

MIL-D-81298D
29 January 1988
SUPERSEDING
MIL-D-81298C
17 FEBRUARY 1978

MILITARY SPECIFICATION

DYE, LIQUID FOR THE DETECTION OF LEAKS IN AIRCRAFT FUEL SYSTEMS

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

1. SCOPE

1.1 Scope. This specification covers the requirements for liquid dyes (see 6.1).

1.2 Classification. This liquid dye shall be of the following types as specified (see 6.2.)

Type I	Red
Type II	Yellow
Type III	Green Fluorescent

2. APPLICABLE DOCUMENTS

2.1 Government documents

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASD/ENES, Wright-Patterson AFB OH 45433-6503 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 6820

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SPECIFICATION

FEDERAL

PFP-C-96 Cans. Metal, 28 Gage and Lighter

MILITARY

MIL-T-5624 Turbine Fuel, Aviation, Grades JP-4 and JP-5

MIL-T-83133 Turbine Fuel, Aviation. Kerosene Types. Grade JP-8

STANDARDS

MIL-STD-105 Sampling Procedure and Tables for Inspection by Attributes

MIL-STD-290 Packaging, of Petroleum and Related Products

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM D 97	Pour Point Of Petroleum Oils, Test Method For
ASTM D 1310	Standard Test Methods For Flash Point And Fire Point Of Liquids By Tag Open-cup Apparatus
ASTM D 1744	Water In Liquid Petroleum Products By Karl Fischer Reagent, Test Method For
ASTM D 2276	Particulate Contaminant In Aviation Turbine Fuels, Test Method For
ASTM D 3241	Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedure) Test Method For
ASTM D 3278	Flash Point Of Liquids By Setaflash Closed-Cup Apparatus, Test Method For

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

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

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2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.4 and 6.5).

3.2 Material. The dyes shall consist essentially of liquid oil soluble dyes, completely organic and containing no reactive amino groups. The composition of the dye shall be made available upon request of the using activity. The product shall be entirely suitable for the intended use (see 6.1).

3.3 Properties. The red and yellow dyes shall conform to the properties shown in table I and 3.4 through 3.7. The green fluorescent dye shall conform to the properties shown in table II and 3.4 through 3.7.

TABLE I. Physical requirements and test methods of red and yellow dyes.

Requirements	Min	Max	Test Method ASTM STD
Moisture, percent		0.05	D 1744
Flash point, open cup, °C (°F)	32 (90)		D1310
or Flash point, closed cup, °C (°F)	25 (77)		D3278
Pour Point, °C (°F)		-18 (0)	D 97
Color value (absorptivity)			1/
Type I (red)	30.0		
Type II (yellow)	24.0		
Wavelength at max absorption, nanometers (nm)			1/
Type I (red)	510	522	
Type II (yellow)	423	442	
Contamination of aircraft fuel, mg/liter			D2276 2/
Type I (red)		2.0	
Type II (yellow)		1.0	

1/ See 4.6.3 for test procedure

2/ See 4.6.1 for test procedure

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TABLE II. Physical requirement and test methods of green fluorescent dye.

Requirements	Min	Max	Test Method ASTM STD
Moisture, percent		0.05	D 1744
Flash point, open-cup °C (°F)	43 (109)		D 1310
or Flash Point, close cup	40 (104)		D 3278
Pour point, °C (°F)		-18 (0)	D 97
Percent Transmittance at 525 nanometers (nm)			
(a) Dilution ratio dye: Xylene = 1:1250		80	<u>1/</u>
(b) Dilution ratio dye Xylene = 1:833		71	<u>1/</u>
Contamination of aircraft fuel mg/litre		1.0	D 2276 <u>2/</u>

1/ See 4.6.4 for test procedure2/ See 4.6.1 for test procedure

3.4 Storage stability. (Due to the length of this test, storage stability evaluation results are not required as a prerequisite to a new contract, but storage stability evaluation shall be initiated during the first article testing. Results of this testing, once completed, shall apply to future deliveries. After storage for 12 months in accordance with 4.6.5 the dye shall show no precipitation, layering or other evidence of gross separation. Results of this test shall be reported at the end of 12 months testing period. Failure to meet any specification requirements or any significant change in performance or properties from the originally approved material (see 4.4.1) shall be cause for disqualification of the dye from future procurement.

3.5 Thermal stability. In addition to the requirements of table I and Table II, type I (red), type II (yellow), and type III (green fluorescent) dyes shall not degrade the thermal stability of MIL-T-5624 or MIL-T-83133 fuels, when tested in accordance with ASTM D 3241 (see 4.6.2). This test is applicable only for the first article sample.

3.6 Color. The liquid dye shall be type I (red), type II (yellow) or type III (green fluorescent) as specified (see 6.2).

3.7 Workmanship. When examined visually, the liquid dye shall be completely homogeneous material free from any insoluble matter.

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4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, 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 supplies and service conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of section 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective materials.

4.2 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.4).
- b. Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified, all inspection shall be performed in accordance with the test conditions of table I and 3.5 through 3.7 on red and yellow dyes; test conditions of table II and 3.5 through 3.7 shall be performed on green fluorescent dye.

4.4 First article inspection

4.4.1 Bulk lot. The total quantity of a homogeneous mixture of liquid dye contained in one isolated container.

4.4.2 Packaged lot. The total number of unit containers of identical size and type that have been filled with a homogeneous mixture of liquid dye of one color offered for acceptance at one time.

4.4.3 First article sample. When a contractor has not previously furnished material under this specification, one gallon of the liquid dye shall be forwarded to an independent, preapproved laboratory for first article testing. Results of this testing shall be provided to the following agency for review and approval prior to product delivery:

Forward to: Air Force Wright Aeronautical Laboratories
 ATTN: AFWAL/POSF
 Wright-Patterson AFB OH 45433-6563

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Mark as follows: Sample for First Article Testing
Dye, Liquid, For The Detection of Leaks in Aircraft
Fuel Systems.
Name and Address of Manufacturer
Submitted by (Name, date) for first article in accordance
with the requirements of MIL-D-81298D

4.5 Quality conformance inspection. Each sample selected in accordance with 4.5.1 shall be examined and tested to determine conformance to all the requirements of Section 3 of this specification except 3.4. Nonconformance of a sample to a requirement shall be cause for rejection of the lot represented by the sample.

4.5.1 Sampling for verification of product quality. A sample of not less than one gallon of dye shall be selected from each bulk lot, and a sample one-gallon can shall be selected from each packaged lot.

4.5.2 Sampling for examination of filled containers. Each packaged lot of containers shall be sampled in accordance with MIL-STD-105, inspection Level I, acceptance quality control level (AQL) 2.5 percent defective and examined for leakage, fill, closure, and preparation for shipment (packaging, packing and marking) in compliance with MIL-STD-290.

4.6 Inspection test methods. Tests to determine conformance to chemical and physical requirements shall be conducted in accordance with ASTM Standards, using the applicable methods as listed in table I and table II and 4.6.1 through 4.6.5.

4.6.1 Particulate contamination. Aviation turbine fuel conforming to MIL-T-5624, grade JP-4, shall be filtered through a 0.45 micron membrane equivalent to that manufactured by Millipore Filter Corporation, 225 Ashby Road, Bedford, MA 01730. Dye the prefiltered fuel in the ratio 2.0 ounces (56.7g weight) of red or yellow dye to 100 gallons (378.5 liters) of fuel, assuring a uniform mixture. In the case of yellow/green fluorescent dye, dissolve 1 fluid ounce (21.5g weight) of dye in 9.75 gallons (36.9 liters) of fuel, assuring a uniform mixture. The contamination resulting from the dissolved liquid dye shall be determined in accordance with ASTM D 2276, method A. Repeat this test using prefiltered fuel conforming to MIL-T-5624, grade JP-5 or MIL-T-83133, grade JP-8.

4.6.2 Thermal stability. Fuel conforming to MIL-T-5624, grade JP-4, or MIL-T-5624, grade JP-5, or MIL-T-83133, grade JP-8, shall be dyed in the ratios shown in table III. When testing in accordance with ASTM D 3241, the thermal stability of the dyed JP-4, JP-5, or JP-8 fuel shall meet MIL-T-5624 or MIL-T-83133 requirements, as applicable.

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TABLE III. Thermal stability dye/fuel mixture ratios.

	Amount of dye	Amount of fuel
Type I (red) dye	1.6 ounces (45.4g)	100 gallons (378.5 liters)
Type II (yellow) dye	1.6 ounces (45.4g)	100 gallons (378.5 liters)
Type III (green fluorescent) dye	1 fluid ounce (21.5g weight)	9.75 gallons (36.9 liters)

4.6.3 Color value and wavelength of maximum absorption. Accurately weigh between 0.3800- to 0.04000-gram sample of red dye or 0.4200- to 0.4400-gram sample of yellow dye and transfer to a 100-ml volumetric flask. Any amount within the given ranges may be taken but record the weight to nearest 0.1 mg. Dilute to the mark with spectral grade xylene (equivalent to American Chemical Society Reagent Grade, "suitable for use in spectrophotometry"). Agitate until the solution is uniform. Using a class A pipet transfer 2.00 ml of this solution into a 250 ml volumetric flask and dilute to a mark with iso-octane. Record the visible spectrum of the final solution in a 1.000-cm cell vs iso-octane employing a spectrophotometer which has been checked for wavelength accuracy and photometric accuracy by standard procedure determine the wavelength of maximum absorbance by inspection of the curve. Calculate the absorptivity of a liquid dye using expression:

$$a = \frac{A}{bc}$$

where A is the absorbance of the solution at the wavelength of maximum absorbance is the cell thickness in centimeters, and c is the concentration of the liquid dye in iso-octane in grams/liter. If the recommended procedure is followed the concentration of the measured dye solution is grams/liter is equal to the sample weight in grams divided by 12.5.

4.6.4 Percent transmittance measurement. Accurately weigh about 1.000 gram fluorescent dye in a 250 ml glass beaker. Dilute the above dye 1250 times (by weight) with spectral grade xylene (equivalent to American Chemical Society Reagent Grade, (suitable for use in spectrophotometry"). Agitate until the solution is uniform. Fill a 2.54 cm diameter glass tube cell with this solution. Measure the percent transmittance of this solution using a spectrophotometer at 525 nm (nanometer). Repeat the above procedure, but this time dilute the fluorescent dye 833 times with xylene.

4.6.5 Storage stability. Store a 1-gallon sample of the liquid dye in its original container at a laboratory room temperature of $25^{\circ} \pm 3^{\circ}\text{C}$ ($77^{\circ} \pm 5^{\circ}\text{F}$) for 12 months. After 12 months, shake the can vigorously by hand and examine visually for evidence of product deterioration or can corrosion. After the visual examination, subject the stored sample to all examinations and tests of this specification.

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5. PACKAGING

5.1 Packaging and packing. The packaging and packing of the liquid dye shall be in accordance with MIL-STD-290. Packaging shall be level A or C; packing shall be level A, B, or C, as specified (see 6.2.).

5.1.1 Unit container. Unless otherwise specified by the procuring activity, the liquid dye shall be furnished in a one-gallon can with metal screw cap conforming to type V, class 4, of PPP-C-96. The can and screw cap shall be constructed also in accordance with the requirements of MIL-STD-290. The screw cap shall contain an inner friction seal with a metal foil pad or facing (See 6.2.).

5.2 Marking. The marking of containers shall be in accordance with MIL-STD-290.

6. NOTES

6.1 Intended use. The liquid dyes covered by this specification are intended for use in coloring aircraft fuels as an aid in the detection of aircraft fuel system leaks.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number, and date of this specification
- b. Size of unit container and quantity (see 5.1.1)
- c. Levels of packaging and packing (see 5.1)
- d. Type and color of dye required (see 3.6)

6.3 Unit of purchase. The liquid dye should be purchased by volume. The unit of purchase is the U.S. gallon (3.785 liters) at 16.5°C (60°F).

6.4 Safety. Adequate ventilation should be provided to remove the highly flammable and toxic solvent vapors.

6.5 First article. When a first article inspection is required, the item(s) should be a first article sample. The first article should consist of one unit. The contacting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the government reserves the right to waive the requirements for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

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6.6 Key words.

Aircraft fuel system

Dye

JP-4

JP-5

JP-8

Leaks

Turbine fuel

6.7 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - AR

Navy - AS

Air Force - 11

Preparing activity:

Air Force - 11

Project 6820-1002

Review activities:

Army - AV, MR

Navy - SH

Air Force - 68

User activities:

Army - SM

Navy - CG

Air Force - 99

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL*(See Instructions - Reverse Side)***1. DOCUMENT NUMBER**

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2. DOCUMENT TITLE

Dye, Liquid For The Detection of Leaks in Aircraft Fuel Sytems

3a. NAME OF SUBMITTING ORGANIZATION**4. TYPE OF ORGANIZATION (Mark one)**☐

VENDOR

☐

USER

☐

MANUFACTURER

☐

OTHER (Specify): _____

b. ADDRESS (Street, City, State, ZIP Code)**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)**