5 March 1968

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

PUMP, CENTRIFUGAL

1. OBJECTIVE

This document describes the procedures to determine the technical performance and safety characteristics of centrifugal pumps and their associated tools and equipment as described in Quantitative Military Requirements (QMR), Technical Characteristics (TC), and Small Development Requirements (SDR), as indicated by the particular design, and to determine the technical and maintenance suitability of the centrifugal pumps for service tests.

2. BACKGROUND

Modern high-speed operations, involving the use of mechanized ground equipment and aircraft, require that adequate supplies of petroleum, oil, and lubricants (POL) be readily and constantly available.

Recognizing the increasing need for vast quantities of fuel to support today's modern Army, concentrated efforts are being made in developing portable, lightweight POL storage and distribution equipment that can handle volume quantities of petroleum products on an expedited but temporary basis until more sophisticated permanent facilities are constructed. Emphasis has been placed on shipping POL forward to Field Army, Corps, and Division areas by either flexible pipeline or bulk transport. Once in the Field Army and forward areas, these products are stored and dispensed to the consuming units through issue facilities known as Class III Supply Points. These points are established and operated by Quartermaster supply units organic to the Field Army and its forward elements.

Vital to the dispensing systems for the various fuels and fluids is the pump assembly. In order to ensure that the pump can fulfill its requirements in these operations, this MTP provides a series of subtests to evaluate its performance characteristics and reliability with respect to 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
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. Camera and Film
m. Electronic Strobe Light
n. Filter Elbows, Male and Female, of required diameter
o. Vacuum Gauge
p. Equipment for Conducting Transportability Tests
q. Platform Scales
r. Measuring Tape
s. Hardness Tester
u. Support Pump, for Hydrostatic Tests

4. REFERENCES

A. Military Specification, MIL-P-52423(MO), 24 March 1965, Pumping Assembly, Flammable Liquid, Bulk Transfer, Gasoline Engine Driven, 350 GPM Capacity at 190 Feet Total Head, Wheel Mounted.
B. Hydraulic Institute, New York, 1965, Hydraulic Institute Standards.
C. TM 5-2805-242-14, Organizational DSGS Maintenance Manual: Engine, Gasoline, Military Standard Models, 26 July 1965.
D. TM 5-4320-242-15, Pumping Assembly, Flammable Liquid, Bulk Transfer, Gasoline Engine Driven, 350 GPM Capacity at 190 Feet Total Head, Wheel Mounted, December 1966.
E. TM 10-4930-203-13, Operator and Organizational Maintenance Manual Fuel System, Supply Point.
F. TM 10-1101, Petroleum Handling Equipment and Operations.
G. USATECOM Regulation 385-6, Safety Release.
H. USATECOM Regulation 705-4, Equipment Performance Report.
I. USATECOM Regulation 700-1, Value Engineering.
J. National Fire Code, Volume V.
K. National Fire Code, Standard Pamphlet No. 70.
L. USAAMC Regulation 385-244, AMC Safety Manual.
M. MTP 10-2-500, Physical Characteristics.
N. MTP 10-2-501, Operator Training and Familiarization.
O. MTP 10-2-503, Transportability.
P. MTP 10-2-505, Human Factors Evaluation.
Q. MTP 10-2-507, Maintenance Evaluation.
R. MTP 10-4-001, Desert Environmental Test of General Supplies and Equipment.
S. MTP 10-4-002, Arctic Environmental Test of General Supplies and Equipment.
T. 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 performance characteristics of centrifugal pumps as follows:

a. Preoperational Tests, consisting of:

1) Balancing Tests - A study to determine the degree of out-of-balance of the impeller and the female spline coupling half.
2) Hardness Test - A determination of the Rockwell C hardness of the impeller shaft, spline hub, and spline teeth of the shaft.
3) Hydrostatic Tests - A study to determine any evidence of leakage through the pump case, fittings, couplings, joints, fuel tank, etc., when subjected to specified pressures.

b. Operational Tests, consisting of:

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 characteristics of the test item at various discharge pressures when pumping water and liquid fuel at specified shaft speeds.

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. Value Analysis - An evaluation to determine whether the pump has any nonfunctional, costly, or "nice-to-have" features.

i. Safety - An evaluation of the safety characteristics of the test item.

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:

a. Assembly
b. Installation
c. Operation
d. Maintenance
e. Safety

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

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 existance 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: 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.

6.2.1 Preoperational Tests

Subject a minimum of three test items, which have undergone the procedures of paragraph 6.1.3, to the following preoperational tests:

6.2.1.1 Balancing Tests

Determine and record the out-of-balance condition of the impeller and the female spline coupling half with the impeller shaft operating at its maximum rated rpm.

NOTE: 1. An out-of-balance condition greater than 0.25 inch-ounce shall constitute failure of this test.
2. If this test cannot be conducted prior to assembly of the test item, obtain a certificate from the Quality Assurance Division, U. S. Army Mobility Equipment Command stating that these tests were conducted.
3. This evaluation shall meet the minimum standards as defined by MIL-P-52423(MO), reference 4A.

6.2.1.2 Hardness Test

Determine and record the Rockwell C hardness for the following test

item components.

a. Impeller shaft
b. Spline hub
c. Spline teeth of the shaft

NOTE: 1. Any hardness reading less than Rockwell C 30 or greater than 35 shall constitute failure of this test.
2. If this test cannot be conducted prior to assembly of the test item, obtain a certificate from the Quality Assurance Division, U. S. Army Mobility Equipment Command stating that these tests were conducted.
3. This evaluation shall meet the minimum standards as defined by MIL-P-52423(MO), reference 4A.

6.2.1.3 Hydrostatic Tests

6.2.1.3.1 Pump Case - Perform the following:

a. Install the test item in a test system consisting of a support pump which has a discharge pressure capability of 150 psig at no flow (or as specified in the test plan).
b. Pump fluid (fuel or water, etc.) through each test item until all air is displaced from the test pump.
c. Close the discharge valve of the test pump and apply a pressure of 150 psig (or as specified in the test plan) for a period of five minutes.
d. Record the following for each test item:

1) Nomenclature of fluid used
2) No flow pressure
3) Evidence of pump case leakage

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

6.2.1.3.2 Pumping Assembly - Perform the following upon completion of paragraph 6.2.1.3.1

a. Open all discharge valves (with the exception of the valve utilized to hold the pressure) with the quick disconnect fitting dust cover in place.
b. Apply a pressure of 150 psig (or as specified in the test plan) for a period of five minutes and examine the pump, fittings, piping and joints for fluid leakage.
c. Close the suction port to which the pressure had been applied and repeat step b with the pressure applied to the adjacent suction point.
d. Record any evidence of fluid leakage.

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

6.2.1.3.3 Fuel Tank - Perform the following upon completion of paragraph 6.2.1.3.2:

a. Remove each fuel tank from the test pump.
b. Submerge each tank, in water, to a depth of not less than 12 inches at the tank top.
c. Apply an internal pressure of 5 psig to each tank and check for air leakage.
d. Record the following for each:

1) Submersion depth (at tank top)
2) 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 preoperational tests.

6.2.2.1 Priming Tests

a. Locate the test items at a height of ten feet above the surface level of the fluid to be pumped.

NOTE: The height is to be measured from the fluid surface to the centerline of the pump impeller.

b. Install the following on the test item:

1) Vacuum gauge on the suction side of the pump, at the impeller inlet.
2) Mercury manometer on the suction side of the pump, at the impeller inlet.
3) Fluid flow meter, of required capacity, in the discharge line.
4) A maximum of six pressure gauges, 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 deliver its rated capacity.

NOTE: Inability of the test item to become primed and deliver full rated capacity in one minute 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

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 inlet impeller and the other side tapped into the flange on the inlet to the suction manifold.

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

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 the 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.

NOTE: An electronic strobe light shall be used to measure rpm's.

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

1) Test item operating at maximum rated rpm.
2) Test item operating at 75 to 80% of maximum rated rpm.
3) Test item operating at ten feet above the fluid level.

c. Prime the test item with water as described in the applicable sections of paragraph 6.2.2.1

d. Operate the test item at a specified speed and determine and record head-capacity data starting at wide-open discharge and taken in ten psi increments of discharge pressure (for a minimum of six readings) until discharge shutoff.

NOTE: The test shall be initiated with the discharge valve in the wide open position for maximum flow and then, throttling a valve down-stream from the pump, the flow will be reduced in order to achieve the additional ten psi decrease until a no-flow condition occurs.

e. Repeat steps c and d for the alternate required speed, as specified.

f. Repeat steps b through e for the test items using liquid fuel as the test fluid.

6.2.3 Operational Reliability

a. Install one 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 Centrifugal Pumps set by the Hydraulic Institute. (See reference 4B)

b. Install the compound Bourdon Tube gauges on the suction side of the pump at the impeller inlet.

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 one minute (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 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 10-2-507, 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 Value Analysis

a. Perform a value analysis of the test item during its operation and maintenance to determine whether the test item has any nonfunctional, costly, or "nice-to-have" features, in accordance with USATECOM Regulation 700-1.

b. Observations shall be made and recorded to determine whether the test item incorporates any features that could be eliminated without compromising its performance, reliability, durability, or safety.

c. During the conduct of the test, the test personnel shall be informally questioned regarding any features of the pump that may be eliminated without decreasing the functional value of the test item. All user comments regarding value analysis shall be recorded in a daily log.

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

6.2.9 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 be rigidly enforced.

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:

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 ft^3

5) For the entire test item:

a) Weight, in pounds
b) Cubage, in ft^3

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) Existance 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. Fabrication 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 Preoperational Tests

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

a. Nomenclature
b. Model number
c. Serial number

6.3.2.1.1 Balancing Tests -

a. Record the out-of-balance condition in inch-ounces for each test item:

1) Impeller
2) Female spline coupling half

b. Record the impeller shaft speed in rpm.

6.3.2.1.2 Hardness Test -

Record the Rockwell C hardness for each of the following test item components:

a. Impeller shaft
b. Spline hub
c. Spline teeth of the shaft

6.3.2.1.3 Hydrostatic Tests -

Record the following for each test item:

a. For the pump case:

1) Fluid nomenclature (water, liquid fuel, etc.)
2) No-flow pressure, in psig
3) Evidence of pump case leakage
4) Duration of pressure application, in minutes

b. For the pumping assembly:

1) Fluid nomenclature (water, MOGAS, etc.)
2) No-flow pressure, in psig
3) Suction port tested (A or B, left or right, as applicable)
4) Evidence of fluid leakage
5) Leakage location (pump, fittings, joints, etc.)
6) Duration of pressure application, in minutes

c. For the fuel tank:

1) Submersion depth (to tank top),in inches
2) Air pressure applied, in psig
3) Evidence of air leakage
4) Duration of pressure application, 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 start of test
2) At end of test

d. Ambient temperature, in degrees F:

1) At start of test
2) At 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)
2) Specific gravity of the fluid
3) Impeller shaft speed, in rpm
4) Duration of test run, in minutes

b. Record the following for each ten psi increment of discharge pressure from wide open discharge to the no-flow condition, for each test:

1) Discharge pressures, in psig
2) Suction lift equivalent, in feet of water

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 MTO 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 item 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 Value Analysis

Record the following throughout the test:

a. Data collected in accordance with the procedures of USATECOM Regulation 700-1.
b. Observations of features of the test item which could be eliminated without compromising its performance, reliability, durability or safety.
c. Comments by test personnel on any features of the test item which could be eliminated without decreasing its functional value.

6.3.2.9 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.

6.4 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 determining the extent to which it meets the requirements of the Technical Characteristics and detail specification for the centrifugal pump and the standards prescribed by MIL-P-52423(MO).

A Safety Release Recommendation in accordance with USATECOM Regulation 385-6 shall be issued based on the data collected under paragraph 6.3.2.9.

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