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Materiel Test Procedure 3-3-022
U. S. Army Artillery Board

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

WEAPON, SELF-PROPELLED, FULL TRACKED

1. OBJECTIVE

The objective of this MTP is to determine the overall suitability of self-propelled weapons for artillery use, and to determine if the weapon meets the specification of its Qualitative Materiel Requirements (QMR's) and Technical Characteristics (TC's).

2. BACKGROUND

The ultimate objective of the Artillery is to carry out effectively its mission of giving close and continuous support to the combat arms and adding depth to the zone of combat. Light and medium artillery weapons perform the mission of close support by neutralizing or destroying those close-in targets that appear to be the most dangerous or likely to offer the greatest hinderance to the advance. Heavier caliber weapons give depth to combat and are required to destroy longer range targets, and isolate the battle area by firing both high explosive and special purpose type projectiles and warheads.

Mobility, the ability to move, emplace, and displace rapidly, is one of the primary considerations in accomplishing support missions and can best be accomplished by weapons of the self-propelled family. Self-propelled weapons are not restricted to road networks and rolling terrain for operations. They negotiate many minor obstacles to rapidly obtain desired firing positions.

The Artillery requires weapons that can be transported easily, emplaced quickly, and employed against close and distant targets with speed and precision. Hence, the requirement exists for new and improved self-propelled weapons.

A self-propelled weapon, as defined for this procedure, consists of an automotive chassis, a cannon, gun mount, elevation-equilibration system, traversing mechanism, recoil mechanism, ammunition and fuze stowage racks, fire control equipment, section equipment stowage facility, intercommunications system, secondary armament, crew served and individual weapon stowage racks, and operating personnel transport space and seating.

3. REQUIRED EQUIPMENT

a. Applicable Ammunition (complete rounds)
b. Suitable Firing Ranges
c. Weapon Shop Facility (organizational)
d. Weapon Shop Facility (direct or general support)
e. Applicable Firing Tables - Tapes, etc.

f. Weapon Section Equipment
g. Aiming Reference
h. Weapon Mechanics Tool Set
i. Aiming Circles (2) and BC Scope
j. Muzzle Velocity Measuring Equipment (radar chronograph and/or skyscreen)
k. Radio and Wire Communications
l. High Speed Motion picture Camera with Film and Still Camera with Film
m. Calibrated Gunners Quadrant
n. Hop Measuring Devices and Associated Equipment
o. Measuring Tape
p. Powder Temperature Thermometer
q. Depth of Ram Gauge
r. Fire Direction Equipment and Facility (with personnel)
s. Flash Equipment for Four Observation Posts and Flash Control (with personnel)
t. Meteorological Data
u. Boresighting Devices
v. Complete Gun Crew, Weapon Mechanic, and Safety Officer
w. Ambulance and Aidman
x. Stopwatch
y. Similar Type Test Item (to be used for comparisons)
z. Blast Pressure Measuring Equipment

4. REFERENCES

A. USATECOM Regulation 385-7 Safety Confirmation
B. USATECOM Regulation 750-15 Maintenance of Supplies and Equipment
C. USATECOM Regulation 385-6 Safety Release
D. TM 9-2305 Fundamentals of Artillery Weapons
E. TM 9-3305-1 Principles of Artillery: Weapons
F. AR 705-5 R&D of Materiel - Army R & D
G. AR 705-2300-8 Water Crossing Requirements for Future Combat and Tactical Vehicles
H. USAMC Regulation 385-12 Verification of Safety of Materiel
I. USAMC Regulation 750-15 Maintenance of Supplies and Equipment
J. MTP 2-3-500 Preoperational Inspection and Physical Characteristics
K. MTP 2-3-501 Safety Hazards
L. MTP 2-3-502 Maintenance
M. MTP 2-3-503 Cargo Capacity
N. MTP 2-3-504 Cross-Country Mobility
O. MTP 2-3-505 Road Mobility
P. MTP 2-3-507 Durability and Reliability
Q. MTP 2-3-508 Stowage
R. MTP 2-3-509 Fording
S. MTP 2-3-510 Inland Waterway Operations
T. MTP 2-3-511 Security (Susceptibility to Detection)

U. MTP 2-3-512 Compatibility with Related Equipment
V. MTP 2-3-513 Fuel and Oil Consumption
W. MTP 2-3-516 Human Factors Engineering
X. MTP 2-3-519 Surface Transportability (vehicles)
Y. MTP 2-3-520 Logistics-over-the-Shore (LOTS)
Z. MTP 2-3-524 Personnel Training
AA. MTP 3-3-081 Sights and Telescopes
BB. MTP 3-3-500 Preoperational Inspection and Physical Characteristics
CC. MTP 3-3-501 Personnel Training
DD. MTP 3-3-502 Battlefield Mobility (Tactical Flexibility and Portability
EE. MTP 3-3-503 Boresight and Zero
FF. MTP 3-3-505 Speed and Precision of Laying
GG. MTP 3-3-506 Accuracy and Precision
HH. MTP 3-3-510 Weapons Functioning
II. MTP 3-3-514 Durability and Reliability
JJ. MTP 3-3-515 Security
KK. MTP 3-3-516 Obscuration
LL. MTP 3-3-517 Safety Hazards
MM. MTP 3-3-518 Maintenance Evaluation
NN. MTP 3-3-519 Transportability
OO. MTP 3-3-521 Human Factors Engineering
PP. MTP 3-3-523 User Reaction
QQ. MTP 3-3-524 Adverse Conditions
RR. MTP 7-3-515 Air Transport (Internal)

5. SCOPE

5.1 SUMMARY

This materiel test procedure describes the following tests conducted on self-propelled weapons, full tracked.

a. Pre-Operational Inspection - A study to ensure the test item is complete and in satisfactory condition prior to initiation of testing.

b. Physical Characteristics - A study to ascertain the physical characteristics of the test item.

c. Mobility and Maneuverability - A study to determine the test item's mobility and maneuverability over improved, dirt, and cross-country roads.

d. Preparation for Action and March Order - A study to determine the ability of service personnel to prepare for action and movement under timed conditions.

e. Stability - A study to determine the stability of the test item while firing under varied conditions.

f. Stowage - A study to determine the adequacy, accessibility and durability of the test item's stowage facilities.

g. Compatibility with Related Equipment - A study to determine the test vehicle's compatibility with related equipment.

h. Security - A study to determine the general visual and aural security aspects of the test item.

i. Inland Waterway Operation - A study to determine the ability of swim type test vehicles to operate in water.

j. Fording - A study to determine the fordability of the test vehicle.

k. Durability and Reliability - A study to determine the test vehicle's ability to operate for a required period of time and a given number of miles.

l. Signal Communications Equipment - A study to determine the adequacy of the test item's communication system under various conditions.

m. Air Transportability - A study to determine the test item's capability to be transported by air.

n. Surface Transportability - A study to determine the test item's capability to be transported by various modes.

o. Logistics-over-the-Shore - A study to determine the test item's capability to be delivered over the beach in a service ready condition.

p. Maintenance Evaluation - A study to determine the maintenance requirements of the test item and the adequacy of maintenance services.

q. Crew Requirements and Accommodations - A study to determine the adequacy of the crew strength and their accommodations.

r. Human Engineering - A study to determine the effectiveness to the man-item relationship during operational use of the test item and to assess the ease of operations, location of levers, gages, handles, their accessibility and ease of identification.

s. Safety Confirmation - A study to confirm the safety characteristics of ammunition and the test item during operational use.

t. Weapon Operational Characteristics - A study to determine whether service personnel are capable of operating the test weapon under various conditions.

u. On-Carriage Fire Control Equipment and Boresighting - A study to confirm the operational accuracy of on-carriage fire control equipment and the ability of the test weapon to retain boresight.

v. Maximum Rate of Fire - A study to determine the maximum rates of fire at varied loading elevations.

w. Effects of Muzzle Brake - A study to determine the effects of muzzle blast with and without muzzle brakes.

x. Accuracy and Precision - A study to determine the accuracy and precision of the test weapon during firing.

y. Secondary Armament - A study to determine the operational performance of secondary armament.

z. Post Operational Inspection - A study to determine the condition of the test item upon completion of testing.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Scheduling

6.1.1.1 Personnel

Prior to arrival of the test item ensure that vehicle and gun testing personnel (service personnel) are adequately trained as prescribed in MTP's 2-3-524 and 3-3-501.

6.1.1.2 Facilities

a. Select and schedule use of direct and indirect fire ranges and flash observation posts in accordance with the provisions of MTP 3-3-506.

b. Make necessary arrangements for use of equipment, special facilities, and instruments listed under paragraph 3.

6.1.1.3 Equipment

Requisition required ammunition, supplies, and special equipment not readily available at the test site.

6.1.1.4 Safety Releases

The project officer shall obtain, prior to performing the test, safety releases for the vehicle, armament, and specific ammunition to be fired.

6.1.2 Preoperational Inspection and Physical Characteristics

Perform a preoperational inspection and determine the physical characteristics of the test vehicle and weapon as described in the applicable sections of MTP 2-3-500 and MTP 3-3-500.

6.2 TEST CONDUCT

6.2.1 Vehicle and Vehicle/Weapon Tests

6.2.1.1 Mobility and Maneuverability

Determine the ability of the test item to be driven over roads as described in the applicable sections of MTP 2-3-504 and MTP 2-3-505, with and without its rated load, and/or the following by service personnel:

a. Drive the test item, without a load, during daylight on a day having moderate temperatures and no precipitation, over a course(s) consisting of paved road, secondary road, sand and wet soil and perform the following:

1) Operate the test item as the lead vehicle in a convoy and determine and record the following for each type of terrain:

a) The vehicle's ability to:

1) Maintain maximum convoy speed
2) Maintain normal convoy speed

3) Maintain minimum convoy speed

b) Speed obtained

1) A maximum convoy speed
2) Normal convoy speed
3) Minimum convoy speed

2) Operate the test item as the last vehicle in a convoy and record the requirements of step 1.a for each type of terrain

3) Operate the test item over each type of terrain and determine and record the ability of the service personnel to perform the following:

a) Maintain the test item's rated operational speed for a minimum of five miles.
b) Execute fast turns to the left and right
c) Execute slow tight turns to the left and right

4) Record the following for the operations of step a.3:

a) Rated operational speed
b) Turning radius while making:

1) Fast turns, both left and right
2) Slow tight turns, both left and right

c) Vehicle stability while:

1) Driving straight
2) Making fast turns
3) Making slow tight turns

d) Difficulties encountered:

1) During straight driving
2) Making fast turns
3) Making slow turns

5) Operate the test item on hard, sandy and rocky soil and determine and record the ability of service personnel to perform the following:

a) On slopey prepared approaches and short non-prepared approaches:

1) Traverse a side slope of approximately 40%
2) Traverse a longitudinal slope of approximately 60%

b) Stop, hold and start the test item when:

1) Ascending and descending a longitudinal slope a minimum of 50%
2) Ascending and descending a side slope a minimum of 30%

6) Record the slopes of step a.5
7) Operate the test item over a level and hilly cross country terrain having natural curves and/or obstacles which will prevent the vehicle from going in a straight line:

a) At its rated cross-country speed
b) On side and longitudinal slopes:

1) Traverse side slope of approximately 30%
2) Traverse longitudinal slope of approximately 45%

c) Stop, hold and start the test item when:

1) Ascending and descending a longitudinal slope a minimum of 30%
2) Ascending and descending a side slope a minimum of 20%

8) Record the following for the operations of step a.7:

a) Level and hilly cross-country speed
b) Slope grades

9) Operate the test item through brush thicket and timber
10) Operate the test item through closed woods and on winding trails
11) Record the following for steps a.9 and a.10:

a) Distance travelled
b) Difficulties encountered
c) Time spent in traversing the various courses

b. Photograph any difficulties encountered with still and motion picture camera, as applicable.

c. Repeat step a under conditions of darkness.

d. Repeat steps a through c under the adverse conditions described in MTP 3-3-524.

e. Repeat steps a through d with the test item combat loaded.

NOTE: If the combat load includes an ammunition trailer, the trailer shall be towed.

6.2.1.2 Preparation for Action and March Order

Determine the ability of an average trained crew to "prepare for action" and "march order" using the criteria of the applicable sections of MTP 3-3-502, and/or the following:

NOTE: 1. "Preparation for Action" consists of operational procedures from the time the vehicle arrives at the firing site until "ready for action".

2. "March Order" consists of operational procedures after ejection of the last round fired until the vehicle and weapon are ready to travel.

6.2.1.2.1 Preparation for Action - Prepare the test item "for action" on level ground, with no precipitation and moderate temperature, during daylight hours, and record the following:

a. Time required to effect "preparation for action".
b. Number of personnel required.
c. Any requirements for special preparations or disposition of associated equipment.
d. The effects of mounted special purpose kits.
e. Unsafe acts or existing conditions.
f. Difficulties encountered, i.e., in proper seating of the spade(s), adjusting of spade(s), ensuring positive lock, etc.

6.2.1.2.2 March Order - Prepare the test item "for March Order" under conditions prescribed in paragraph 6.2.1.3.1 and record the following:

a. Time required to effect "march order"
b. Number of personnel required
c. Method of stowage of equipment
d. Unsafe acts or existing conditions
e. Difficulties encountered, i.e., unlocking spade(s), self-cleaning action of spade(s) after withdrawal, etc.

6.2.1.2.3 Night Time Conditions - Repeat paragraphs 6.2.1.3.1 and 6.2.1.3.2 under the following nightime conditions:

a. Moonlight
b. Dark night (blackout)

6.2.1.2.4 Adverse Terrain Conditions - Repeat paragraphs 6.2.1.3.1 through 6.2.1.3.3 under the following terrain conditions:

a. Sand
b. Rocky
c. Hillside:

1) Forward slope

2) Reverse slope
3) Record percent of slope

6.2.1.2.5 Adverse Environmental Conditions - Repeat paragraphs 6.2.1.3.1 through 6.2.1.3.4, as applicable, under the conditions described in MTP 3-3-524.

6.2.1.3 Stability

a. During the conduct of paragraph 6.2.2.5 determine the displacement of the carriage and weapon shock on the test item as follows:

1) Measure and record the displacement of the carriage firing at maximum charge:

a) At low, medium, and high quadrants of elevation
b) At maximum left, maximum right and center traverse
c) On hard and loose soil:

1) With spade(s) seated
2) With spade(s) withdrawn

NOTE: 1. Measure displacement by scribing a line on the vehicle, or by noting deflection difference between the aiming circle and panoramic telescope, or by noting the aiming post or reference misalignment.

2. Measurements of displacement shall be made after firing rounds 1 through 5.

2) Inspect road and track wheels for rim cracks, road arm defacement and cracks, and leaking wheel seals. Record all deficiencies.
3) Inspect lockout system and record deficiencies.
4) Make carriage reaction traces using hop recorders and retain the traces.
5) Note and record rocking of chassis during firing.

b. Obtain and retain motion pictures of the test item during firings.

6.2.1.4 Stowage

a. During the conduct of mobility testing, with the crew, equipment and ammunition for primary and secondary armament loaded on the test item, and during firing tests, conduct the applicable requirements of MTP 2-3-508, and/or determine and record the following:

1) Adequacy of stowage facilities, i.e., racks, tie-downs, containers, etc.
2) Stowage interference with operations

3) Accessibility of stowed items while firing
4) Durability of stowage facilities
5) Requirements of removal or handling of stowed load to service vehicle components or armament
6) Improper lock functioning of ammunition stowage racks
7) Adequacy of physical security of items stowed on the exterior portion of the test item

b. Obtain and retain photographs depicting adverse conditions.

6.2.1.5 Compatibility with Related Equipment

a. Determine the test vehicle's compatibility with related equipment using the criteria of MTP 2-3-512 while performing the following:

1) Towing a similar vehicle
2) Towing a lighter vehicle
3) Being towed by a similar vehicle
4) Being towed by a recovery vehicle
5) Being recovered from immobilized positions by an appropriate recovery vehicle

b. Record the requirements of MTP 2-3-512 and/or the following, as applicable, for each performance:

1) Results of towing:

a) Similar vehicle
b) Lighter vehicle

2) Results of being towed by:

a) Similar vehicle
b) Recovery vehicle

3) Ease and adequacy of test vehicle's coupling provisions, interference on turns, and general towing reactions.
4) Ability of recovery vehicle to recover test vehicle from adverse conditions
5) Towing requirements, i.e. disconnections of power train, etc.

c. Obtain and retain photographs depicting adverse conditions.

6.2.1.6 Security

Determine the general visual and aural security aspects of the test item by performing applicable sections of MTP's 2-3-511 and 3-3-515 and the following:

a. Operate the test vehicle and similar type vehicle in an

isolated area. Determine and record aural noise comparisons.

NOTE: Compare engine and suspension noises for signature signs.

b. Record noted torching and differences in configuration

c. Observe the test item's position from 600 meters and record sighting of fighting compartment and fire control lights during night time and sight reflections.

6.2.1.7 Inland Waterway Operations

For applicable flat and swim type test vehicles, determine its ability to operate in water as described in applicable sections of MTP 2-3-510, and the following:

a. Operate the test vehicle, with full payload, in a calm lake or deep water with little or no current, for a minimum of 1 hour prior to each quarterly maintenance inspection. The vehicle shall negotiate varying degrees of wet and dry slopes while entering and exiting the water. Determine and record the following for each inspection and performance:

1) Testing time
2) Evidence of water pollution to bearings, seals, cavities, etc.
3) Freeboard measurement at front, rear, corner, and side while:

    a) Standing still
    b) Travelling at maximum water speed
    c) Turning at maximum water speed

4) Water speed attained
5) Degrees of slopes negotiated:

    a) Entering water
    b) Exiting water

6) Noted entry of water into the test vehicle when:

    a) Entering the water
    b) Exiting the water

7) Bottoming action of vehicle when entering the water
8) Traction obtained on various types of soil
9) Adequacy of bilge pump(s):

    a) Amount of noise
    b) Volume of water dispersed
    c) Condition of water strainer

6.2.1.8 Fording

Determine the inherent capability of the test vehicle, with full payload, to accomplish shallow water fording as defined in AR 705-2300-8, by performing the applicable sections of MTP 2-3-509, and determine and record the following:

a. Inherent capability of test item to ford a minimum of 42 inches
b. If a deep water fording kit is provided for tactical vehicles:

1) Simplicity of installation
2) Time required for installation

c. The firmness of the undersurface of the crossing site
d. Fording depth

NOTE: Fording depth includes test item's sinkage depth and wave height.

e. Difficulties encountered

6.2.1.9 Durability and Reliability

Determine the durability and reliability of the test item using the criteria of MTP's 2-3-507 and 3-3-514 as follows:

a. If not otherwise specified, after completion of all other tests, the test item shall continue operation until total mileage accumulated, while loaded, during total testing has reached a minimum of 4,000 miles for track vehicles and 10,000 miles for wheeled vehicles.

NOTE: 1. The required mileage will be accumulated at 50 percent on secondary roads, 25 percent on paved roads, and 25 percent cross-country or as required by the QMR or TC.

2. Efforts will be made to accumulate the complete 4,000 miles during the conduct of other tests and as a troop unit operates.

3. The test item will be combat loaded during all testing for durability and reliability.

b. Record the following for each type of terrain:

1) Type and weight of load
2) Actual test mileage accumulated
3) Engine operating hours
4) Engine idle hours
5) Vehicle operating hours
6) Number of rounds fired and charges
7) Number of emplacements made
8) All failures and frequency of repeated failures

9) All parts assemblies and components which failed to meet the TC established criteria.

6.2.1.10 Signal Communications Equipment

During the conduct of other test requirements while operating at low, medium, and high speeds on highways, secondary roads, and cross-country, determine to what extent the vehicle commander can communicate with the driver/operator and other crew members over track, engine, and chassis vibration noises as follows:

a. Determine and record the vehicle commander's ability to communicate with driver and other crew members as follows:

1) With vehicle halted and engine speeds of:

a) Idling RPM's
b) 1000 RPM's
c) 1500 RPM's
d) Maximum RPM's

2) With vehicle moving and engine speeds of:

a) Minimum RP
b) 1000 RPM's
c) 1500 RPM's
d) Maximum RPM's

b. Repeat step 2 1) and determine the ability of section chief to talk to the crew through the interphone amplifier.

c. Determine and record the effects of turbocharge cut-in and track vibrations.

6.2.1.11 Air Transportability

Determine the suitability of the test item to be air transported as described in the applicable sections of MTP 7-3-515.

6.2.1.12 Surface Transportability

Determine the surface transportability of the test item as described in the applicable sections of MTP 2-3-519.

6.2.1.13 Logistics-Over-The-Shore

Determine the test item's logistics-over-the-shore capabilities as described in the applicable sections of MTP 2-3-520.

6.2.1.14 Maintenance Evaluation

During the conduct of this MTP the maintainability of the test

item shall be determined as described in applicable sections of MTP's 2-3-502 and 3-3-518 and the following:

a. Perform scheduled maintenance as required by the applicable maintenance manuals.

b. Perform unscheduled maintenance as required.

c. Record the following for each type of maintenance performed:

1) Type of maintenance
2) Description of maintenance action
3) Amount of lubrication used, if applicable
4) Time required to perform each maintenance action
5) Number of personnel required to perform each maintenance action
6) Ease of performing each maintenance action
7) Repair parts used
8) All parts, assemblies and components which failed to meet the TC established criteria
9) Maintenance failures and repeated failures
10) Interchangeability of parts
11) All down time
12) Evaluation of skill level requirements
13) Adequacy of maintenance literature
14) Adequacy of tools
15) Time required and difficulties encountered servicing the test weapons recoil and counter recoil systems, equilibrators and reservoir.

6.2.1.15 Crew Requirements and Accommodations

Crew requirements shall be established based on the considerations of paragraphs 6.2.1.2 and 6.2.1.16. Determine and record the following:

a. Number of crew members required to adequately perform the required functions.

b. Difference in personnel requirements when conducting direct or indirect firing over an extended period.

c. Availability of seating for each crew member.

d. Availability of space for servicing the weapon and position of personnel when ready to fire.

NOTE: Adequacy, comfort, and safety shall be kept in mind when making observations.

e. Adequacy of lighting in fighting compartment on the weapon, stowed equipment, and ammunition preparation.

f. Adequacy of method or route for each crew member to mount and dismount the test item and availability of nonskid surfaces, steps, or ladders.

6.2.1.16 Human Engineering

Determine the suitability of the test item's design as regards the man-machine relationship by performing the applicable sections of MTP's 2-3-516 and 3-3-521.

a. Record the following:

1) Effects of adverse weather and terrain on driver, assistant driver and crew
2) Effects of 72-hour operation on personnel traveling under "buttoned up" criteria
3) Crew reaction to vehicle noise and vibration in the fighting compartment during travel and after extensive periods of travel

b. During the performance of this MTP have personnel fill out questionnaires designed to gather their opinions on man-weapon compatibility, safety hazards and areas where improvements may be made. Reposition the crew and evaluate all comments.

6.2.1.17 Safety Confirmation

During the conduct of this MTP, determine the factors which present safety hazards as described in the applicable sections of MTP's 2-3-501 and 3-3-517, and then the following:

NOTE: Observations shall be made continuously for any unsafe or potentially unsafe condition which may be cause for the cessation of testing. These unsafe or questionable conditions must be resolved in favor of safety before operations are resumed.

a. Verify that safety releases for the weapon and ammunition are in order before conduct of firing.
b. Continuously observe for safety hazards during all firing and non-firing exercises.
c. Verify that the safety features built into the test item satisfy the requirements of the QMR or the TC.
d. Resolve unsafe or potentially unsafe conditions in favor of safety prior to start or continuation of testing.
e. Record the following:

1) All apparent or suspected safety hazards
2) Resolved safety hazards
3) Degree of fulfillment of the test item to safety requirements specified in QMR's and TC's

6.2.2 Weapon Tests

6.2.2.1 Weapon Operational Characteristics

Determine the ability of an average trained crew to fire the test

weapon using the criteria of the applicable sections of MTP 3-3-510 and the effect of prolonged operation on the weapon's associated equipment, under various conditions as follows:

NOTE: Operational characteristics tests can be performed during the conduct of preparation for action and march order tests (paragraph 6.2.1.2).

6.2.2.1.1 Direct Fire Tests - Direct fire tests shall be conducted as follows:

a. Emplace the test specimen on level ground, with no precipitation and moderate temperature during daylight and darkness (blackout) hours.

b. Set the test weapon for maximum right traverse and 0 mil elevation.

c. Fire the test weapon at its specified sustained--rate-of-fire for its maximum allowable time.

d. Record the following:

1) Ammunition used
2) Charge used, if applicable
3) Excess handwheel effort required for traversing and elevation
4) Distance (in mils) moved, for traverse and elevation, when rotating the handwheel one revolution
5) Effort required for loading, unloading, power ramming and hand ramming
6) Effort required to handle the ammunition and/or operate ammunition handling equipment
7) Smoothness of the breech mechanism
8) Inconsistancy in row depth
9) Ramming cycle time
10) Effects of both evacuation and build-up of air continuation in the fighting compartment when "buttoned up"
11) Operability of the case ejection mechanism, when applicable
12) Frequency of hydraulic pump operation and running time
13) Limits of test weapon traverse and areas of dead space
14) Difficulties encountered during firing

e. Repeat steps a through d with the test weapon at center traverse.

f. Repeat steps a through d with the test weapon at maximum left traverse.

g. Repeat steps a through f on the following terrain:

1) Sand
2) Rock

6.2.2.1.2 Indirect Fire Tests - Indirect fire tests shall be conducted as follows:

a. Emplace the test specimen on the forward slope of a hill, having a 5% slope with no precipitation, moderate temperature during daylight hours.

b. Set the weapon at its minimum allowable elevation for the terrain conditions, for the ammunition used and center traverse.

c. Repeat steps c and d of paragraph 6.2.2.1.1.

d. Repeat steps a through c with the test weapon set at the following elevations: Record the tube relation to the "in-battery" position at quadrants in excess of 700 mils.

1) 200 mils
2) 400 mils
3) 600 mils
4) 800 mils
5) Maximum elevation

e. Repeat steps a through d on a forward slope of 10%.

f. Repeat steps a through d on a forward slope of 15%.

g. Repeat steps a through d on the reverse slope of a hill.

h. Determine and record the following:

1) Limits of elevation and traverse
2) Dead space areas
3) Effects of different loading elevations on the loading and ramming cycle.

6.2.2.1.3 Adverse Conditions - Repeat paragraphs 6.2.2.1.1 and 6.2.2.1.2 under the conditions described in MTP 3-3-524.

6.2.2.2 On-Carriage Fire Control Equipment and Boresighting

NOTE: Basic periodic tests shall be performed upon receipt of the test weapon, at prescribed intervals during the test as indicated in the test plan, after accidents or traversing extremely rough terrain, and whenever the weapon fires inaccurately for no readily apparent reason using the criteria of MTP 3-3-081.

6.2.2.2.1 On-Carriage Fire Control Equipment - Observe the functioning of on-carriage fire control equipment throughout all tests during daylight and darkness and record the following:

a. Visability limits of panoramic telescope resulting from traversing.

b. Ease and speed of operation.

c. Any difficulties encountered in using night lighting devices.

d. Finding of loose reticles or prisms and the presence of moisture in sights.

e. Any play in the sight head.
f. All required adjustments

6.2.2.2.2 Boresighting - Boresight the weapon before and after each firing using the criteria of MTP 3-3-503 and record the following:

a. All adjustments made
b. Difficulties encountered making adjustments.
c. Ability of the test weapon to retain boresight.

6.2.2.3 Maximum Rate of Fire

a. During the conduct of paragraph 6.2.2.1 determine the maximum rate of fire for the test weapon at elevations of 400, 800 and maximum elevation with the test weapon set at center, maximum right and maximum left traverse.

6.2.2.4 Effects of Muzzle Brake (if applicable)

Determine the effects of muzzle blast, with and without a muzzle brake during the conduct of paragraphs 6.2.2.1, and 6.2.1.5 and on the test item's stability (paragraph 6.2.1.3) and personnel as follows:

6.2.2.4.1 Preparation for Test - Setup instrumentation to measure the overpressures in the immediate vicinity of the test item.

6.2.2.4.2 Muzzle Brake Attached - Record and/or obtain the following:

a. Effects on crew:

1) Crew discomfort due to muzzle blast or overpressure
2) Obscuration effects, particularly during low elevation or direct firing

b. Effects on weapon

1) Effects of muzzle blast and overpressures on weapon's stability

c. Effects on surroundings:

1) Progressive erosion of natural terrain due to blast effects

d. Overblast readings
e. Photographs of muzzle flash due to weapon firing during daylight and night time.

6.2.2.4.3 Muzzle Brake Removed (when applicable) - During the conduct of paragraph 6.2.1.3, record the data required in paragraph 6.2.2.4.2.

6.2.2.5 Accuracy and Precision

Determine the accuracy and precision of the test weapon during the conduct of paragraph 6.2.2.1, as described in MTP 3-3-506.

6.2.2.6 Secondary Armament

a. Visually inspect the secondary armament mount and record the presence of cracks, abrasions, etc.

b. Install the secondary armament on its mount with the test item combat loaded.

c. Fire the secondary armament through 360 degrees of both above and below the horizontal plane, with the test item in its traveling position on the various terrains of paragraph 6.2.2.1 and determine and record the following:

1) Maximum elevation
2) Minimum elevation
3) Field of fire during:

    a) Maximum elevation
    b) Minimum elevation

4) Dead space
5) Effect of maximum and minimum elevation fire on armament operation body position through 360 degrees of traverse
6) Ease of loading and reloading the secondary armament
7) Personnel exposure during loading and reloading operations
8) Final disposition of fired cartridge cases in relation to crew members normal positions and the primary weapon traverse and elevating mechanism
9) Time of fire for continuous firing from the initial ammunition chest capacity
10) Ability of the weapon mount traversing lock to retain the weapon stationary during travel

d. Visually inspect the mount for cracks, abrasions and abnormal wear.

e. Repeat steps c and d with the test item in its "buttoned up" position.

6.2.3 Post-Operational Inspection

At the completion of testing, the test item shall be subject to the technical and preoperational inspections of MTP 2-3-500 and MTP 3-2-500 to determine any adverse effects which may have resulted from the testing.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Preoperational Inspection and Physical Characteristics

Data shall be collected and recorded as described in the applicable sections of MTP 2-3-500 and MTP 3-3-500.

6.3.2 Test Conduct

6.3.2.1 Vehicle and Vehicle/Weapon Tests

6.3.2.1.1 Mobility and Maneuverability -

a. Record the following for all tests:

1) Time of day (daylight, night time)
2) Weather conditions (rain, clear, etc.)
3) Temperature in °F
4) Vehicle condition (loaded, unloaded)

b. Record the following while operating in convoy:

1) Vehicle position (lead, last)
2) Type of terrain (paved road, secondary road, etc.)
3) Vehicle ability to:

a) Maintain minimum convoy speed
b) Maintain normal convoy speed
c) Maintain maximum convoy speed

4) Speed, in mph, for:

a) Minimum convoy speed
b) Normal convoy speed
c) Maximum convoy speed

c. Record the following while determining the vehicles level road operating ability:

1) Type of terrain (sand, wet soil, etc.)
2) Vehicle's ability to:

a) Maintain operational speed
b) Execute fast turns:

1) To the right
2) To the left

c) Execute slow tight turns:

1) To the left
2) To the right

3) Vehicle stability while:

a) Driving straight
b) Making fast turns
c) Making slow tight turns

4) Difficulties encountered:

a) Driving straight
b) Making fast turns
c) Making slow tight turns

5) Rated operational speed
6) Turning radius, in feet, for:

a) Slow tight turns:

1) Left
2) Right

b) Fast turns:

1) Left
2) Right

d. Record the following while operating the test item on slopes:

1) Type of terrain (hard, sand, rocky, cross-country)
2) Type of slope (prepared, unprepared)

a) For longitudinal slopes

1) Value in %
2) Vehicle's ability

b) For side slopes:

1) Value in %
2) Vehicle's ability

3) For stop, hold and start

a) Longitudinal slopes

1) Value in %
2) Vehicle's ability to:

(a) Ascend
(b) Descend

b) Side slopes

1) Value in %
2) Vehicle's ability to:

(a) Ascend
(b) Descend

e. Record the following while operating the test item through brush, timber, woods, etc.):

1) Type of terrain (brush, timber, woods, winding trails)
2) Distance travelled
3) Difficulties encountered
4) Time required, in minutes

f. Record the total mileage travelled
g. Retain all photographs

6.3.2.1.2 Preparation for Action and March Order -

Record the following for each performance:

a. Preparation for Action

1) Time required, in minutes
2) Number of personnel required
3) Requirements for special preparations or disposition of associated equipment
4) Effects of mounted special purpose kits
5) Unsafe acts or existing conditions
6) Difficulties encountered
7) Time of day (night, day)
8) Type of terrain
9) Weather conditions
10) Handwear used

b. March Order

1) Time required, in minutes
2) Number of personnel required
3) Method of stowage of equipment
4) Unsafe acts or existing conditions
5) Difficulties encountered
6) Time of day
7) Type of terrain
8) Weather conditions
9) Handwear used

6.3.2.1.3 Stability -

a. Record the following during firing:

1) Type of terrain (rocky, hard, etc.)
2) Spade condition (seated, withdrawn)
3) Ammunition used (fixed, variable)
4) Ammunition charge, if applicable (1, 3, 5, etc.)
5) Displacement of the carriage, in inches, at maximum charge:

a) At low quadrants of elevation
b) At medium quadrants of elevation
c) At high quadrants of elevation
d) At maximum left traverse
e) At maximum right traverse
f) At center traverse
g) Rocking of chassis (if applicable)

b. Record the following during travelling:

1) Deficiencies noted in road and track wheels
2) Deficiencies noted in lockout system

c. Retain photographs, and all traces showing hop

6.3.2.1.4 Stowage -

a. Record the following:

1) Data collected as described in the applicable sections of MTP 2-3-508
2) Adequacy of stowage facilities
3) Stowage interference with operations
4) Accessibility of stowed items while firing
5) Durability of stowage facilities
6) Removal or handling requirements of stowed load in order to service vehicle components or armament
7) Improper lock functioning of ammunition stowage racks
8) Adequacy of physical security of items stowed or the exterior portion of the test item

b. Retain all photographs

6.3.2.1.5 Compatibility with Related Equipment -

a. Record the following:

1) Data collected as described in the applicable sections of MTP 2-3-512
2) Results of towing

a) Similar vehicle
b) Lighter vehicle

3) Results of being towed by:

a) Similar vehicle
b) Recovery vehicle

4) Ease and adequacy of test vehicle's:

a) Coupling provisions
b) Interference on turns
c) General towing reactions

5) Ability of recovery vehicle to recover test vehicle from adverse conditions
6) Towing requirements

b. Retain all photographs.

6.3.2.1.6 Security -

Record the following:

a. Data collected as described in applicable sections of MTP's 2-3-511 and 3-3-515
b. Noted comparison of aural noise between test item and similar type vehicle.
c. Noted torching and differences in configuration
d. Observance of test item's position from 600 meters.

6.3.2.1.7 Inland Waterway Operation -

Record the following:

a. Data collected as described in applicable sections of MTP 2-3-510
b. Testing time, in minutes
c. Evidence of water pollution to bearings, seals, etc.
d. Freeboard measurement at front, rear, corners, and sides while:

1) Standing still
2) Traveling at maximum water speed
3) Turning at maximum water speed

e. Water speed attained
f. Degrees of slopes negotiated:

1) Entering water
2) Exiting water

g. Entry of water into the test vehicle when:

1) Entering the water
2) Exiting the water

h. Bottoming action of vehicle when entering the water
i. Traction obtained on various types of soil
j. Adequacy of bilge pump(s):

1) Amount of noise
2) Volume of water dispensed, gallons per hour
3) Condition of water strainer

6.3.2.1.8 Fording -

Record the following:

a. Data collected as described in applicable sections of MTP 2-3-509
b. Inherent capability of the test item to ford a minimum of 42 inches
c. For deep water fording kits:

1) Simplicity of installation
2) Time required for installation

d. The firmness of the under surface of the crossing site
e. Fording depth, in inches
f. Difficulties encountered

6.3.2.1.9 Durability and Reliability -

Record the following:

a. Data collected as described in the applicable sections of MTP's 2-3-507 and 3-3-514
b. For each type of terrain:

1) Type of terrain (paved road, secondary road, etc.)
2) Type and weight of load, in pounds
3) Actual test mileage accumulated
4) Engine operating hours
5) Engine idling hours
6) Vehicle operating hours
7) Weapon operating hours
8) Failures and frequency of repeated failures
9) All parts assemblies and components which failed to meet the TC established criteria
10) Number of emplacements made

6.3.2.1.10 Signal Communications Equipment -

Record the following:

a. Ability of the vehicle's commander to communicate with the driver and other crew members:

1) With vehicle halted and engine speeds of:

a) Minimum RPM's
b) 1000 RPM's
c) 1500 RPM's
d) Maximum RPM's

2) With vehicle moving and engine speeds of:

a) Minimum RPM's
b) 1000 RPM's
c) 1500 RPM's
d) Maximum RPM's

b. Ability of the section chief to talk to crew through the interphone amplifier:

1) With vehicle halted and engine speeds of:

a) Minimum RPM's
b) 1000 RPM's
c) 1500 RPM's
d) Maximum RPM's

c. The effects of turbocharge cut-in and track vibrations.

6.3.2.1.11 Air Transportability - Data shall be collected and recorded as described in applicable sections of MTP 7-3-515.

6.3.2.1.12 Surface Transportability - Data shall be collected and recorded as described in applicable sections of MTP 2-3-519.

6.3.2.1.13 Logistics - Over-the-Shore - Data shall be collected and recorded as described in applicable sections of MTP 2-3-520.

6.3.2.1.14 Maintenance Evaluation -

Data shall be collected and recorded as described in applicable sections of MTP's 2-3-502 and 3-3-518, and record the following:

a. Type of maintenance
b. Description of maintenance action
c. Amount of lubrication used, in ounces, if applicable
d. Time, in hours, required to perform each maintenance action
e. Number of personnel required to perform each maintenance action
f. Ease of performing each maintenance action
g. Repair parts used
h. All parts, components and assemblies which failed to meet the TC established criteria
i. Maintenance failures and repeated failures

j. Interchangeability of parts
k. All down time, in hours, days
l. Evaluation of skill level requirements
m. Adequacy of maintenance literature
n. Adequacy of tools
o. For test weapon's recoil and counter-recoil system, equilibrator and reservoir:

1) Time required to service, in minutes
2) Difficulties encountered

6.3.2.1.15 Crew Requirements and Accommodations -

Record the following:

a. Number of crew members required to adequately perform the required functions
b. Difference in personnel requirements when conducting direct or indirect firing over an extended period
c. Availability of seating for crew members
d. Availability of space for servicing the weapon and position of personnel when ready to fire
e. Adequacy of lighting
f. Adequacy of method or route for each crew member to mount and dismount, and availability of non-skid surfaces, steps, or ladders.

6.3.2.1.16 Human Engineering - Data shall be collected and recorded as described in applicable sections of MTP's 2-3-516 and 3-3-521.

6.3.2.1.17 Safety Confirmation -

Data shall be collected and recorded as described in applicable sections of MTP's 2-3-501 and 3-3-517, and record the following:

a. All apparent or suspected safety hazards
b. Resolved safety hazards
c. Degree of fulfillment of the test item to safety requirements specified in QMR's and TC's.

6.3.2.2 Weapon Tests

6.3.2.2.1 Weapon Operational Characteristics -

a. Record the following for all tests:

1) Time of test (daytime, night time)
2) Test site temperature in °F
3) Test site weather condition (clear, snow, rain)
4) Test site terrain condition (wet, frozen, dry, etc.)
5) Handwear used (gloves, arctic mittens, none)
6) Ammunition used (fixed, variable, etc.)

7) Charge used, if applicable (1, 3, 5, etc.)
8) For hydraulic pump operation:

a) Frequency of operation (times per hour)
b) Running time (in minutes)

9) Effect of prolonged operation on associated equipment
10) Test being performed (maximum rate-of-fire, sustained rate-of-fire)

b. Record the following for direct fire tests:

1) Test site terrain (ground, sand, rock)
2) Test item traverse (maximum left, maximum right, center)
3) Effort (easy, very easy, hard, etc.) required to:

a) Elevate, depress and traverse the weapon
b) Handle the ammunition and ammunition handling equipment

1) Load, unload
2) Power ram
3) Hand ram

4) Distance moved, in mils, for one rotation of:

a) Traverse handwheel
b) Elevation handwheel

5) Smoothness of breech mechanism operation
6) Inconsistency in ram depth
7) Ramming cycle time
8) Operability of case ejection mechanism, if applicable
9) Effect of bore evacuation in the "buttoned up" condition
10) Limits of weapon traverse
11) Location of dead space

c. Record the following for indirect fire tests:

1) Test site terrain (forward slope, reverse slope)
2) Percent of slope (5, 10, 15)
3) Test item traverse (maximum left, maximum right, center)
4) Test item elevation in mils (200, 400, 600, etc.)
5) Effort (easy, very easy, hard, etc.) required to:

a) Elevate, depress and traverse the weapon
b) Handle the ammunition and ammunition handling equipment

1) Load, unload
2) Power ram

3) Hand ram

6) Distance moved, in mils, for one rotation of:

a) Traverse hand wheel
b) Elevation hand wheel

7) Smoothness of breech mechanism operation
8) Inconsistencies in ram depth
9) Ramming cycle time
10) Operability of case ejection mechanism, if applicable
11) Effects of bore evacuation in the "buttoned up" condition
12) Limits of weapon traverse
13) Location of dead space
14) Limits of weapon elevation
15) Difficulties encountered during firing
16) Tube relation to "in-battery" position at quadrants in excess of 700 mils
17) Effect of elevation on loading and ramming cycle

6.3.2.2.2 On-Carriage Fire Control Equipment and Boresighting -

a. On-Carriage Fire Control Equipment

Record the following:

1) Visuability limits of panoramic telescope, in degrees
2) Ease and speed of operation
3) Difficulties encountered in using night lighting devices
4) Loose reticles or prisms and the presence of moisture in sights
5) Play in the sight head
6) Required adjustments
7) When conducted (prior to operational characteristics test, during stability test, etc.)

b. Boresighting

Record the following:

1) When conducted
2) Data collected as described in the applicable sections of MTP 3-3-503
3) Adjustments made
4) Difficulties encountered in making adjustments
5) Ability of the test item to retain boresight

6.3.2.2.3 Maximum Rate of Fire -

Record the following for each performance:

a. Loading elevation in mils (400, 800, etc.)
b. Loading traverse (maximum left, maximum right, center)
c. Maximum rate-of-fire, in rounds per minute
d. Degree of fulfillment of the test weapon with the QMR requirement and technical manual established limits.

6.3.2.2.4 Effects of Muzzle Brake -

a. Record the following:

1) Disposition of muzzle brake (attached, removed)
2) Effects on crew:

a) Muzzle blast or overpressure crew reaction
b) Crew reaction to obscuration

3) Effect on weapon stability
4) Erosion caused by blast effects
5) For over blast measurements:

a) Location of blast meters
b) Blast meter measurements

b. Retain photographs of muzzle flash.

6.3.2.2.5 Accuracy and Precision - Data shall be collected and recorded as described in the applicable sections of MTP 3-3-506.

6.3.2.2.6 Secondary Armament -

Record the following:

a. Type of secondary armament
b. Type of mount
c. Evidence of mount cracks, abrasions, etc. prior to firing
d. Test item condition (travelling, "buttoned up")
e. Maximum elevation
f. Minimum elevation
g. Field of fire, in degrees

1) Maximum elevation
2) Minimum elevation

h. Location of dead space
i. Effect of firing on the armament operator's body, with weapon at:

1) Maximum elevation
2) Minimum elevation

j. Ease of loading and reloading weapon

k. Personnel exposure during loading and reloading operations

l. Disposition of ejected cartridge cases

m. Time required to fire initial ammunition chest capacity, in minutes

n. Ability of the weapon mount traversing lock to retain the weapon stationary during travel

o. Post firing cracks, abrasions, or evidence of abnormal wear to the mount

6.3.3 Post-Operational Inspection

Data shall be collected and recorded as described in the applicable sections of MTP 2-3-500 and 3-3-500.

6.4 DATA REDUCTION AND PRESENTATION

Data obtained for each performance will be summarized, compared and evaluated. Appropriate charts and graphs will be used to summarize and compare the test data. Special consideration will be given to any condition or circumstance which may have contributed to any test result.

Time required to conduct functions under various conditions will be so identified. Crew requirements other than TOE Authorizations will be recorded and explained.

Data collected as prescribed in MTP 2-3-500 and MTP 3-3-500 shall be compared and presented with that specified in the QMR or TC.

Data collected showing preliminary and pre-operational inspections, and post technical and operational inspections shall be compared and significant changes presented.

All qualitative data collected shall be evaluated against the requirements of the QMR and TC to determine the degree of fulfillment.

Motion and still pictures will be identified.