METRIC

MIL–PRF–38219C(USAF)
18 September 1995

SUPERSEDING
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1 March 1985

PERFORMANCE SPECIFICATION

TURBINE FUEL, LOW VOLATILITY, JP–7

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

1. SCOPE

1.1 Scope. This specification covers one grade of aviation turbine fuel designated as JP–7.

2. APPLICABLE DOCUMENTS

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

2.2 Government documents

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASC/ENSI, Bldg 125, 2335 Seventh St Ste 6, Wright–Patterson AFB OH 45433–7809, by using the Standardization Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A FSC 9130

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL–I–27686 Inhibitor, Icing, Fuel System

STANDARDS

FEDERAL

FED–STD–313 Material Safety Data Sheets, Preparation and Submission of
FED–STD–791 Lubricants, Liquid Fuels, and Related Products; Methods of Testing

DEPARTMENT OF DEFENSE

MIL–STD–290 Packaging of Petroleum and Related Products

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

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS

ASTM D86 Standard Test Method for Distillation of Petroleum Products (DoD adopted)
ASTM D93 Standard Test Method for Flash Point by Pensky–Martens Closed Tester (DoD adopted)
ASTM D130 Standard Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test (DoD adopted)
ASTM D381 Standard Test Method for Existent Gum in Fuels by Jet Evaporation (DoD adopted)
ASTM D445 Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity) (DoD adopted)
ASTM D1094 Standard Test Method for Water Reaction of Aviation Fuels (DoD adopted)
ASTM D1266 Standard Test Method for Sulfur in Petroleum Products (Lamp Method) (DoD adopted)
ASTM D1298 Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method (DoD adopted)
ASTM D1319 Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption
ASTM D2276 Standard Test Method for Particulate Contamination in Aviation Fuel (DoD adopted)

ASTM D2382	Standard Test Method for Heat of Combustion of Hydrocarbon Fuels by Bomb Calorimeter (High–Precision Method) (DoD adopted)
ASTM D2386	Standard Test Method for Freezing Point of Aviation Fuels (DoD adopted)
ASTM D2622	Standard Test Method for Sulfur in Petroleum Products by X–Ray Spectrometry (DoD adopted)
ASTM D3120	Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbon by Oxidative Microcoulometry (DoD adopted)
ASTM D3227	Standard Test Method for Mercaptan Sulfur in Gasoline, Kerosene, Aviation Turbine, and Distillate Fuels (Potentiometric Method) (DoD adopted)
ASTM D3241	Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedure) (DoD adopted)
ASTM D3338	Standard Test Method for Estimation of Heat of Combustion of Aviation Fuels (DoD adopted)
ASTM D3343	Standard Method for Estimation of Hydrogen Content of Aviation Fuels (DoD adopted)
ASTM D3701	Standard Test Method for Hydrogen Content of Aviation Turbine Fuels by Low Resolution Nuclear Magnetic Resonance Spectrometry (DoD adopted)
ASTM D3948	Standard Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer (DoD adopted)
ASTM D4052	Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter (DoD adopted)
ASTM D4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products
ASTM D4177	Standard practice for Automatic Sampling of Petroleum and Petroleum Products (DoD adopted)
ASTM D4294	Standard Test Method for Sulfur in Petroleum Products by Non–Dispersive X–Ray Fluorescence Spectrometry (DoD adopted)
ASTM D4306	Standard Practice for Aviation Fuel Sample Containers for Test Affected by Trace Contamination
ASTM D4952	Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test)
ASTM D5006	Standard Test Method for Determination of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels
ASTM D5452	Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
ASTM E29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (DoD adopted)
ASTM E77	Standard Method for Verification and Calibration of Liquid–in–Glass Thermometers (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, Inc.; 1916 Race Street, Philadelphia PA 19013–1187; (215) 299–5585.)

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

3. REQUIREMENTS

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

3.2 Materials. Except as otherwise specified herein, the fuel shall consist completely of hydrocarbon compounds which contains additives in accordance with 3.4.

3.3 Chemical and physical requirements. The chemical and physical requirements of the finished fuel (hydrocarbon blend plus all additives listed herein) shall conform to the requirements listed in section 3 and table I when tested in accordance with the applicable test methods. Requirements contained herein are not subject to correction for test tolerances.

3.3.1 Storage stability. The finished fuel shall remain stable and conform to the requirements in section 3 and table I for at least one year when tested in accordance with 4.5.3.

3.4 Additives. The additives listed herein shall be used in amounts not to exceed those specified (see 6.4). The type and amount of each additive used shall be reported (see 6.2e). Additives other than those listed in the following paragraphs will be permitted only by special authorization from the acquisition activity.

3.4.1 Antioxidants. To prevent the formation of gums and peroxides, one of the following antioxidants shall be blended into the fuel immediately after it is processed and before it is exposed to air. The antioxidant shall be added to the fuel at a concentration of 24 mg of inhibitor (not including weight of the solvent) per liter of fuel (8.4 lb inhibitor/1000 barrels of fuel):

a. 2,6–ditertiary butyl–4–methylphenol

b. 2,4–dimethyl–6–tertiary butylphenol

c. 2,6–ditertiary butylphenol

d. Mixed tertiary butylphenol composition:

   75 percent 2,6–ditertiary butylphenol
   10 to 15 percent 2,4,6–tritertiary butylphenol
   10 to 15 percent ortho–tertiary butylphenol.

3.4.2 Metal deactivator. A metal deactivator, N,N′–disalicylidene–1,2–propanediamine or N,N′–disalicylidene–1,2–cyclohexanediamine, may be added in an amount not to exceed 5.7 mg of active ingredient per liter of fuel (2 lbs of active ingredient per 1,000 barrels of fuel).

3.4.3 Fuel system icing inhibitor. The fuel system icing inhibitor, to be added at a concentration in accordance with table I, shall conform to *MIL–I–27686.*

3.4.4 Lubricity additive. A lubricity additive, PWA–536, shall be added in an amount not less than 200 parts per million (ppm) (weight/weight) and not more than 250 ppm (weight/weight).

TABLE I. Chemical and physical requirements and test methods.

Requirements	Minimum	Maximum	*ASTM Standards* Test Methods
Aromatics, vol percent		5	*D1319*
Mercaptan Sulfur, mass percent[1]		0.001	*D3227*
Sulfur, total, mass percent		0.1	*D1266*, *D2622*, *D3120*, or [10] *D4294*
Distillation Temperature, °C (°F)			[2] *D86*
Initial boiling point	182 (360)		
10 percent recovered	196 (385)		
20 percent recovered	[3] 206 (403)		
50 percent recovered		Report	
90 percent recovered		260 (500)	
End point		288 (550)	
Residue, volume percent		1.5	
Distillation Loss, volume percent		1.5	
Flash Point, °C (°F)	60 (140)		*D93*
Density, at 15°C			*D1298* or [10] *D4052*
kg/L, min (API max)	0.779 (50.1)		
kg/L, max (API min)		0.806 (44.0)	
Vapor Pressure, kPa (psi) at 149°C		20.7 (3.0)	[4]
Vapor Pressure, kPa (psi) at 260°C		331 (48.0)	[4]
Freezing Point, °C (°F)		–43.3 (–46)	*D2386*
Viscosity, centistokes, at –20°C		[5] 8.0	*D445*
Heating Value, Net Heat of Combustion, MJ/kg (BTU/lb)	43.5 (18,700)		*D2382* or *D3338*
Hydrogen Content, mass percent	14.40		*D3343* or [10,6] *D3701*

TABLE I. Chemical and physical requirements and test methods – Continued.

Requirements	Minimum	Maximum	*ASTM Standards* Test Methods
Copper Strip Corrosion, at 100°C (212°F)		1b	*D130*
Thermal Stability (JFTOT)			[7] *D3241*
JFTOT, change in pressure drop in 5 hours, mm Hg		25.0	
JFTOT, delta TDR Spun		12	
Existent Gum, mg/100 mL		5.0	*D381*
Particulate Matter, mg/L			[8] *D2276* or [8] *D5452*
Origin		0.3	
Destination		0.5	
Water Reaction, Interface rating		1b	*D1094*
Separation rating		(2)	
Water Separometer Index	85		*D3948*
Fuel System Icing Inhibitor, vol percent	0.10	0.15	[9] *D5006*

[1] The mercaptan determination may be waived at the option of the inspector if fuel is “Doctor Sweet” when tested in accordance with *ASTM D4952*.

[2] A condenser temperature of 0°C to 4.4°C (32°F to 40°F) shall be used. To insure accurate IBP data, the operator must cut back on the heating rate when the vapor/condensate ring rises to within about 25 mm (1 in.) of the vapor tube. The reduced heating rate allows the thermometer to reflect more accurately the true vapor temperature when the first condensate is collected.

[3] The temperature reading at the 20 percent recovered point shall be corrected for the emergent stem in accordance with *ASTM E77*, paragraph 7, Treatment of Data.

[4] Test shall be performed in accordance with the vapor pressure test in appendix A or appendix C of this specification.

[5] Until an ASTM thermometer calibrated for the –20°C condition becomes available, this test may be conducted at –34.5°C (–30°F) with a maximum allowable viscosity of 15.0 centistokes.

[6] Mass hydrogen content may be calculated using *ASTM D3343* or measured using *ASTM D3701*. In case of conflict, *ASTM D3701* shall apply.

[7] For specific test conditions see 4.5.2.1.

[8] Filter not less than 3.79 liter (1 gallon) of fuel to determine the total solids.

[9] Test shall be performed in accordance with *ASTM D5006* or *FED–STD–791*, method 5327, method 5340, or method 5342. Use the appropriate scale of the refractometer.

[10] Referee test method.

3.5 Odor. The odor of the fuel shall not be nauseating or irritating. No substances of known dangerous toxicity under usual conditions of handling and use shall be present.

3.6 Material Safety Data Sheets. Material Safety Data Sheets shall be prepared and submitted in accordance with *FED–STD–313*. Material Safety Data Sheets shall also be forwarded as specified in 4.7.

3.7 Workmanship. When examined visually, the finished fuel shall be water white; free from undissolved water, sediment, or suspended matter; and shall be clean and bright at the ambient temperature or at 21°C (70°F), whichever is higher.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follow:

a. First article inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 First article inspection. Test requirements of 3.3.1 shall be complied with prior to bid on any product required under this specification. This test shall be conducted in accordance with 4.5.3.

4.2.1 Sample. One 208–liter (55–gallon) drum of fuel from the first batch that represents the product offered to the Government under any contract shall be forwarded to WL/POSF, Bldg 490, 1790 Loop Road N, Wright–Patterson AFB OH 45433–7103. Test data which show the results of tests required by 3.3 and 3.3.1 performed on products produced or blended in an identical manner to the batch sample shall accompany the 208–liter (55–gallon) sample forwarded under each contract. The Government will perform tests as necessary to confirm or validate the contractor's test results. Failure of the storage stability test will render the contractor ineligible for further contract award, pending assurance by the supplier to the satisfaction of the Wright Laboratory's Fuels Branch (WL/POSF) that any future product will meet the storage stability requirement. The storage stability test must then be repeated on the improved product to prove that the product is totally acceptable.

4.3 Conformance inspection. Test for the acceptance of individual lots shall consist of tests for all requirements specified in section 3, except storage stability. Quality conformance inspection shall include the test requirement herein. Contractor shall send a 7.08 liter (2 gallon) sample of each batch of fuel produced under any contract to a designated acquisition activity laboratory for acceptance testing.

4.3.1 Inspection lot. For acceptance purposes, individual lots shall be examined as specified herein and subjected to tests for all requirements cited in section 3.

4.3.1.1 Bulk lot. A bulk lot shall consist of an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single isolated container, or manufactured in a single plant run (not to exceed 24 hours), through the same processing equipment, with no change in ingredient material.

4.3.1.2 Packaged lot. A packaged lot shall consist of an indefinite number of 208–liter (55–gallon) drums or smaller unit packages of identical size and type, offered for acceptance, and filled from the isolated tank which contains a homogeneous mixture of material or filled with a homogeneous mixture of material manufactured in a single plant run (not to exceed 24 hours), through the same processing equipment, with no change in ingredient material.

4.3.2 Sampling plans

4.3.2.1 Sampling for verification of product quality. Each bulk or packaged lot of material shall be sampled for verification of product quality in accordance with *ASTM D4057* or *ASTM D4177*, or both, except where individual test procedures contain specific sampling instructions.

4.3.2.1.1 Sample containers. A number of jet fuel properties are very sensitive to trace contamination which can originate from sample containers. Refer to *ASTM D4306* for recommended sample containers.

4.3.2.2 Sampling for examination of filled containers for delivery. A random sample of filled containers shall be selected from each lot. The samples shall be examined in accordance with 4.5.1.3.

4.3.2.3 Special samples. One 208–liter (55–gallon) drum of fuel from the first production lot that represents the product offered to the Government under an initial contract will be forwarded to the Air Force Wright Laboratory at WL/POSF, Bldg 490, 1790 Loop Rd N, WPAFB OH 45433–7103. Test data which shows the results of tests required by 3.3 shall accompany the 208–liter (55–gallon) sample. The Government will perform tests as necessary to confirm or validate the company's test results. A complete report of analysis shall be forwarded to the same address for all lots of fuel produced under any Government contract. Failure of any tests conducted within 12 months after receipt of the fuel sample shall render the contractor ineligible for further contract award, pending verification of the quality of the product to the satisfaction of the acquisition activity.

4.3.3 Inspection. Inspection shall be performed in accordance with method 9601 of *FED–STD–791*.

4.3.4 Batch sample. WL/POSF reserves the right to have a 18.9–liter (5–gallon) sample of each batch of fuel produced under any contract forwarded to WL/POSF, Bldg 490, 1790 Loop Road N, Wright–Patterson AFB OH 45433–7103. This sample will be stored at Wright–Patterson AFB and will represent a retained sample from each batch of fuel produced. All specification tests may be performed any time within 12 months from date of manufacture. Failure of any test will render the contractor ineligible for further contract award, pending verification of the quality of the product to the satisfaction of Wright Laboratory's Fuels Branch (WL/POSF). The contracting officer and contractor will be promptly advised of any failures.

4.4 Inspection conditions. Requirements contained in table I are absolute, as defined in *ASTM E29*, and shall not be subject to correction for test tolerances. If multiple determinations are made, results falling within any specified repeatability and reproducibility tolerances may be averaged. For rounding off of significant figures, *ASTM E29*, absolute method, shall apply to all tests required by this specification.

4.5 Methods of inspection

4.5.1 Examination of product

4.5.1.1 Visual inspection. Samples selected in accordance with 4.3.1 shall be visually examined for compliance with 3.7.

4.5.1.2 Examination of empty containers. Before filled, each empty unit container shall be visually inspected for cleanliness and suitability in accordance with *ASTM D4057*.

4.5.1.3 Examination of filled containers. Samples taken as specified in 4.3.2 shall be examined for conformance to *MIL–STD–290* with regard to fill, closure, sealing, leakage, packaging, packing, and markings. Any container with one or more defects under the required fill shall be rejected.

4.5.2 Chemical and physical tests. Tests to determine conformance to chemical and physical requirements (see 3.3) shall be conducted in accordance with the applicable test methods (*FED–STD–791* or *ASTM*) listed in table I, except for those specified herein.

4.5.2.1 Thermal stability. The thermal stability test shall be conducted using *ASTM D3241* (JFTOT), as modified below. The heater tube shall be rated for deposits using the Alcor Mark 8A Tube Deposit Rater (TDR) as modified in accordance with appendix B or the Alcor Mark 9 TDR (see 4.5.2.1.2a).

4.5.2.1.1 Test conditions

a. Heater tube temperature at maximum point:
   355°C (671°F)

b. Fuel system pressure:
   3.45 MPa (500 pounds/square inch of gravity)

c. Fuel flow rate:
   3.0 mL/minute

d. Test duration:
   300 minutes

e. Quantity of test fuel:
   1 liter

4.5.2.1.2 Test results. The fuel sample is acceptable, if all the following criteria are met:

a. The maximum differential between the post–test and the pretest TDR spun rating does not exceed 12 TDR units. Both before and after the JFTOT test, use the modified Mark 8A or Mark 9 TDR to rate the heater tube at 2–millimeter (mm) increments from 20 mm to 50 mm along the length of the heater tube. The maximum delta increase in the TDR ratings (i.e., the maximum difference measured between the post–test and the pretest TDR rating) shall be reported. If the maximum increase in TDR rating does not exceed 12 TDR units, the results are satisfactory.

b. The maximum differential pressure across the test filter shall be reported. The results are satisfactory if the differential pressure drop does not exceed 25 mm of mercury.

4.5.2.1.3 Reported data. The following data shall be reported:

a. Tube deposit TDR ratings.

b. Differential pressure across the test filter.

4.5.2.2 Vapor pressure. The vapor pressure test shall be conducted in accordance with appendix A or appendix C.

4.5.3 Storage stability. The storage stability test on the finished fuel shall be conducted by placing 200 ±3.8 liters (53 ±1 gallons) of fuel in a 208–liter (55–gallon), 18 gauge DOT 17E uncoated steel drum. The filled drum shall be stored at 54.4°C (130°F) for one year (12 months). Samples shall be withdrawn at 3–month intervals and subjected to the thermal stability test (see 4.5.2.1). The fuel will be subjected to all test requirements of table I at the conclusion of the 12–month storage stability test. If the fuel fails any of the 3–month thermal stability tests, the fuel shall be resampled and retested to insure the initial sample was valid. Failure of the thermal stability test at any 3–month interval or failure of any of the table I test requirements at the conclusion of the 12–month storage stability test constitutes a failure of the storage stability test (see 4.2.1). This test will be conducted by the Air Force Wright Laboratory (WL/POSF), Bldg 490, 1790 Loop Road N, Wright–Patterson AFB OH 45433–7103.

4.6 Test report. Test data required by 4.5.2 shall be reported in the same order as listed in table I, unless directed otherwise by the procuring activity.

4.7 Material Safety Data Sheets. Material Safety Data Sheets prepared as specified in 3.6 shall be submitted to the contracting activity.

5. PACKAGING

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

6. NOTES

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

6.1 Intended use. The JP–7 fuel covered by this specification is intended for use in aircraft turbine engines. The fuel covered by this specification is not intended for general acquisition. It is a limited production item to be consumed only by systems which use engines that require this product. The contracting officer should contact the following organization if clarification of requirements is required:

WL/POSF, Bldg 490
1790 Loop Rd N
Wright–Patterson AFB OH 45433–7103.

6.2 Acquisition requirements. Acquisition documents must specify the following:

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

b. Issue of *DoDISS* to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).

c. Packaging requirements (see 5.1).

d. Quantity required and size containers desired.

e. Location, injection method, and type of additives, as required.

f. One copy of the certificate of analysis that lists those items in table I should be forwarded to the acquisition activity and the following organization for each batch of fuel acquired under this specification:

WL/POSF, Bldg 490
1790 Loop Rd N
Wright–Patterson AFB OH 45433–7103.

g. The acquisition activity shall state if the contractor is to be required to submit a 208–liter (55–gallon) drum of fuel, or a sample acceptable to the Air Force Wright Laboratory (WL/POSF) (see 4.3.2.3).

6.3 Conversion of metric units. Units of measure have been converted to the International System of Units (Metric) in accordance with *ASTM E380*. If test results are obtained in units other than Metric or there is a requirement to report dual units, *ASTM E380* or *ASTM D1250 Volume XI/XII* should be used to convert the units.

6.4 Precaution of mixing additives. To prevent any possible reaction between the concentrated forms of different additives (see 3.4), the fuel contractor is cautioned not to commingle additives before they are added to the fuel.

6.5 Material Safety Data Sheets. Contracting officers will identify those activities which require copies of completed Material Safety Data Sheets prepared in accordance with *FED–STD–313*. The pertinent Government mailing addresses for submission of data are listed in *FED–STD–313*.

6.6 Subject term (key word) listing

Antioxidant
Aviation turbine fuel
Fuel system icing inhibitor
Icing inhibitor
Lubricity additive
Metal deactivator
Viscosity

6.7 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.

Custodian:
Air Force – 11

Review activity:
Air Force – 68
DLA – PS

Preparing activity:
Air Force – 11

(Project 9130–1050)

APPENDIX A

VAPOR PRESSURE TEST

A10. SCOPE

A10.1 The test covered by this appendix is designed to determine the vapor pressure of JP–7 jet fuel by distillation and vapor reflux methods.

A20. METHOD A – DISTILLATION

A20.1 Perform distillation according to *ASTM D86*.

A20.2 If 20 percent distillation point falls between 360′ F and 420′ F and there is not more than 50′ F difference between the initial boiling point and 20 percent fuel evaporated point, read the vapor pressure directly from figure A1.

A20.3 Record and report the results.

A30. METHOD B – VAPOR REFLUX

A30.1 Apparatus. The apparatus for this test shall include the following:

a. Vacuum pump

b. Powerstat

c. Magnetic stirrer, Teflon–coated stirring bar magnet

d. Heating mantle, Glas–Col 500 mL

e. Flask, Pyrex round bottom, 500 mL, short neck T joint 24/40 with thermometer well

f. Pyrex T joints 24/30 and 10/30

g. Condenser, reflex, Friedrichs with T joint 24/30

h. Thermometer, mercury T joint 10/30, 75 mm, immersion 10′ C to 250′ C

i. Thermometer, mercury, 76 mm, immersion 10′ C to 260′ C

j. Manometer, U tube

k. Rubber tubing, vacuum and medium wall

l. Stopcock, needle valve, brass $^{1}/_{4}$ inch

m. Condenser, cold finger, size 10, 300 mm

n. Dewar flask, vacuum.

A30.2 Solutions. None.

APPENDIX A

APPLICABLE TO FUELS OF RVP LESS THAN 0.1 PSI
AND 5 TO 95% ASTM DISTILLATION RANGE LESS THAN 200° F

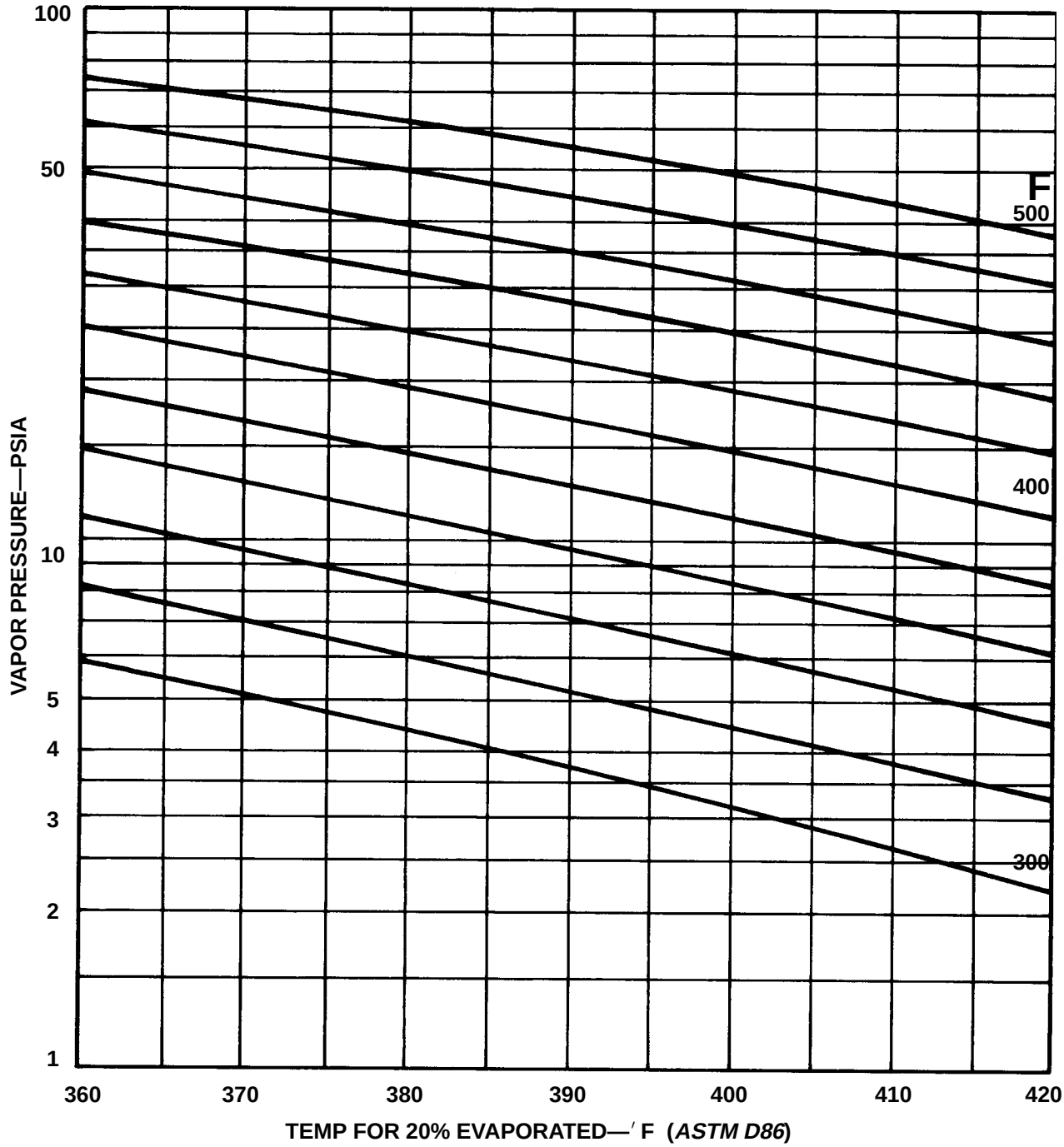

FIGURE A1. Vapor pressure reading – distillation method.

A30.3 Procedure

a. Sample preparation

(1) Transfer 600 mL of the sample into a large separatory funnel.

(2) Shake the funnel for 1 to 2 minutes and then let contents settle for 15 to 20 minutes.

(3) Draw off lower 100 mL of fuel and discard.

b. Assemble apparatus in accordance with figure A2.

c. Place 300 mL of the prepared sample in the 500–mL flask.

d. Place ice around cold finger in the Dewar flask.

e. Begin the stirring action and carefully evacuate the system to degas the sample. The system shall be evacuated at ambient temperatures for a period of 10 minutes.

f. Control of temperature and pressure

(1) Slowly increase the temperature of the contents of the flask by varying the powerstat.

(2) At no time shall the sample be allowed to bump the flask or boil up into the condenser.

(3) If the magnetic stirrer makes a thumping sound, an indication of too rapid increase in temperature, reduce the setting of the powerstat.

(4) A bleed valve is provided so that a continuous, stable vacuum is maintained.

(5) With proper adjustment of temperature and pressure, a reflux action is noted within the neck of the condenser. (Refluxing shall be to the same height for each run.)

(6) When refluxing reaches an equilibrium at this level, the temperature of the reflux vapor will agree within 4′ C of the liquid.

(a) If the two temperatures do not agree within 4′ C, change the system pressure, increase temperature, and repeat temperature–pressure measurements until stable reflux conditions are met.

(b) Stable reflux conditions shall be those where the temperatures, pressure, and height of reflux in the condenser do not change on three successive readings at 3–minute intervals.

g. Change the system pressure, increase the temperature, and repeat the temperature–pressure measurements over the entire pressure range up to atmospheric pressure. A minimum of four stable reflux conditions (boiling points) shall be obtained.

h. Record the temperature of the liquid, temperature of the vapor, and pressure of the system at stable reflux conditions.

i. Correct the pressure as shown by the manometer for variations in barometric pressures.

j. Allow the fuel to cool to ambient temperature and pressure.

k. Remove sufficient fuel from the flask and perform distillation according to *ASTM D86*.

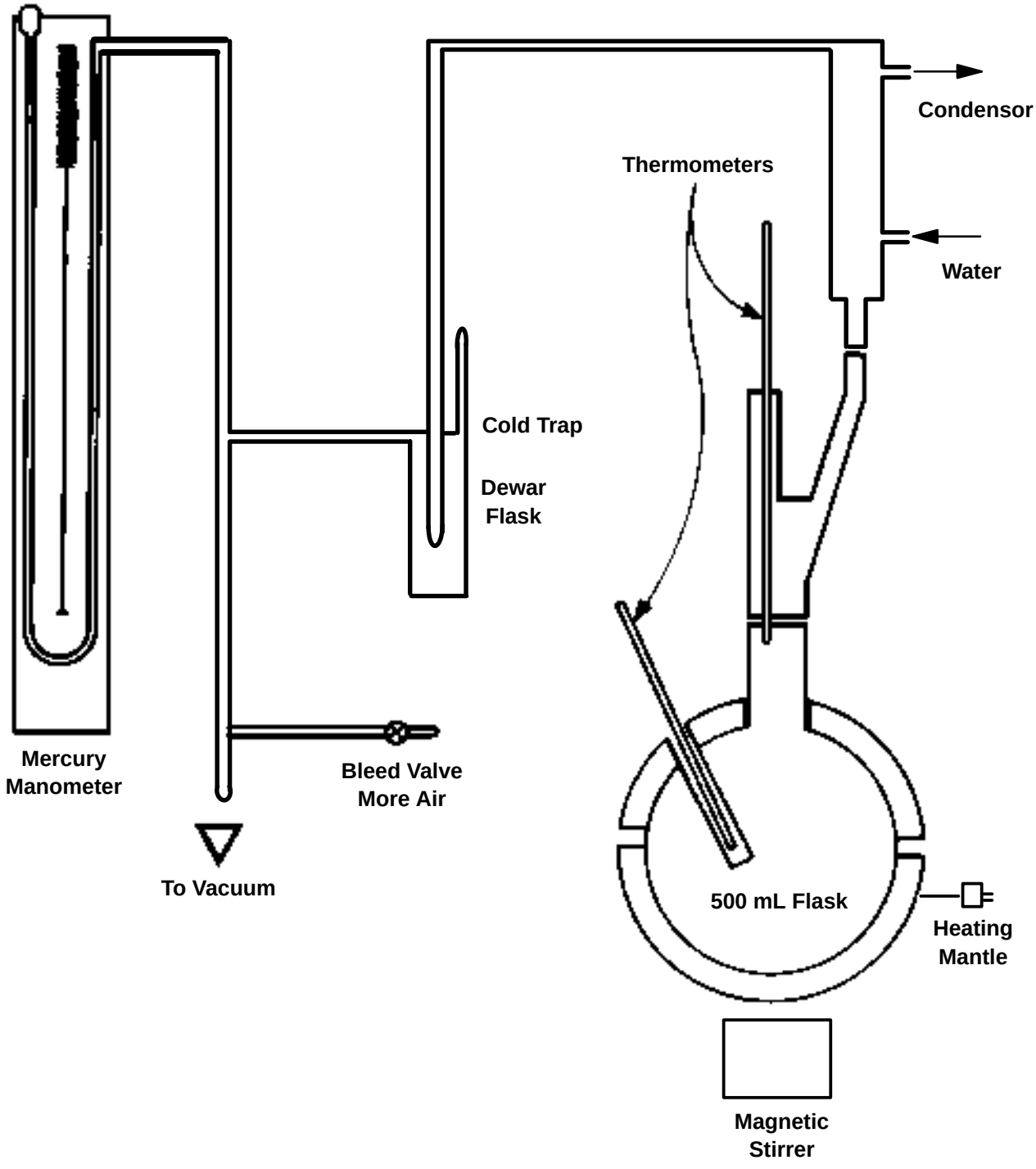

FIGURE A2. Vapor pressure reading – distillation method.

A30.4 Calculations

A30.4.1 Report of results

a. Plot on semilog paper the reciprocal of absolute temperature on the abscissa versus the log of vapor pressure in psi on the ordinate for each boiling point.

b. Draw a smooth curve through the boiling points obtained, and extend the lines slightly at each end.

c. Report the results of corrected vapor pressure as determined by the vapor reflux method from the prepared graph at desired temperature.

APPENDIX B

ALCOR MARK 8A TUBE DEPOSIT RATER MODIFICATIONS

B10. SCOPE

B10.1 This appendix gives instructions for the modification of the Alcor Mark 8A Tube Deposit Rater (TDR) so that accurate measurements of the Delta Spun TDR ratings can be obtained.

B20. SUMMARY

B20.1 JFTOT heater tubes often have a pretest Spun TDR rating of zero or below when rated with the Mark 8A TDR in accordance with *ASTM D3241*. This occurs because the surface finish of the heater tube test section is difficult to control and new heater tubes have pretest ratings which range from about –5 TDR units to about +5 TDR units. To compensate accurately for differences in the pretest ratings of the JFTOT heater tubes, the pretest rating is subtracted from the post test rating to obtain the Delta Spun TDR rating. However, the production model of the Mark 8A TDR cannot rate tubes below the 0 TDR level since the range of the meter is 0 to +50 TDR units. Accurate positive and negative TDR values can be obtained when the original meter is replaced with a digital millivolt meter that can read both positive and negative voltages. (NOTE: If the modification instructions given below are followed, 1 millivolt (mv) will equal 1 TDR unit.) This appendix gives the instructions necessary to make this change.

B30. APPARATUS

B30.1 Alcor Mark 8A Tube Deposit Rater in accordance with *ASTM D3241*. Alcor Inc., 10130 Jones Maltsberger Road, PO Box 32516, San Antonio TX 78284.

B30.2 Digital millivolt meter with a minimum scale range of ±50 mv and a minimum accuracy of ±2 percent at 50 mv. The digital millivolt meter must have its own internal power supply that is compatible with available AC power. A suitable meter is the Simpson Model 2850, PN 22984, with a range of ±199.9 mv and input power requirements of 120/240 vac, 50 to 400 Hz.

B30.3 A 1000 ohm resistor, $^1/_4$ watt (required for Option 2, below).

B30.4 Suitable electrical wiring, connectors, and other hardware to connect electrically the digital millivolt meter to the Mark 8A TDR and, if desired, to attach physically the digital millivolt meter to the Mark 8A TDR.

B40. PROCEDURE

B40.1 Option 1. Leave the Existing Meter in Place. This option will enable the use of the TDR with either the existing meter or with the digital millivolt meter, but not concurrently. The two meters will not give identical readings; therefore, the TDR must be calibrated using the meter selected for use.

B40.1.1 Connect the digital millivolt meter in parallel with the existing meter. It may be necessary to drill holes in the TDR case to bring out electrical leads from the existing meter terminals to the digital millivolt meter. The 1000–ohm resistor is not used with this option. To avoid confusion, It is suggested that the face of the existing meter be covered when the digital millivolt meter is used.

B40.2 Option 2. Replace the Existing Meter. This option is recommended, as there will be a small but significant difference in the readings of the digital millivolt meter and the existing meter when Option 1 is used. Confusion could arise with both meters operational.

B40.2.1 Remove the existing meter from the Mark 8A TDR. Connect the 1000–ohm resistor between the two leads that were connected to the existing meter. Connect the digital millivolt meter in parallel with the 1000–ohm resistor. With the existing meter removed, leads from the TDR to the digital millivolt meter can be brought out through the front of the TDR, as there will be a 2–inch–diameter hole where the meter was located. If the digital millivolt meter gives negative readings during calibration, reverse the leads which lead to the digital millivolt meter.

B40.3 It may be possible to find a suitable digital millivolt meter that can be installed within the TDR case in lieu of the original meter. However, most digital millivolt meters are considerably deeper than the original TDR meter and there may not be sufficient room to accommodate the new meter within the TDR case. It may be possible, however, to obtain digital meters which have a detachable display that could be mounted on the front of the TDR with the remainder of the digital meter located within the TDR case (if there is room) or attached to the side or back of the TDR.

B40.4 Some users may want to connect the AC power input to the digital meter through the TDR on–off switch.

B50. CALIBRATION

B50.1 The calibration procedure for the digital millivolt meter is the same as for the original meter. The Low Cal and the High Cal controls are used to adjust the meter readings to agree with the calibration tube ratings as before. Note the greater sensitivity of the digital millivolt meter may cause some jitter, but this should only be in the tenth of a millivolt (i.e., TDR unit) range.

B60. OPERATION

B60.1 Mark 8A Tube Deposit Rating Methods. See *ASTM D3241*, paragraph 9.2.

B60.2 Delta Spun TDR. With the digital millivolt meter, negative TDR readings are possible and the sign (i.e., plus [+] or minus [–]) of the TDR rating must be recorded as well as the TDR value. The pretest rating must be algebraically subtracted from the post test rating to obtain the Delta Spun TDR rating. The Delta Spun TDR shall be determined along the length of the JFTOT tube from position 14 to position 56 at 2–mm increments. The largest value shall be reported.

APPENDIX C

REFLUX VAPOR PRESSURE TEST

C10. SCOPE

This procedure is applicable for pure compounds and narrow boiling range hydrocarbon liquids. It is recommended the test be limited to fluids which exhibit no greater than 70′ C difference between the *ASTM D86* IBP and FBP.

C20. APPLICABLE DOCUMENTS

MIL–T–38219A, Appendix C, “Vapor Pressure Test”

C30. SUMMARY OF METHOD

Three hundred mL of material are heated in a 500–mL Pyrex flask that is constructed to provide magnetic stirring, liquid and vapor temperature observation, and ground glass fitting, for attachment to a condenser. The fuel is outgassed by vacuum at ambient temperature for a minimum of 10 minutes. Pressure of the system is set by means of the Whitey micro bleed valve while vacuum is maintained on the system. Heat is applied to the Pyrex fuel container while constant pressure is maintained and the fuel stirred magnetically. After the fuel begins to boil, the height of the fuel reflux in the condenser is observed and care taken to maintain a constant reflux height during the entire test procedure. The reflux rate is considered to be at equilibrium when the vapor temperature and the liquid temperature agree within 4′ C. The pressure and the indicated temperatures of liquid and vapor are recorded at each pressure point selected during the run. Higher pressure determinations are made by opening the bleed valve in selected increments and increasing the applied heat. A minimum of four stable reflux conditions (boiling points) are obtained and plotted on semilog paper—the reciprocal of absolute temperature on the abscissa versus the logarithm of vapor pressure in psi on the ordinate for each boiling point.

C40. REAGENTS AND MATERIALS

The following are reagents and materials used to perform the reflux vapor pressure test:

Vacuum grease used to seal ground glass joints and seat rubber stoppers

Note: Silicone grease has been shown to cause foaming during post test distillations of some fuels.

Acetone, reagent grade, to clean glassware.

C50. APPARATUS

The following apparatus are used to perform the reflux vapor pressure test:

Vacuum system able to attain 0.01 psia

Variable AC voltage transformer, VWR Catalog No. 62546–251 or equivalent

Magnetic stirrer, Teflon–coated magnetic stirring bar. One–half–inch StarHead magnetic stir bars are satisfactory.

Heating mantle, Glas–Col 500 mL or equivalent

Flask, 500 mL, Pyrex round bottom, short neck standard taper joint 24/40 with thermometer well, VWR Catalog No. 29129–428 or equivalent

Tube, connecting, three way, joints 24/40. Upper ends have outer joints and bottom has inner member joint. VWR Catalog No. 62960–024 or equivalent

Condenser, Liebig, Pyrex, 41–mm OD × 300–mm long with 24/40 joint at bottom. VWR Catalog No. 23122–000 or equivalent

Rubber tubing, vacuum and medium wall

Bleed valve, $^{1}/_{4}$–inch, Whitey Micro Metering, Catalog No. 22RS4 or equivalent

Trap, vacuum, separable, joint 29/42; VNVR Catalog No. 55096–100 or equivalent

Dewar flask, vacuum, flask large enough to accommodate the vacuum trap and cooling medium

Neoprene stoppers, green, solid No. 5 and No. 4, VWR Catalog No. 59589–212 and 59589–198 or equivalent. The No. 5 and the No. 4 neoprene stoppers must be drilled with holes to permit passage of $^{3}/_{32}$–inch OD probe through the No. 5 stopper and $^{1}/_{4}$–inch OD tubing through the No. 4 stopper.

Thermocouples, Chromel–Alumel, calibrated, $^{3}/_{32}$–inch diameter, SS sheathed, closed end. Thermocouple probe 10–inch long with 6–foot lead wire

Omega Digicator or equivalent, for thermocouple temperature read–out

Transducer, 0 to 15 psia, transducer housing to be equipped with threaded fitting compatible with $^{1}/_{4}$–inch Swagelok hardware.

Digital pressure readout system, Anadex Model DPM–735–V1–A115, or equivalent

Refrigerated cooling bath, Endocal Model RTE–5B or equivalent.

C60. SAMPLE

The sample will be prepared as follows:

1. Transfer 600 mL of the sample into a clean, 1000–mL separatory funnel.
2. Cap the funnel top.
3. Shake the funnel for 1 to 2 minutes.
4. Allow contents to settle for 15 to 20 minutes.
2. Draw off lower 100 mL of fuel and discard.

APPENDIX C

C70. PREPARATION OF APPARATUS

Preparation of the apparatus includes the following steps:

1. Assemble the apparatus as shown on figure C1.

2. Place 300 mL of the prepared sample and a magnetic stir bar in the 500–mL flask.

3. Place ice around the vacuum trap in the Dewar flask.

4. Position the vapor phase thermocouple through the No. 5 stopper so the probe tip is centered and even with the top rim of the 24/40 joint of the 500–mL flask.

5. Place the liquid phase thermocouple in the flask thermometer well and add 5 mL of high–flashpoint oil to the well.

6. Begin the stirring action with the magnetic stirrer set at a high speed. Open the micrometer bleed valve and slowly engage the vacuum. If the vacuum system is opened too rapidly, the fuel may bump up into the condenser. Begin to close the bleed valve as the system pressure decreases. When the bleed valve is completely closed, continue the fuel outgassing for a period of 10 minutes.

C80. PROCEDURE

The following steps are to be performed for the reflux vapor pressure test:

1. Decrease the magnetic stirrer speed to a rate such that only a small vortex is noted in the fuel.

2. Slowly raise the system pressure to 1.5 psia using the micrometer bleed valve and the flask temperature by use of the variable transformer control.

3. Adjust the heat input and stirring speed to preclude violent boiling of the fuel which would cause bumping.

4. Verify pressure and temperature are properly adjusted; this ensures a steady reflux action of the fuel. The height of the reflux can be noted in the bottom section of the condenser. Condenser temperature of 15′ C (60′ F) has been found to be satisfactory. Condenser temperature is controlled by adjusting the refrigerated cooling bath temperature controller.

5. When refluxing is equilibrated, observe the liquid and vapor phase temperatures displayed by the Omega Digicator and the pressure reading displayed by the Anadex pressure module.

6. If the two temperatures do not agree within 4′ C, change the system pressure by means of the bleed valve, increase the temperature, and repeat temperature–pressure measurements until stable reflux conditions are reached.

7. Ensure stable reflux conditions are such that the temperature, pressure, and fuel reflux height do not change on three successive readings at 3–minute intervals.

8. Raise the system pressure, increase the temperature, and repeat the temperature–pressure measurements over the entire pressure range up to atmospheric pressure. A minimum of four stable reflux conditions (boiling points) will be obtained.

9. Record the temperature of the liquid, temperature of the vapor, and pressure of the system at stable reflux conditions.

10. Allow the fuel to cool to ambient temperature and pressure.

11. Remove sufficient fuel from the flask and run a distillation test as specified by *ASTM D86*. Results will agree within the prescribed limits with those obtained previous to the run or the test results will be discarded. If a significant increase in the IBP is observed between pretest and post test distillations, this indicates the probability that some loss in lighter ends has occurred and caused errors in vapor pressure determinations.

C90. CALCULATIONS

Calculations are to be performed as follow:

1. Plot on semilog paper the reciprocal of absolute temperature on the abscissa versus the logarithm of vapor pressure in psi on the ordinate for each boiling point.

2. Draw a smooth curve through the boiling points obtained, extending the lines slightly at each end.

3. Report the results of vapor pressure as determined by the vapor reflux method from the prepared graph at desired temperatures.

NOTE: An alternate method of plotting the vapor pressure as a function of temperature has been found to be satisfactory. Use three–cycle semilog paper to plot the temperature (′F) on the abscissa and the logarithm of pressure (psia) on the ordinate for each boiling point. A smooth curve can be drawn through these points.

APPENDIX C

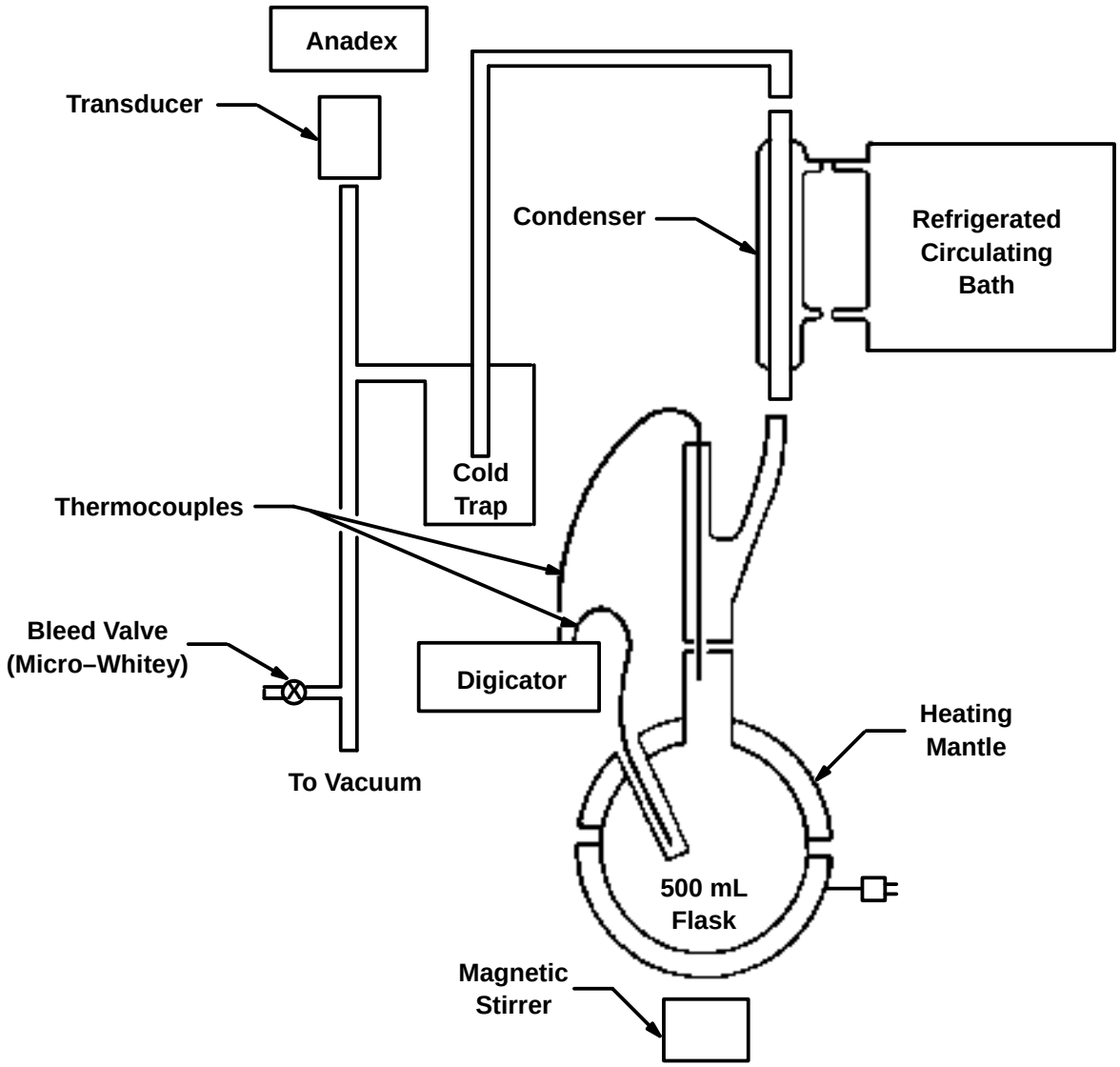

FIGURE C1. Vapor pressure apparatus reflux method.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

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

TURBINE FUEL, LOW VOLATILITY, JP–7

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

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