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Material Test Procedure 4-2-607*
Aberdeen Proving Ground

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

CHECK FIRING OF MASTER AND REFERENCE PROPELLANTS

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1. OBJECTIVE

The objective of this document is to instruct personnel in the techniques of conducting and evaluating check firing of artillery, tank, mortar, and recoilless rifle ammunition master and reference propellants.

2. BACKGROUND

Check firing is employed to determine whether or not a master or reference propellant is functioning satisfactorily and whether its continued use as a calibration lot should be permitted. These firings are performed on all master and reference lots to insure that no significant physical or chemical changes affecting ballistic performance have occurred in the propellant since the previous firing check or calibration test. The same care must be exercised in the check firing as in the calibration test to insure proper evaluation of propellant functioning.

While firings are being conducted at the proving grounds, arsenals are performing surveillance tests on the identical lots for additional verification of their satisfactory condition. Check firings are conducted at intervals outlined by the commodity command.

3. REQUIRED EQUIPMENT

- a. Chronograph - counter and camera.
- b. Appropriate Meteorological Equipment to measure barometric pressure, relative humidity, and temperature.
- c. "Check" Weapon.
- d. Star Gage.
- e. Pressure Gage (copper crusher).
- f. Dummy Thermocoupled Rounds.
- g. Scales, propellant loading.
- h. Constant-temperature Magazine (70° ± 2° F).
- i. Thermocouples and Temperature Indicating Equipment.

REFERENCES

- A. USATECOM Regulation 702-1, Quality Control - USATECOM Ammunition Calibration Program, 12 December 1968.
- B. MIL-STD-1231B, Surveillance Inspection of Industrial Stocks of Propellant in Storage, 2 August 1962.
- C. Local safety regulations.
- D. MTP 3-2-600, Recoil and Equilibrator Systems.
- E. MTP 3-2-801, Measurement of Internal Diameters of Cannon.
- F. MTP 3-2-810, Weapon Pressure Instrumentation.

*Supersedes issue dated 1 September 1966.

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6.1.3 Ammunition

Preparation of ammunition and ammunition components shall be as follows:

- a. Take all ammunition components, as well as pressure gage coppers, from the same metal parts lots used in the previous check or calibration firing.
- b. Check the propellant loading scales for zero reading with the correct counter-balance. The weight of the propellant shall be the same as that determined in the calibration test (MTP 4-2-606).
- c. Prepare a one-half-pound sample of propellant for shipment to an arsenal for closed bomb test and a one-quarter-pound sample for moisture analysis.
- d. Specify lot number of test propellant, web size, manufacturer, and year manufactured.
- e. Assemble pressure gages with the proper copper lot previously set aside for check tests.
- f. Prepare dummy thermocoupled rounds for use in temperature measurements.
- g. Record projectile model and lot numbers and filler type.
- h. Weigh all projectiles and record all weights.
- i. Number each projectile for future correlation with the round number in the firing record.
- j. Measure and record diameters, in two planes, of all projectiles at the bourrelet, the rotating band, and on the body above and below the band.
- k. Record propellant charge weight as well as total bagged charge weight for separate-loading ammunition.
 - l. If bag type charge is to be used, record composition and grade.
 - m. Record dimensions of bagged charges: length and diameter at three positions along the charge.
 - n. Record primer model, number of grains, and lot number.
 - o. Record igniter, type, grade, and weight when used.
 - p. Record fuze model and lot numbers when used.
 - q. Record cartridge case model and lot numbers.
 - r. For any ammunition item or ammunition component, including the propellant, which is determined not to be in compliance with drawing requirements:

- 1) Appropriately label the item
- 2) Segregate and hold it for disposition instructions

Under no circumstances shall such materiel be used in check firing.

- s. Weigh and record the weight of the cartridge case, if used.

6.1.4 Final Inspection

The following final inspections shall be made during the last stage of preparation for assembly:

- a. Check each propellant container for leakage using the procedures of MIL-STD-1231B.
- b. When firing fixed ammunition, check crimping machine pressure for

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obtaining the required bullet pull.

c. Check rounds visually for any defects, such as dents or other abnormalities that would prevent satisfactory functioning.

6.2 TEST CONDUCT

6.2.1 Prefiring

The following shall be accomplished on the day of firing:

a. Measure and record chronograph coil distances (muzzle to first coil, first coil to second coil) as described in MTP 4-2-805.

b. Measure and record recoil mechanism pressure (MTP 3-2-600).

c. Provide the chronograph operator with coil distances, the weapon caliber and type, the weight and model of projectile, and expected muzzle velocities.

d. Check the constant-temperature magazine to insure that the rounds have been conditioned as required ($70^{\circ} \pm 2^{\circ}\text{F}$ for 24 hours).

6.2.2 Firing

NOTE: The following restrictions to this test shall be observed:

a) Any interruption of firing exceeding 1 hour will require starting the check firing program anew.

b) A check firing test must be completed on the same day it is begun.

Just before firing the first conditioning round, and on an hourly basis thereafter until the completion of firing, record meteorological data consisting of temperature and barometric pressure

Record the test weapon elevation and azimuth of line of sight, and location of test site.

6.2.2.1 Conditioning Rounds

Fire two conditioning rounds and record the tube round number and projectile muzzle velocity (MTP 4-2-805).

NOTE: Conditioning round projectile velocities shall be used to provide a check on the chronograph prior to the firing of check rounds.

6.2.2.2 Check Rounds

Fire check rounds as indicated under the appropriate heading of Table I.

NOTE: Check rounds shall be fired for the highest velocity prescribed for the weapon propellant under test.

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TABLE I - NUMBER OF ROUNDS TO BE FIRED IN UNIFORMITY SERIES

Zones		For Zoned Ammunition							
Total	Arrangement	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Single Granulation Propellant									
*1	NA	-	-	-	-	-	-	-	-
2	NA	7	7	-	-	-	-	-	-
3	NA	7	4	7	-	-	-	-	-
4	NA	7	4	4	7	-	-	-	-
5	NA	7	4	4	4	7	-	-	-
6	NA	7	4	4	4	4	7	-	-
7	NA	7	4	4	4	4	4	7	-
8	NA	7	4	4	4	4	4	4	7
Dual Granulation Propellant									
3	Zone 1 Fast Prop. Zones 2 & 3 Slow Prop.	7	7	7	-	-	-	-	-
4	Zone 1 Fast Zones 2 to 4 Slow	7	7	4	7	-	-	-	-
4	Zones 1 & 2 Fast Zones 3 & 4 Slow	7	7	7	7	-	-	-	-
5	Zone 1 Fast Zones 2 to 5 Slow	7	7	4	4	7	-	-	-
5	Zones 1 & 2 Fast Zones 3 to 5 Slow	7	7	7	4	7	-	-	-
6	Zone 1 Fast Zones 2 to 6 Slow	7	7	4	4	4	7	-	-
6	Zones 1 & 2 Fast Zones 3 to 6 Slow	7	7	7	4	4	7	-	-
6	Zones 1 to 3 Fast Zones 4 to 6 Slow	7	4	7	7	4	7	-	-
7	Zone 1 Fast Zones 2 to 7 Slow	7	7	4	4	4	4	7	-
7	Zones 1 & 2 Fast Zones 3 to 7 Slow	7	7	7	4	4	4	7	-
7	Zones 1 to 3 Fast Zones 4 to 7 Slow	7	4	7	7	4	4	7	-
8	Zone 1 Fast Zones 2 to 8 Slow	7	7	4	4	4	4	4	7
8	Zones 1 & 2 Fast Zones 3 to 8 Slow	7	7	7	4	4	4	4	7
8	Zones 1 to 3 Fast Zones 4 to 8 Slow	7	4	7	7	4	4	4	7

*For single zone or fixed type round - 10 rounds.

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Obtain the following data for all check rounds fired:

- a. Weapon tube and gun round number.
- b. Test round number.
- c. Charge weight.
- d. Projectile weight.
- e. Projectile seating measurement, as described in MTP 4-2-802, for separate-loading rounds.
- f. Travel time from constant-temperature magazine to weapon.
- g. Time round remains in weapon before firing.
- h. Time of firing.
- i. Muzzle velocity as described in MTP 4-2-805 and corrected for projectile weight and presence of gages.

NOTE: If the recorded velocity differs from the expected velocity by more than 2 percent, cease firing and determine the cause.

- j. Chamber pressure, as described in MTP 3-2-810 and corrected for projectile weight and presence of gages.
- k. Estimated amount and color of smoke generated.
- l. Estimated amount and color of muzzle flash generated.
- m. Residue, if any, in cartridge, case, chamber, or bore.
- n. Malfunction of weapon, recoil mechanism, or component parts.
- o. Visible evidence of breakdown of tube, breech, recoil mechanism, carriage, etc.
- p. Length of recoil, in inches, as described in MTP 3-2-815.

6.2.2.3 Temperature Confirmation With Dummy Rounds

Check propellant temperatures, by use of dummy thermocoupled rounds or charges, once during and after the firing of check rounds by the following procedure:

- a. Record temperature of dummy round or charge while in the constant-temperature magazine, and time of day.
- b. Transport the dummy round or charge to the weapon and insert. Record temperature, time of leaving magazine, and time of loading into weapon.
- c. Record temperature in 1-minute intervals for a period of 5 minutes, with round or charge inserted in weapon, starting 1 minute after insertion, and indicate time of recording.
- d. Remove dummy round or charge from weapon and return it to the constant-temperature magazine.

NOTE: Do not reuse the dummy round or charge until it has been in the constant-temperature magazine for a minimum of 24 hours.

6.2.3 Post-Firing

Upon completion of firing:

- a. Star gage the weapon as described in MTP 3-2-801.
- b. Remeasure the distances between the weapon muzzle and the first

velocity coil and the first and second coils.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Weapon

Record the following:

- a. Tube land diameter in inches or millimeters
- b. Tube round number
- c. Gun caliber, model and serial numbers
- d. Tube caliber, model and serial numbers
- e. Carriage caliber, model and serial numbers
- f. Recoil mechanism caliber, model and serial numbers

6.3.1.2 Ammunition

Record the following:

- a. Lot number of test propellant, web size, manufacturer, year manufactured, and whether propellant is a reference or a standard.
- b. Projectile model and lot numbers.
- c. Individual projectile weights and numbers.
- d. The diameters of all projectiles at two planes at the bourrelet, the rotating band, and on the body above and below the band, in inches.
- e. Propellant weight of each zone charge.
- g. Cartridge case weight - when used.
- h. Length and diameter in inches of bagged charges at three positions along the charge.
- i. Primer model, number of grains, and lot numbers.
- j. Igniter type, grade and weight (in ounces).
- k. Fuze model and lot numbers.
- l. Cartridge case model and lot numbers.

6.3.1.3 Final Inspection

Record the following:

- a. Crimp machine pressure (force in inch-pounds for use with fixed ammunition only).
- b. Noticeable round defects.
- c. Proper propellant container sealing.

6.3.2 Test Conduct

6.3.2.1 Prefiring

Record the following:

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- a. Chronograph coil distances (muzzle to first coil, first coil to second coil) as described in MTP 4-2-805.
- b. Recoil mechanism pressure as described in MTP 3-2-600.

6.3.2.2 Firing

Record the following:

- a. Meteorological data, on an hourly basis, consisting of:
 - 1) Temperature
 - 2) Relative humidity
 - 3) Barometric pressure
- b. Location of test site
- c. Test weapon elevation
- d. Azimuth of line of sight

6.3.2.2.1 Conditioning Rounds -

Record the following:

- a. Tube round number
- b. Projectile muzzle velocity

6.3.2.2.2 Check Rounds -

Record the following:

- a. Weapon tube and gun round number.
- b. Test round number.
- c. Charge weight.
- d. Projectile weight.
- e. Projectile seating measurement, as described in MTP 4-2-802, for separate-loading rounds.
- f. Travel time from constant-temperature magazine to weapon.
- g. Time round remains in weapon before firing.
- h. Time of firing.
- i. Muzzle velocity as described in MTP 4-2-805 and corrected for projectile weight and presence of gages.
- j. Chamber pressure, as described in MTP 3-2-810 and corrected for projectile weight and presence of gages.
- k. Estimated amount and color of smoke generated.
- l. Estimated amount and color of muzzle flash generated.
- m. Residue, if any, in cartridge, case, chamber, or bore.
- n. Malfunction of weapon, recoil mechanism, or component parts.
- o. Visible evidence of breakdown of tube, breech, recoil mechanism, carriage, etc.
- p. Length of recoil, in inches, as described in MTP 3-2-815.

6.3.2.2.3 Temperature Confirmation With Dummy Rounds -

- a. Temperature of dummy round or charge while in constant temperature magazine.
- b. Time of day.
- c. During transport of the dummy round or charge to the weapon:
 - 1) Temperature
 - 2) Time of leaving magazine
 - 3) Time of loading into weapon
- d. Temperature of dummy round or charge in weapon at 1 minute intervals for a period of 5 minutes, starting 1 minute after insertion.

6.3.2.3 Post Firing

Record the following:

- a. Star gage data as detailed in MTP 3-2-801.
- b. Distance between weapon muzzle and the first velocity coil and the first and second coils.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 General

All data recorded under paragraph 6.3, the results of moisture analysis (in percentage), and pressure gage data obtained from the loading plant will constitute the final report on the check firing. Using corrected values, muzzle velocity and chamber pressure means and standard deviations shall be calculated for all 7- or 10-round groups. Maximum dispersion shall be substituted for standard deviation in the case of 4-round groups. These data added to the previous check and calibration data on the tube constitute the tube permanent log.

6.4.2 Criteria

The calibration values shall be considered valid if the check firing results are not statistically different from the calibration firings at the 95-percent confidence level. If the mean of the velocity or pressure or the standard deviation of these parameters is significantly different at the 95-percent confidence level, the proving ground shall determine the cause of such difference prior to acceptance of the calibration values or requiring a new calibration.

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