

**MIL-T-50009A**

18 AUGUST 1960

SUPERSEDING

MIL-T-50009 (CmlC)

22 MAY 1959

**MILITARY SPECIFICATION****THICKENER, INCENDIARY OIL, M4**

*This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.*

**1. SCOPE**

1.1 This specification covers one type of thickener.

**2. APPLICABLE DOCUMENTS**

2.1 Government documents. The following documents of the issue in effect on date of invitation for bids form a part of this specification to the extent specified herein:

**SPECIFICATIONS****FEDERAL**

- RR-S-366 — Sieves, Standard for Testing Purposes.
- PPP-B-35 — Bags; Textile, Shipping, Burlap, Cotton and Waterproof Laminated.
- PPP-B-621 — Boxes, Wood, Nailed and Lock-Corner.
- PPP-B-636 — Boxes, Fiber.
- PPP-D-760 — Drums and Pails, Metal (5- and 16.64-Gallon).

**MILITARY**

- MIL-L-73 — Lacquer, Lusterless.

- MIL-E-74 — Enamel, Lusterless, Quick Drying.
- JAN-I-711 — Incendiary Oils, Consistency of; Test Procedures.
- MIL-T-704 — Treatment and Painting of Material.
- MIL-C-10464 — Cans, Hermetic Sealing, Metal, Light Gage, Tearstrip Type.
- MIL-E-10687 — Enamel; Lusterless, Quick Drying (for Ammunition).

**STANDARDS****FEDERAL**

- Fed. Std. No. 595 — Colors.
- Fed. Test Method Std. No. 791 — Lubricants, Liquid Fuels and Related Products; Method of Test.

**MILITARY**

- MIL-STD-105 — Sampling Procedures and Tables for Inspection by Attributes.

FSC 1365

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MIL-STD-129 — Marking for Shipment and Storage.

MS602 — Test Solvent (for Fuel Thickeners).

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

## INTERSTATE COMMERCE COMMISSION

49 CFR 71-90 — Interstate Commerce Commission Rules and Regulations for the Transportation of Explosives and Other Dangerous Articles.

(The Interstate Commerce Commission regulations are now a part of the Code of Federal Regulations (Revised 1956) available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Orders for the above publication should cite "49 CFR 71-90 (Rev. 1956) .")

## AMERICAN SOCIETY FOR TESTING MATERIALS

ASTM D1182-84- Method of Test for Apparent Density and Bulk Factor of Granular Thermoplastic Molding Powder.

(Applications for copies of the above standards should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. )

## 3. REQUIREMENTS

3.1 Material. The thickener shall be an intimate mixture of  $97.0 \pm 0.5$  parts of thickening agent (3.1.1 ) and sufficient approved antiagglomerant (6.3) to total 100 parts by weight. The supplier shall certify that the material complies with this requirement,

3.1.1 *Thickening agent.* The thickening

agent shall be the diacid aluminum soap of isooctanoic acid (3.1.1.1).

3.1.1.1 Isooctanoic acid. The isooctanoic acid shall consist of a mixture of acids derived from isooctyl alcohol or isooctyl aldehyde and shall contain principally dimethylhexanoic acid, methyl heptanoic acid, and methylethylpentanoic acid .

3.2 Gel formation. All gels, prepared and tested as specified in 4.5.1, shall have a vortex time of not more than 300 seconds.

3.3 Gel consistency.

3.3.1 *Two-percent gel.* All 2-percent gels prepared and tested as specified in 4.5.2 shall have a consistency of not more than 300 grams (g) nor less than 180 g after storage at  $77^\circ \pm 2^\circ\text{F}$ . The average results of duplicate tests on two specimens shall agree within 50 g.

3.3.2 Four-percent gels. All 4-percent gels prepared and tested as specified in 4.5.2 shall have a consistency of not more than 650 g nor less than 400 g after storage at  $77^\circ \pm 2^\circ\text{F}$ , and not more than 600 g nor less than 350 g after storage at  $150^\circ \pm 5^\circ\text{F}$ . The average results of duplicate tests on the specimens shall agree within 50 g.

3.4 Granulation. The material Shall have a granulation conforming to table I, when tested as specified in 4.5.3.

TABLE I. Granulation

Sieve size	Percent through
3360 microns (No. 6) . . . . .	100
840 microns (No. 20) . . . . .	75 (min.)
149 microns (No. 100) . . . . .	40 (max.)

3.5 Moisture. The thickener shall contain not more than 1.2 percent by weight of moisture when tested as specified in 4.5.4.

3.6 Chlorides. The thickener shall contain not more than 0.3 percent by weight of chlorides when tested as specified in 4.5.5.

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3.7 Moisture sensitivity. The thickener shall have a moisture sensitivity of not less than 0.6 when tested as specified in 4.5.6.

3.8 Apparent density. The thickener shall have an apparent density of not less than 0.45 g per milliliter (ml) when tested as specified in 4.5.7.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Objective evidence. The supplier shall present objective evidence, as required by the Government representative, that all requirements of sections 3 and 5 have been met (see 6.5).

4.3 Alternative inspection (including testing) procedures. The supplier may utilize any alternative inspection procedure which will assure equal or better quality by submitting a written proposal with justification and obtaining written approval from the Government prior to its institution. In case of dispute, the procedures of this specification shall govern.

#### 4.4 Inspection provisions.

4.4.1 Lotting. A lot shall consist of a batch of the thickener produced by one manufacturer, from the same materials and under essentially the same manufacturing conditions (see 6.6).

#### 4.4.2 Sampling.

4.4.2.1 *Nondestructive examination.* Sampling shall be conducted in accordance with Standard MIL-STD-105.

4.4.2.2 For test. A sample shall be taken from each lot, the size to be calculated on the basis of one-tenth of the square root of the number of containers in the lot raised to the next higher whole number. If there are fewer than three containers in a lot, each container shall be sampled. In all other cases, no fewer than three containers shall be selected. A one-pound specimen shall be removed from each container in the sample and placed in a clean, dry container labeled to identify the lot and the container from which it was taken. A composite specimen shall be made with equal portions from each specimen except one, and the composite and the individual specimen shall be tested as specified in 4.5. Where there are only 1 or 2 specimens, each one shall be tested.

4.4.3 *Examination.* Sample containers of thickener shall be examined for level A preparation for delivery requirements in accordance with the classification of defects and with Standard MIL-STD-105.

#### 4.4.4 Classification of defects.

##### 4.4.4.1 Preparation for delivery (sec. 5).

Categories	Defects
<i>Critical</i>	None defined.
<i>Major</i>	AQL 2.5 percent defective.
101	Bags, wooden or metal containers incorrect.
102	Metal container treatment and painting incorrect.
103	Metal container interior coating missing or improperly applied.
104	Bags, wooden or metal containers damaged, leaking, or broken.
105	Quantity packaged per bag or metal container incorrect.
106	Quantity packed per wooden or metal container incorrect.
107	Slotted partitions or pads missing where required.

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108	Bags, wooden or metal containers closure incorrect.
109	Strapping of wooden containers loose or missing.
110	Mixing instruction incorrectly packaged, missing, or improperly located in or on container.
111	Marking incorrect, missing, or illegible.
Minor. 201	AQL 4.0 percent defective, Packing arrangement in wooden containers incorrect.

4.5 Tests. Distilled water and analytical grade chemicals shall be used throughout the tests. Where applicable blank determinations shall be run and corrections applied where significant.

#### 4.5.1 Gel formation.

4.5.1.1 *Equipment.* The equipment required for preparing gels for test purposes shall consist essentially of the following:

- (a) A mechanical stirrer rotating at a speed of  $300 \pm 10$  revolutions per minute (rpm). The stirrer shall be fabricated of a glass or corrosion-resistant metal rod, 3/8 inch in diameter, with four vanes of the same material as the rod, 7/8 by 7/8 by 1/8 inch, set at right angles and with the faces parallel to the axis of the rod.
- (b) A square, pint-size, mason-type jar approximately 3 by 3 by 5 inches.
- (c) Storage containers of the type described in method 100 of Specification JAN-I-711.
- (d) Constant temperature baths (air or liquid) capable of maintaining the specified test temperatures.
- (e) A weighing room maintained at  $77^\circ \pm 2^\circ\text{F.}$  and a maximum relative humidity of 50 percent.

4.5.1.2 *Procedure.* Place  $192.0 \pm 0.2$  g of test solvent conforming to Standard MS602 into the glass jar and immerse the stirrer

in the solvent to such a depth that the tops of the vanes are 3 centimeters (cm) below the surface. Start the stirrer, adjust the temperature to  $77^\circ \pm 2^\circ\text{F.}$ , and maintain the temperature throughout the test. Add  $8.0 \pm 0.1$  g of the specimen, Record the time of addition of the sample and the time at which the gel covers a mark on the stirrer shaft 1 cm below the initial liquid level. Record the time elapsed as vortex time.

#### 4.5.2 Gel consistency.

4.5.2.1 *Procedure.* All gels shall be prepared in duplicate for each specimen, using the equipment specified in 4.5.1.1, and test solvent conforming to MS602. The solution temperature during stirring shall be maintained at  $77^\circ \pm 2^\circ\text{F.}$  The amounts of specimen and test solvent shall conform to table II.

TABLE II. *Gel formulae for consistency test*

Gel	Specimen (g)	Test solvent (g)
2 percent . . . . .	$5.00 \pm 0.05$	$245.0 \pm 0.2$
4 percent . . . . .	$10.00 \pm 0.05$	$240.0 \pm 0.2$

The gels shall be stored in glass jars or in storage tubes manufactured from steel, stainless steel, or anodized aluminum, for a period of  $24 \pm 4$  hours at the applicable temperature specified in 3.3. At the end of the storage period each gel shall be tested for consistency in accordance with method 100 of Specification JAN-I-711, except that in testing the 2 percent gel and 4 percent gel the load shall be reduced by 25 g instead of 50 g and one conditioning stroke shall be used instead of the five called for in method 100.

4.5.2.2.1 *Two percent gels.* Results of consistency tests on 2 percent gels within each set of duplicates shall agree within 25 g. Tests shall be repeated until this condition is met, using fresh gel preparations.

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4.5.2.2.2 *Four percent gels.* Results of consistency tests on 4 percent gels within each set of duplicates shall agree within 50 g. Tests shall be repeated until this condition is met, using fresh gel preparation.

4.5.3 *Granulation.* Prepare a nest of sieves No. 6, 20, and 100 conforming to Specification RR-S-366, and place a receiving pan at the bottom. Place 50.0 g of the specimen on the No. 6 sieve, cover, and assemble in a mechanical shaker geared to produce  $300 \pm 15$  gyrations and  $150 \pm 10$  taps of the striker per minute. Vibrate for 5 minutes with the tapper in operation. Weigh portions retained on each sieve and calculate the amounts on a percentage basis.

4.5.4 *Moisture.* Weigh out rapidly, to the nearest decigram, approximately 25 g of the specimen and immediately disperse in  $500 \pm 10$  ml of benzene in a round bottom liter flask. After the sample has been dispersed ( approx. 5 min. ) determine the moisture content in accordance with method 3001.5 of Fed. Std. 791 with the following exceptions and additional details:

- (a) Use the entire 500 ml of suspension instead of the 100 ml specified.
- (b) Heat the flask by means of a liquid bath or an electric heating mantle. Maintain the temperature of the bath or heating mantle at  $140^\circ \pm 5^\circ\text{C}$ . during the distillation period.
- (c) Distill for 2 hours. Wash down the condenser tube with three 10-ml portions of benzene, scrubbing the tube at the same time with a stiff brush to loosen water droplets. Resume the distillation for an additional  $\frac{1}{2}$  hour; then repeat the washing and scrubbing. Remove the condenser and loosen the water droplets adhering to the side wall of the trap by policing clown with a glass rod equipped with a rubber policeman. Form a good meniscus on the water collected in the bottom of the trap by wiping the surface of the trap wall at the interface level, exerting a firm pressure on the trap wall. Free any droplets of benzene caught in the water phase with the policeman. Remove water adhering to the policeman by twirling the policeman in the upper benzene phase.
- (d) Protect the top of the condenser tube by a calcium chloride tube or equivalent, except during the rinsing and scrubbing operations.
- (e) At all times during the distillation, maintain the heating medium at a level about  $\frac{1}{4}$  inch below the level of the suspension in the liter flask.
- (f) Make a blank determination by subjecting 500 ml of benzene to the same treatment as the suspension and correct all determinations accordingly.
- (g) Determine the efficiency of recovery by treating similarly 500 ml of benzene to which 0.50 ml of water has been added. If, after correction for the blank, the apparatus fails to recover  $0.50 \pm 0.05$  ml of water, tighten all connections and repeat the test. No determination shall be made with apparatus which has not demonstrated satisfactory recovery.
- (h) Ground glass connections may be used in the apparatus in place of the tight-fitting corks, Care shall be exercised to prevent the entrance of atmospheric moisture by condensation on such joints.

4.5.5 *Chlorides.* Weigh  $5.00 \pm 0.01$  g of the specimen into a 400-ml beaker. Add 20 ml of 6 N nitrate acid, and carefully heat until dissolved. Transfer the solution quanti-

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tatively to a 250-ml separator funnel and draw off the aqueous bottom layer into a glass-stoppered, 500-ml Erlenmeyer flask. Wash the oil layer three times with 25 ml portions of water, drawing off the aqueous layer after each washing into the 500-ml flask containing the first draw-off. To this flask add 5 ml of nitrobenzene, 5 ml of ferric ammonium sulfate indicator, and 2 ml of 0.02 N potassium thiocyanate. Titrate with 0.02 N silver nitrate until the indicator color disappears and then add 5 ml excess of silver nitrate. Shake vigorously for approximately 5 minutes to assure complete coagulation of the silver chloride, and then back titrate with 0.02 N potassium thiocyanate. Run a blank and apply any significant corrections. Calculate the percent chloride as follows:

$$\text{Percent chlorides} = \frac{(AB - CD) 3.546}{W}$$

where: A = milliliters of silver nitrate, total.

B = normality of silver nitrate,

C = milliliters of potassium thiocyanate.

D = normality of the potassium thiocyanate.

W = weight of specimen in g.

4.5.6 *Moisture sensitivity*. Prepare and test a 2 percent gel as specified in 4.5.2.1 except that a single gel shall be prepared from the specimen. Designate the consistency of this specimen as A. Take a second portion of approximately 75 g from the specimen and spread it evenly over the surface on an aluminum tray having an area of approximately 120 square inches. Place the tray in a humidity cabinet maintained at 8001? and 80-percent relative humidity for a period of 15 minutes  $\pm$  30 seconds. Transfer the humidified material to a container, leaving not more than 10 percent void, and tightly close. Prepare and test a 2-percent gel as specified in 4.5.2.1. Designate the consistency of this specimen as B. Calculate the moisture

sensitivity as follows:

$$\text{Moisture sensitivity} = \frac{B}{A}$$

4.5.7 *Apparent density*. Determine the apparent density in accordance with ASTM method D1 182-54 and report the results in g per ml.

4.6 Acceptance /rejection criteria. If the individual or composite specimen fails to meet the test requirements of the specification, the lot represented shall be rejected.

## 5. PREPARATION FOR DELIVERY

### 5.1 Packaging.

#### 5.1.1 Level A.

5.1.1.1 *Two-pound quantity*. Two pounds  $\pm$  1 ounce of thickener shall be packaged in a type II hermetically sealed rectangular can, conforming to Specification MIL-G 10464. The can interior surfaces shall be coated with a 1-roil thick clear phenolic or vinyl coating. The exterior can surfaces shall be coated as specified in the can specification with color of the finish coat conforming to color No. 34087 of Federal Standard No. 595.

5.1.1.2 *Thirty-three and one-third pounds*. Thirty-three and one-third pounds  $\pm$  4 ounces of thickener shall be packaged in a bag conforming to type III, class 6, style B, bag number P55, of Specification PPP-B-35. The bag shall have approximate dimensions of 12 by 4 by 36 inches. After filling, closure shall be accomplished in accordance with the appendix of the bag specification. The polyethylene bag liner shall be closed by heat seal.

### 5.2 Packing.

#### 5.2.1 Level A.

5.2.1.1 *Two-pound quantity*. Twelve cans



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of thickener, packaged as specified in 5.1.1.1, shall be packed in one layer of two rows in a snug-fitting class 2, style 2½<sub>L</sub> nailed wood box conforming to Specification PPP-B-621, with approximate inside dimensions of 15¾, by 14½ by 7½ inches. To separate cans, each box shall be provided with interlocking, half-slotted partitions constructed from W6c fiberboard conforming to Specification PPP-B-636, and filler pads, fabricated from the same material as the partitions, shall be used as required to make a tight pack. The box shall be closed in accordance with the requirements of Specification PPP-B-621, except that all nails used to secure top shall be driven only into the horizontal cleats at top of the box. Strapping shall be in accordance with the appendix thereto, using galvanized strapping. A waterproof envelope, 4½ by 5¾ inches in size, containing mixing instructions shall be securely tacked to the unmarked end of the box between the box cleats.

5.2.1.2 *Twenty-pound quantity.* Twenty-pound quantities ± 4 ounces shall be packed in 5-gallon drums conforming to type II, class 2 of Specification PPP-D-760. All surfaces of the drum shall be treated in accordance with Specification MIL-T-704, type C, except that all interior surfaces shall be coated in accordance with the applicable requirements of the container specification, and all exterior surfaces shall be finished with one coat of enamel conforming to either Specifications MIL-L-73, MIL-E-74, or MIL-E-10687, with enamel color conforming to color No. 36231 of Federal Standard 595. A copy of mixing instructions packaged as specified in 5.2.1.1 shall be affixed to the inside cover of drum, with a suitable adhesive, prior to drum closure.

5.2.1.3 *One hundred-pound quantity.* Three 33⅓-pound bags of thickener, packaged as specified in 5.1.1.2, shall be packed in an 18-gage steel 30-gallon drum conforming to Specification 37A of Interstate Commerce Commission Regulations. The drum shall be

of the fully removable head type with bolted ring cover. The cover shall be provided with either a flowed-in or continuous solid rubber gasket under the curl. Strip sponge rubber gaskets shall not be used. After effecting or tight closure, a hexagonal locknut shall be used to prevent loosening at the closing nut. All metal surfaces of the drum shall be treated and painted in accordance with requirements of type C, Specification MIL-T-704, except all exterior surfaces of drums shall have a finish coat of enamel conforming to either Specification MIL-L-73, MIL-E-74, or MIL-E-10687. The color of the enamel shall conform to color No. 36231 of Federal Standard No. 595. A copy of mixing instructions packaged as specified in 5.2.1.1 shall be affixed to the inside cover of drum, with a suitable adhesive, prior to drum closure.

5.3 Marking. In addition to any special marking required by the contract or order, unit packages and shipping containers shall be marked in accordance with Standard MIL-STD-129. The tops of exterior containers shall contain the following additional markings in 2-inch letters of a contrasting color:

“DO NOT OPEN EXCEPT FOR USE OR  
INSPECTION  
MIXING INSTRUCTIONS INSIDE”

## 6. NOTES

6.1 Intended use. The material covered by this specification is intended for batch mixing of thickened fuels for use in flame throwers.

6.2 Ordering data. Procurement documents should specify the title, number, and date of this specification.

6.3 Antiagglomerant. The following materials have been tested and found to be satisfactory antiagglomerants:

- (a) Santocel C — Monsanto Chemical Company.

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(b) Attasorb — Minerals and Chemicals Corporation of America.

6.4 Stock number. The Federal stock numbers for this item are:

1365-542-0425 -30-gallon drum.

1365-542-0426 — 2-pound can.

1365-542-0427 — 5-gallon drum.

6.5 Objective evidence. Provisions for objective evidence and inspection records, and maintenance of inspection records will be specified by the procuring activity.

6.6 Batch. A batch is defined as that quantity of material which has been manufactured by some unit chemical process and subjected to some physical mixing process

intended to make the final product substantially uniform.

Notice. When Government drawings specification, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention on that may in any way be related thereto.

## Custodians:

Army—Chemical Corps

Navy-Bureau of Naval Weapons

## Preparing activity:

Army-Chemical Corps



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## APPENDIX

### INSTRUCTIONS FOR HAND MIXING THICKENED FUELS WITH M4 THICKENER

#### 10. SCOPE

10.1 This appendix covers the instructions to be included in containers of M4 thickener, as specified in the preparation for delivery requirements.

#### 20. APPLICABLE DOCUMENTS

20.1 The following specification of the issue in effect on date of invitation for bids forms a part of this appendix:

FEDERAL

UU-P-121 — Paper, Bond and Writing,  
White.

#### 30. REQUIREMENTS

30.1 General. The instructions shall be printed in black printer's ink on yellow or white paper conforming to Specification UU-P-121. Each page shall measure approximately 51¼ by 8 inches.

30.2 Instructions. The following information shall appear in the instructions:

##### INTERIM INSTRUCTIONS FOR HAND MIX- ING OF THICKENED FUELS WITH THICKENER, M4

1. GENERAL. Thickened fuel consists of gasoline mixed with a thickener to form a gel. In general the thicker the gel the more slowly it burns. A third ingredient called a peptizer is used to accelerate the formation of the gel at low temperature.

Peptizer. The recommended peptizer, 2-ethylhexoic acid, will accelerate gel formation at temperatures below 40°F.; however, use of a peptizer tends to cause the production of thinner fuel and it is usually necessary to increase the thickener content of the

mix. If 2-ethylhexoic acid is not available, cresylic acid, commercial phenols or cresols, or alcohols may be used, but these substances have a tendency to break down the gels, especially at low thickener concentrations.

2. MIXING PROCEDURE. The most widely used hand-mixing method is in open-end steel drums. A wood paddle is used to stir the gasoline while thickener is being added. The basic batch is 20 gallons, and the thickener and peptizer requirements given in the table are for this quantity of gasoline. Procedure for this method is as follows:

##### (a) *Above 40°F.*

- (1) Measure gasoline and pour into open-top steel drums or other containers.
- (2) Stir while adding thickener (see tables for amounts).
- (3) Continue stirring for about 5 minutes after all the thickener has been added.
- (4) Stir for 1 minute every 20 minutes until a suitable gel is formed. A good gel can be expected in 1 or 2 hours. The gel will improve if allowed to set 2 or more hours.

##### (b) *Below 40°F.*

- (1) Same procedures as in step (1) above.
- (2) Add peptizer and stir for one minute.
- (3) Steps (2) and (3) above.
- (4) Stir for *one* minute every 20 minutes until a suitable gel

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is formed. A reasonably good gel can be expected in 4 hours. Gels usually improve if allowed to age 12 to 18 hours.

3. THICKENED FUEL FORMULAS. Portions recommended in tables are on the basis

of 20 gallons of fuel; changes in quantity of fuel prepared should be in direct ratio to listed amounts. These, however, are to be used as guides only and should be modified as necessary. Due to unpredictable types, qualities, and ages of gasoline, small trial batches with all thickeners are recommended before attempting large quantities.

*Mixing chart*

Gasoline temperatures	Portable flame thrower		Mechanized flame thrower	
	Thickener	Peptizer	Thickener	Peptizer
Above 40°F. ....	2.2	0	4.8	0
0 to 40°F. ....	2.2	0.6	4.8	0
-40° to 0°F. ....	2.2	1.2	4.8	.12

Note. All quantities in pounds per 20 gallons gasoline. Z-ethylhexoic acid peptizer weighs 1 pounds per pint. A canteen cup holds 1½ pints.

#### 4. FIELD NOTES:

- (a) Be sure all containers used for mixing or storing thickened fuel *are* free from dirt, grease, alcohol, animal fats, water, etc.
- (b) Always add thickener very *slowly* and stir vigorously. If thickener is added too fast, lumps will form in the mix. Lumps will usually dissolve if the batch is allowed to set overnight.
- (c) If time permits, always run a trial batch.
- (d) If available, gear pumps from ¾ to 2 inches in size may be used for mixing and recirculating, instead of stirring with a paddle. In cold weather, a pump often produces better fuels. Centrifugal

pumps may be used, but are not as good.

- (e) Good gel is a clear amber color, sticky and rubbery, and ropy when handled. Gel that will not pour easily is too thick for use in portable flame throwers. The feel to the hand is the best gage of good fuel.
- (f) A peptizer does, in effect, the same things as heating gasoline. If gasoline can be heated, a peptizer is not necessary.
- (g) Blends of gasoline mixed with fuel oil, crude oil, jet engine fuel, or crankcase drainings should not be used in mixing thickened fuels, except where unavoidable due to lack of gasoline. IN SUCH CASES, BE SURE TO RUN A TRIAL BATCH.