

MIL-P-63404 (AR)  
11 September 1980

MILITARY SPECIFICATION  
PROPELLANT M6  
FOR USE IN CHARGE, PROPELLING, 155MM, M119A2

This specification is approved for use by the US Army Armament Research and Development Command, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers M6 Propellant for use in Propelling Charge M119A2 for M199 cannon on HOW, medium, towed: 155MM; M198 and M185 cannon on SP How, 155MM: M109A1/A2/A3.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids, or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-A-48078 - Ammunition, Standard Quality Assurance Provisions, General Specification for

MIL-C-63405 - Charge, Propelling, 155MM, M119A2, Loading, Assembling and Packing

STANDARDS

MILITARY

MIL-STD-652 - Propellants, Solid, for Cannon, Requirements and Packing

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Armament Research and Development Command, Attn. DRDAR-QA, Dover, New Jersey 07801 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL-P-63404 (AR)

DRAWINGS

US ARMY ARMAMENTS RESEARCH AND DEVELOPMENT COMMAND

9333954 - Charge, Propelling, 155MM: M119A2

(Copies of specifications, standards, drawings and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

3. REQUIREMENTS

3.1 Materials. The propellant shall be M6, conforming to the requirements of MIL-STD-652 and Dwg 9333954.

3.2 Ballistic Assessment Requirements - The propellant, when fired in the M185 cannon with the M107 projectile shall comply with the following requirements at 70°F and standard weapons conditions (see 4.5.1). The propellant shall be capable of assessment to a velocity of 2,251 feet per second (fps) without an associated average pressure less than 26,000 pounds per square inch (psi) or greater than 33,000 psi.

3.3 Ballistic Uniformity Requirements - The propellant, when fired in the M185 cannon with the projectile (M107), shall comply with the following requirements when tested as specified in 4.5.1.2. All charges (reference, master calibration and test) shall be manufactured in accordance with MIL-C-63405.

3.3.1 Uniformity of Velocity - The standard deviation of velocity for the lot at 70°F shall not exceed 6.8 fps.

3.3.2 Individual Maximum Pressure - The propellant shall not produce an individual pressure greater than 41,000 psi at 145°F.

3.3.3 Average Pressure - At 70°F and standard weapon conditions, the propellant shall not produce an average pressure greater than 33,000 psi, nor less than 26,000 psi.

3.4 Initial production. This specification contains provisions for initial production inspection. Requirements for the submission of initial production inspection samples by the contractor shall be as specified in 4.5.1.2.1.

MIL-P-63404 (AR)

3.5 Preproduction inspection. This specification contains provisions for preproduction inspection. Requirements for the submission of preproduction inspection samples by the contractor shall be as specified in 4.3.1.

3.6 Workmanship. The best commercial practices shall be used in the formulation of propellant furnished under this specification, and all other applicable documents. The propellant and its standard ingredients shall be protected from the action of direct sunlight and acid fumes. Unless otherwise specified, no reground propellant or nitrocellulose shall be used in the manufacture of propellant procured under this specification.

#### 4 QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection and standard quality assurance provisions. Unless otherwise specified herein or in the contract, the provisions of MIL-A-48078 shall apply and are hereby made a part of this detail specification.

4.2 Classification of inspection. The following types of inspection shall be conducted on the unit product:

- a. Preproduction Sample Inspection
- b. Quality Conformance Inspection

4.3 Preproduction sample (pilot lots). The preproduction sample is intended to provide the necessary information to establish the propellant granulation needed to meet the required ballistic parameters.

4.3.1 Submission. The Contractor shall select three (3) propellant granulations which, from experience, should best fit the requirements of this specification. The contractor shall submit a preproduction sample as designated by the Contracting Officer for evaluation in accordance with 4.3.2, consisting of three (3) pilot lots approximately 1200 lbs each representing the three (3) candidate granulations.

4.3.2 Inspections to be performed. Each of the pilot lots comprising the preproduction sample and submitted in accordance with 4.3.1 may be subjected by the Government to any or all of the requirements of this specification.

MIL-P-63404 (AR)

4.3.3 Rejection. Government Engineering and Product Assurance personnel and the Contractor shall review the pilot lot test data and shall select a granulation size which best fits the requirements of this specification. The Technical Agency shall notify the Contracting Officer of the selected granulation. The Contractor shall request approval from the Contracting Officer to produce the selected granulation. If none of the pilot lots submitted meets the requirements of this specification, a new preproduction sample shall be submitted in accordance with 4.3.1. All future production lots should be of the same basic granulation.

#### 4.4 Quality conformance inspection

4.4.1 Inspection lot formation. Inspection lots shall comply with the lot formation provisions of MIL-A-48078.

#### 4.4.2 Examination and testing.

PRECAUTION - This specification covers sampling and testing of chemical, toxic or explosive materials which are potentially hazardous to personnel. Accordingly, it is emphasized that all applicable safety rules, regulations and procedures must be followed in handling and processing these materials.

4.4.2.1 Sampling for laboratory testing (see 3.1). Each lot of propellant shall be sampled and tested for composition, form, dimensions and chemical/physical properties in accordance with MIL-STD-652. (see 6.4).

4.4.2.2 Sampling for ballistic testing (see 3.2). Each lot of propellant shall be sampled for Proving Ground tests in accordance with MIL-STD-652.

4.4.2.3 Charge establishment (see 3.2). If the lot does not meet the applicable requirements, testing shall cease and the Test Director shall immediately notify the procuring activity.

4.4.2.4 Velocity uniformity (70°F) (see 3.3.1). If the product of the factor (.72) times the velocity standard deviation of the rounds tested in accordance with 4.5.1.2 exceeds the applicable requirements, apply referral criteria in accordance with 4.5.1.4. If the referral criteria cited does not apply, the lot shall be rejected. The factor makes allowance for the probability that a standard deviation from a smaller sample size exceeds the true standard deviation by chance alone. The standard deviation shall be calculated with (n-1) as the divisor in a standard statistical technique equivalent to that shown in MIL-STD-414.

MIL-P-63404 (AR)

#### 4.4.2.5 Individual Maximum Pressure (see 3.3.2)

4.4.2.5.1 Initial production (see 6.5). If any individual pressure observed during 145°F uniformity firings, after correction for difference between as-fired and recommended service charge weight, exceeds the applicable requirement, the lot shall be rejected.

4.4.2.5.2 Subsequent production. If any individual pressure observed during the 70°F uniformity series, when corrected to standard conditions and recommended charge weight, exceeds 37,000 psi, the lot shall be tested at +145°F in accordance with 4.5.1.2.1. If any individual pressure at 145°F, when corrected to recommended charge weight, exceeds 41,000 psi, the lot shall be rejected.

4.4.2.6 Average pressure (70°F) (see 3.3.3) - If the average pressure obtained exceeds the applicable requirements, apply referral criteria in accordance with 4.5.1.4. If the referral criteria cited do not apply, the lot shall be rejected.

#### 4.5 Test methods and procedures

4.5.1 Proving ground assessments. This test shall be performed at a Government Proving Ground in accordance with the applicable acceptance test procedure using M107 projectiles inert loaded within 0.01 lb of an as fired weight of 95.0 lb using Primer, Percussion, M82 and fired in a M185 Cannon with 50 percent (minimum) remaining life. All charges shall be temperature conditioned in a large conditioning box, with adequate air circulation to assure uniform conditioning, at the required temperature for a minimum of 24 hours and assurance will be made that, when fired, the charges are at the conditioning temperature (as indicated by thermocoupled control charges or liquid crystal gages). The following tolerances shall apply to all temperature conditionings: -50°F, + 5°F; 70°F, + 2.5°F; 145°F, -5°F. Copper crusher gages (2) shall be used to measure the maximum chamber pressure of each charge. Velocity coils will be used to measure the muzzle velocity of each charge. Test charges shall be assembled in accordance with drawing 9333954 and MIL-C-63405.

## MIL-P-63404 (AR)

4.5.1.1 Charge establishment (see Table 1).

4.5.1.1.1 Charge slope method. Three or more groups of charges loaded with selected charge weights of propellant (weights selected should bracket expected service charge weight) shall be conditioned and fired at 70°F. Three calibration charges shall also be conditioned and fired at 70°F, with the test charges. From the data obtained, a charge weight shall be calculated which will yield the prescribed service velocity (see 3.2). This calculated charge weight shall then be loaded into charges for the uniformity series (see 4.5.1.2.1). The difference between the corrected velocity obtained during the uniformity series and the service velocity shall be compensated for by a final adjustment in charge weight using the slope of the velocity charge weight curve previously established. The resultant will be the recommended charge weight.

4.5.1.1.2 Constant slope method. After ten (10) lots of a given production series have been fired to provide a good knowledge of the propellant characteristics, the charge slope method of assessment may be discontinued and the charge weight determined by the constant slope method. A composite charge weight versus velocity curve and charge weight versus pressure curve can be established from test results generated. This curve can then be used as in 4.5.1.1.1 to calculate the charge weight needed to achieve service velocity. This calculated charge weight is then to be loaded into charges for the uniformity series and final adjustment is to be made as indicated above for the charge slope method (see 4.5.1.1.1). The resultant will be the recommended charge weight. After nine consecutive lots of propellant are tested using the constant slope method, the tenth lot shall be tested using the charge slope method.

4.5.1.2 Uniformity (see Table 1)

4.5.1.2.1 Initial Production. Thirty charges shall be assembled with the established charge weight of propellant. Ten rounds each shall be conditioned to -50°F, 70°F and 145°F (as indicated by thermocoupled control charges or liquid crystal gages). Charges fired at 70°F shall be fired alternately with calibration charges and shall be corrected to standard weapon/firing conditions (i.e. the difference between calibration performance under test conditions and standard conditions). Firing results at all temperatures shall be corrected to recommended charge weight conditions (i.e. the difference between as fired charge weight and recommended charge weight). The means and standard deviations of the velocities and pressures at all firing temperatures shall be calculated using corrected results.

MIL-P-63404 (AR)

4.5.1.2.2 Subsequent production. Ten (10) charges shall be assembled and tested at 70°F, fired alternately with calibration charges. The means and standard deviations of the velocity and pressure shall be calculated on results corrected to standard conditions and recommended charge weight. If any individual pressure exceeds the 70°F individual maximum pressure control (see 4.4.2.5.2), ten additional test charges shall be conditioned and fired at 145°F. All results at 145°F shall be corrected to recommended charge weight. If any individual charge at 145°F exceeds 41,000 psi, the lot shall be rejected.

4.5.1.3 Retest criteria. A lot shall be retested whenever any of the following conditions exist or whenever the proving ground deems it necessary.

a. The final adjustment in charge weight exceeds 6.0 ozs of the charge weight used in uniformity firings, retest for uniformity in accordance with 4.5.1.2.

b. If for any reason, the Proving Ground considers that test conditions have detrimentally affected the test results, additional charges as required shall be tested.

4.5.1.4 Referral criteria. A test lot shall be referred to the procuring activity for disposition whenever any of the following conditions exist or whenever the proving ground deems it necessary.

a. Calibration charges fired in any test phase fail to comply with Section 3 of this specification.

b. Calibration correction applied exceeds two percent of the expected muzzle velocity.

c. Calibration components are not available.

d. Number of test or calibration results utilized in calculations is less than specified.



## MIL-P-63404 (AR)

e. Any unusual occurrences during ballistic testing, such as excessive delays between rounds, poor projectile flights, etc. Each such event shall be reported in detail on the applicable firing record.

f. Test lot fails velocity standard deviation or average pressure requirement at 70°F and any extreme test value is an outlier. The following test shall be performed to determine if a single test result is an outlier. With a sample size of 10 at a significance level of 0.05, the critical value ( $T_c$ ) is 0.477. Calculate a test value ( $T_t$ ) as follows:

For Low Outlier

For High Outlier

$$T_t = \frac{(x_2 - x_1)}{(x_9 - x_1)}$$

$$T_t = \frac{(x_{10} - x_9)}{(x_{10} - x_2)}$$

Where:

$x_1$  = test result being tested as low outlier

$x_2$  = test result adjacent to  $x_1$ , after all the test results are ordered from smallest to largest

$x_9$  = test result adjacent to the largest test result

$x_{10}$  = test result being tested as high outlier

$x_1$  or  $x_{10}$  is an outlier if  $T_t$  is greater than  $T_c$ .

## 5. PACKAGING

5.1 Packing and marking. Packing and marking shall be in accordance with MIL-STD-652, except that all propellant designated for use as reference shall be packed level A.

## 6. NOTES

6.1 Ordering data. Ordering data shall be in accordance with MIL-A-48078 with the following exceptions:

6.1.1 Procurement requirements. Procurement requirements of MIL-A-48078 shall apply.



MIL-P-63404 (AR)

6.1.2 Contract data requirements. One copy each of the Propellant Description Sheet and the Acceptance Test Summary shall be forwarded to each office designated by the contracting officer. Copies of data item descriptions required by the contractor in connection with specific procurement functions should be obtained from the procuring activity.

6.2 Proving ground test summary (see Table 1).

6.3 Drawings. Drawings listed in Section 2 of this specification under the heading US Army Armament Research and Development Command (ARRADCOM) may also include drawings prepared by, and identified as, Edgewood Arsenal, Frankford Arsenal, Rock Island Arsenal or Picatinny Arsenal drawings. Technical data originally prepared by these activities is now under the custodianship of ARRADCOM.

6.4 Surveillance sample. Samples shall be forwarded to US Army Armament Research and Development Command, Dover, NJ 07801, ATTN: DRDAR-LCE-MP for the propellant surveillance test program in accordance with MIL-STD-652.

6.5 Initial production lots. The initial production lots represent the first ten consecutive lots from each manufacturer which have been produced and met the acceptance criteria of the specification. Throughout production, if 3 consecutive lots fail on first test, testing shall revert back to the initial production plan. Lapse in production of 90 days or more shall cause testing to revert back to initial production plan.

6.6 Muzzle velocity and muzzle velocity standard deviation. This requirement is based on obtaining a nominal velocity of 2245 fps with the M549 RA projectile family in an M199 cannon at zone 7.

6.7 Individual maximum pressure. Individual maximum pressure specified in 3.3.2 is based on firing an M107 projectile loaded to an as fired weight of 95.0 lbs. Any change in weight or projectile will require an adjustment of this pressure requirement.

MIL-P-63404 (AR)

TABLE 1  
PROVING GROUND TEST SUMMARY

Test Phase	Temp (°F)	Sample Size		Velocity Requirements		Pressure Requirements	
		Cal	Test	Service vel (fps)	Stand Dev of vel (fps)	Ave Press (psi)	Indiv Max Press (psi)
Charge Establishment	70	3	9	2251	NA	26,000- 33,000	37,000
Uniformity	-50*	N/A	10	NA	NA	NA	NA
	70	10	10	2251	6.8	33,000	37,000
	+145**	N/A	10	NA	NA	NA	41,000

\*Initial production only

\*\*Initial production or when required by para 4.4.2.5.2

MIL-P-63404 (AR)

CUSTODIAN:  
ARMY-AR

PREPARING ACTIVITY:  
ARMY-AR

PROJECT NUMBER: 1376-A157