NOT MEASUREMENT SENSITIVE

MIL-DTL-32074 (USAF)
6 OCTOBER 2000

DETAIL SPECIFICATION

EXPLOSIVE, PLASTIC-BONDED, CAST AFX-757

This specification is approved for use by the Department of the Air Force and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope.

This specification establishes the requirements for the procurement of one type of the plastic-bonded explosive, AFX-757, for use in ordnance.

2. APPLICABLE DOCUMENTS

2.1 General.

The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: AAC/EN, 102 West D Ave., Ste 300, Eglin AFB FL 32542-5910, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 1376

2.2. Government documents.

2.2.1 Specifications, standards, and handbooks.

The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-T-82825	Triphenylbismuth
MIL-DTL-398	RDX (Cyclotrimethylenetrinitramine)
DoD-D-23443	Di-(2-ethylhexyl) Adipate, Technical
MIL-L-3061	Lecithin (for Use in Explosives)

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-286	Propellants, Solid: Sampling, Examination and Testing
MIL-STD-650	Explosive: Sampling, Inspection and Testing
DOD-STD-2101	Classification of Characteristics

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications.

The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

NAVAL SEA SYSTEMS COMMAND (CAGE CODE 10001)

WS 16305	Isophorone Diisocyanate
WS 16321	4,4'-Methylenebis (2,6-Di-Tert-Butylphenol)
WS 18485	Ammonium Perchlorate (for use in PBX explosives)
WS 23148	Polybutadiene, Liquid Hydroxyl-Terminated
WS 23150	Aluminum Powder, Spherical

(Application for copies of WSs should be addressed to the Commander, Indian Head Division, Naval Surface Warfare Center, 101 Strauss Ave., ATTN: Code 8410P, Indian Head, MD 20640-5035.)

2.3 Non-Government publications.

The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

CHEMICAL PROPULSION INFORMATION AGENCY (CPIA)

CPIA Publication No. 21 JANNAF Solid Propellant Mechanical Behavior Manual (Supplement)

(Application for copies should be addressed to the Chemical Propulsion Information Agency, John Hopkins University, Applied Physics Laboratory, John Hopkins Road, Laurel, MD 20723-6099.)

2.4 Order of precedence.

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article inspection.

When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Materials.

The AFX-757 explosive shall be a plastic-bonded and castable explosive material and shall contain a plastic material which is used to polymerize with the other ingredients to make it more flexible.

3.3 Formulation (M101).

The formulation of explosive AFX-757 shall comply with the requirements specified in table I.

3.3.1 Equivalent ratio.

The weight percent of isophorone diisocyanate shall be calculated using an NCO/OH ratio between 1.0/1 to 1.1/1. The NCO/OH ratios shall be calculated using the equivalent weights of materials obtained by chemical analysis using the techniques of WS 16305, 4.5.2 (Isocyanate content), and WS 23148, 4.6.2 (Hydroxyl content determination). To avoid shelf-life problems with component materials, this chemical analysis must be conducted at least every six months on lots of materials being used. The weight percent of each ingredient shall be to two significant figures.

3.3.2 Raw materials.

The RDX shall comply with MIL-DTL-398. The nominal 4 micron RDX shall have the particle size distribution as shown:

Distribution	Particle size (micron)	
	Nominal	Range
10%	2	0.4 – 3.0
50%	4	3.0 – 8.0
90%	11	9.0 – 15.0

TABLE I. AFX-757 formulation.

INGREDIENTS	PERCENT (by weight):			SPECIFICATION
	Nominal	Minimum	Maximum	
Sym-Cyclotrimethylene Trinitramine (RDX)				
Type II Class I	5.0	4.0	6.0	MIL-DTL-398
Type II 4 micron	20.0	19.0	21.0	MIL-DTL-398
Aluminum Powder, Spherical, Type IV	33.0	32.0	35.0	WS-23150
Polybutadiene, Liquid, [1/] Hydroxyl-Terminated, Type II (PolyBD)	4.44	----	----	WS-23148
Di (2-ethylhexyl) [2/] Adipate (DOA)	6.65	----	----	DoD-D-23443
Ammonium Perchlorate (AP)	30.0	29.0	32.0	WS-18485
Triphenylbismuth (TPB)	0.05	0.01	0.10	MIL-T-82825
Isophorone Diisocyanate (IPDI)	0.45	----	----	WS-16305
4,4'-Methylenebis (2,6-Di-Tert-Butylphenol)	0.05	0.04	0.06	WS-16321
Lecithin (liquid)	0.40	0.30	0.50	MIL-L-3061

[1/] Calculate polybutadiene and IPDI percentage per 3.3.1
[2/] Di-(2-ethylhexyl) Adipate weights to be 1.5 times polybutadiene weight.

NOTE: Typical equivalent analyses of binder components used to establish nominal composition are as follows: PolyBD-0.82 milliequivalent weight per gram (meq/g) (hydroxyl value) or 1219.5 g/eq (equivalent weight).
IPDI = 113.47 meq/g (equivalent weight)
NCO/OH Ratio = 1.0/1 (nominal)

3.3.2. Cure conditions.

The AFX-757 shall be cured at a temperature between 50 °C and 60 °C until a constant Shore "A" hardness of at least 20 is achieved.

3.4. Cured explosive requirements.

The cured AFX-757 explosive shall meet the requirements specified in table II.

TABLE II. Cured explosive requirements.

PROPERTY	MIN	MAX	TEST METHOD
a. Density, gm/cc (grams/cubic centimeter at 25 °C)	1.76	1.86	4.6.1
b. Stress (max), psi (at 25 °C)	30	-----	4.6.2
c. Strain, max stress, % (at 25 °C)	10	-----	4.6.2
d. Hardness, Shore “A” (15 sec) (at 25 °C)	20	-----	4.6.3
e. Vacuum stability (at 100 °C) milliliter (ml) gas per gm per 48 hours	-----	0.5	4.6.4
f. % Ammonium perchlorate (AP)	29	32	4.6.5
g. % Aluminum (Al)	32	35	4.6.5
h. % RDX	24	26	4.6.5
i. % AP plus % Al plus % RDX	85	93	4.6.5
NOTE: Values for the chemical analysis specified in f. (% AP), g. (% Al), and h. (% RDX) above, are to be determined from the average values obtained on triplicate samples using the procedures specified in 4.6.5.			

3.5. Workmanship.

The explosive material shall be free from foreign materials and manufactured in a manner to assure compliance with all of the requirements of this specification. The workmanship exhibited in the first article sample shall be evaluated to determine acceptability. The approved standards of workmanship shall thereby become a minimum requirement for all units offered for acceptance.

4. VERIFICATION

4.1 Classification of inspections.

The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.2)

b. Conformance inspection (see 4.3)

4.2 First article inspection.

First article inspection shall be performed by the contractor, after award of contract and prior to production, at a location acceptable to the Government. First article inspection shall be performed on samples which have been produced with equipment and procedures normally used in production. First article approval is valid only on the contract under which it is granted, unless extended by the Government to cover other contracts. Any production prior to acceptance of the first article sample is at the contractor's risk.

4.2.1 Sample.

A sample shall consist of two sets of representative explosive material selected from a minimum batch of 225 kilograms after isocyanate has been added. A set will contain approximately 2000 grams of explosive. A set shall be composed of a specimen of explosive selected from the first third of the batch and a separate specimen of explosive selected from the final third of the batch. A batch is defined as that quantity of material which has been subjected to one or more chemical or physical processes (or combination thereof) intended to produce a desired product having substantially uniform characteristics.

4.2.2 Inspection routine.

Material from one of the two sample sets from the batch shall be subjected to the tests specified in 4.6. The second sample set shall be forwarded to the procuring activity in a form suitable for the tests specified in 4.6.

4.2.3 Acceptance criteria.

Failure to meet the requirements of this specification shall be cause for rejection of the first article sample.

4.3 Conformance inspection.

The quality conformance inspection shall consist of the tests specified by 4.4.1, 4.4.3, and 4.4.5.

4.3.1 Sample.

Sample shall be same as that of 4.2.1, except that it shall consist of one set. Uncured material for analysis shall be selected from the same containers from which the cast samples are poured.

4.3.1.1 Sample identification.

Each explosive sample container and specimen shall be marked with the following information:

a. Complete explosive designation
b. Lot number
c. Weight of the lot
d. Manufacturer's name and plant designation
e. Contract number
f. Date of manufacture and sampling

4.3.2 Acceptance criteria.

An explosive which fails to meet any of the requirements of 3.4 when tested (see 4.4) shall be classified as defective, thus resulting in the rejection of the batch from which it was obtained.

4.4 Test procedures.

All explosive specimens used in the following tests shall be cured to a constant Shore "A" hardness (see 3.4).

4.4.1 Density.

4.4.1.1 Samples.

Density shall be determined on two samples cut from two separate cured test specimens (one sample taken from the beginning of the pour and one sample taken from the end of the pour). Each sample should weigh between ten and twenty grams.

4.4.1.2 Density determination.

The density of the sample shall be determined on an analytical balance equipped for weighing in a liquid medium. The sample shall be weighed to an accuracy of 0.1 milligram, first in air then in isooctane.

4.4.1.3 Density calculation.

The density is calculated according to the following formula:

$$D = \frac{W_a}{W_a - W_b} \times D_H$$

Where:

D = Density of test sample, grams per cubic centimeter

D_H = Density of isooctane at test temperature, grams per cubic centimeter

W_a = Weight of test sample in air, grams

W_b = Weight of test sample in isooctane, grams

4.4.1.4 Acceptance criteria.

If one sample selected for density fails to meet the requirements of a., in table II, another sample shall be taken from the same section of mix and tested. If the second sample meets the density requirement, the batch shall be considered to meet the density requirement of the specification. If the second sample fails to meet the density requirement, then the batch shall be considered as unacceptable.

4.4.2 Stress and strain at maximum stress.

Stress and strain at maximum stress shall be determined in accordance with JANNAF Solid Propellant Mechanical Behavior Manual, CPIA Publication No. 21, Section 4.3.2, Uniaxial Tensile Tests at Constant Strain Rate, Nov 1970. Class C testing shall be used, however, final specimens may be die cut from the half inch slices from the bulk sample. The specimens for

testing may be selected from the first third of the batch or the final third when sampled as specified in 4.3.1.

4.4.3 Shore "A" hardness test.

4.4.3.1 Sample.

The explosive of 4.3.1 in a suitable form as in 4.4.1.1 shall be tested for Shore "A" hardness. Any sample which exhibits exudation at the surface at the end of the cure period will not be tested.

4.4.3.2 Shore "A" hardness (15 seconds) determination.

The hardness of the cured material shall be determined using a type A-2 Durometer, with a maximum dial indicator or hand, together with a constant-load operating stand (Code DRCL). The total weight of the dead weight, holding screw and durometer shall be 1065 grams. The test specimen shall be placed under the durometer pointer with the pointer resting on the surface of the sample. Release the lock called a "Pawl." Do not permit the point to shock the sample. Record the instrument dial reading 15 seconds after release. Use a stopwatch to measure the time. Determine three values each on the top and the bottom of the specimens. Report the average of the top average and the bottom average as the test value.

4.4.4. Vacuum stability test.

4.4.4.1 Test procedure.

The procedure shall be as described in MIL-STD-650, Method 03.1.1 except that the sample size shall be at least 0.2 gram. The sample shall be cut into small cubes with a maximum size of 3 millimeters before being placed in the vacuum stability test tube. Two samples, one from each section of the batch, shall be tested.

4.4.5 Ammonium perchlorate (AP), aluminum (Al), and RDX analysis.

4.4.5.1 Sample preparation.

4.4.5.1.1 Sample preparation procedure for cured AFX-757.

a. GENTLY rub a small block of AFX-757 across the face of a non-conductive, flat, wooden abrader to obtain 1.0 – 2.0 gms of prepared sample. This procedure shall be carried out behind a safety shield. Proper handling shall be practiced in accordance with local safety instructions.

b. For cured AFX-757, an accurate chemical analysis can be made using abraded AFX-757 samples which have the majority (= 80% by number) of the abraded particles less than 1.2 mm in size.

4.4.5.1.2 Sample preparation procedure for uncured AFX-757.

Collect 1.0 – 2.0 gms of uncured AFX-757 in a tared, 30 mL, medium porosity fritted glass filtering crucible.

4.4.5.2 Test procedure for cured and uncured AFX-757.

Weighed samples of cured and uncured AFX-757 material are extracted with n-heptane, and the residue is dried and weighed. The loss in weight is equivalent to the amount of Lecithin (weight % n-Heptane extractable). The remaining residue is then extracted with water, dried, and weighed. The loss in weight is equivalent to the amount of ammonium perchlorate (weight % AP) in the sample. The material is subsequently extracted with acetone, dried, and weighed. The loss in weight is equivalent to the amount of RDX and HMX present in the sample (weight % RDX/HMX). Finally, the remaining material is treated with HCI, washed with water, dried, and weighed. The loss in weight is equivalent to the amount of aluminum in the sample (weight % Al). The remaining solid residue is the amount of cross-linked polymeric material in the sample.

4.4.5.2.1 Detailed analytical procedure for cured and uncured AFX-757.

The analytical procedure for cured and uncured AFX-757 is as follows:

a. Weigh 1.0 – 2.0 gms of the prepared AFX-757 sample to the nearest 0.1 mg (sample weight A – see e. below) in a tared, 30 mL, medium porosity fritted glass filtering crucible (sample weight A plus crucible weight B - see e. below).

b. Add 25 mL of n-Heptane at ambient temperature to the contents of the crucible, letting the solvent filter unaided through the crucible into a 30-mL beaker. Wait for approximately ten (10) minutes then filter off the remaining solvent using a vacuum filtrator.

c. Repeat procedure b. above until a total of 100 mL of n-Heptane has been added in 25 mL increments.

WARNING: Solvent vapors are hazardous. Proper handling and disposal shall be practiced in accordance with local safety instructions and Material Safety Data Sheets (MSDS).

d. Dry the crucible at 80-90 °C to a constant weight. Cool the crucible and contents in a desiccator to room temperature and weigh (weight C below).

e. Calculate the total weight % of Lecithin as follows:

$$\% \text{ Lecithin} = \frac{B - C}{A} \times 100$$

Where:

A = Weight of sample

B = Weight of crucible plus sample before n-heptane extraction

C = Weight of crucible plus residue after n-heptane extraction

f. Add 25 mL of distilled water at ambient temperature to the contents of the crucible, letting the solvent filter unaided through the crucible into a 30 mL beaker. Wait for approximately ten (10) minutes then filter off the remaining solvent using a vacuum filtrator.

g. Repeat procedure f. above until a total of 100 mL of distilled water has been added in 25 mL increments.

h. Dry the crucible at 80-90 °C to a constant weight. Cool the crucible and contents in a desiccator to room temperature and weigh (weight D – see i. below).

i. Calculate the weight % of Ammonium Perchlorate (AP) as follows:

$$\%AP = \frac{C - D}{A} \times 100$$

Where:

A = Weight of sample

C = Weight of crucible plus residue before water extraction

D = Weight of crucible plus residue after water extraction

NOTE: If the weight % of AP is less than expected, repeat procedures f. and h. above. This additional procedure may be repeated an additional two times, as necessary.

j. Add 25 mL of acetone at ambient temperature to the contents of the crucible, letting the solvent filter unaided through the crucible into a 30-mL beaker. Wait for approximately ten (10) minutes then filter off the remaining solvent using a vacuum filtrator.

k. Repeat procedure j. above until a total of 100 mL of acetone has been added in 25mL increments.

l. Dry the crucible at 80-90 °C to a constant weight. Cool the crucible and contents in a desiccator to room temperature and weigh (weight E – see m. below).

m. Calculate the weight % of RDX (and HMX) as follows:

$$\%RDX = \frac{D - E}{A} \times 100$$

Where

A = Weight of sample

D = Weight of crucible plus residue before acetone extraction

E = Weight of crucible plus residue after acetone extraction

NOTE: If the weight % of RDX is less than expected, repeat procedures j. and l. above. This additional step may be repeated an additional two times, as necessary.

n. To the remaining contents in the crucible, CAREFULLY add 2-4 mL of 3N HCI. After the reaction has subsided, add small increments of 6N HCI to the crucible until all aluminum (Al) has reacted. This is indicated by the absence of bubbles being formed.

NOTE: Do not leave the sample in contact with the acid solution for more than twenty-four hours. Loss of polymer will likely occur.

o. Rinse the contents of the crucible with a total of 100 mL of distilled water to remove traces of the acid and filter using a vacuum filtrator.

p. Dry the crucible at 80-90 °C to a constant weight. Cool the crucible and contents in a desiccator to room temperature and weigh (weight F- see q. below).

q. Calculate the weight % of Al as follows:

$$\% \text{ Al} = \frac{E - F}{A} \times 100$$

Where:

A = Weight of sample

E = Weight of crucible plus residue before HCI extraction

F = Weight of crucible plus residue after HCI extraction

r. Calculate the weight % of Polymer as follows:

$$\% \text{ Polymer} = \frac{F - T}{A} \times 100$$

Where:

F = Weight of crucible plus residue after HCI extraction

T = Tare weight of crucible with glass stirring rod

A = Weight of sample

5 PACKAGING

5.1 Packaging.

For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity (see 6.4)

6 NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1. Intended use.

AFX-757 is a high-energy explosive intended for use in ordnance. This explosive is military unique because it is used in the warhead of major weapon systems.

6.2. Acquisition requirements.

Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).

c. Exceptions to this specification, applicable drawings, or other referenced documents.

d. Desired completeness and availability of inspection records, including data cards. Use a DoD Form 1423 with appropriate Data Item Description (DD Form 1664).

e. Type and degree of contractor quality assurance system required.

f. Whether or not the test samples required are included in the material ordered.

g. Testing activities designated by the procuring agency to perform tests.

h. Packaging requirements (see 5.1).

6.3 Explosive safety precautions.

Explosive safety precautions should be in accordance with DoD Instruction 4145.26M, DoD Contractors Safety Manual for Ammunition, Explosives and Related Dangerous Material.

6.4 Safety marking.

Any precautionary and safety markings required on packages should be in accordance with the Code of Federal Regulations, Title 49 – Transportation, Parts 100 to 199, inclusive.

(Copies of CFRs are available from the Superintendent of Documents, U.S. Government Printing Office, 732 N Capitol St NW, Washington DC 20402-0002.)

6.5 Subject term (key word) listing.

Aluminum powder

Di (2 ethylhexyl) adipate (DOA)

Explosive material

Isocyanate

HMX

Sym-cyclotrimethylene trinitramine (RDX)

CONCLUDING MATERIAL

Custodians:

Air Force – 22

Review activities:

Air Force – 70, 99

Preparing activity:

Air Force – 22

Agent:

Air Force – 11

Project No. 1376-0078

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-DTL-32074 (USAF)	**2. DOCUMENT DATE (YYYYMMDD)** 2000 10 06

3. DOCUMENT TITLE

EXPLOSIVE, PLASTIC-BONDED, CAST AFX-757

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON *(if applicable)*	**7.DATE SUBMITTED** (YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME AAC/EN (AF 22)	b. TELEPHONE *Include Area Code)* (1) Commercial (850)882-3310 X2021 (2) AUTOVON 872-3310 X2021
c. ADDRESS *(Include Zip Code)* 102 West D Ave., Ste 300 Eglin AFB FL 32542-5910	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman road, Suite 2533, Ft. Belvoir, VA 22060-2533 Telephone (703) 767-6888 AUTOVON 427-6888

DD Form 1426, FEB 1 BSOLETE