

11 March 1968

Materiel Test Procedure 9-2-182
General Equipment Test Activity

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

PUMP, RECIPROCATING

1. OBJECTIVE

This document describes the procedures to determine the technical performance and safety characteristics of reciprocating pumps and their associated tools and equipment as described in QMR's, Technical Characteristics, and SDR's, and as indicated by the particular design and to determine the technical and maintenance suitability of the reciprocating pumps for service tests.

2. BACKGROUND

Power pumps (reciprocating pumps which are driven by power from an outside source) are positive displacement machines, which, at constant speed, deliver the same capacity at any pressure within the capability of the driver and the strength of the pump. The inherently high efficiency of a power pump is almost independent of capacity and pressure and is only, slightly, lower for a small pump than for a large one. Thus, the power pump is most useful in application requiring high pressures, high suction lifts and low capacities and where its high efficiency more than offsets its high initial cost.

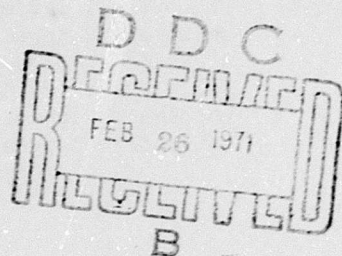
Modern reciprocating power pumps are built with totally enclosed self-lubricating power ends, effectively protected from damage by any leakage of the fluid being pumped or from dirt in the surrounding atmosphere. Various methods are used for reciprocating the piston such as mechanical linkages or fluids under pressure. Piston speeds up to 300 fpm in short-stroke pumps with relative speeds of 300 to 720 rpm permit direct connection to the driver or to a single-reduction drive unit.

In some applications, constant delivery at varying pressures is a distinct advantage, with the power pump acting as a metering device. In other applications, a control problem results which can be met by varying the speed, by-passing at constant speed or by intermittent loading and unloading of the pump. For a given volume rate of flow through the pump, the pressure at the pump outlet may be high or low depending on the pressure necessary to force the fluid through the system connected to the pump.

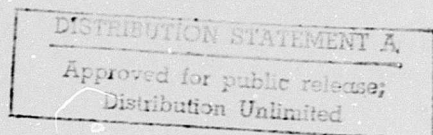
In order to ensure that a reciprocating pump can fulfill the requirements for particular applications, its performance characteristics and reliability must be evaluated in terms of the applicable standards and safety codes.

3. REQUIRED EQUIPMENT

- a. Suction Hose of required length and diameter
- b. Discharge Hose of required length and diameter
- c. Bourdon Tube Gauges
- d. Mercury Manometers
- e. Pressure Gauges of the required pressure ranges



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- f. Hose Fittings, as required
- g. Gauge Fittings, as required
- h. Collapsible Fuel Tank, of required capacity
- i. Fluid Flow Meter, of the required indicating range
- j. Test Fluids, as required
- k. Stopwatch
- l. Tachometer
- m. Filter Elbows, Male and Female, of required diameter
- n. Vacuum Gauge
- o. Equipment for conducting Transportability tests
- p. Platform Scales
- q. Measuring Tape
- r. Hardness Tester
- s. Support Pump, for Hydrostatic Tests
- t. Dynamometer, as required
- u. Voltmeter/Ammeter, as required

4. REFERENCES

- A. Hydraulic Institute, New York, 1965, Hydraulic Institute Standards.
- B. TM 10-1101, Petroleum Handling Equipment and Operations.
- C. USATECOM Regulation 385-6, Safety Release.
- D. USATECOM Regulation 705-4, Equipment Performance Report.
- E. USATECOM Regulation 700-1, Value Engineering.
- F. National Fire Code, Volume V.
- G. National Fire Code, Standard Pamphlet No. 70.
- H. USAAMC Regulation 385-244, AMC Safety Manual.
- I. MTP 10-2-500, Physical Characteristics.
- J. MTP 10-2-501, Operator Training and Familiarization.
- K. MTP 10-2-503, Transportability.
- L. MTP 10-2-505, Human Factors Evaluation.
- M. MTP 10-2-507, Maintenance Evaluation.
- N. MTP 10-4-001, Desert Environmental Test of General Supplies and Equipment.
- O. MTP 10-4-002, Arctic Environmental Test of General Supplies and Equipment.
- P. MTP 10-4-003, Tropic Environmental Test of General Supplies and Equipment.

5. SCOPE

5.1 SUMMARY

This procedure describes the preparation for, and methods of, evaluating the overall performance, reliability and maintainability of reciprocating power pumps as follows:

- a. Hydrostatic Tests - A study to determine any evidence of leakage through the pump case, fittings, couplings, seals, fuel tank, etc., when subjected to specified pressures.
- b. Operational Tests, consisting of:

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- 1) **Priming Tests** - An evaluation of the time required for the test item to become fully primed and to deliver its full capacity when pumping water and liquid fuel.
- 2) **Suction Losses** - An evaluation of the pressure loss through the suction piping and fittings on the test item suction manifold when pumping water and liquid fuel.
- 3) **Performance Characteristics** - An evaluation of the performance of the test item in accordance with the rating and test code standards when operating at the specified motor speed at a specified static lift.

c. **Operational Reliability** - An evaluation of the capability of the test item to operate continuously over 12-hour periods, for a minimum of 100 hours, at its full rated capacity, without evidence of leakage or malfunctions of any components.

d. **Environmental Tests** - An evaluation to determine whether the test item is capable of functioning suitably under desert, arctic and tropic conditions.

e. **Transportability** - A study to determine whether the test item can withstand the shock and vibration that it may encounter during normal handling and transporting conditions.

f. **Maintenance Evaluation** - A study to determine whether the manufacturer's technical and maintenance instructions, provided with the test item, are adequate and to determine whether the test item is designed to facilitate maintenance and repair.

g. **Human Factors Evaluation** - A study to determine the effectiveness of the man-item relationship during operational use of the test item and the degree of ease, simplicity and effort in installing, operating and maintaining the test item.

h. **Safety** - An evaluation of the safety characteristics of the test item.

i. **Value Analysis** - An evaluation to determine any unnecessary test item features which may be eliminated without reducing test item performance or safety.

5.2 LIMITATIONS

None

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Personnel Training and Familiarization

a. Ensure the availability of test personnel who have been trained in accordance with the applicable procedures of MTP 10-2-501 and are cognizant of the following test item aspects:

- 1) Assembly
- 2) Installation
- 3) Operation
- 4) Maintenance

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5) Safety

b. Ensure that test personnel are familiar with publications such as TM 10-1101, Petroleum Handling Equipment and Operations (reference 4B).

6.1.2 Initial Inspection

Upon receipt of the test item at the test site, perform the following:

- a. Visually inspect the test item packages and record the following:
 - 1) Evidence of packaging damage or deterioration.
 - 2) Identification markings including:
 - a) Name of contractor
 - b) Number and date of contract
 - c) Date of manufacture
 - d) Other markings pertaining to the test item
- b. Record the following equipment furnished with the test item:
 - 1) Technical manuals
 - 2) Associated tools
 - 3) Repair parts
- c. Weigh and measure the individual package(s) of the test item and its accessories and record the following:
 - 1) For each shipping package:
 - a) Contents
 - b) Weight
 - c) Length, width and height
 - d) Cubage
- d. Unpack the test item, visually inspect it and record the following, when applicable:
 - 1) Evidence of defects in:
 - a) Manufacturing
 - b) Material
 - c) Workmanship
 - 2) Evidence of damage
 - 3) Evidence of wear
- e. Photograph all test item damage and use sketches and narration, whenever necessary, to describe the condition of the test item.
- f. Record the presence of identification and instruction plates, including:

- 1) Nomenclature
- 2) Model number
- 3) Serial number
- 4) Servicing instructions
- 5) Precautionary instructions

g. Record the existence of shortages.

6.1.3 Physical Characteristics

Subject a minimum of three test items to the applicable procedures of MTP 10-2-500 and the following, if applicable:

a. Measure and record the following for each test item, if applicable:

- 1) Component weights
- 2) Component lengths
- 3) Component diameters
- 4) Overall weight
- 5) Overall length
- 6) Overall diameter
- 7) Hose line diameters
- 8) Fitting and connector diameters
- 9) Pressure gauge connector diameters

6.1.3.1 Pumping Assembly - Major Defects

Examine the pumping assembly and record the following major defects, if applicable:

- a. Fabrication not in accordance with drawings.
- b. Dimensions not as specified.
- c. Assembly of components incorrect or bolted connections not securely tightened.
- d. Components missing.
- e. Tires, wheels, hubs, axles, and springs not as specified, if applicable.
- f. Fittings, piping, or valves not as specified.
- g. Fire extinguisher, bracket, and bracket location not as specified.
- h. Tool box and location not as specified.
- i. Performance data plate not as specified.
- j. Ground terminal missing, location not as specified, or not securely attached to frame.
- k. Ground rods and cables not as specified.
- l. Piping, fittings, hose, and cable not supported as specified.
- m. Canvas cover not as specified.
- n. Welding not as specified.

6.1.3.2 Pumping Assembly - Minor Defects

Examine the pumping assembly and record the following minor defects, if applicable:

- a. Treatment and painting not as specified
- b. Identification markings missing or not legible
- c. Bearing lubricant not as specified
- d. Technical publications not as specified or missing
- e. Repair parts and maintenance tools not as specified or missing

6.2 TEST CONDUCT

- NOTE:
1. During installation and operation of the test item, the operating techniques provided in the manufacturer's instruction manual or draft technical manual shall be followed. Any change or deviation from these instructions shall be recorded in the test item log book.
 2. Since the fluctuations in flow and pressure inherent to a power pump make it difficult to obtain exact readings and since all measurements are subject to some error, a tolerance of plus and minus two (2) percent shall be allowed on all values directly measured and plus and minus two (2) percent on efficiency which is calculated from the readings of capacity, pressure and power. In addition, a plus tolerance of five (5) percent over rated capacity may be allowed with a corresponding allowance in horsepower input, providing the driver is not over-loaded beyond its allowable service factor.
 3. All performance data shall be corrected to sea level conditions, a barometric pressure of 29.92 inches of mercury.

6.2.1 Hydrostatic Tests

- a. Subject a minimum of three test items, which have undergone the procedures of paragraph 6.1.3, to the hydrostatic tests.
- b. Perform the hydrostatic tests using water as the test fluid, or, where specified, a light oil or kerosene.
- c. Tests shall be performed at room temperature and an operating pressure equal to $1\frac{1}{2}$ times the maximum working pressure unless otherwise specified.

6.2.1.1 Pump Case

- a. Install each test item in a test system, as specified in the test plan.
- b. Subject the test items to an internal hydrostatic pressure, as specified, for a minimum of two minutes.
- c. Record the following for each test item:
 - 1) Test fluid nomenclature
 - 2) Internal pressure
 - 3) Evidence of pump case leakage

NOTE: Any fluid leakage through the pump case or joints shall constitute a failure of this test.

6.2.1.2 Pumping Assembly

Perform the following upon completion of paragraph 6.2.1.1:

a. Open all discharge valves (with the exception of the valve utilized to maintain the specified pressure) and ensure that the quick-disconnect fitting dust covers are in place.

b. Subject the test items to an internal hydrostatic pressure, as specified, for a minimum of five minutes.

c. Record the following for each test item:

- 1) Test fluid nomenclature
- 2) Internal pressure
- 3) Evidence of fluid leakage
- 4) Leakage location
- 5) Measures taken to correct defects, as applicable

NOTE: Any fluid leakage through the pump, fittings, piping, or joints shall constitute a failure of this test.

6.2.1.3 Fuel Tank

Perform the following, as applicable, upon completion of paragraph 6.2.1.2:

a. Remove the fuel tank(s) from each test item.

b. Apply an internal air pressure of five psi to each fuel tank with all attachments and submerge the tank in water to a depth of not less than 12 inches at the tank top.

c. Record the following for each tank:

- 1) Tank identity
- 2) Submersion depth (at tank top)
- 3) Any evidence of air leakage

NOTE: Any evidence of leakage from the tank shall constitute a failure of this test.

6.2.2 Operational Tests

Perform the following tests on a minimum of three test items which have successfully undergone hydrostatic tests:

6.2.2.1 Priming Tests

a. Install the following on the test item:

- 1) Vacuum gauge on the suction side of the pump for the measurement of suction pressure.
- 2) Mercury manometer on the suction side of the pump.
- 3) Fluid flow meter, of required capacity, in the discharge line,

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- to measure fluid flow after priming occurs.
- 4) A maximum of six pressure gauges, or as appropriate, of the required pressure range, on the discharge side of the pump.
- c. Determine and record the following immediately before the start of the test:
- 1) Ambient temperature
 - 2) Fluid temperature
 - 3) Barometric pressure
- d. Fill the pump case with fluid, at the priming port and start the pump.
- e. Determine and record the time required for the test item to become fully primed and to delivery its rated capacity.
- NOTE: Inability of the test item to become primed and deliver full rated capacity in the time specified shall constitute a failure of this test.
- f. Record the following for each test item after one minute of operation:
- 1) Fluid flow rate
 - 2) Fluid suction pressure
 - 3) Fluid discharge pressures
 - 4) Any difficulty encountered during the priming operation
- g. Measure and record the following, after the priming operation, for each test item:
- 1) Ambient temperature
 - 2) Fluid temperature
- h. Record the following for each test:
- 1) Fluid nomenclature
 - 2) Specific gravity of the fluid
- i. Repeat steps a through h until a minimum of two tests have been run using the following types of fluid:
- 1) Water
 - 2) Liquid fuel

6.2.2.2 Suction Losses

Perform the following, as applicable:

- a. Locate the test item in the system so that a flow rate, as specified in the test plan, can be obtained.

b. Install mercury manometers on the test items with one side of the measuring instrument connected to the face of the pump inlet and the other side tapped into the face of the inlet to the suction manifold piping.

c. Operate the test item, at the specified maximum flow rate, using water as the test fluid.

- NOTE:
1. The total suction lift shall not exceed that specified or, if a positive suction head is specified, the total suction head shall not be less than that specified. If the conditions set forth above are not immediately obtainable, the tests shall be delayed until such conditions have been established.
 2. If it is necessary that a valve in the suction line be closed partially to obtain specified inlet pressures, an effective cushion chamber shall be installed at or near the pump to absorb the cyclical flow variation inherent to a power pump to prevent excessive pressure fluctuation, vibration, or noise.
 3. The gauge connection orifices shall be flush with and normal to the wall of the liquid passage, and the wall shall be smooth and parallel with the flow in the vicinity of the orifices. The orifices shall be from 1/8 inch to 1/4 inch in diameter, and their edges shall be free from burrs or irregularities and shall be rounded to a radius of 1/16 inch. All gauge connections shall be tight.

d. Measure and record the pressure loss through the suction piping and fittings on the manifold.

NOTE: A pressure loss greater than that specified in the test plan shall constitute a failure of this test.

e. Record the following:

- 1) Fluid nomenclature
- 2) Specific gravity of fluid
- 3) Fluid temperature

f. Repeat the suction loss tests (steps a through e) using liquid fuel as the test fluid.

6.2.2.3 Performance Characteristics

a. Instrument the test items as described in paragraph 6.2.2.1.

b. Determine the performance characteristics of each test item in accordance with the rating standards and test code standards for reciprocating pumps established by the Hydraulic Institute (reference 4A) observing the following conditions:

- 1) Before collecting data, or before continuing the tests after an important change of conditions during operation, the

- apparatus shall be run under stable conditions for sufficient length of time to bring about equilibrium and steady readings.
- 2) Where petroleum products are used as the test liquid, viscosity shall be maintained within 10 percent of that specified for the duration of the test.
 - 3) In the measurement of capacity, corrections shall be made for the difference in temperature at the pump and at the measuring device to compensate for the volume difference.
 - 4) Ensure that the supplier of all instruments has provided evidence that all instruments have been properly calibrated, that they are being used under conditions corresponding to the calibration and that they are in good condition corresponding essentially to that at the time of calibration.

6.2.2.3.1 Capacity - Perform the following:

- a. Operate the test item and determine and record head-capacity data for each test item as described by the applicable sections of reference 4A using water as the test fluid.
- b. Repeat step a using a liquid fuel as the test fluid.

6.2.2.3.2 Total Pressure - Perform the following:

- a. Determine and record the total working pressure developed by the test items as described by the applicable sections of reference 4A using water as the test fluid.

NOTE: Accurate determination of the working pressure of a power pump requires the use of a receiver or cushion chamber of sufficient size to essentially absorb the cyclic variations in flow before throttling to establish the desired pressure. Throttling of the line to a pressure gauge or the use of a damping device in the gauge line does not ensure an accurate determination.

- b. Repeat step a using liquid fuel as the test fluid and record the specific gravity of the test fluid.

6.2.2.3.3 Power Input - Perform the following, as applicable, with the test item operating at the specified discharge pressure:

- a. Determine and record the input shaft speed of the test item driving unit using an electronic tachometer.
- b. Determine and record the input torque of the test item driving unit shaft using an appropriate dynamometer.

NOTE:

1. An example of a torque measuring device is the transmission dynamometer where strain gauge elements bonded to the shaft act as the measurement transducers.
2. For test items driven by electric motors, the power input can be determined by measuring the input current and input voltage and calculating the power in watts. This data can

be used as a check against the mechanical data.

6.2.3 Operational Reliability

a. Install the Bourdon Tube pressure gauge on the discharge pressure hose running from the pump discharge to the pump discharge gauge. Space four gauges 90° around a straight piece of discharge pipe 20 inches long and located just after the discharge valve. (This is in accordance with the Rating Standards and Test Code Standards for Reciprocating Pumps set by the Hydraulic Institute. (See reference 4A).

b. Install two compound Bourdon Tube gauges on the suction side of the pump.

NOTE: If only one gauge is supplied with the pump, calibrate and install a second gauge.

c. Install a positive displacement fluid flow meter in the discharge line.

d. Fill the pump case with either petroleum fuel or a suitable liquid having a specific gravity of 0.72 to 0.75 and prime the pumping assembly against a closed discharge with a static suction lift equivalent to 10 feet of water at standard atmospheric conditions.

e. Prime the pump and verify and record its ability to operate at its full-rated capacity within the time specified (see paragraph 6.2.2.1).

f. Open the test item discharge and initiate operation of the test item at the flow rate and head specified in the test plan.

g. Operate the test item for not less than 12 continuous hours daily until the test item has been operated for a minimum of 100 hours.

NOTE: During operation, only minor adjustments to the engine and discharge valving may be performed. A maximum shutdown time of 15 minutes is allowable for engine maintenance and examination during each 12-hour period.

h. Visually inspect the test item during operations and record evidence of the following:

- 1) Leakage through the pump case, pipe fittings or pump shaft seal.
- 2) Malfunction of any component.

i. Observe and record the following for each test item each hour during the operational periods:

- 1) Flow rate
- 2) Suction pressures (2)
- 3) Discharge pressures (6)
- 4) Fluid temperature
- 5) Ambient temperature

j. Record the barometric pressure at four-hour intervals during the

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operation of the test item including readings at the start and finish of operation.

k. Record the following for each test:

- 1) Test fluid nomenclature
- 2) Specific gravity of the fluid
- 3) Number of hours of operation
- 4) Number of hours of downtime

NOTE: Inability of the test item to meet any of the stated requirements shall constitute a failure of this test.

6.2.4 Environmental Tests

Operational tests, under desert, arctic, and tropic conditions shall be performed as described in MTP 10-4-001, MTP 10-4-002, and MTP 10-4-003, respectively.

NOTE: The test item shall perform as specified in the test plan, in any ambient temperature from plus 120°F to minus 25°F.

6.2.5 Transportability

a. Subject a minimum of three test items to the applicable procedures of MTP 10-2-503.

b. At the completion of each section of transportability tests, repeat the procedures of paragraph 6.2.2.3.

6.2.6 Maintenance Evaluation

a. Subject the test items to the applicable procedures of MTP 10-3-507, during the entire period of testing.

b. Maintain a test log, throughout the test, in which the following observations and maintenance operations shall be recorded:

- 1) Scheduled maintenance conducted in accordance with manufacturer's instructions furnished with the pump.
- 2) Equipment deficiencies, causes, and suggested or corrective action taken.
- 3) The adequacy of the interchangeability of parts for replacement operations.
- 4) The adequacy and accuracy of the technical and maintenance instructions provided by the manufacturer.

6.2.7 Human Factors Evaluation

Evaluate the test item, over the entire period of testing, with respect to the effectiveness of the man-item relationship during the installation, operation and maintenance of the test item in accordance with the applicable procedures of MTP 10-2-505.

6.2.8 Safety

Determine the safety characteristics of the pump, as follows:

a. Before the test of the pump is begun, precautions will be taken to assure that any electrical devices meet all requirements for operation in hazardous locations as specified in Volume V of the National Fire Code.

b. Observe and record the following:

- 1) Any condition which might present a safety hazard
- 2) Cause(s) of the hazard
- 3) Steps taken to alleviate/eliminate the hazard

NOTE: 1. During fuel handling operations, normal safety precautions, as specified in TM 10-1101, shall be observed.
2. If the test item is to be used in an area where POL equipment and explosive vapors are present, it is mandatory that the explosion proof provision paragraphs 601c, 603e, 1202B of AMCR 385-244 and the National Fire Code Standard Pamphlet No. 70 is rigidly enforced.

6.2.9 Value Analysis

a. Throughout the test, the test item shall be examined for any unnecessary features as described in USATECOM Regulation 700-1.

b. During operation of the test, observe and record any features which could be eliminated without compromising performance, reliability, durability or safety.

c. Collect and record, in the daily log, comments of the test personnel about features of the test item that may be eliminated without decreasing the functional value of the test item.

d. The test team members shall study the test item during use and comment separately in the daily log on elimination of unnecessary features, using their experience and background with respect to value analysis.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Personnel Training and Familiarization

Record data, collected as described in the applicable sections of MTP 10-2-501.

6.3.1.2 Initial Inspection

a. Record the following upon receipt of each test item:

- 1) Evidence of package damage or deterioration.
- 2) Identification markings, including:

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- a) Name of contractor
 - b) Number and date of contract
 - c) Date of manufacture
 - d) Other markings pertaining to the test item
- 3) Equipment furnished with the test item, including:
- a) Technical manuals
 - b) Associated tools
 - c) Repair parts
- 4) For each shipping package:
- a) Contents
 - b) Weight, in pounds
 - c) Overall dimensions, in feet and inches
 - d) Cubage, in ft³
- 5) For the entire test item:
- a) Weight, in pounds
 - b) Cubage, in ft³
- 6) Defects in:
- a) Manufacture
 - b) Material
 - c) Workmanship
- 7) Evidence of damage
- 8) Evidence of wear
- 9) Presence of identification or instruction plates, including:
- a) Nomenclature
 - b) Model number
 - c) Serial number
 - d) Servicing instructions
 - e) Precautionary instructions
- 10) Existence of shortages

b. Retain all photographs

6.3.1.3 Physical Characteristics

- a. Record data, collected as described in the applicable sections of MTP 10-2-500.
- b. Record the following, if applicable:
 - 1) For individual test item components:
 - a) Component nomenclature

- b) Component weight, in pounds
- c) Component length, in inches
- d) Component diameter, in inches

c. For complete test item (fully assembled):

- 1) Weight, in pounds
- 2) Length, in feet
- 3) Overall diameter, in inches
- 4) Diameter of inlet pipe, in inches
- 5) Diameter of outlet pipe, in inches
- 6) Diameter of pressure-gauge connections, in inches

6.3.1.3.1 Pumping Assembly - Major Defects -

Record the following defects for each test item pumping assembly, if applicable:

- a. Fabrications not in accordance with drawings.
- b. Dimensions not as specified.
- c. Component assembly incorrect or bolted connections not fully tightened.
- d. Components missing
- e. Tires, wheels, hubs, axles, and springs not as specified.
- f. Fittings, piping or valves not as specified.
- g. Fire extinguisher bracket and bracket location not as specified.
- h. Tool box and location not as specified.
- i. Performance data plate not as specified.
- j. Ground terminal missing, location not as specified or terminal not securely attached to the frame.
- k. Ground rods and cables not as specified.
- l. Piping, fittings, hose, and cable not supported as specified.
- m. Canvas cover not as specified.
- n. Welding not as specified.

6.3.1.3.2 Pumping Assembly - Minor Defects -

Record the following defects for the test item pumping assembly, if applicable:

- a. Treatment and painting not as specified.
- b. Identification markings missing or not legible.
- c. Bearing lubricant not as specified.
- d. Technical publications not as specified or missing.
- e. Repair parts and maintenance tools not as specified or missing.

6.3.2 Test Conduct

6.3.2.1 Hydrostatic Tests

Record the following for each test item undergoing hydrostatic tests:

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- a. Nomenclature
- b. Model number
- c. Serial number

6.3.2.1.1 Pump Case -

Record the following:

- a. Fluid nomenclature (water, liquid fuel, etc.)
- b. Internal pressure, in psig
- c. Evidence of pump case leakage
- d. Duration of pressure application, in minutes

6.3.1.2 Pumping Assembly -

Record the following:

- a. Fluid nomenclature (water, liquid fuel, etc.)
- b. Internal pressure, in psig
- c. Evidence of fluid leakage
- d. Leakage location (fittings, joints, seals, etc.)
- e. Measures taken to correct defects
- f. Duration of pressure application, in minutes

6.3.2.1.3 Fuel Tank -

Record the following, as applicable:

- a. Submersion depth (to tank top), in inches
- b. Air pressure applied, in psig
- c. Evidence of air leakage
- d. Tank identity (A side, B side or appropriate designation)
- e. Duration of submersion, in minutes

6.3.2.2 Operational Tests

Record the following for each test item undergoing the operational tests:

- a. Nomenclature
- b. Model number
- c. Serial number

6.3.2.2.1 Priming Tests -

Record the following for each priming test:

- a. Fluid nomenclature (water, liquid fuel, etc.)
- b. Specific gravity of the fluid
- c. Fluid temperature, in degrees F:

- 1) At the start of test
 - 2) At the end of test
- d. Ambient temperature, in degrees F:
- 1) At the start of test
 - 2) At the end of test
- e. Barometric pressure, in inches of Hg
- f. Fluid flow rate, in gallons per minute
- g. Fluid suction pressure, in psig
- h. Fluid discharge pressures, in psig
- i. Time required for priming, in seconds
- j. Any difficulty encountered during the priming operation

6.3.2.2.2 Suction Losses -

Record the following for each suction loss test:

- a. Fluid nomenclature (water, liquid fuel, etc.)
- b. Specific gravity of the fluid
- c. Fluid temperature, in degrees F
- d. Pressure loss (differential) through the suction piping, in psig
- e. Fluid flow rate, in gallons per minute

6.3.2.2.3 Performance Characteristics -

- a. Record the following for each performance test:
 - 1) Fluid nomenclature (water, liquid fuel, etc.)
 - 2) Specific gravity of the fluid
 - 3) Duration of the test run, in minutes
- b. Record the following for capacity measurements:
 - 1) Capacity data, collected as described in the applicable sections of reference 4A.
 - 2) Temperatures, in degrees F, at:
 - a) Pump
 - b) Measuring device
- c. Record the total pressure data collected as described in reference
- d. Record the following for power input determinations, as applicable:
 - 1) Driving unit input shaft speed, in rpm
 - 2) Driving unit input shaft torque, in foot-pounds
 - 3) Drive motor input current, in amperes
 - 4) Drive motor input voltage, in volts

4A:

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6.3.2.3 Operational Reliability

a. Record the following for each test item undergoing operation reliability testing:

- 1) Nomenclature
- 2) Model number
- 3) Serial number

b. Record the following for each reliability test:

- 1) Fuel nomenclature (liquid fuel, etc.)
- 2) Specific gravity of the fluid
- 3) Total time of operation, in hours
- 4) Total "downtime", in minutes
- 5) Suction lift equivalent, in feet of water

c. Record the following hourly during each test item "daily" operational period:

- 1) Time for test item to pump at full capacity after priming, in seconds.
- 2) Fluid flow rate, in gallons per minute.
- 3) Suction pressures, in psig.
- 4) Discharge pressures, in psig.
- 5) Fluid temperature, in degrees F.
- 6) Ambient temperature, in degrees F.
- 7) Time at which the measurements were recorded.

d. Record the barometric pressure, in inches of Hg, at:

- 1) Start of operation
- 2) Four hours after start of operation
- 3) Eight hours after start of operation
- 4) Finish of operation

e. Record the times at which the barometric pressures were recorded, in hours.

6.3.2.4 Environmental Tests

Record data collected, as described in the applicable sections of MTP 10-4-001, MTP 10-4-002, and MTP 10-4-003, respectively.

6.3.2.5 Transportability

a. Record data, collected as described in the applicable sections of MTP 10-2-503.

b. Record performance data as required by paragraph 6.2.2.3.

6.3.2.6 Maintenance Evaluation

a. Record maintenance data, collected as described in the applicable sections of MTP 10-2-507.

b. Record the following observations and maintenance operations for each test during the period of testing:

- 1) Scheduled maintenance operations.
- 2) Equipment deficiencies including:
 - a) Causes of deficiencies
 - b) Suggested or corrective action taken
- 3) Adequacy of the interchangeability of parts for replacement operations.
- 4) Adequacy and accuracy of the manufacturer's technical and maintenance instructions.

6.3.2.7 Human Factors Evaluation

Record data, collected as described in the applicable sections of MTP 10-2-505.

6.3.2.8 Safety

Record the following throughout the test:

- a. Normal safety precautions followed during fuel pumping and handling operations.
- b. Any condition that does not meet the standards of the National Fire Code.
- c. Any special precautions required for operating and maintaining the test item.
- d. Any condition which might present a safety hazard.
- e. Cause(s) of the safety hazard.
- f. Steps taken to alleviate/eliminate the hazard.

6.3.2.9 Value Analysis

Record the following:

- a. Unnecessary features as described in USATECOM Regulation 700-1.
- b. Any features observed which could be eliminated without compromising performance, reliability, durability, or safety.
- c. Comments of the test personnel about features which could be eliminated.
- d. Comments of the test team members on elimination of unnecessary features, using their experience and background with respect to value analysis.

6.4 DATA REDUCTION AND PRESENTATION

Data obtained during the conduct of the test will be summarized using charts and graphs, as appropriate. The test data will be evaluated by deter-

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mining the extent to which it meets the requirements of the Technical Characteristics and detail specification for the reciprocating pump.

Calculate the test item drive unit input power from the measured speed and torque using the following expression:

$$\text{H.P.} = \frac{2\pi nt}{33,000}$$

where: n = input shaft speed, in rpm.
t = input shaft torque, in foot-pounds

Compare the calculated value from the mechanical data with the value calculated from the electrical input data where the test item is driven by an electric motor.

NOTE: To convert watts to horsepower, multiply by 1.341×10^{-3}

A Safety Release Recommendation in accordance with USATECOM Regulation 385-6 shall be issued based on the data collected under paragraph 6.3.2.8.

In cases where a test item has failed a subtest, an Equipment Performance Report shall be completed in accordance with USATECOM Regulation 705-4.

ACCESSION FOR	
CPDTI	WHITE SECTION <input checked="" type="checkbox"/>
ODC	BUFF SECTION <input type="checkbox"/>
UNRECORDED	<input type="checkbox"/>
SEARCHED	
BY	
DISTRIBUTION AVAILABILITY CODES	
REST.	AVAIL. CODE OR SPECIAL
A	