

INCH-POUND

MIL-PRF-46676B (AR)
10 October 2006
SUPERSEDING
MIL-E-46676A (AR)
17 April 1964

PERFORMANCE SPECIFICATION

FLEXIBLE EXPLOSIVE

This specification is approved for use by the US Army Armament Research, Development, and Engineering Center (ARDEC) and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification describes performance requirements and quality assurance provisions for two grades of flexible explosive (see 6.1.1) designated as:

Grade A, for Navy use (See Table I)
Grade B, for Army use (See Table I)

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in Sections 3 or 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 of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

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 cited in the solicitation or contract (see 6.2).

Comments, suggestions, or questions on this document, should be addressed to, U.S. Army ARDEC, ATTN: AMSRD-AAR-QES-E, Picatinny, New Jersey 07806-5000 or emailed to ardec-stdzn@pica.army.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST online database at <http://assist.daps.dla.mil>.

AMSC N/A

FSC 1375

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DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-C-401 - Composition B

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-650 - Explosive: Sampling, Inspection, and Testing
MIL-STD-1168 - Ammunition Lot numbering and Ammunition Data Card
MIL-STD-1916 - DoD Preferred Methods for Acceptance of Product

(Copies of these documents are available online at <http://assist.daps.dla.mil> or from the Standardization Documents Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

2.3 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 Qualification. The flexible explosive furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.1.1 and 6.4).

3.2 Conformance Inspection. When specified, a sample of flexible explosive shall be subjected to qualification conformance inspection (See 4.1.2)

3.3 Support and ownership requirements.

3.3.1 Form. The flexible explosive shall be in sheet form of uniform thickness. Width, thickness, and length of sheets will vary and shall be as specified for each solicitation. (See 6.2)

3.3.2 Color. Unless otherwise specified, the color shall be olive drab.

3.3.3 Workmanship. The flexible explosive shall be free from cracks, voids, air bubbles, holes, blisters, dirt, and other impurities.

3.4 Operating Requirements.

3.4.1 Physical Properties. The flexible explosive shall conform to the physical properties listed in Table I.

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TABLE I. Physical properties.

Property	Grade A (Navy Use)	Grade B (Army Use)
Detonation Continuity	Uniformly Depressed	N/A ¹
Detonation Velocity (MPS), min	6600	6600
Shock Sensitivity	None ²	N/A ¹
ERL Bruce-ton Impact Sensitivity	Equivalent to Comp B	N/A ¹
Friction Sensitivity	None ²	None ²
Electrostatic Sensitivity	None ²	None ²
Bullet Impact Sensitivity	None ²	None ²
Bar Drop Impact Sensitivity	None ²	None ²
Flame Sensitivity	None ²	None ²
Density (g/cc), min	1.4	1.4
Exudation (Wt. %), max	0.10	0.10
Vacuum Stability (mL), max	5	5
Cracks at 160°F, (in), max	0.0625	0.0625
Cracks at -40°F, (in), max	0.0625	0.0625
Color Change	No Change	No Change
DMDNB ³ Content (Wt.%)	1.25 ± 0.25	1.25 ± 0.25
Notes: 1 - N/A indicates no requirement 2 - None indicates that the requirement is for <u>no energetic reaction</u> . 3 - DMDNB refers to the taggant 2,3-Dimethyl-2,3-Dinitrobutane		

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4. VERIFICATION

TABLE II. Requirements/verification cross reference matrix.

Method of Verification					Classes of Verification								
1- Analysis 2- Demonstration (end item test) 3- Examination 4- Test					A1 – Qualification for Grade A A2 – Qualification for Grade B B1 – Conformance for Grade A B2 – Conformance for Grade B								
Section 3 Requirements	Description	Verification Method				Verification Class				Section 4			
		1	2	3	4	A1	A2	B1	B2	A1	A2	B1	B2
3.3.1	Form			X		X	X	X	X	4.2.1			
3.3.2	Color			X		X	X	X	X	4.2.2			
3.3.3	Workmanship			X		X	X	X	X	4.2.3			
TABLE I	Detonation Continuity				X	X				4.3.1	N/A	N/A	N/A
TABLE I	Detonation Velocity, MPS, min				X	X	X	X	X	4.3.2			
TABLE I	Shock Sensitivity				X	X				4.3.3	N/A	N/A	N/A
TABLE I	Sensitivity: ERL Bruceton Impact				X	X				4.3.4	N/A	N/A	N/A
TABLE I	Friction Sensitivity				X	X	X			4.3.5		N/A	N/A
TABLE I	Electrostatic Sensitivity				X	X	X			4.3.6		N/A	N/A
TABLE I	Bullet Impact Sensitivity				X	X	X			4.3.7		N/A	N/A
TABLE I	Bar Drop Impact Sensitivity				X	X	X	X	X	4.3.8			
TABLE I	Flame Sensitivity				X	X	X			4.3.9		N/A	N/A
TABLE I	Density	X				X	X	X	X	4.3.10			
TABLE I	Exudation				X	X	X	X	X	4.3.11			
TABLE I	Vacuum Stability				X	X	X			4.3.12		N/A	N/A
TABLE I	Cracks at 160°F, in (max)				X	X	X	X	X	4.3.13			
TABLE I	Cracks at -40°F, in (max)				X	X	X	X	X	4.3.14			
TABLE I	Color Change				X	X	X			4.3.15		N/A	N/A
TABLE I	DMDNB Percent	X		X		X	X	X	X	4.3.16			

4.1 Classification of verification. The verification requirements specified herein are classified as follows:

- a. Qualification inspection
- b. Conformance inspection

4.1.1 Sampling for tests. Forty pounds of Flexible explosive of the specified dimensions are required for both qualification and conformance inspection by the various tests in Section

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4.3. The samples shall be selected at random from a single production lot. Samples for tests shall be taken in accordance with MIL-STD-1916, unless otherwise specified in Section 4.

4.1.2 Qualification inspection. Upon formal application, flexible explosive qualification shall consist of specified tests for all requirements specified in Section 3, (see Table I).

4.1.2.1 Qualification rejection. If a product fails to meet any of the requirements specified in Section 3, that product shall not be qualified, and shall not be listed on the QPL.

4.1.3 Conformance inspection. When specified, conformance inspection of product lots shall consist of specified tests for all the requirements in Section 3 except for those indicated in Table 2 to be not required.

4.1.3.1 Lot Formation. A lot shall consist of one or more batches of flexible explosive in accordance with the same processing operation, conditions, drawing, and specification. Lot interfixing shall be in accordance with MIL-STD-1168.

4.1.3.2 Rejection of lots. If a product sample fails to pass any of the specified tests, the production lot represented by that sample shall be rejected.

4.2 Support and ownership verification.

4.2.1 Form. Samples shall be taken from the production lot as specified and examined using standard measuring equipment to verify form dimension and thickness requirements.

4.2.2 Color. A specimen shall be examined visually for conformance to paragraph 3.3.2.

4.2.3 Workmanship. The lot shall be visually inspected for any cracks, voids, air bubbles, holes, blisters, dirt, and other impurities. Evidence of said impurities shall be cause for lot rejection.

4.3 Operating verifications.

4.3.1 Detonation continuity. A sheet of explosive 0.08 ± 0.004 inches by 3 inches by 10 inches shall be attached to a steel witness plate at least $\frac{1}{4}$ inch thick by means of adhesive coating. The witness plate shall be large enough to back the entire slab of explosive. A military M6 blasting cap or equivalent shall be secured against the middle of the 3 inch side of the charge, and the assembly shall be mounted in a steel water tank capable of being pressurized to 10,000 psi. The charge shall be detonated after 45 minutes under a measured 10,000 psi hydrostatic pressure, at ambient temperature. After detonation, the witness plate shall be uniformly depressed and shall show no plateau indicative of a detonation discontinuity. A discontinuity in detonation shall be cause for rejection.

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4.3.2 Detonation Velocity. Two specimens, ¼ by ¼ by 12 inches, shall be attached to a wooden bar ¼ inch by 1 inch by 9 inches with two 9/32 inch holes 7.871 inches from center to center. One end of the specimen shall be even with one end of the bar and the other end shall have a three inch overhang which is used for the starting relay. Chronograph contactors shall be inserted into the holes of the bar so that they are flush with the explosive. The contactors shall be connected to an electronic counter which measures microseconds. An M6 blasting cap or equivalent shall be used to initiate the specimen. If any specimen fails to comply with the requirement, the lot shall be rejected. NOTE – it is important that the lead wires from the contactors be turned away from the blasting cap so that the initial detonation does not start the counter. The rate of detonations shall be calculated as follows.

$$R = \frac{0.2}{A} \times 1,000,000$$

Where:

A = time in microseconds

R = rate in meters/second (MPS)

4.3.3 Shock sensitivity. The cylinder case for the drop test shall be constructed of mild steel with walls of 0.06 inches thick and having internal diameter of 5 inches and a length of 12 inches. The case shall have threaded mild steel caps, 3/8 inch thick. A charge of flexible explosive shall be pressed so as to fill the case snugly. The case shall be fixed horizontally beneath a weight of 336 pounds, equipped underneath with 3 equally spaced steel studs (3 inches long and ¾ inch in diameter) so that when the weight is dropped the studs will penetrate the top surface of the case. Ten cases shall be tested by dropping the weight on each case from a height of 5 feet. A blast or explosion shall be cause for rejection, a fire unaccompanied by a blast or explosion is permissible.

4.3.4 ERL Bruceton impact sensitivity. The Flexible explosive shall be in a powder form and be able to pass through 20 mesh screen. Twenty five samples having a diameter of 0.188 ± 0.002 inches and a weight of 35 ± 2 milligrams shall be prepared for this test.

4.3.4.1 Impact machine. An ERL-Bruceton type drop test machine with 320 centimeters maximum drop height equipped with “type 12 tools” and a 2.5 kilogram weight shall be used, or equivalent.

4.3.4.2 Noisemeter. A peak reading noisemeter consisting of a microphone, amplifier, and peak reading voltmeter shall be used. The amplifier or voltmeter shall have an adjustment for zeroing out the background noise. The amplifier of the noisemeter shall be capable of voltage gain of 50 decibels with provisions for varying the gain. The noisemeter shall have a response between 100 cycles and 20 kilocycles and shall be equipped with a dynamic type microphone having output level within -60 decibels to -52 decibels.

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4.3.4.3 Procedure. The noisemeter shall be adjusted to zero-out room noise and determine maximum noise caused by the striker falling 320 centimeters onto a 35 milligram pellet of inert powder. In any test a reading above this maximum shall be classified as a fire.

The impact machine shall be standardized using Composition B Type II conforming to MIL-C-401. Approximately 5 grams of Composition B shall be ground and screened on a sieve stack consisting of a 16 mesh (U.S. Standard) on top, a 30 mesh in the middle, and a 50 mesh on the bottom. The material remaining on the 16 mesh and the material passing through the 50 mesh sieves shall be discarded. Equal amounts of material on 30 and 50 mesh sieves shall be thoroughly mixed. The Composition B shall be made into pellets weighing 35 ± 2 milligrams, and having a diameter of 0.188 ± 0.002 inches. The pellets shall be pressed at 30,000 pounds per square inch.

A one inch square of flint paper, 5/0 grade or equivalent, shall be placed on the anvil for each test. Before the tests are performed the explosion and non-explosion point shall be determined. After the approximate heights of explosion and non-explosion are determined, the 25 samples shall be tested as follows: Place the specimen on the flint paper and drop the weight from 40 centimeters or 1.6 log units; if no explosion results raise the striker on tenth log increment at a time and place a new specimen and paper on the anvil until an explosion occurs, then lower the striker on tenth log increment until a fresh specimen does not explode. The striker and anvil shall be cleaned with acetone after each drop and wiped dry with a clean cloth. The height and results of each drop shall be recorded as follows: An explosion shall be recorded as a plus sign and a non-explosion as a minus sign.

Summary of Firing Data

a	b	c	b.c
	0		
	1		
	2		
	3		
	4		
	5		
		N	A

Where:

a = the drop heights in log increments of 0.1 log unit, beginning with the lowest drop height at which a test (explosion or non-explosion) was observed.

b = arbitrary consecutive numbers.

c = the number of tests observed at each corresponding drop height.

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b.c = the quantities obtained by multiplying the values listed in column “c” times the number listed in column “b” for each corresponding drop height.

N = the sum of column “c”

A = the sum of column “b.c”

The 50 percent point shall be calculated as follows: if more non-explosions occurred than explosions, the drop height associated with each explosion will be used in the calculations. If more explosions occurs that non-explosions, the drop heights associated with each non-explosion shall be used to calculate the 50 percent drop height in centimeters.

- if non-explosion values are used:

$$\text{Log}(50_{\text{percentpoint}}) = C + 0.1\left(\frac{A}{N} + \frac{1}{2}\right)$$

- if explosion values are used:

$$\text{Log}(50_{\text{percentpoint}}) = C + 0.1\left(\frac{A}{N} - \frac{1}{2}\right)$$

Where:

C = lowest drop height at which value used in the calculation was recorded in column “a”.

N = the sum of column “c”

A = the sum of column “b.c”

A 50 percent initiation height lower than that for Composition B shall be cause for rejection.

4.3.5 Friction sensitivity. A sample 1/8 x 1/8 x 1/32 of an inch shall be placed on an anvil of the sliding friction machine having a friction surface of (304 stainless steel) 60 micron finish. A force of 900 to 1000 pounds shall be applied to the friction surface and a velocity of approximately 8 feet per second to the anvil by striking it with a pendulum dropped from a 90 degree position. Twenty samples shall be selected for this test. Any evidence of decomposition whether light or sound shall be cause for rejection.

4.3.6 Electrostatic sensitivity. A sample approximately 0.250 inches in diameter and 0.100 inches thick shall be placed on a metal anvil of the electrostatic machine. The metal needle of the machine shall be adjusted so that when depressed the needle is 0.03 ± 0.003 inches from the anvil surface. The anvil and the needle shall be connected to a condenser circuit having a

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voltage of 3000 to 4000 volts and capacitance that with the voltage will produce a 4.0 joule spark. The needle shall be rapidly depressed into the sample. Twenty samples shall be selected for this test. Any flame or explosion shall be cause for rejection.

4.3.7 Bullet impact sensitivity. Ten rounds of 7.62mm M80 ball cartridge or commercial .308 equivalent shall be fired from a gun perpendicular to the target at 40 feet. The target shall consist of a flexible sheet of explosive ¼ inch by 3 inches by 3 inches sandwiched between a 1/16 inch thick mild steel front plate and 1 inch mild steel back-up plate. If any of the bullets cause the specimen to explode the lot shall be rejected.

4.3.8 Bar drop impact sensitivity. Ten specimens with length and width of 1 inch and 0.050 ± 0.010 inches in thickness shall be selected for this test. A 10 pound steel bar with a diameter of ½ inch at the striking face shall be dropped from a height of 15 feet into a piece of flexible explosive placed on a steel anvil. If any specimen tested is accompanied by an explosion or burning, the lot shall be rejected.

4.3.9 Flame Sensitivity. One specimen ¼ by ½ by 3 inches shall be placed into sawdust soaked with kerosene and ignited. If a specimen explodes the lot shall be rejected.

4.3.10 Density. Three specimens shall be weighed to the nearest milligram and measured with a suitable instrument to determine the volume. The density shall be calculated by the formula below.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

If the average of the three tests fails to comply with the requirement, the lot shall be rejected.

4.3.11 Exudation. The sheet shall be ¼ inch thick and cut to a 1 ½ inch square and then placed on 15 layers of Watman No. 1 filter paper cut in 2 inch diameter circles with a porous release paper placed between the explosive and the layers of filter paper. A 125-gram brass weight 1 ½ inch square shall be placed on top of the sample. This assembled sample shall then be placed on a wire screen and stored in a forced draft oven for 24 hours at 160°F. Before assembly, the brass weight shall be weighed. The initial weight of the filter paper shall also be recorded. After hot storage, the sample and brass weight shall be removed from the filter paper while still warm. The sample and brass weight shall be cooled while in an upside down position. When cool the sample and brass weight shall be weighed together. The filter paper shall be weighed separately. Report both weight loss from the sample, if any, and weight gained on the filter paper, if any. In order to avoid an incorrect result due to volatile loss, exudation from the explosive sample shall be computed based only on the weight gained on the filter paper. The exudation of flexible explosive shall be calculated as follows:

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$$\frac{(\Delta \text{Weight gain on Filter Paper})}{\text{Exudation} = \text{(Sample Weight After Test + Weight Gain on Filter Paper)}}$$

Exudation = (Sample Weight After Test + Weight Gain on Filter Paper)

The test shall be run in triplicate and the average of the three results shall be reported to determine compliance with the requirements. Failure to comply with the requirement shall be cause for rejection of the lot.

4.3.12 Vacuum Stability. The gas evolution shall be determined on one 5 gram sample by the vacuum stability test at 212°F as per Method 503.1 of MIL-STD-650. If any specimen fails to comply with the requirements, the lot shall be rejected.

4.3.13 Cracks at elevated temperature. Three specimens of ¼ inch thickness and 3/8 inch by 3 inches shall be selected and placed in a ventilated oven maintained at a temperature of 160 ± 5° F for seven days. The specimens shall then be removed and allowed to cool to ambient conditions. The samples shall be bent 90° on a ¼ inch diameter mandrel over a period of five seconds, then the samples shall be examined for cracks. If any specimen fails to comply with the requirement the lot shall be rejected.

4.3.14 Cracks at cold temperature. The three specimens of ¼ inch thickness and 3/8 inch by 3 inches and mandrel shall be placed in a box maintained at a temperature of -40 ± 5° F for one hour. The specimen shall then be removed from the cold box and bent 90° on a ¼ inch diameter mandrel with a bending time of 5 seconds. The specimen shall then be examined for cracks. If any specimen fails to comply with the requirement the lot shall be rejected.

4.3.15 Color Change. Three specimens, ¼ inch thickness by 3/8 inch by 3 inches, shall be immersed in a distilled water bath maintained at 160 ± 5°F for 24 hours. The samples shall then be visually compared with other samples not placed in the bath to determine if there was any change in color. If any specimen fails to comply with the requirement, the lot shall be rejected.

4.3.16 2,3-Dimethyl-2,3-Dinitrobutane content. Two 4 gram samples shall be taken from the beginning, middle and end, (6 total samples), of each produced batch immediately prior to packaging. The samples shall be adequately protected to ensure no taggant degradation while awaiting analysis. Each sample shall be analyzed in duplicate. One gram each of the samples will be dissolved in 100 mL acetonitrile. To ensure complete dissolution of DMDNB, the sample solution will be sonicated and shaken for about one hour each, and set aside overnight before determination of DMDNB by high performance liquid chromatography (HPLC) with the following conditions:

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Varian Bondesil C-8, 5 μ m
 Column: RP-8/5, 25 cm, dia. 4.6 mm
 Mobile phase: 30 % CH₃OH/70% H₂O
 Detector: UV, 220 nm
 Temp: 35°C
 Flow rate: 1.5 mL/min
 Chart speed: 1.0 cm/min
 Injection volume: 10 μ L

Any of the samples failing to meet the requirement of 1.25 ± 0.25 weight percent shall be cause for rejection. (See 6.4)

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. 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.

6. NOTES

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

6.1 Intended use. The flexible explosive covered by this specification is military unique and will be used for a variety of military demolition purposes.

6.1.1 Grades of flexible explosive. The difference between Grade A and Grade B, as identified in TABLE I, is that Grade A specifies requirements for Detonation continuity, Shock sensitivity, and Impact sensitivity, whereas Grade B does not.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification, and of all documents referenced in Section 2

b. Color required, if other than olive drab.

c. Form (sheet width, thickness, length).

d. QPL number and date

e. Special packing and marking instructions that apply to this material can be obtained from the Packaging Group at U.S. Army ARDEC, ATTN: AMSRD-AAR-AIL-P,

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Picatinny Arsenal, NJ 07806-5000.

f. Requirement for acceptance inspection equipment (AIE) designs. Submit equipment designs as required to include the following: Commander ARDEC, U.S. Army, ATTN: AMSRD-AAR-QES-B, Picatinny Arsenal, NJ 07806-5000.

g. Distribution of ammunition data cards. Distribution of data cards should include the following: Commander ARDEC, U.S. Army, ATTN: AMSRD-AAR-QES-B, Picatinny, NJ 07806-5000.

6.3 Inspection equipment. Inspection equipment required to perform the inspections prescribed in this specification is identified in the Examinations and Test Method paragraphs herein. Inspection design and approval should be as specified in the contract or order (see 6.2f).

6.4 Qualification. With respect to products requiring qualification, awards will be made only for such products which are, at the time of award of contract, qualified for inclusion in Qualified Products List, QPL-46676, whether or not such products have actually been so listed by that date. The attention of suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to the qualification of products may be obtained from U.S. Army ARDEC, ATTN: AMSRD-AAR-QES-E, Picatinny, NJ 07806-5000 or by email at ardec-stdz@pica.army.mil.

6.4.1 QPL access. QPLs are available to view or download at <http://assist.daps.dla.mil>

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

6.6 Flexible explosive manufactured before September 95 and in accordance with MIL-E-46676A (Amendment 1) does not contain DMDNB in formulation of the flexible explosive.

6.7 Subject term (key word) listing.

Sheet explosive
Energetic material

Custodian:
Army-AR

Preparing Activity:
Army-AR
(Project: 1375-2006-001)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil>.