inlet pressure.
- (b) One hour at 18 to 16 inches Hg abs inlet pressure.

During the first $1/2$ hour, the rate of leakage of oil out of the pump through the drive shaft seal shall be determined. During the last hour, the pump outlet sight glass shall be observed to determine air leakage. The shaft seal oil leakage shall not exceed a rate of 5 ml per hour, and the air leakage into the pump shall be negligible.

4.5.4 Proof Pressure Run.- The pump shall be operated for 1 minute at 3,750 rpm minimum, 18 to 30 inches Hg abs inlet pressure, 125-percent rated minimum outlet pressure and $125^{\circ} \pm 25^{\circ}\text{F}$ oil inlet temperature. There shall be no oil leakage through the pump housing or cover, or at the gaskets or ports. The drive shaft seal leakage shall not exceed a rate of $1/8$ ml of oil per minute.

4.5.5 Capacity and Shaft Seal Leakage.-

4.5.5.1 Capacity and Shaft Seal Leakage - Individual Test.- The capacity and shaft seal leakage shall be determined at 1,500 rpm, rated outlet pressure, 26 inches Hg abs inlet pressure, and an air pressure of 2-psi gage in the chamber between the shaft seal and drive pad. The allowable variation in capacity for any given pump design at 1,500 rpm shall be as indicated on figure 1. The shaft seal leakage shall not exceed a rate of 5 ml per hour.

4.5.5.1.1 Shaft Seal Leakage Under Pressure.- The shaft seal leakage shall not exceed a rate of 5 ml per hour when the above test is repeated with inlet pressure of 12 psi gage and a seal chamber pressure of 3.5 inches Hg abs.

4.5.5.2 Shaft Seal Leakage - Sampling Test.- The shaft seal leakage shall not exceed a rate of 5 ml per hour when the pump is operated under the conditions called for under paragraphs headed Capacity - Sampling test, Torque - Sampling test, Endurance, and Recalibration.

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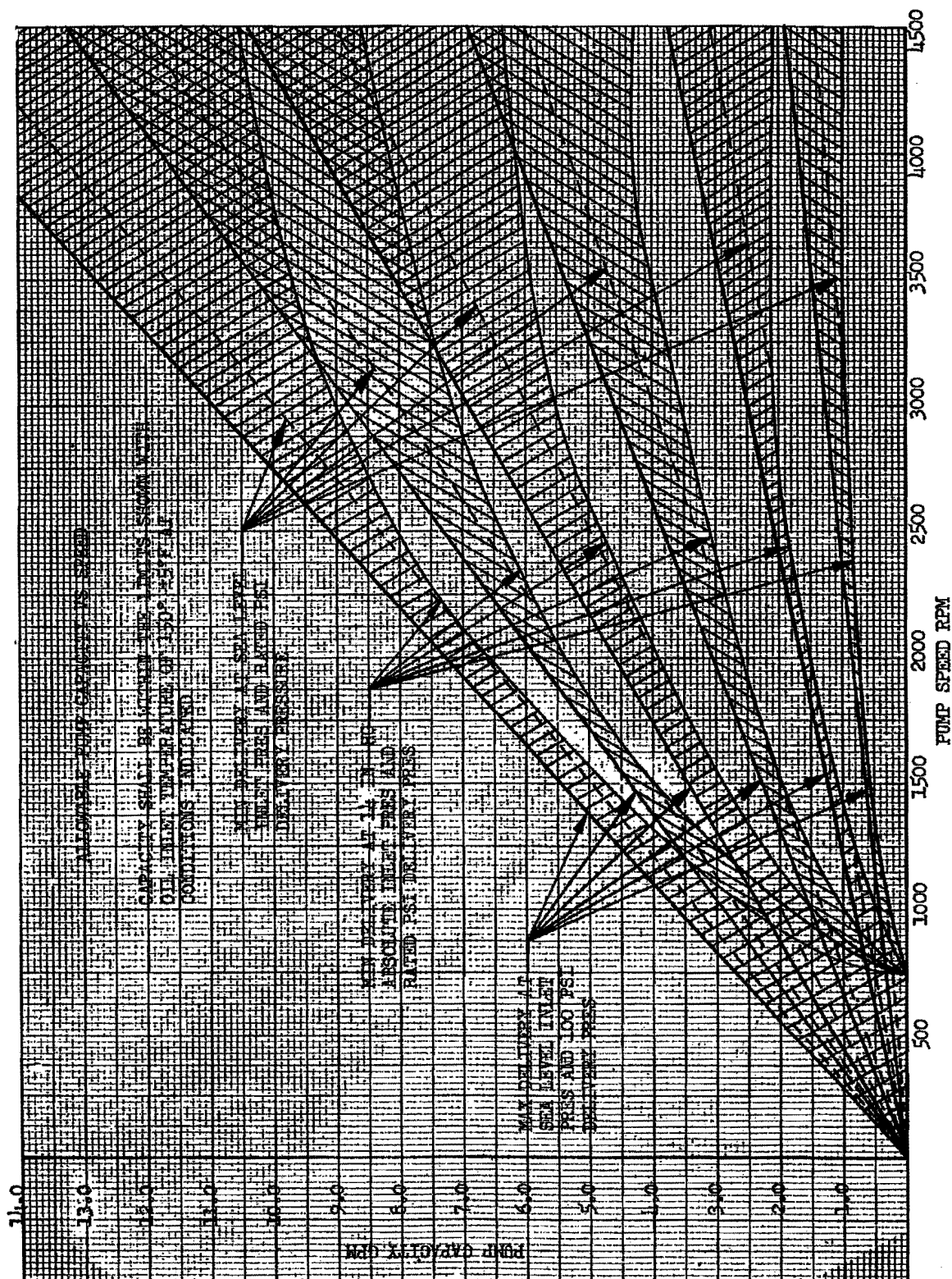


FIGURE 1. Allowable Capacity - Speed Variation

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4.5.5.3 Capacity - Sampling Test.-- The capacity of the pump shall be measured at 150° ±5°F oil inlet temperature after at least 5 minutes of operation under each of the conditions shown in table II.

TABLE II

Pump Speed	Pump Inlet Pressure : In. Hg Abs	Pump Delivery Pressure
750	29	Minimum and Rated
1,500	28	Minimum and Rated
3,750	14	Minimum and Rated

The capacity shall be within the limits specified in figure 1.

4.5.6 Torque.--

4.5.6.1 Torque - Individual Test.-- The torque required to drive the pump shall be measured at any one speed from 1,500 to 3,750 rpm, rated ±50 psi delivery pressure and 18 inches of Hg abs inlet pressure. The torque shall not exceed the value specified in table I under the driving torque column.

4.5.6.2 Torque - Sampling Test.-- The torque required to drive the pump shall be measured at the inlet pressure conditions specified in table I, except that the pump speed shall be 3,400 to 3,800 rpm only. The torque shall not exceed the values specified in table I.

4.5.6.3 Torque - Qualification Test.-- The torque required to drive the pump under the conditions specified in table I shall be measured. The torque shall not exceed the value specified in table I.

4.5.7 Operation.-- The capacity of the pump and torque required to drive the pump shall be determined at the conditions specified below. The capacity in either direction of rotation shall be within the limits specified on figure 1. The pump inlet pressure shall be maintained as shown in table III unless otherwise specified. During all of these runs, the shaft seal leakage shall be measured. The apparatus set-up shall conform to figure 2. The pump shall operate satisfactorily under all the conditions specified, the shaft seal leakage shall not exceed a rate of 5 ml per hour, and the air leakage past the seal into the pump shall be negligible. The pump inlet temperature shall be maintained at 150° ±5°F unless otherwise specified.

TABLE III
Inlet Pressure Operation Test

Pump Speed ±75 RPM	In. Hg Abs
750	29
1,500	28
2,250	26
3,000	22
3,750	18
4,500	18

4.5.7.1 Sea Level Operation (Clockwise Rotation).-- Runs shall be made at each of the speeds listed in table III at zero (or lowest possible pressure), 25, 50, 75, and 100 percent rated delivery pressure.

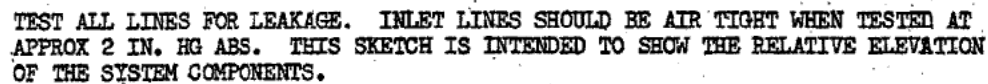


FIGURE 2. Capacity and Operation Test Set-Up

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4.5.7.2 Pressurized Tank Operation (Clockwise Rotation).— The oil tank shall be so pressurized that the pump inlet pressure is 12-psi gage and a pressure of 3.5 inches of Hg abs will be maintained in the chamber between the pump shaft seal and the drive. The pump shall then be tested at speeds of 1,500, 3,750, and 4,500 rpm at zero (or lowest possible pressure) and rated pressure.

4.5.7.3 Altitude Operation (Clockwise Rotation).— The oil tank pressure shall be reduced until the pump inlet pressure is 14 inches of Hg abs and the drive shaft seal chamber shall be maintained at 3.5 inches of Hg abs. Runs shall be made at 1,500, 3,750, and 4,500 rpm at zero (or lowest possible pressure) and rated pressure. These runs shall then be repeated but with atmospheric pressure in the pump drive shaft seal chamber. The pump capacity shall be within the limits specified on figure 1.

4.5.7.4 Sea Level Runs (Counterclockwise Rotation).— The pump shall be set up for counterclockwise rotation and the break-in run or any portion thereof repeated as may be required. Runs shall be made at 750, 1,500, 3,750, and 4,500 rpm at zero (or lowest possible pressure) and rated pressure.

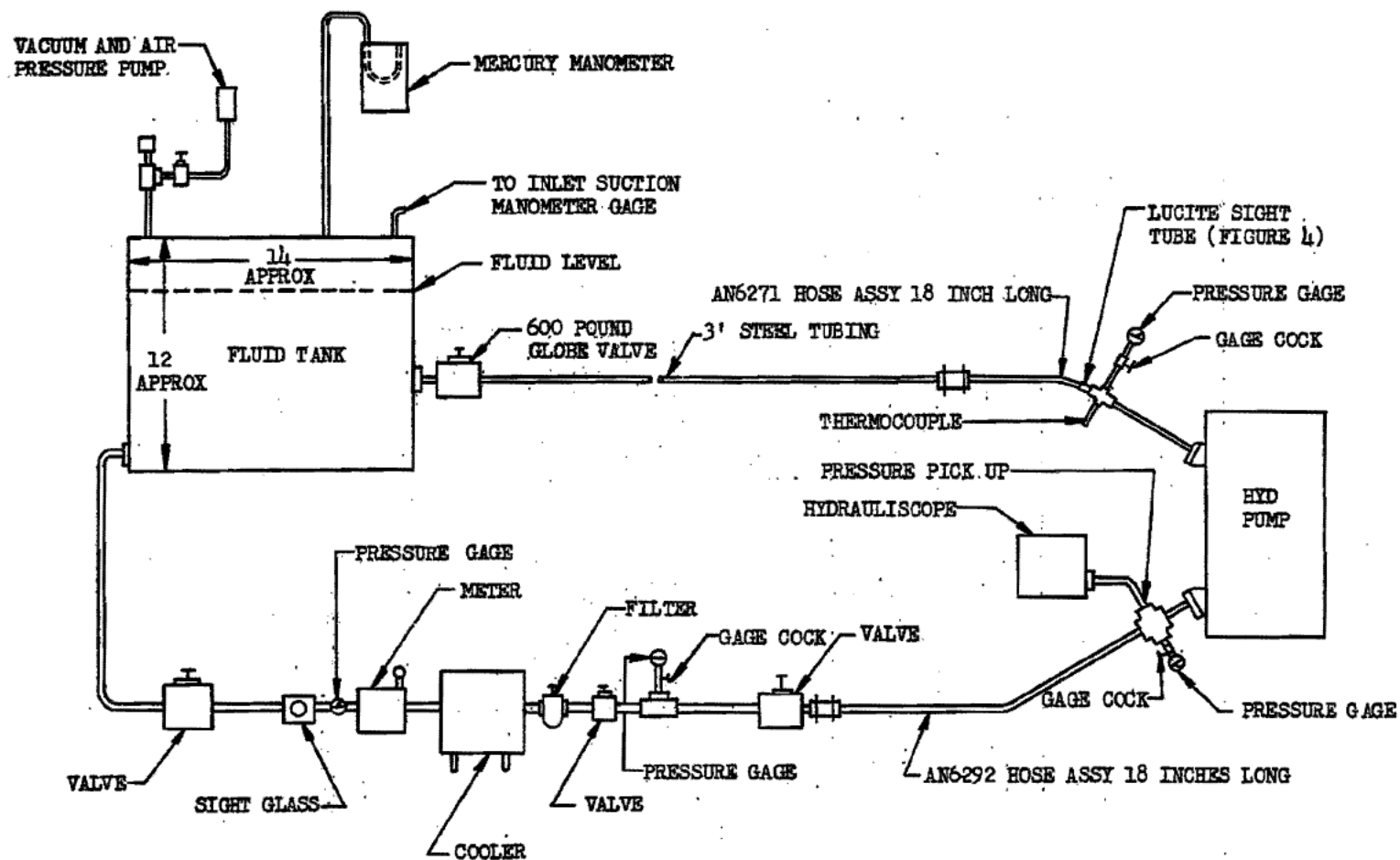
4.5.7.5 Pressure Pulsation Test.— The apparatus shall be set up as shown in figures 3 and 4. The reservoir shall contain 10 gallons of oil which shall be maintained at a temperature of $150^{\circ} \pm 5^{\circ}\text{F}$. The entrained air at the pump inlet shall not exceed 5 percent. The pump shall be brought up to $1,500 \pm 50$ rpm, and the discharge pressure shall be brought up to rated pressure by adjusting the two throttle valves to maintain rated pressure at the pump discharge port and one-half the rated discharge pressure between the two throttle valves. After establishing the mean discharge pressure by means of the Bourdon tube gage, the gage shall be isolated by closing the gage cock while the pressure pulsation reading is taken. Allowing 5 minutes operation of test rig before each reading, data shall be taken every 5,000 feet, up to 30,000 feet. Upon completion of these runs, the above tests shall be repeated at pump speeds of $3,750 \pm 50$ rpm and $4,500 \pm 50$ rpm. The pressure pulsations in the system shall not exceed 21,000 psi during all the above runs.

4.5.8 Low Temperature Starting.— The pump and hydraulic oil shall be cooled by some means to a temperature of $-65^{\circ} \pm 5^{\circ}\text{F}$. After a minimum time of 72 hours at this temperature, the pump shall be started and brought up to 3,750 rpm 50 times. These starts shall be made without reservoir pressurization and with the lowest inlet suction and outlet pressure practicable. In making these starts, the acceleration of the pump shall be uniformly accomplished in the time periods specified in table IV for each speed increment, allowing a swell period of 3 seconds between each increment. After reaching the specified maximum speed, the pump shall be run for 2 minutes. Then 25 starts shall be made and the pump brought up to 3,750 rpm in the same manner but with the outlet pressure adjusted to 125 percent rated pressure $+30$ psi -0 psi. This pressure is to be maintained by the pressure regulating valve specified herein under Endurance. The capacity of the refrigerating equipment and the length of time between the starts shall be such that the pump body and oil reservoir temperatures shall be from -60° to -70°F at the beginning of each of the above 75 starts.

TABLE IV
Low Temperature Starting

Increment	Initial Speed RPM	Final Speed RPM	Acceleration Time Seconds
A	0	750	20
B	750	2,000	15
C	2,000	3,750	10

4.5.9 Endurance.— Apparatus for the Endurance test shall be set up essentially as shown in figure 5. The pump shall satisfactorily complete the 560 hours of operation with no failure of parts and no excessive wear.

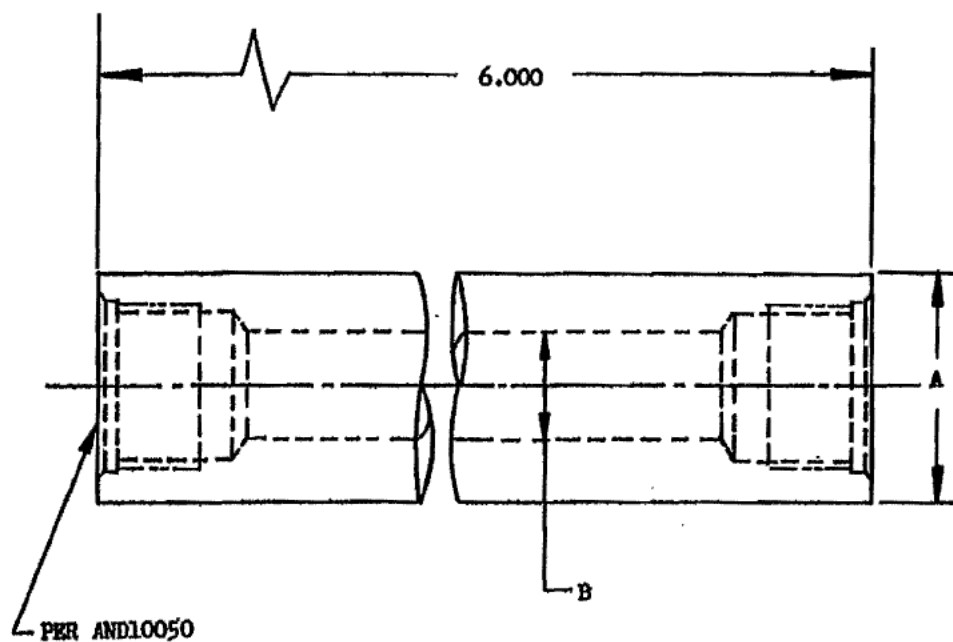


DIMENSIONS IN INCHES.

FIGURE 3. Pressure Pulsation Test Set-Up

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DASH NO.	TUBE OD	A	B MIN
-1	1/2	1.125	.444
-2	5/8	1.250	.555
-3	3/4	1.487	.680
-4	1	1.734	.930
-5	1-1/4	2.062	1.180

DIMENSIONS IN INCHES.

FIGURE 4. Sight Tube - Lucite

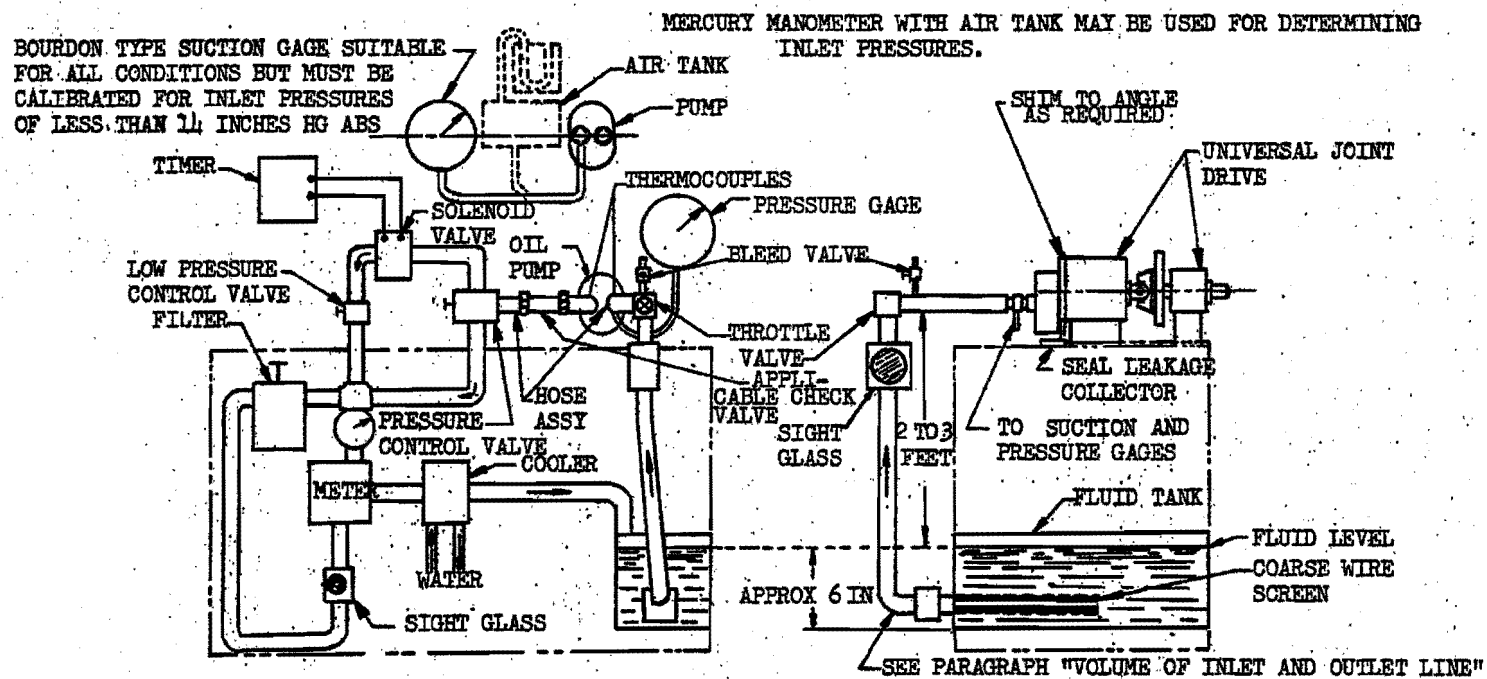


FIGURE 5. Endurance Test Set-Up

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4.5.9.1 Universal Joint Drive.— The entire Endurance test shall be conducted with the pump driven by means of a variable velocity universal joint drive. The universal joint drive may include 1 or 2 universal joints which shall be of a type having the axes of the trunion bearings in a common plane. The angles, as listed in table V, apply for the speeds as shown for both single and double universal joint drives. Single joint drives shall be set up with the joint shafts at the angle shown. Double joint drives shall be set up with both joint shafts at the angle shown and with the driving and driven shafts of the entire universal joint drive parallel.

TABLE V
Universal Joint Angles - Endurance Test

Pump RPM	Universal Joint Angle (Degrees)		Torsional Vibration
	Tolerance $\pm 1/2$ -0 Degrees		Amplitude (\pm Degrees)
	Single Joint Drives	Double Joint Drives	
500 to 2,999 Incl	20	15	2
3,000 to 4,313 Incl	15	10	1
4,314 to 10,000 Incl	6	4-1/2	3/16 (0.187)

4.5.9.1.1 The total moment of inertia of the drive side of the universal joint shall be at least 20 times that of the pump rotors and the parts of the universal joints subjected to variable velocity, or sufficiently great so that the torsional oscillations of the drive side shall be less than 10 percent of the torsional oscillations of the driven shaft side. The universal joint drive, including the connection to the pump, shall be torsionally rigid.

4.5.9.1.2 Pressure Regulating Valve.— The pump outlet pressure shall be maintained by a direct acting, or hydraulically balanced, spring loaded pressure regulating valve, during the entire Endurance test. No fixed position valve shall be used as a bypass for the spring loaded valve.

4.5.9.1.3 Volume of Inlet and Outlet Lines.— The volume of the entire pump inlet line, including surge tank, if used, as measured above the fluid level in the oil tank up to the pump inlet port shall be from 150 to 250 times the rated cubic displacement of the pump. The rated cubic displacement shall be derived by dividing the rated capacity at rated pressure by 1,500. The length of the outlet line between the pump and check valve shall be not more than 2 feet and the size of the line shall be that specified by Drawing AND10050 for the port size shown on the pump drawing.

4.5.9.2 Quantity of Oil.— The total quantity of hydraulic oil in the Endurance test stand system shall not exceed 10 gallons. Any quantity of oil as desired up to and including 10 gallons shall be initially placed in the system and no additional oil may be added throughout the entire Endurance test.

4.5.9.3 Time Schedule and Cycles.— The 560 hours of running shall consist of repeating cycles of high and low pressure operation. One low and one high pressure period together shall be one cycle. The low pressure period shall consist of 12 $\pm 1/2$ minutes of operation at 25-percent rated pressure. This shall be immediately followed by a high pressure period which shall consist of 3 $\pm 1/4$ minutes at 100-percent rated pressure. The change in pressures shall occur in less than 1 second.

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4.5.9.3.1 Test conditions shall be as specified in table VI. The inlet pressure shall be set for each speed at the 25-percent rated pressure condition, and the adjustment utilized to maintain the inlet pressure shall not be changed for the rated pressure period.

TABLE VI
Endurance Test

Time Hours	Speed	Pump Inlet Pressure	Drive Shaft Seal Pressure ±1 In. Hg	Inlet Fluid Temperature (±5°F)
50	1,500-1,690	12 psi gage	30 In. Hg Abs	(100°F)
200	2,820-3,000	14 In. Hg Abs	3.5 In. Hg Abs	(150°F)
250	3,750-3,900	14 In. Hg Abs	3.5 In. Hg Abs	(150°F)
50	4,320-4,500	14 In. Hg Abs	3.5 In. Hg Abs	(150°F)
10	750- 850	12 psi gage	30 In. Hg Abs	(150°F)

4.5.9.4 Air Bleed.- At least once each 24-hour period, during the first 550 hours of Endurance test, air shall be bled into the pump inlet line. The pump shall be required to pump air for a period of 5 minutes with the discharge restriction being a standard AN check valve as shown in figure 5. The pump shall be required to regain its prime within 5 minutes when thus operated.

4.5.9.5 Measurements shall be taken before and after the Endurance test and a wear analysis shall be made showing the wear on each rubbing part. If, during the Endurance testing, a major part fails, the test shall be terminated. The replacement hydraulic pump shall have a redesigned part or one of different material corresponding to the failed part except that, if the failure was caused by faulty material or workmanship, the testing agency may authorize the installation of a part of the original design and material with the defect overcomes. The Endurance test shall be considered completed when every major part has concurrently completed the Endurance test. Minor parts may be replaced and penalty runs conducted at the option of the testing agency.

4.5.9.6 Test Data.- The test reports required shall include the results of all the test runs and shall be graphically presented with capacity, torque, volumetric efficiency, and over-all efficiency plotted against pump speed for each pressure run. The report shall contain a tabulation of the averages of rpm inlet and outlet pressures, oil temperatures, shaft seal leakage, and room temperature for both the high and low pressures for each of the conditions outlined in table VI. The readings shall be recorded at least twice during each 24-hour period, except that when the test period is less than 24 hours long, readings shall be recorded at least twice during each 10-hour period.

4.5.10 Recalibration.- Following the Endurance test, the pump shall be calibrated at 750, 1,500, and 3,750 rpm at zero, or lowest possible pressure, and rated outlet pressure, with inlet pressures in accordance with table II. The shaft seal leakage shall be measured at 3,750 rpm and rated outlet pressure. The shaft seal leakage shall not exceed a rate of 5 ml per hour, the pump capacity shall not have decreased more than 25 percent from the capacity prior to the Endurance test at the 1,500 rpm and rated pressure conditions of operation, and the pump shall be operable at 750 rpm and rated pressure for a period of 15 minutes.

4.5.11 Shearing Section Strength.- The pump drive shaft including the shearing section shall be sheared and the torque required to shear the drive measured. The shearing section torque shall fall within the maximum and minimum limits listed in table I.

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5. PREPARATION FOR DELIVERY

5.1 Application.- The requirements specified herein apply only to direct purchases by or direct shipments to the Government.

5.2 Preservation and Interior Packaging.-

5.2.1 Preservation.- Unless otherwise specified, each pump shall be completely filled with hydraulic oil conforming to Specification MIL-O-6083. Each pump shall then be sealed by caps conforming to Specification MIL-C-5501. The exterior surfaces of the pump shall be protected from corrosion by coating with corrosion-preventive compound conforming to Specification AN-C-124. The spline drive shall be covered with a suitable protective cover to prevent possible mechanical damage.

5.2.2 Packaging.- Unit packages shall consist of one pump preserved as specified in paragraph headed Preservation, wrapped in a grease-proof paper conforming to Specification JAN-B-121, grade A, and sealed with tape conforming to Specification JAN-P-127. The wrapped pump shall be cushioned and packed in a paperboard or fiberboard box conforming to Specification JAN-P-108, JAN-P-120, or JAN-P-133.

5.3 Packing.- Unless otherwise specified, all items shall receive overseas packing. Each container, insofar as possible, shall contain the identical number of articles, shall be of uniform size, and shall be designed to enclose the contents in a snug tight-fitting manner. The gross weight of the shipping container when packed for shipment shall not exceed 200 pounds.

5.3.1 Domestic Packing.- Unless otherwise specified, interior packages shall be packed in substantial containers so constructed as to insure acceptance by common or other carrier for safe transportation at the lowest rate to the point of delivery. Except as specified herein, the container shall conform to the requirements of the Consolidated Freight Classification Rules in effect at the time of shipment, except that fiberboard, when used, shall have a minimum Mullen test of 275 pounds. Containers shall be able to withstand storage, rehandling, and reshipment without the necessity of repacking.

5.3.2 Overseas Packing.- Unless otherwise specified, the unit packages shall be packed in a shipping container constructed in accordance with Specification JAN-P-105, or Specification JAN-P-106. All plywood used shall conform to Specification JAN-P-139, type A or B, condition I. Shipping containers shall be provided with a sealed case-liner fabricated from material conforming to Specification JAN-P-125, the joints and closures of which shall be sealed with adhesive conforming to Specification MIL-A-140. The only exception will be when the unit or intermediate package is waterproofed by virtue of a condition or wrap.

5.4 Marking and Labeling.-

5.4.1 Packages.- Each unit package shall be durably and legibly marked with the following information in the same size, type, or lettering in such a manner that the markings will not become damaged when the packages are opened:

PUMP, HYDRAULIC, POWER DRIVEN FIXED DISPLACEMENT _____ GPM (rated pressure)
Specification MIL-P-7858
AN Part No.
Stock No. (USAF or Navy, as applicable)
Manufacturer's Part No.
Manufacturer's Serial No.
Contract or Order No.
Name of Manufacturer
Name of Contractor (if different from manufacturer)

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5.4.2 Shipping Containers.- Each shipping container shall be marked in accordance with the requirements applicable to the individual Services, as specified in MIL-STD-129.

6. NOTES

6.1 Intended Use.- The hydraulic pumps covered by this specification are intended for use on aircraft for hydraulic operation of such mechanisms as landing gears, brakes, flaps, gun turrets, servo units, bomb bay doors, and automatic pilots. These pumps are primarily intended to be driven by the airplane engine. When driven by other means, additional test and separate approval may be required by the Wright Air Development Center for Air Force contracts or by the Bureau of Aeronautics on Navy contracts.

6.2 Ordering Data.- Requisitions, contracts, and orders should state the AN part number of the hydraulic pump desired, and whether domestic packing is required.

6.3 Provisions for Qualification Tests.- The right is reserved to reject any bids on engine-driven hydraulic pumps which have not been subjected to the required tests and found satisfactory. The attention of manufacturers is called to this provision, and they are urged to request authorization for tests of the hydraulic pumps which they propose to offer to the Air Force or Navy under this specification. Requests for authorization of tests together with certified test reports showing conformance with all the requirements of this specification and the manufacturer's assembly and detail drawings, and for information as to the marking and forwarding of samples should be addressed to the Commanding General, Wright Air Development Center, Wright-Patterson Air Force Base, Dayton, Ohio, the qualifying agency, with a copy to the Bureau of Aeronautics, Navy Department, Washington 25, D. C.

6.3.1 It is to be understood that upon receipt of the Letter of Authorization, samples shall be furnished at no cost to the Government, and that the manufacturer shall pay the transportation charges to and from the designated point where tests are to be made. In the case of failure of the sample or samples submitted, consideration will be given to the request of the manufacturer for additional tests only after it has been clearly shown that changes have been made in the product which the Government considers sufficient to warrant additional tests.

NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Custodian:
Air Force

Other interest:
Army - O
Navy - A