

MIL-F-53053  
17 July 1985

MILITARY SPECIFICATION

FUEL PRODUCT, COAL-OIL MIXTURE (COM):

INDUSTRIAL TYPE COMBUSTOR-BOILERS

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

1. SCOPE

1.1 Scope. This specification covers one grade of industrial type, combustor-boiler, coal-oil mixture, fuel product, hereinafter referred to as "COM".

1.2 Site-specific requirements. Various chemical and physical properties of COM directly affect the retrofit of boilers to be adapted to COM firing. The appendix to this specification contains guidelines that affect boiler retrofit to COM use and the selection of site-specific requirements that are necessary for acquisition of COM suitable for use in retrofitted boilers.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

STANDARDS

FEDERAL

FED-STD-791 - Lubricants, Liquid Fuels and Related Products; Methods of Testing.

MILITARY

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

<p>Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: USA Belvoir Research and Development Center, ATTN: STRBE-DS, Fort Belvoir, VA 22060-5606 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.</p>
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FSC 9140

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## MIL-F-53053

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein.

## DEPARTMENT OF TRANSPORTATION (DOT)

49 CFR, 171-179 - Hazardous Materials Regulations.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, DC 20402.)

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

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 95 - Water in Petroleum Products and Bituminous Materials by Distillation.
- D 197 - Sampling and Fineness Test of Pulverized Coal.
- D 388 - Coals by Rank.
- D 396 - Fuel Oils.
- D 1857 - Fusibility of Coal and Coke Ash.
- D 2015 - Gross Calorific Value of Solid Fuel by the Adiabatic Bomb Calorimeter.
- D 2669 - Apparent Viscosity of Petroleum Waxes Compounded with Additives (Hot Melts).
- D 3174 - Ash in the Analysis Sample of Coal and Coke.
- D 3177 - Total Sulfur in the Analysis Sample of Coal and Coke.
- D 3236 - Apparent Viscosity of Hot Melt Adhesives and Coating Materials.
- D 3286 - Gross Calorific Value of Solid Fuel by the Isothermal Jacket Bomb Calorimeter.
- D 4057 - Manual Sampling of Petroleum and Petroleum Products.
- E 11 - Wire-Cloth Sieves for Testing Purposes.

(The test methods listed above are included in Volumes 05.01, 05.02, 05.03, and 05.05 of the Annual Book of ASTM Standards and are available individually. Applications for copies of all ASTM publications should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

## MIL-F-53053

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

## 3. REQUIREMENTS

3.1 Description. The COM shall be a mixture of pulverized bituminous coal and residual fuel oil. The COM may also contain limited amounts of water and stabilizing additives. The COM is subject to temperature limitations for storage and use that are similar to No. 6 fuel oil (see 6.5).

3.2 Materials. Materials shall be as specified herein. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

3.2.1 Coal. Coal shall be pulverized bituminous coal which conforms to the pulverized coal properties specified in table I. The contractor shall obtain the name and location of the coal bed which was the source of the coal and shall make the name and location of the bed available for review by the contracting officer or designated representative.

TABLE I. Pulverized coal properties.

Property	Amount	ASTM test method
Fineness; Passing ASTM E 11 wire cloth Sieve sizes, percent, minimum (min)		D 197
No. 100 Sieve (150 micrometers [ $\mu$ m])	99	
No. 200 Sieve (75 $\mu$ m)	80	
No. 325 Sieve (45 $\mu$ m)	Report	
Fixed carbon; dry, mineral-matter-free basis: percent, min	70	D 388 <sup>1/</sup>
Volatile matter; dry, mineral-matter-free basis: percent, maximum (max)	30	D 388 <sup>1/</sup>

<sup>1/</sup> The Parr formula or the approximation formula may be used, but in the event of dispute, the Parr formula shall be the referee method.

3.2.2 Oil. Oil shall conform to ASTM D 396, grade No. 6 fuel oil.

3.2.3 Water. Water shall be fresh or potable quality. Before adding to the COM, water shall be filtered through a size No. 100 (150  $\mu$  m) wire cloth sieve conforming to ASTM E 11. Salt, saline or brackish water shall not be added to the COM.

## MIL-F-53053

3.2.4 Additives. Additives to the COM shall be limited to stabilizing additives. Additives shall contain no sodium and shall not act by forming gels (see 6.3.1). Any additive to the COM shall be identified by at least one of the following:

- a. Chemical name, composition and structure.
- b. Manufacturer's name and address, trade name or commercial designation, and generic chemical classification.

The contractor shall obtain the identify of any additives to the COM and shall make the identity available for review by the contracting officer or designated representative.

3.3 Physical and chemical properties.

3.3.1 Coal content. The coal content of the COM shall be not less than 40 percent nor more than 60 percent.

3.3.2 Oil content. The oil content of the COM shall be not less than 40 percent nor more than 60 percent.

3.3.3 Water content. The water content of the COM, including water used in grinding, preparation, absorbed moisture, water contamination and water present as an ingredient in any stabilizing additive, shall be not more than 10 percent.

3.3.4 Additive content. The stabilizing additive content of the COM shall be not more than 2 percent.

3.3.5 Sulfur content. The sulfur content of the COM shall be not more than the percent specified (see 6.2).

3.3.6 Gross calorific value. The gross calorific value of the COM, when tested in accordance with ASTM D 2015 or ASTM D 3286, shall be not less than the value specified (see 6.2).

3.3.7 Ash content. The ash content of the COM shall be not more than the percent specified (see 6.2).

3.3.7.1 Ash softening temperature. The softening temperature of the ash in an oxidizing atmosphere shall be not less than the temperature specified (see 6.2).

3.3.8 Fineness. The fineness of the COM shall be such that when pumped through a 180  $\mu$  m (size No. 80) wire cloth sieve, the material retained on the sieve shall be not more than 0.1 percent.

3.3.9 Viscosity.

## MIL-F-53053

3.3.9.1 Viscosity at 50° C (122° F). The viscosity of the COM at 50° C (122° F), when measured at shear rates of 10, 100, 3000 reciprocal seconds ( $s^{-1}$ ), shall be not more than the viscosity specified (see 6.2).

3.3.9.2 Viscosity at 85° C (185° F). The viscosity of the COM, at a temperature of 85° C (185° F), when measured at shear rates of 10, 100, and 3000  $s^{-1}$ , shall be not more than the viscosity specified (see 6.2).

3.3.10 Stability. The stability of the COM shall be such that the viscosity of COM aged for not less than 30 days at 50° C shall not differ from the original non-aged COM viscosity by more than 30 percent.

3.4 Workmanship. The COM shall be uniform in appearance and free from lumps, hard pack (see 6.3.2), and supernatant liquid.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 Inspection requirements. Inspection requirements shall be in accordance with FED-STD-791, method 9601.

4.1.2 Component and material inspection. The contractor is responsible for insuring that components and materials are manufactured, examined and tested in accordance with referenced specifications and standards, as applicable.

4.2 Classification of inspection. The inspection requirement specified herein is classified as a quality conformance inspection (see 4.3).

#### 4.3 Quality conformance inspection.

##### 4.3.1 Sampling.

4.3.1.1 Lot. For the purpose of quality conformance inspection, a lot shall be all of the COM produced by one manufacturer at one plant, from the same batch of raw materials and by the same manufacturing process, during one 24 hour period, which is offered for inspection at one time. The lot size shall be determined as the quality of filled bulk (tank truck or tank car) containers offered for inspection.

## MIL-F-53053

4.3.1.2 Sampling for examination and tests. Sampling for examination and tests shall be in accordance with D 4057.

4.3.2 Examination. Samples selected in accordance with 4.3.1.2 shall be examined as specified in 4.4.1. AQL shall be 1.0 percent defective.

4.3.3 Tests. Samples selected in accordance with 4.3.1.2 shall be tested as specified in 4.4.2. Failure of any test shall be cause for rejection.

#### 4.4 Inspection procedure.

4.4.1 Examination. The COM shall be examined for conformance to 3.4. Non-uniformity of appearance, presence of lumps, presence of hard pack, or presence of supernatant liquid shall be individual defects.

4.4.2 Tests. The COM shall be tested as specified in table II, in the order shown.

TABLE II. COM test schedule.

Test	Test paragraph	Requirement paragraph
Coal content.	4.4.2.1.1	3.3.1
Oil content.	4.4.2.1.2	3.3.2
Water content.	4.4.2.2	3.3.3
Additives content.	4.4.2.3	3.3.4
Sulfur content.	4.4.2.4	3.3.5, 6.2c
Gross calorific value	4.4.2.5	3.3.6, 6.2d
Ash content.	4.4.2.6	3.3.7, 6.2e
Ash softening temperature.	4.4.2.7	3.3.7.1, 6.2f
Fineness of COM.	4.4.2.8	3.3.8
Viscosity		
at 50° C (122° F).	4.4.2.9	3.3.9.1, 6.2g
at 85° C (185° F).	4.4.2.9	3.3.9.2, 6.2h
Stability.	4.4.2.10	3.3.10

4.4.2.1 Coal and oil content tests. The coal and oil content tests use acetone to wash the COM. It is possible that some compounds contained in the coal in COM formulations will be soluble in the oil or in the acetone used to wash the COM in these tests. When such is the case, the soluble part of the coal may be washed through the filter along with the oil and cause systematic errors in both coal and oil content tests. To compensate for such errors, prepare a known mixture of coal, oil, water and additives by weighing out these components from the same source of bulk material used in the COM formulation being tested, in approximately identical proportions as the COM formulation. Mix the components thoroughly into a working standard and test the working standard for both coal and oil content as specified herein. Compare the

## MIL-F-53053

percentages known to be in the working standard with the percentages obtained for working standard samples tested. Calculate correction factors for both coal content and oil content in accordance with the following equations:

$$\text{Correction factor, coal} = \frac{\text{Percent coal known to be in working standard}}{\text{Percent coal found in working standard when tested as specified.}}$$

$$\text{Correction factor, oil} = \frac{\text{Percent oil known to be in working standard}}{\text{Percent oil found in working standard when tested as specified.}}$$

## Warning

Tests for coal and oil content may be hazardous due to the highly flammable characteristics of acetone. Use caution in the storage and use of acetone.

The United States Government neither assumes nor accepts responsibility for any injury or damage that may occur during or as a result of these tests.

4.4.2.1.1 Coal content test. Weigh a 1.0 micrometer ( $\mu\text{m}$ ) porosity polytetrafluoroethylene membrane filter to the nearest milligram (mg). Place the filter in a holder and assemble to a suction flask. Weigh out 5 grams (g) of COM to the nearest mg and transfer it quantitatively to the assembled suction filter flask. Use a small amount of acetone from a wash bottle to rinse the COM container and to transfer any adhering COM to the filter. Wash the COM with approximately 80 milliliters (mL) of acetone in 20 mL increments. (If difficulty in filtration is experienced, this test may have to be repeated with a higher porosity filter). When washing is complete, save the filtrate for the oil content test specified in 4.4.2.1.2. Dry the filter and retained coal particles at 105° C (221° F) for one hour, cool, and weigh to the nearest mg. From the initial weight of the COM specimen and the weight of the dried coal particles, calculate the percentage of coal in the COM. Multiply the result by the correction factor, coal obtained from the working standard equation in 4.4.2.1. A corrected coal content of less than 40 percent or more than 60 percent shall constitute failure of this test.

4.4.2.1.2 Oil content test. Pour the filtrate saved from the coal content test into a previously weighed evaporating dish and rinse the filtration flask with acetone. Add the rinse washings to the dish. Gently warm the dish until the acetone has evaporated. Exercise care to avoid spilling or splashing of the liquid. Then, heat the dish and contents for one hour in an oven at 105° C (221° F) to evaporate any remaining water, while avoiding spilling or splashing. Remove the dish after the hour has elapsed and allow to cool. Weigh the dish and remaining contents to the nearest mg. Subtract the weight of the dish to obtain the weight of the oil remainder. From the initial weight of the COM sample and the weight of the oil remainder, calculate the percentage of oil in the COM. Multiply the result by the correction factor, oil obtained from the working standard equation in 4.4.2.1. A corrected oil content of less than 40 percent or more than 60 percent shall constitute failure of this test.

## MIL-F-53053

4.4.2.2 Water content test. Water content of the COM shall be tested in accordance with ASTM D 95. A water content of more than 10 percent shall constitute failure of this test.

4.4.2.3 Additive test. There are few chemical restrictions on additives to stabilize COM. Therefore, no unique test can be specified as to percentage of additive and the primary control on additive percentage of the total weight of COM must occur during the manufacturing process. However, any physical or chemical tests used for quality control of any additive used in the manufacturing process, including detailed procedures, shall be made available for review by the contracting officer or designated representative.

4.4.2.4 Sulfur content test. The sulfur content of the COM shall be determined in accordance with ASTM D 3177. A sulfur content percentage that exceeds the amount specified (see 6.2c) shall constitute failure of this test.

4.4.2.5 Gross calorific value. The gross calorific value of the COM shall be determined in accordance with ASTM D 2015 or ASTM D 3286. A gross calorific value that is less than specified (see 6.2d) shall constitute failure of this test.

4.4.2.6 Ash content test. The ash content of the COM shall be determined in accordance with ASTM D 3174. An ash content percentage that is more than specified (see 6.2e) shall constitute failure of this test.

4.4.2.7 Ash softening temperature. The softening temperature of the ash in the COM shall be determined in accordance with ASTM D 1857. An ash softening temperature that is less than specified (see 6.2f) shall constitute failure of this test.

4.4.2.8 Fineness of COM test. This test requires that the specimen be taken at a sampling port and valve downstream of the mixing unit so that a heated, pressurized stream of COM is available for testing. Prepare a screen assembly containing a No. 80 ( $180\mu\text{m}$ ) wire cloth screen conforming to ASTM E 11. Route the heated, pressurized COM stream through the screen assembly. Flush the port and valve with the screen assembly removed and replace the screen assembly. Weigh a clean, empty container having a capacity of approximately 2 liters (L). Place the container to receive COM after passing through the screen assembly. Open the valve at the port and allow not less than 1.0 kilogram (kg) of COM to flow through the screen assembly. Close the valve and transfer any COM clinging to the downstream side of the screen assembly to the 2 L container. Weigh the container with the collected COM to the nearest g. Subtract the weight of the container to obtain the weight of the COM to the nearest g. Remove the screen assembly, wash the retained particles on the screen with acetone, and allow to dry. Observe the warning concerning acetone specified in 4.4.2.1. Then tap or brush the retained particles onto a glazed paper or foil. Weigh the retained particles to the nearest mg. Calculate the percent retained particles according to the following equation:



## MIL-F-53053

$$\text{Percent retained particles} = \frac{\text{Weight of retained particles}}{\text{Weight of collected COM}} \times 100$$

A percent of retained particles which is greater than 0.1 shall constitute failure of this test.

4.4.2.9 Viscosity test. The viscosity of the COM at 50° C (122° F) and 85° C (185° F) shall be determined in accordance with ASTM D 2669 or ASTM D 3236. The test method used, make and model of instrument, spindle number, and spindle speed (rpm) shall be reported for each determination. A viscosity at either temperature which is more than specified (see 6.2g and 6.2h) shall constitute failure of this test.

4.4.2.10 Stability test. Prepare a settling column having a height that is not less than 10 times the column diameter. A column having an inside diameter of from 7.5 centimeters (cm) (1.91 inches) to 10 cm (2.54 inches) and a height of from 75 cm (11.9 inches) to 100 cm (20.54 inches) shall be fabricated from stainless steel or other suitable material that is chemically resistant to COM. The column shall be equipped with a water jacket for temperature control and end caps or sampling ports for removal of COM specimens from the top and bottom of the column. An approximately 5L sample of COM shall be thoroughly mixed until homogenous. The viscosity of the COM sample shall have been determined at 50° C (122° F) and a shear rate of 10 s<sup>-1</sup> in accordance with 4.4.2.9. Record shall be made of the viscosity, test method used, make and model of instrument, spindle number, and spindle speed (rpm). Fill the column with the COM while exercising care to prevent trapped air pockets. Leave enough room at the column top for COM expansion when heated. Cap the column and store in a vertical position in a vibration free area for not less than 30 days. Maintain a column temperature of not less than 49° C (120.2° F) nor more than 51° C (123.8° F) by heated water circulated through the water jacket. After 30 days, take specimens of COM from the top 10 percent and bottom 10 percent of the column. Determine the viscosity of these specimens using the same test method, temperature, shear rate, instrument and spindle used to determine viscosity of the COM sample before filling the column. If the viscosity of either the top specimen or the bottom specimen differs from the original viscosity recorded before the sample was stored in the column by more than 30 percent, it shall constitute failure of this test.

## 5. PACKAGING

5.1 Packaging. All shipping containers utilized in the distribution of this bulk commodity, whether they be tank cars, tank trucks, or any other suitable means, shall comply with Department of Transportation Regulation 49 CFR.

5.1.1 Marking. The application of all identification information shall be in accordance with the requirements of DOT 49 CFR. Additional marking shall be as specified in the contract or purchase order and as specified in MIL-STD-129.

## 6. NOTES

6.1 Intended use. The COM is intended for use as a fuel in military combustor boilers which are primarily those of the 6 to 15 megawatt per hour industrial type.

## MIL-F-53053

6.1.1 Site-specific requirements. Existing boilers, not designed for firing COM, must be subjected to engineering analysis and may require modification to use COM for firing. Existing boilers that are candidates for COM as a fuel are: those designed to fire coal, but are presently firing oil; those designed for firing oil; and those designed for firing gas. The requirements for COM, intended for use in existing boilers, must be site-specific to accommodate the boiler and any modifications thereto. The COM requirements may also be affected by applicable environmental regulations on smokestack emissions in effect at the boiler site.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. Quantity of COM required (see 6.4).
- c. Percent maximum sulfur content of COM required (see 3.3.5).
- d. Minimum gross calorific value of COM required (see 3.3.6).
- e. Percent maximum ash content of COM required (see 3.3.7).
- f. Minimum ash softening temperature of COM required (see 3.3.7.1).
- g. Maximum viscosity of COM at 50° C (122° F) required at 10, 100 and 3,000 s<sup>-1</sup> (see 3.3.9.1).
- h. Maximum viscosity of COM at 85° C (185° F) required at 10, 100 and 3,000 s<sup>-1</sup> (see 3.3.9.2).
- i. Type and size of container required (see 5.1).

6.3 Definitions.

6.3.1 Gel-forming additives. A gel-forming additive is any additive which causes the viscosity of the COM, when measured at 50° C (122° F) and a shear rate of 10 sec<sup>-1</sup>, to increase by more than 10 percent when compared to a sample of COM without the additive.

6.3.2 Hard pack. Hard pack is a dense, tightly-packed layer of settled particles that cannot be readily dispersed by stirring.

6.4 Unit of purchase. The unit of purchase for COM should be the U.S. gallon (231 cubic inches at 15.6° C [60° F]). Alternately, COM may be purchased by the pound, avoirdupois.

6.5 COM storage and use temperature. Storage tanks for COM should be held at approximately 50° C (122° F) prior to pumping. The COM should be heated to approximately 120° C (248° F) just prior to boiler injection.

Custodian:

Army - ME

Preparing activity:

Army - ME

Review activities:

Army - CE, SM

DLA - PS

Project 9140-0101

User activity:

Air Force - 68

Civil Agencies Coordinating Activity:

DOE

## MIL-F-53053

## APPENDIX

## Significance of Coal-Oil Mixture Fuel Product for Military Industrial Boiler Retrofitting and Operation.

## 10. SCOPE

10.1 Scope. This Appendix is intended to set forth the key specific COM fuel product chemical and physical properties that directly affect the retrofit of the intended steam boiler and that are site-specific as to the design of the boiler. The chemical and physical properties of the COM fuel product will vary according to the specific amount and types of coal, fuel oil, and stabilizing agent that the fuel product contains. Each of the specific chemical and physical properties will affect specific system components of the intended boiler. These specific properties and general guidelines as to their significant effects on boiler operation and components are set forth below:

## 20. APPLICABLE DOCUMENTS

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 3682 - Major and Minor Elements in Coal and Coke Ash by Atomic Absorption.

(Application for copies of all ASTM publications should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

## 30. GUIDELINES FOR ESTABLISHING FUEL PROPERTY LIMITS.

30.1 Viscosity. The viscosity affects the overall pumpability of the fuel product. The viscosity of the fuel in the storage tank at a specified temperature should be such as to allow pumping at a rate to meet boiler output requirement. The storage temperature should be kept as low as possible consistent with pumping requirements to minimize settling. The viscosity just prior to injection has to be matched to the burner nozzle to allow adequate atomization of the fuel for efficient combustion. Boiler modifications may involve replacement of the boiler fuel oil pump, fuel flow control valves and control system, and possibly the entire burner or burner components subjected to high shear from increased viscosity. In most instances it will probably be desirable to keep the fuel heated in its storage tank at a temperature appropriate for No. 6 fuel oil.

30.2 Ash content. The increased ash content of the coal slurry will require additional ash handling equipment to remove the bottom ash as well as additional downstream particulate removal (bag house, etc.) equipment. The boiler house

## MIL-F-53053

## APPENDIX

may have to be modified to include ash storage transfer to disposal, etc. When pumped, the high ash-laden coal slurry will, to some extent, abrade the plumbing. Therefore, abrasion-resistant (hard-faced) elbows and bends in lines as well as increased radii will be required in most cases.

30.3 Sulfur content. The sulfur content of the coal slurry will have to be either low enough to conform to local emission codes or the boiler will have to be equipped with a wet or dry scrubber to capture sulfur dioxide (SO<sub>2</sub>).

30.4 Ash softening temperature. Softening of ash for coal-oil mixtures is of great significance to the use of this fuel product in a boiler. The formation of clinkers and slag (fused ash) contributes to handling problems of the ash and to a reduction of heat transfer into the boiler tubes. The "wetting" of tubes by fused ash also contributes to corrosion. Ideally, the ash should not be molten or agglomerated by the time the combustion gases contact the tubes. Ash should remain in a finely divided state as fly ash. As such it will be blown through the fire box and into the dust collection system (bag house or electrostatic precipitator). The higher the heat release rate in the fire box, the higher the requirement for ash softening temperature. For the intended use in an industrial boiler operation, the ash softening temperature should be as high as practical; however, the establishment of values for procurement of coal-oil mixture fuel product will depend upon the design of the boiler and the availability of soot blowers or retrofit to include soot blowers. Specific minimum temperature values for ash softening temperature under oxidizing conditions must be specified for each boiler installation.

30.5 Ash fouling potential. Ash fouling potential has been found to be a useful indicator for predicting the behavior of ashes and slags in combustion chambers. It can be calculated as the product of the ash base/acid ratio and the percent sulfur. The base/acid ratio is defined by the equation:

$$\text{base/acid ratio} = \frac{\text{CaO} + \text{MgO} + \text{Fe}_2\text{O}_3 + \text{K}_2\text{O} + \text{Na}_2\text{O}}{\text{Al}_2\text{O}_3 + \text{SiO}_2 + \text{TiO}_2}$$

A suitable method for determining the oxides in the ash is ASTM D 3682. The ash fouling potential has not been standardized as an ASTM test method.

30.6 Stability. Stability refers to the degree of permanence of the mixture. Mixtures of solids and liquids will separate as contrasted to a true solution of a solid in a liquid which will not separate. Because the coal-oil mixture can and will separate, a type of "shelf life" or period of time that the mixture will retain a specified percentage of viscosity or a specified percentage of its original solids in suspension (under given static conditions of non-movement and temperature) can be established. Due to a certain amount of instability it may be desirable to require a recirculation system with a stirring mechanism.

MIL-F-53053

APPENDIX

30.7 Calorific value. The COM is intended for use in variously designed boilers (see 6.1). Consequently, a certain percentage of derating of the boiler will occur, primarily depending on the specific heat release rate of the boiler and the percent loading of coal and its calorific value. To ensure that the boiler facility after modification is able to meet the required steam or hot water demand, it is important that a specified calorific value be established.



**INSTRUCTIONS:** In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

**NOTE:** This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification 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.

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DEPARTMENT OF THE ARMY

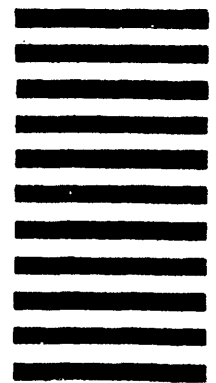


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## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-F-53053		2. DOCUMENT TITLE Fuel Product, Coal-Oil Mixture (COM): Industrial Type Combustor-Boilers	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one)	
b. ADDRESS (Street, City, State, ZIP Code)		<input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify): _____	
5. PROBLEM AREAS			
a. Paragraph Number and Wording:			
b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First, MI) - Optional		b. WORK TELEPHONE NUMBER (Include Area Code) - Optional	
c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional		8. DATE OF SUBMISSION (YYMMDD)	