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TECP 700-700
Materiel Test Procedure 2-2-703*
Aberdeen Proving Ground

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

LABORATORY TESTS OF POWER TRAIN COMPONENTS

1. OBJECTIVE

The objective of laboratory dynamometer testing of engine and power train components is to determine performance and endurance characteristics. The information desired is basically the same as that derived from engine testing.

2. BACKGROUND

The evaluation of a vehicle power plant requires a complete knowledge of the performance characteristics of the various components which either convert the engine output to a more usable form or serve as utilities to enable the engine or transmission to perform their functions. However, unlike the engine, most of these items are not self-powered, and a motoring dynamometer is required.

The transmission itself is ordinarily the most important of these components in that it is potentially the greatest source of power loss or consumption. It can serve not only to multiply torque as required, but, depending upon design, it can also divide torque for steering purposes, control direction of movement, transmit energy from point of origin to point of use, provide vehicle braking, convert energy, and furnish a means of interrupting power flow.

3. REQUIRED EQUIPMENT

a. Electrical (Motoring) Dynamometer
b. Sprocket Dynamometers
c. Absorption Dynamometers
d. Calibrated Gear-Boxes
e. Electrical Load Banks
f. Fluid Recirculating System
g. Thermocouples
h. Applicable Engine (to be used as a prime mover)
i. Transmission Steering Performance Specifications

4. REFERENCES

A. Standard Laboratory Procedures, For the Automotive Engineering Laboratory; available upon request from The Aberdeen Proving Ground Technical Library Branch

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B. MTP 2-2-700 Laboratory Tests of Reciprocating Internal Combustion Engines

5. SCOPE

5.1 SUMMARY

This procedure describes operating, endurance, and when applicable, steering tests, to be run on power train components having a rotary motion.

5.2 LIMITATIONS

Power train components which involve fluid flow only (such as air cleaners and mufflers) are discussed in MTP 2-2-700.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Arrival Instructions

a. Identify and record the test item by manufacturer, model, serial number, capacity, etc.

b. Record type of lubricant or fluid to be pumped, including lot, batch, and specification number, and when applicable, the chemical analysis of the lubricant and/or fluid.

6.1.2 Inspection and Gaging

Disassemble the power train and visually inspect and gage the individual components.

For new equipment, preliminary tests shall be made on units, not undergoing the tests of this procedure, to determine the specific points of maximum, or critical wear which shall be gaged.

6.1.3 Preparation of Transmission for Power Tests

Attach a motoring dynamometer and gear box to the transmission.

Attach a calibrated gear box to the transmission that shall match transmission output speed to dynamometer speed.

Attach an absorption dynamometer to the gear box to act as a transmission load.

6.1.4 Preparation of Other Components of the Power System

Attach electrical load banks or fluid recirculating systems, as a load for the other power system components as applicable. Insure that there are adequate controls and instrumentation so that current and voltage, and pressure and flow can be controlled and measured.

6.1.5 Preparation of The Steering Mechanism (Crossdrive type transmission)

Attach calibrated gear boxes, connected by slip couplings, to the

output of the transmission steering drive.

Attach sprocket dynamometers to the gear boxes.

6.2 TEST CONDUCT

6.2.1 Operating Test

No definite operating cycle can be prescribed for either performance or endurance testing, as these depend upon the power system under test, but the following checks shall be included in the test plan:

6.2.1.1 Performance Tests

Data shall be recorded on speed, power input, power output, and transmission fluid operating temperatures and pressures of the test item under the following conditions:

a. Normal load and:
   1. Idling speed
   2. 20-percent of rated speed
   3. 40-percent of rated speed
   4. 60-percent of rated speed
   5. 70-percent of rated speed
   6. 100-percent of rated speed
   7. 110-percent of rated speed

b. 10-percent overload and:
   1. 80-percent of rated speed
   2. 100-percent of rated speed
   3. 110-percent of rated speed

6.2.1.2 Endurance Tests

A testing cycle comparable to the expected field use of the test item shall be established. The following shall be included in the test cycle:

a. Periodic disassembly of the item for visual inspection and gaging.
b. Periodic chemical analysis of the transmission fluid/lubricant.

Use an engine of an appropriate size as prime mover in place of the electrical (motoring) dynamometer.

NOTE: 1. The engine supplies additional stresses from torque fluctuations which cannot be duplicated by the dynamometer. These stresses can significantly affect the endurance characteristics of the transmission.
2. Endurance testing can be accomplished, in a shorter time span, by accelerating the test items normal operating cycle in the following manner:

output of the transmission steering drive.

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6.3 TEST DATA

6.3.1 Arrival Inspection

Record the following:

a. For power system under test

1. Manufacturer
2. Model
3. Serial number
4. Load capacity

b. For lubricant or fluid pumped

1. Lot
2. Batch
3. Specification numbers
4. Chemical analysis

6.3.2 Inspection and Gaging

Record the following:

a. Visual observations
b. Dimensions of gaged components, in inches

6.3.3 Operating Test

a. Record the following under normal load conditions:

1. Speed in rpm
2. Power input, in horsepower
3. Power output, in horsepower
4. Fluid/lubricant temperature, in degrees F
5. Fluid/lubricant pressures, in psi

b. Record the following under overload conditions:

1. Speed, in rpm
2. Power input, in horsepower
3. Power output, in horsepower
4. Fluid/lubricant temperature, in degrees F
5. Fluid/lubricant pressures, in psi

6.3.4 Endurance Tests

a. Record the following for each given speed

1. Environmental conditions:

a) Temperature, in degrees F
b) Dust conditions

2. Operating time, in hours
3. Fluid/lubricant temperature, in degrees F° at:

   a) Start of sequence
   b) Midpoint of sequence
   c) End of sequence

4. Fluid/lubricant pressure in psi at:

   a) Start of sequence
   b) Midpoint of sequence
   c) End of sequence

b. Record total operating time in hours
c. Record the chemical analysis of the fluid/lubricant

6.3.5 Steering Tests

Record visual observations

6.3.6 Post Test Inspection and Gaging

Record the following:

a. Visual observations
b. Dimensions of gaged components, in inches

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Operating Tests

Data shall be presented by curves of efficiency (ratio of output torque to input torque) versus the transmission speed (rpm).

6.4.2 Endurance Tests

Performance data shall be presented as a plot of output (horsepower or rpm) versus endurance operating time and the wear data as determined by dimensional changes of the gaged components taken during the testing.

Loss in performance should be explained by wear, accumulation of deposits or change in operating conditions (environmental conditions). However, wear does not always result in loss of performance but sometimes leads to sudden failure.

Chemical changes in the transmission fluid/lubricant also affects transmission performance and deterioration of the fluid/lubricant can be more significant, in loss of transmission performance, than the aforementioned conditions.

6.4.3 Steering Tests

Steering tests shall be evaluated by comparing the wear, deposits, distortion and evidence of overheating of the steering components, for the

time it is operated, with performance standards submitted by the transmission manufacturer.