Designation: D 5968 – 01

An American National Standard

Standard Test Method for Evaluation of Corrosiveness of Diesel Engine Oil at 121°C[1]

This standard is issued under the fixed designation D 5968; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

The method described in this test method is based on the gas turbine lubricant corrosion and oxidation test described in Federal Test Method Standard 791, Method 5308. Because this test method relates to corrosion in diesel engines rather than in gas turbines, temperatures, metal coupons, and certain parts of the test procedure were modified to be more appropriate for heavy duty diesel engines.

The method described in this test method can be used by any properly equipped laboratory, without outside assistance. However, the ASTM Test Monitoring Center (TMC)[2] provides reference oils and an assessment of the test results obtained on those oils by the laboratory (see Annex A1). By these means, the laboratory will know whether their use of the test method gives results statistically similar to those obtained by other laboratories. Furthermore, various agencies require that a laboratory utilize the TMC services in seeking qualification of oils against specifications. For example, the U.S. Army imposes such a requirement in connection with several Army engine lubricating oil specifications.

Accordingly, this test method is written for use by laboratories that utilize the TMC services. Laboratories that choose not to use those services may simply ignore those portions of the test method that refer to the TMC.

This test method may be modified by means of Information Letters issued by the TMC. In addition, the TMC may issue supplementary memoranda related to the method (see Annex A1). For other information, refer to the research report on the Cummins Bench Corrosion Test.[3]

1. Scope

1.1 This test method is used to test diesel engine lubricants to determine their tendency to corrode various metals, specifically alloys of lead and copper commonly used in cam followers and bearings. Correlation with field experience has been established.[4]

1.2 The values stated in acceptable SI units are to be regarded as the standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific hazard statements are given in 5.3.1, 6.6, 6.7, 6.8, 6.9, 6.10, 6.11, 7.1.1, 7.1.2, 7.1.5, and 7.4.1.

2. Referenced Documents

2.1 *ASTM Standards:*

D 130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test[5]

D 4636 Test Method for Corrosiveness and Oxidation Stability of Hydraulic Oils, Aircraft Turbine Engine Lubricants, and Other Highly Refined Oils[6]

D 5185 Determination of Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oils and Determination of Selected Elements in Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)[6]

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[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.B0.02 on Heavy Duty Engine Oils.

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[2] ASTM Test Monitoring Center, 6555 Penn Ave., Pittsburgh, PA 15206-4489, Telephone: (412) 365-1000, Fax: (412) 365-1045 (reference oil test telephone reports), Fax: (412) 365-1047 (other messages), Telephone Oil Assignments: (412) 365-1004.

[3] Available from ASTM International Headquarters. Request RR:D02-1322. The research report and this test method are supplemented by Information Letters and Memoranda issued by the ASTM Test Monitoring Center. This edition incorporates revisions contained in all information letters through No. 01–1. Users of this test method shall contact the ASTM Test Monitoring Center to obtain the most recent of these.

[4] Wang, J. C., and Cusano, C. M., "Development of A Bench Test to Detect Oils Corrosive to Engine Components," SAE Technical Paper No. 940790, 1994.

[5] *Annual Book of ASTM Standards*, Vol 05.01.

[6] *Annual Book of ASTM Standards*, Vol 05.02.

E 691 Practice for Conducting an Inter-Laboratory Study to Determine the Precision of a Test Method[7]

2.2 *U.S. Federal Test Method Standards:*[8]

Federal Test Method Standard 791, Method 5308.7 Corrosiveness and Oxidation Stability of Light Oils (Metal Squares)

3. Summary of Test Method

3.1 Four metal coupons of copper, lead, tin, and phosphor bronze are immersed in a measured amount of engine oil. The oil, at an elevated temperature, is blown with air for a period of time. When the test is completed, the coupons and the stressed oil are examined to detect corrosion.

3.2 An industrial reference oil is tested with each group of tests to verify test acceptability.

4. Significance and Use

4.1 This test method is intended to simulate the corrosion process of non-ferrous metals in diesel lubricants. The corrosion process under investigation is that believed to be induced primarily by inappropriate lubricant chemistry rather than lubricant degradation or contamination. This test method has been found to correlate with an extensive fleet database containing corrosion-induced cam and bearing failures.

5. Apparatus

5.1 The main apparatus consists of the following items of standard wall borosilicate glassware as shown in Figs. 1-6.

[7] *Annual Book of ASTM Standards*, Vol 14.02.

[8] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, Attn: NPODS.

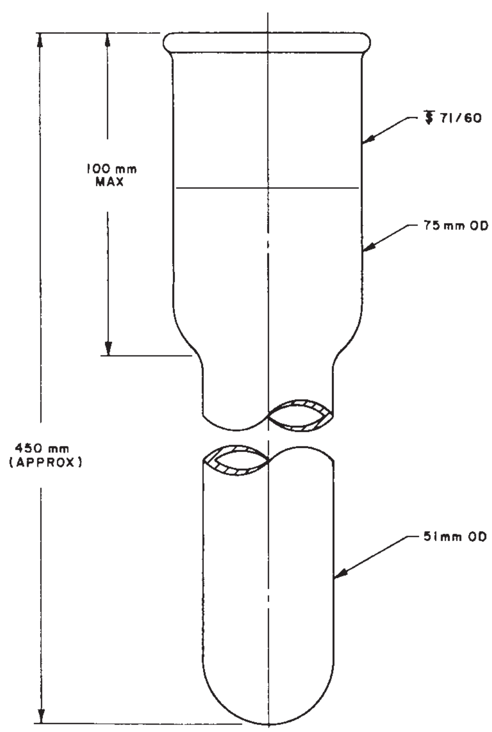

FIG. 1 Sample Tube

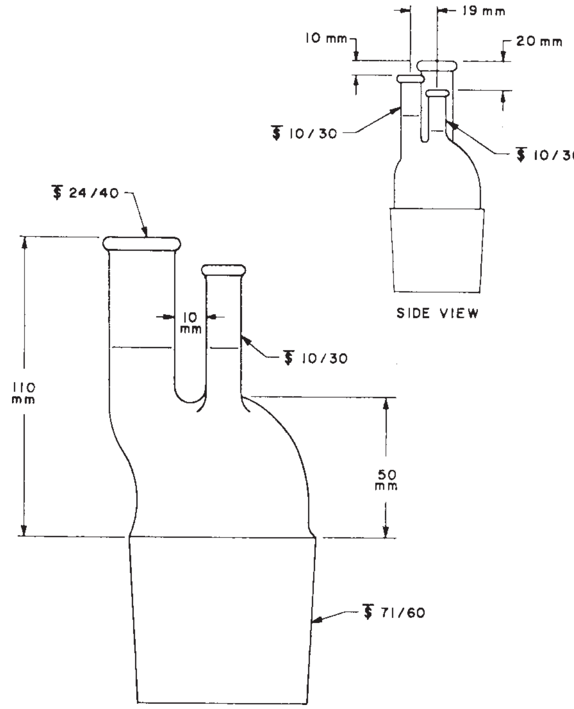

FIG. 2 Sample Tube Head

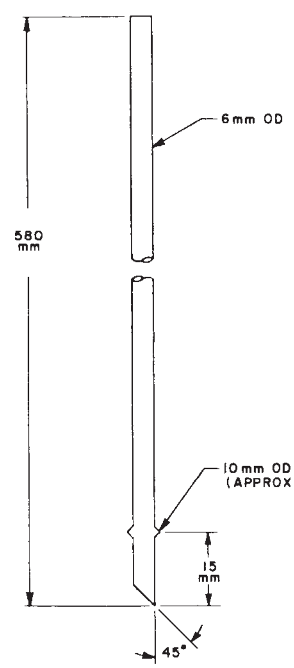

FIG. 3 Air Tube

5.1.1 *Main Sample Tube*, Fig. 1.

5.1.2 *Sample Tube Head*, Fig. 2.

5.1.3 *Air Tube*, Fig. 3.

5.1.4 *Thermocouple Tube*, Fig. 4.

5.1.5 *Condenser, Allihn Type*, Fig. 5.

5.1.6 *Assembled Apparatus*, Fig. 6.

5.2 Additional glassware items and assembly accessories needed are:

5.2.1 *Spacers (for metal specimen)*, of borosilicate glass, standard wall, 9-mm outside diameter, 6-mm length.

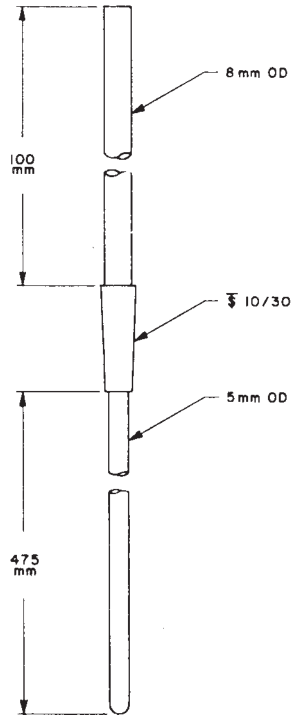

FIG. 4 Thermocouple Tube

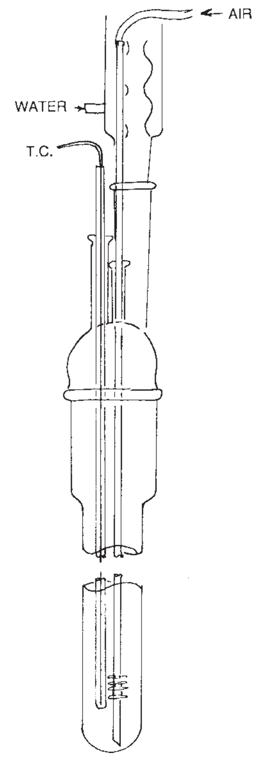

FIG. 6 Assembled Apparatus

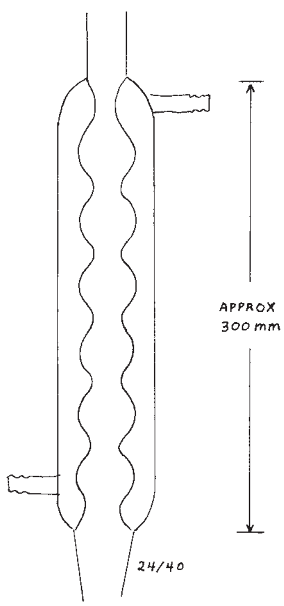

FIG. 5 Condenser, Allihn Type

5.2.2 *Oil Sampling Tube, Borosilicate Glass*, 4-mm outside diameter, with sampling end approximately 600 mm to reach into main sample tube. Tube is bent U-shape with exit end fitted by a one-hole stopper to a 25-mL filtering flask. Exit end may be any convenient length.

5.2.3 *Adapter*, [9,10] Polytetrafluoroethylene for 10/18 joint for sealing of air tube to sample tube head.

5.3 Other items and equipment are:

5.3.1 *Heating Bath*, constant temperature control within ±0.5°C (±1°F) of test temperature with an immersion depth of 250 ± 20 mm. Oil or aluminum baths are recommended. (**Warning**—There are exposed hot surfaces on apparatus. Avoid skin contact by use of protective equipment.)

5.3.2 *Hood Ventilation*, to adequately remove fumes during heating.

5.3.3 *Air Supply*, dry air, with a dew point of − 68°C (−90°F) maximum and free of reactive contaminants.

5.3.4 *Flowmeter*, capable of measuring 10 ± 1 L/h.

5.3.5 *Balance*, analytical sensitivity 0.1 mg.

5.3.6 *Balance, Laboratory*, 2500-g capacity, 0.1-g sensitivity.

5.3.7 *Microscope*, with 20-diameter magnification.

5.3.8 *Assembly Fixture*, wood slotted to hold coupons squares (assembly as shown in Fig. 7) for tying with wire.

5.3.9 When air needs to be conditioned there is a need for an air drier. The method used is optional provided the air characteristics of 5.3.3 are attained. For drying, a satisfactory method is the use of a glass column containing 8-mesh anhydrous calcium sulfate with a column diameter such that velocity of air does not exceed 1.2 m/min.

5.3.10 *Oven*, optional, to dry glassware at elevated temperature.

5.3.11 *Forceps*, stainless steel.

5.3.12 *Thermocouple*.

[9] A satisfactory source for this item is Kontes Glass Co., Vineland, NJ 08360.

[10] The sole source of supply of the apparatus known to the committee at this time is noted in the adjoining footnote. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

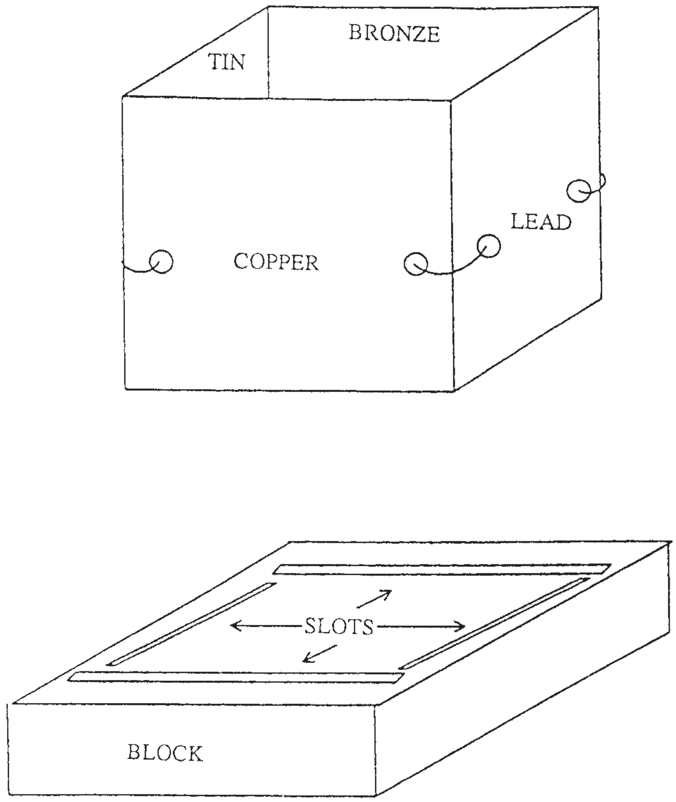

FIG. 7 Arrangement of Metal Coupons

5.3.13 *Brush*, short-bristled, stiff (old-style typewriter cleaning brush or equivalent).

6. Reagents and Materials

6.1 *Purity of Reagents*—Use reagent grade chemicals in all tests. Unless otherwise indicated it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.[11]

6.2 *Metal Specimens:* [10,12]

6.2.1 Coupons, 0.081 cm thick by 2.5 cm square, one each, with two drilled holes (as shown in Fig. 7), as follows:

6.2.1.1 Copper (R401-A),

6.2.1.2 Lead (R401-lead),

6.2.1.3 Tin (R401-tin), and

6.2.1.4 Phosphor Bronze (R401-LEADz).

6.3 *Nichrome Wire*, clean (for tying coupons together).

6.4 *Abrasive Paper*, 240 grit aluminum oxide and 400 grit silicon-carbide.[13] Do not use iron-containing abrasives such as natural emery.

6.5 *Cotton*, absorbent.

6.6 *Acetone* (ACS), sulfur-free. (**Warning**—Flammable. Health hazard.

6.7 *Degreasing Solvents*, Trichlorotrifluorethane or 1,1,1-trichloroethane. (**Warning**—Harmful if inhaled.)

6.8 *Glassware Cleaning Solution*, mix 35 mL of saturated sodium dichromate (aqueous) solution and 1000 mL of concentrated sulfuric acid. (**Warning**—Causes severe burns.)

6.9 *Carbon Remover for Glassware*, [10,14] Oakite Stripper R-8. (**Warning**—Corrosive, causes severe burns.)

6.10 *Tetrahydrofuran*. (**Warning**—Toxic and flammable. Health hazard.)

6.11 *Naphtha, Aromatic*. (**Warning**—Flammable. Health hazard.)

6.12 *Filter Paper*.

6.13 *Kimwipe Tissues*, or similar.

6.14 *Industrial Reference Oil*.[2]

7. Preparation of Apparatus

7.1 *Cleaning of Glassware from Previous Run*:

7.1.1 Rinse all glassware items and the air tube adapter with degreasing solvent to remove residual oil, and air dry. (**Warning**—Harmful if inhaled.)

7.1.2 Fill or immerse the sample tube, air tube, and the 9-mm glass spacers in carbon remover at room temperature until carbonaceous deposits are removed. Water rinse after removal. (**Warning**—Corrosive, causes severe burns.)

7.1.3 Wash all glassware items and the air tube adapter with detergent.[10,15] Rinse with water to remove detergent, and dry.

7.1.4 Store all items in a dust free cabinet until needed for test. If stored longer than one week, rinse again with distilled water before use, and dry.

7.1.5 A more elaborate glass cleaning procedure can be used, if it is for a given situation. This cleaning procedure is necessary in a referee situation unless a cleaning solution can be used which is satisfactory to all parties involved. Fill and immerse all glassware items with glassware cleaning solution and soak for 3 to 16 h. (**Warning**—Corrosive, causes severe burns.)

7.1.6 Remove glassware from cleaning solution, rinse several times with tap water, followed by distilled water, and oven dry.

7.2 *Cleaning of Glassware (New)*:

7.2.1 Proceed as in 7.1.3 and 7.1.6 in that order (omit 7.1.1, 7.1.2, 7.1.4, and 7.1.5).

7.3 *Assembly*—Assemble as shown in Fig. 6 using only the test oil to lubricate glass joints during assembly.

7.4 *Preparation of Metal Specimens*:

7.4.1 Wash a length of the metal tying wire with tetrahydrofuran and acetone and allow to dry. (**Warning**—This and the following preparation processes should be performed under a fume hood.)

7.4.2 The metal squares are prepared as follows:

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[11] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

[12] Satisfactory metal specimens may be obtained from: Test Engineering, Inc. (TEI), 12718 Cimarron Path, San Antonio, TX 78249-3423. This is the only coupon source to be used for obtaining a valid reference run and data for certification.

[13] Suitable abrasive paper meeting these specifications is included with the metal coupons from the source indicated in 6.2.

[14] Oakite Stripper R-8 is available from Oakite Products, Inc., 50 Valley Rd., Berkeley Heights, NJ 07922. It has been found satisfactory for this purpose.

[15] A detergent found satisfactory is Alconox made by Alconox, Inc., 215 Park Ave. S., New York, NY 10003.

7.4.2.1 Using the 240 grit abrasive paper, remove all surface blemishes from both sides and all four edges of each square, and any burrs from the drilled holes. Finish polishing with 400 grit paper wetted by acetone to remove marks from previous polishing. A good technique is to place abrasive paper on a flat surface, then rub the specimen with longitudinal strokes in a direction perpendicular to that used with 240 grit paper. Use a different sheet of paper for each metal type.

7.4.2.2 In all succeeding steps, handle the squares only with tongs or filter paper until the final weighing. If large defects or particles are present on the metal coupons, course sand paper should be used first to remove them; this is followed by polishing with the 240 and 400 grit abrasive paper.

(1) Store the polished metal coupon in tetrahydrofuran and proceed until all coupons are polished.

(2) Remove each square from the tetrahydrofuran, clean all metal dust from the square by rubbing vigorously with clean pads of absorbent cotton until a fresh pad remains unsoiled.

(3) Wash squares in tetrahydrofuran and allow them to dry in a dessicator.

(4) Immediately weigh each square to within 0.1 mg.

(5) Arrange all squares in the wooden assembly fixture in the pattern shown in Fig. 7. The sequence should be: lead, copper, tin, phosphor bronze.

7.4.2.3 Using only forceps to handle the clean wire, tie the squares together as shown in Fig. 7.

8. Procedure

8.1 *Preparation for New Test Set-Up for Reference Oil and Test Oils*:

8.1.1 Insert the tied coupons in the test tube, positioning the squares vertically (so that the air tube can be inserted to touch the bottom of the test tube). Weigh the air tube, test tube, and contents together to within 0.1 g.

8.1.2 Add 100 ± 1 mL of oil to the test tube, reweigh the air tube, test tubes, and contents together to within 0.1 g, and determine the weight of oil added.

8.1.3 Assemble the test tube and condenser and mount the assembly so that 30 ± 5 cm of test tube is submerged in the bath with the sample operating at a temperature of 121 ± 0.5°C.

8.1.4 Start the flow of cooling water through the condenser jacket.

8.1.5 Insert the air tube (orifice-end down) through the condenser and into the oil sample and support it so that its orifice is within 0.3 cm of the bottom of the tubes.

8.2 To begin testing connect the source of clean, dry air (5 ± 0.5 L/h) to the air tube and allow the air to flow for 168 h.

8.3 *End of Test*—After 168 h at 121°C, shut off the air-flow, disassemble, and check test setup as follows:

8.3.1 Remove air supply and disconnect condenser.

8.3.2 Remove test tube from the constant-temperature bath, allow it to cool, and wipe off the outside of the tube with a naphtha-dampened cloth.

8.3.3 Re-weigh the air tube, test tube, and contents to within 0.1 g, determine weight of oil sample remaining, and compute the percentage of weight loss resulting from evaporation of oil (see 10.1). If the evaporation loss is greater than 8 %, leakage is present. Correct the leak, and repeat the determination, using fresh oil sample and new coupons.

8.3.4 Using forceps, withdraw the coupons from the test tube, and remove the wire holding them together. (Retain the test tube and sample for further examination).

8.4 *Preparing Squares for Examination*:

8.4.1 Using forceps, wash each square individually in tetrahydrofuran.

8.4.2 Repeat the washing, using fresh tetrahydrofuran, scrubbing the squares with the short-bristled brush until the tetrahydrofuran shows no additional discoloration. Use a piece of Kimwipe, dampened with acetone, to rub and wipe the coupons repeatedly until the tissue remains clean after wiping. Allow the squares to air-dry. The reaction products that are to be removed by this cleaning process may tend to have a stronger affinity to the bronze material, and therefore may be more difficult to remove from the bronze coupon. Improper removal of the reaction products from the coupons may result in inaccurate weight change measurements. With the bronze coupon, brushing may need to be more vigorous to remove the reaction products, but care must be taken not to scrub to the point where any of the coupon surfaces are being polished or abraded.

8.5 *Examining Each Square*:

8.5.1 Re-weigh each square to the nearest 0.1 mg and compute (in mg/cm^2 of surface) the change in weight of each square (see 10.2).

8.5.2 Rate both sides of the copper coupon according to Test Method D 130, and note the color of any stains present on the copper and bronze squares.

8.6 *Examining the New Oil and the Oil Sample in the Test Tube*:

8.6.1 Immediately after calibration of the ICP-AES instrument (as specified in Test Method D 5185), use Test Method D 5185 to determine, in duplicate, the concentration of copper, lead, and tin in both the new and used oil.

9. Reference Oil Testing

9.1 Test a TMC-coded reference oil along with each batch of non-reference oil tests. Run the reference oil simultaneously with, and in the same bath as, the non-reference oils.

NOTE 1—Annex A1 discusses the involvement of the ASTM TMC with respect to the reference test monitoring program.

9.1.1 Prior to requiring a reference oil test, procure a supply of reference oils directly from the TMC. These oils have been formulated or selected to represent specific chemistry types, or performance levels, or both. Each reference oil sample is identified using a unique set of identification codes on the container labels. The coded reference samples provide for a blind reference testing program to protect against the possibility of bias in the results.

9.1.1.1 The testing laboratory tacitly agrees to use the TMC reference oils exclusively in accordance with the TMC's published Policies for Use and Analysis of ASTM Reference Oils, and to run and report the reference oil test according to TMC guidelines.

NOTE 2—Policies for the Use and Analysis of ASTM Reference Oils is available from the TMC.

9.1.2 Request a reference oil assignment from the TMC for the CBT Test. The TMC shall determine the specific reference oil to be tested by the laboratory. Assignments shall be made by the TMC using the unique identifying codes on the reference oil container labels. Provide the TMC with the bath identification number for the test.

9.1.3 Run the TMC reference oil test according to the procedure and in the same manner as the non-reference oil test(s).

9.1.4 *Reporting of Reference Oil Test Results*—Report the results of all reference oil tests to the TMC according to the following directives:

9.1.4.1 Use the data reporting formats detailed in Annex A2 (see Figs. A2.1 through A2.4) for reporting all TMC reference oil test data to the TMC. Report only the reference oil results to the TMC; do not include any non-reference test data. Complete all of the required blank fields on the forms.

9.1.4.2 Transmit reference test data by electronic means, or by telephone facsimile, to the TMC immediately upon completion of the test analysis. Include all of the reporting forms in the transmission.

NOTE 3—Specific protocols for the electronic transmission of test data to the TMC are available from the TMC.

9.1.4.3 In addition to the transmitted data, send by mail or other courier one copy of the completed standard final reference test report to the TMC. The signatory line on the mailed Final Report Cover Sheet (Fig. A2.1) requires an original signature by an authorized representative of the testing laboratory. This signature is not to be a copy or mechanically reproduced. The signature affirms the statements made in the affidavit on the Final Report Cover Sheet. Mail the final test report so that it is received at the TMC within 30 days from the test completion date.

9.1.5 *Evaluation of Reference Test Oil Results*—Upon receipt of the transmitted TMC reference oil test results, the TMC shall review the test for operational adherence to the published procedure. If the test is found to be operationally valid, the reference oil results shall be evaluated using acceptance criteria established by the governing surveillance panel. The reference oil acceptance criteria are subject to change at the discretion of the surveillance panel.

9.1.5.1 If the transmitted test is found to be both operationally valid and statistically acceptable the testing laboratory will be notified of the acceptable status of the reference test. The uncoded TMC reference oil identification will also be disclosed to the testing laboratory. The validity findings are considered preliminary until the formally signed final report of the data is received and reviewed by the TMC. Discrepancies between the initial transmitted data and the mailed final report may result in the suspension or reversal of the preliminary validity decision.

9.1.5.2 In the event that a TMC reference oil test is found to be unacceptable, an explanation of the problem relating to the failure shall be provided to the testing laboratory. If there is an obvious operational reason for the failed test, correct the problem before requesting another TMC reference oil assignment. If the reason for the fail is not obvious, recheck all test related equipment for compliance to the procedure and good laboratory practice. Following this recheck the TMC will assign another TMC reference oil for testing.

9.1.6 *Status of Non-Reference Oil Tests Relative to TMC Reference Oil Tests*—The batch of non-reference tests is considered valid only if the results of the TMC reference oil test meet the predetermined acceptance specifications for the particular reference oil tested.

10. Calculations

10.1 *Evaporation Loss*:

$$L = [(W_1 - W_2)/W_3] \times 100 \quad (1)$$

where:

L = percentage evaporation loss,
W_1 = initial weight of the air tube, test tube and contents, including oil,
W_2 = final weight of the air tube, test tube and contents, including oil, and
W_3 = initial weight of oil sample.

10.2 *Change in Metal Square Weight*:

$$M = \frac{M_2 - M_1}{2 \times (W \times Le)} \quad (2)$$

where:

M = change in metal weight per surface area, mg/cm^2,
M_1 = final weight, mg,
M_2 = original weight, mg,
W = width of metal square, cm, and
Le = length of metal square, cm.

10.3 *Change in Metal Concentration in the Used Oil*:

$$C = C_2 - C_1 \quad (3)$$

where:

C = change in metal concentration before and after test,
C_1 = average of the duplicate measurement of metal concentration in new oil, and
C_2 = average of the duplicate measurement of metal concentration in used oil.

10.3.1 *Correction Factor*—Apply a correction factor of 0.276 to the lead coupon batches designated by the Central Parts Distributor (CPD) with a serial number ending in "-A" or –Cx" (where x denotes a number designating the coupon batch cut). Multiply non-reference test results for change in lead (C in 10.3) by this correction factor as follows:

$$C_{\text{Lead Corrected}} = C_{\text{Lead}} \times 0.276 \quad (4)$$

where:

$C_{\text{Lead Corrected}}$ = corrected change in lead concentration, ppm, and
C_{Lead} = change in lead concentration, before and after test, ppm, as determined in 10.3.

11. Report (See Annex A2 for Report Format)

11.1 Report the raw data of the calibration and the analysis of the NIST reference oil SRM1085a.

11.2 Report concentrations of copper, lead, and tin in oil before and after adjustment based on the internal standard, and the difference (C in 10.3).

11.2.1 Report the corrected change in lead concentration ($C_{Lead\ Corrected}$ in 10.3.1), and the applied correction factor (0.276), for non-reference oils.

11.3 Report the tarnish rating of the copper coupon based on the highest rating (most corrosion) if the rating is different for either side.

11.4 Report the change in weight of each of the coupons in mg/cm^2.

12. Precision and Bias

12.1 *Precision*—The precision of the test method was determined by performing round robin tests in seven participating labs in accordance with guidelines set in Practice E 691.

12.1.1 *Lead*—Precision was established at three severity levels with 7 labs and 21 tests at each level:

Mild coupons: average 130.1 ppm	CV: 26.6 %
Severe coupons: average 370.1 ppm	CV: 13.1 %
Most severe coupons: average 387.2 ppm	CV: 9.4 %
Average 14.9 ppm (6 labs and 54 tests)	CV: 29.6 %

12.1.2 *Copper*:

NOTE 4—CV is the coefficient of variance and is obtained by the following equation:

$$CV = \frac{\text{Reproducibility Standard Deviation}}{\text{Average}} \quad (5)$$

where:
Reproducibility Standard Deviation is defined in Practice E 691.

13. Keywords

13.1 corrosion; diesel engines; lubricants; wear

ANNEXES

(Mandatory Information)

A1. THE ROLE OF THE ASTM TEST MONITORING CENTER AND THE CALIBRATION PROGRAM

A1.1 *Nature and Functions of the ASTM Test Monitoring Center (TMC):*

A1.1.1 The ASTM TMC[2] is a non-profit organization located in Pittsburgh, Pennsylvania. TMC is staffed to administer engineering studies, conduct laboratory visits, perform statistical analyses of reference oil test data, blend, store, and ship reference oils, and provide the associated administrative functions to maintain the referencing calibration program for various lubricant tests as directed by Subcommittee D02.B and the Test Monitoring Board. The TMC coordinates its activities with the test sponsors, the test developers, the surveillance panels, and the testing laboratories.

A1.2 *Rules of Operation of the ASTM TMC:*

A1.2.1 The TMC operates in accordance with the ASTM Charter, the ASTM Bylaws, the Regulations Governing ASTM Technical Committees, the Bylaws Governing ASTM Committee D02, and the Rules and Regulations Governing the ASTM Test Monitoring System.

A1.3 *Management of the ASTM TMC:*

A1.3.1 The management of the Test Monitoring System is vested in the Test Monitoring Board (TMB) elected by Subcommittee D02.B. The TMB selects the TMC Administrator who is responsible for directing the activities of the TMC staff.

A1.4 *Operating Income of the ASTM TMC:*

A1.4.1 The TMC operating income is obtained from fees levied on the reference oils supplied and on the calibration tests conducted. Fee schedules are established and reviewed by Subcommittee D02.B.

A1.5 *Conducting a Reference Oil Test:*

A1.5.1 For those laboratories which choose to utilize the services of the ASTM TMC in maintaining calibration of test methods, calibration testing must be conducted at regular intervals. These tests are conducted using coded reference oils supplied by the ASTM TMC as outlined in 9.1. It is a laboratory's responsibility to maintain the calibration in accordance with the test procedure.

A1.6 *New Laboratories:*

A1.6.1 Laboratories wishing to become a part of the ASTM Test Monitoring System will be requested to conduct reference oil tests to ensure that the laboratory is using the proper testing techniques. Information concerning fees, laboratory inspection, reagents, testing practices, appropriate committee membership, and rater training can be obtained by contacting the TMC Administrator.[2]

A1.7 *Introducing New Reference Oils:*

A1.7.1 The calibrating reference oils produce various corrosion characteristics. When new reference oils are selected, member laboratories will be requested to conduct their share of tests to enable the TMC to establish the proper industry average and test acceptance limits. The ASTM D02.B02 Corrosiveness of Diesel Lubricants Surveillance Panel will require a minimum number of tests to establish the industry average and test acceptance targets for new reference oils.

A1.8 *TMC Information Letters:*

A1.8.1 Occasionally, it is necessary to change the procedure, and notify the test laboratories of the change, prior to consideration of the change by either Subcommittee D02.B on Automotive Lubricants, or committee D02 on Petroleum Products and Lubricants. In such a case, the TMC will issue an Information Letter. Subsequently, prior to each semiannual Committee D02 meeting, the accumulated Information Letters are balloted by Subcommittee D02.B. By this means, the Society due process procedures are applied to these Information Letters.

A1.8.2 The review of an Information Letter prior to its original issue will differ according to its nature. In the case of an Information Letter concerning a part number change which does not affect test results, the TMC is authorized to issue such a letter. Long-term studies by the Surveillance Panel to improve the test procedure through improved operation and hardware control may result in a recommendation to issue an Information Letter. If obvious procedural items affecting test results need immediate attention, the test sponsor and the TMC will issue an Information Letter and present the background and data to the Surveillance Panel for approval prior to the semiannual Subcommittee D02.B meeting.

A1.8.3 Authority for the issuance of Information Letters was given by the Committee on Technical Committee Operations in 1984, as follows:" COTCO recognizes that D-2 has a unique and complex situation. The use of Information Letters is approved providing each letter contains a disclaimer to the affect that such has not obtained ASTM consensus. These Information Letters should be moved to such consensus as rapidly as possible."

A1.9 *TMC Memoranda:*

A1.9.1 In addition to the aforementioned Information Letters, supplementary memoranda are issued. These are developed by the TMC, and distributed to the Corrosiveness of Diesel Lubricants Surveillance Panel and to participating laboratories. They convey such information as approvals for test parts or materials, clarification of the test procedure, notes and suggestions of the collection and analysis of special data that the TMC may request, or for any other pertinent matters having no direct effect on the test performance, results, or precision and bias.

A2. REPORT FORMAT

A2.1 Figs. A2.1-A2.6 are sample Report Formats and data dictionary information required by the TMC.

VERSION *20010118*

CONDUCTED FOR
TSTSPON1
TSTSPON2

LABVALID	V = VALID
	I = INVALID
	N = RESULTS CANNOT BE INTERPRETED AS REPRESENTATIVE OF OIL PERFORMANCE (NON-REFERENCE OIL).

Test Number			
Bath *BTHNO*	Bath Run Number: *BTHRUNNO*		Bath Position: *RBTHPOS/BTHPOS*
End of Test Date: *DTCOMP*		End of Test Time: *EOTTIME*	
Oil Code[A]: *CMIR/OILCODE*			
Formulation/Stand Code: *FORM*			
Alternate Codes:	*ALTCODE1*	*ALTCODE2*	*ALTCODE3*

In my opinion this test *OPVALID* been conducted in a valid manner in accordance with the Test Method D5968 and the appropriate amendments through the information letter system. The remarks included in the report describe the anomalies associated with this test.

[A] CMIR or non-Reference Oil Code

SUBLAB

Testing Laboratory
SUBSIGIM

Signature
SUBNAME

Typed Name
SUBTITLE

Title

FIG. A2.1 Final Report Cover Sheet

Summary of Results

Lab: *LAB*	Bath No.: *BTHNO*	Bath Run No.: *BTHRUNNO*	Bath Position: *RBTHPOS/BTHPOS*
EOT Date: *DTCOMP*		EOT Time: *EOTTIME*	
Oil Code: *CMIR/OILCODE*		Start Date: *DTSTRT*	
Formulation/Stand Code: *FORM*			
Test Length: *TESTLEN*			

TEST OIL IDENTIFICATION	
REFERENCE OIL TEST	NON-REFERENCE OIL TEST
CMIR CODE: *CMIR*	OILCODE: *OILCODE*
TMC OIL NO.: *IND*	FORMULATION/STAND CODE: *FORM*
SAE VISCOSITY: *RSAEVISC*	SAE VISCOSITY: *SAEVISC*
LAB OIL CODE: *RLABOCOD*	LAB OIL CODE: *LABOCODE*

CHANGE IN METAL CONCENTRATION (ppm)										
METAL TYPE	REFERENCE OIL TEST					NON-REFERENCE OIL TEST				
	New Oil Average (ppm)	Used Oil Average (ppm)	Change in Concentration (ppm)	Correction Factor	Corr. Avg.	New Oil Average (ppm)	Used Oil Average (ppm)	Change in Concentration (ppm)	Correction Factor	Corr. Avg.
Copper (Cu)	*RCUNA*	*RCUUA*	*RCUCMC*			*CUNA*	*CUUA*	*CUCMC*		
Lead (Pb)	*RPBNA*	*RPBUA*	*RPBCMC*	*RPBCOR*	*RPBCORA*	*PBNA*	*PBUA*	*PBCMC*	*PBCOR*	*PBCORA*
Tin (Sn)	*RSNNA*	*RSNUA*	*RSNCMC*			*SNNA*	*SNUA*	*SNCMC*		

ASTM D-130 COPPER STRIP RATING	
REFERENCE OIL TEST	NON-REFERENCE TEST
RCUSTRIP	*CUSTRIP*

METAL TYPE	REFERENCE TEST SPECIMEN		NON-REFERENCE TEST SPECIMEN BATCH I.D. NUMBER
	BATCH ID NUMBER	BATCH CODE	
Copper (Cu)	*RCUIDNO*	*REFBATCH*	*CUIDNO*
Lead (Pb)	*RPBIDNO*		*PBIDNO*
Tin (Sn)	*RSNIDNO*		*SNIDNO*
Bronze	*RBRIDNO*		*BRIDNO*

FIG. A2.2 Summary of Results

Detailed Test Results

Lab:	Bath No.: *BTHNO*	Bath Run No.: *BTHRUNNO*	Bath Position: *RBTHPOS/BTHPOS*
EOT Date: *DTCOMP*		EOT Time: *EOTTIME*	
Oil Code: *CMIR/OILCODE*		Start Date: *DTSTRT*	
Formulation/Stand Code: *FORM*			

METAL CONCENTRATION: NEW OIL						
METAL TYPE	REFERENCE OIL TEST			NON-REFERENCE OIL TEST		
	Run 1 (ppm)	Run 2 (ppm)	Average (ppm)	Run 1 (ppm)	Run 2 (ppm)	Average (ppm)
Copper (Cu)	*RCUN1*	*RCUN2*	*RCUNA*	*CUN1*	*CUN2*	*CUNA*
Lead (Pb)	*RPBN1*	*RPBN2*	*RPBNA*	*PBN1*	*PBN2*	*PBNA*
Tin (Sn)	*RSNN1*	*RSNN2*	*RSNNA*	*SNN1*	*SNN2*	*SNNA*
Internal Std.	*RISN1*	*RISN2*	*RISNA*	*ISN1*	*ISN2*	*ISNA*

METAL CONCENTRATION: USED OIL						
METAL TYPE	REFERENCE OIL TEST			NON-REFERENCE OIL TEST		
	Run 1 (ppm)	Run 2 (ppm)	Average (ppm)	Run 1 (ppm)	Run 2 (ppm)	Average (ppm)
Copper (Cu)	*RCUU1*	*RCUU2*	*RCUUA*	*CUU1*	*CUU2*	*CUUA*
Lead (Pb)	*RPBU1*	*RPBU2*	*RPBUA*	*PBU1*	*PBU2*	*PBUA*
Tin (Sn)	*RSNU1*	*RSNU2*	*RSNUA*	*SNU1*	*SNU2*	*SNUA*
Internal Std.	*RISU1*	*RISU2*	*RISUA*	*ISU1*	*ISU2*	*ISUA*

EVAPORATION LOSS (%)	
REFERENCE OIL TEST	NON-REFERENCE TEST
REVAPLOS	*EVAPLOS*

WEIGHT CHANGE OF METAL SPECIMENS:[A]		
Metal Type	REFERENCE OIL TEST	NON-REFERENCE TEST
	Weight Change (mg/cm^2)	Weight Change (mg/cm^2)
Copper	*RCUWTCH*	*CUWTCH*
Lead	*RPBWTCH*	*PBWTCH*
Tin	*RSNWTCH*	*SNWTCH*
Bronze	*RBRWTCH*	*BRWTCH*

[A] (+ for weight increase, - for weight loss)

FIG. A2.3 Detailed Test Results

Comments

Lab:	Bath No.: *BTHNO*	Bath Run No.: *BTHRUNNO*	Bath Position: *RBTHPOS/BTHPOS*
EOT Date: *DTCOMP*		EOT Time: *EOTTIME*	
Oil Code: *CMIR/OILCODE*		Start Date: *DTSTRT*	
Formulation/Stand Code: *FORM*			

Number of Comment Lines	*TOTCOM*	

FIG. A2.4 Comments

18-jan-2001

Data Dictionary

Sequence	Form	Test Area	Field Name	Field Length	Decimal Size	Data Type	Units/Format	Description
10	0	CBT	VERSION	8	0	C	YYYYMMDD	CBT VERSION 20010118
20	0	CBT	TSTSPON1	40	0	C		CONDUCTED FOR, FIRST LINE
30	0	CBT	TSTSPON2	40	0	C		CONDUCTED FOR, SECOND LINE
40	0	CBT	LABVALID	1	0	C	V, I OR N	TEST LAB VALIDATION (V, I OR N)
50	0	CBT	BTHNO	5	0	C		BATH NUMBER
60	0	CBT	BTHRUNNO	4	0	C		BATH RUN NUMBER
70	0	CBT	RBTHPOS	2	0	C		REFERENCE BATH POSITION
80	0	CBT	BTHPOS	2	0	C		NON-REFERENCE BATH POSITION
90	0	CBT	DTCOMP	8	0	C	YYYYMMDD	COMPLETED DATE(YYYYMMDD)
100	0	CBT	EOTTIME	5	0	C	HH:MM	COMPLETED TIME(HH:MM)
110	0	CBT	OILCODE	38	0	C		NON-REFERENCE OIL CODE
120	0	CBT	CMIR	6	0	C		CMIR
130	0	CBT	FORM	38	0	C		FORMULATION/STAND CODE
140	0	CBT	ALTCODE1	10	0	C		ALTERNATE OIL CODE 1
150	0	CBT	ALTCODE2	10	0	C		ALTERNATE OIL CODE 2
160	0	CBT	ALTCODE3	10	0	C		ALTERNATE OIL CODE 3
170	0	CBT	OPVALID	8	0	C		OPERATIONAL VALIDITY -- HAS/HAS NOT
180	0	CBT	SUBLAB	40	0	C		SUBMITTED BY: TESTING LABORATORY
190	0	CBT	SUBSIGIM	70	0	C		SUBMITTED BY: SIGNATURE IMAGE
200	0	CBT	SUBNAME	40	0	C		SUBMITTED BY: SIGNATURE TYPED NAME
210	0	CBT	SUBTITLE	40	0	C		SUBMITTED BY: TITLE
220	1	CBT	LAB	2	0	C		LAB CODE
230	1	CBT	DTSTRT	8	0	C	YYYYMMDD	START DATE (YYYYMMDD)
240	1	CBT	TESTLEN	3	0	Z	HHH	TEST LENGTH (HHH)
250	1	CBT	IND	6	0	C		TMC OIL CODE
260	1	CBT	RSAEVISC	7	0	C		REFERENCE SAE VISCOSITY GRADE
270	1	CBT	SAEVISC	7	0	C		NON-REFERENCE SAE VISCOSITY GRADE
280	1	CBT	RLABOCOD	12	0	C		REFERENCE LABORATORY INTERNAL OIL CODE
290	1	CBT	LABOCODE	12	0	C		LABORATORY INTERNAL OIL CODE
300	1	CBT	RCUNA	7	1	A	PPM	REF. COPPER METAL TYPE NEW OIL AVERAGE [<](PPM)
310	1	CBT	RCUUA	7	1	A	PPM	REF. COPPER METAL TYPE USED OIL AVERAGE [<](PPM)
320	1	CBT	RCUCMC	7	1	A	PPM	REF. COPPER CHANGE IN CONCENTRATION [<](PPM)
330	1	CBT	CUNA	7	1	A	PPM	NON-REF. COPPER METAL TYPE NEW OIL AVERAGE [<](PPM)
340	1	CBT	CUUA	7	1	A	PPM	NON-REF. COPPER METAL TYPE USED OIL AVERAGE [<](PPM)
350	1	CBT	CUCMC	7	1	A	PPM	NON-REF. COPPER CHANGE IN CONCENTRATION [<](PPM)
360	1	CBT	RPBNA	7	1	A	PPM	REF. LEAD METAL TYPE NEW OIL AVERAGE [<](PPM)
370	1	CBT	RPBUA	7	1	A	PPM	REF. LEAD METAL TYPE USED OIL AVERAGE [<](PPM)
380	1	CBT	RPBCMC	7	1	A	PPM	REF. LEAD CHANGE IN CONCENTRATION [<](PPM)
390	1	CBT	RPBCOR	6	3	A	PPM	CORRECTED REF. LEAD CHANGE IN CONCENTRATION [<](PPM)
400	1	CBT	RPBCORA	7	1	A	PPM	CORR. AVG. REF. LEAD CHANGE IN CONCENTRATION [<](PPM)
410	1	CBT	PBNA	7	1	A	PPM	NON-REF. LEAD METAL TYPE NEW OIL AVERAGE [<](PPM)
420	1	CBT	PBUA	7	1	A	PPM	NON-REF. LEAD METAL TYPE USED OIL AVERAGE [<](PPM)
430	1	CBT	PBCMC	7	1	A	PPM	NON-REF. LEAD CHANGE IN CONCENTRATION [<](PPM)
440	1	CBT	PBCOR	6	3	A	PPM	CORR. NON-REF. LEAD CHANGE IN CONCENTRATION [<](PPM)
450	1	CBT	PBCORA	7	1	A	PPM	CORR. AVG. NON-REF LEAD CHANGE IN CONCENTRATION [<](PPM)
460	1	CBT	RSNNA	7	1	A	PPM	REF. TIN METAL TYPE NEW OIL AVERAGE [<](PPM)
470	1	CBT	RSNUA	7	1	A	PPM	REF. TIN METAL TYPE USED OIL AVERAGE [<](PPM)
480	1	CBT	RSNCMC	7	1	A	PPM	REF. TIN CHANGE IN CONCENTRATION [<](PPM)
490	1	CBT	SNNA	7	1	A	PPM	NON-REF. TIN METAL TYPE NEW OIL AVERAGE [<](PPM)
500	1	CBT	SNUA	7	1	A	PPM	NON-REF. TIN METAL TYPE USED OIL AVERAGE [<](PPM)
510	1	CBT	SNCMC	7	1	A	PPM	NON-REF. TIN CHANGE IN CONCENTRATION [<](PPM)
520	1	CBT	RCUSTRIP	3	0	C		REFERENCE COPPER STRIP RATING
530	1	CBT	CUSTRIP	3	0	C		NON-REFERENCE COPPER STRIP RATING

FIG. A2.5 Data Dictionary

18-jan-2001 Report: ASTM Data Dictionary

Sequence	Form	Test Area	Field Name	Field Length	Decimal Size	Data Type	Units/Format	Description
540	1	CBT	RCUIDNO	15	0	C		REFERENCE SPEC. BATCH ID FOR COPPER
550	1	CBT	CUIDNO	10	0	C		NON-REFERENCE SPEC. BATCH ID FOR COPPER
560	1	CBT	RPBIDNO	15	0	C		REFERENCE SPEC. BATCH ID FOR LEAD
565	1	CBT	REFBATCH	1	0	C		REFERENCE SPEC. BATCH
570	1	CBT	PBIDNO	10	0	C		NON-REFERENCE SPEC. BATCH ID FOR LEAD
580	1	CBT	RSNIDNO	15	0	C		REFERENCE SPEC. BATCH ID FOR TIN
590	1	CBT	SNIDNO	10	0	C		NON-REFERENCE SPEC. BATCH ID FOR TIN
600	1	CBT	RBRIDNO	15	0	C		REFERENCE SPEC. BATCH ID FOR BRONZE
610	1	CBT	BRIDNO	10	0	C		NON-REFERENCE SPEC. BATCH ID FOR BRONZE
710	2	CBT	RCUN1	7	1	A	PPM	REF. COPPER METAL TYPE NEW OIL RUN 1 [<](PPM)
720	2	CBT	RCUN2	7	1	A	PPM	REF. COPPER METAL TYPE NEW OIL RUN 2 [<](PPM)
730	2	CBT	CUN1	7	1	A	PPM	NON-REF. COPPER METAL TYPE NEW OIL RUN 1 [<](PPM)
740	2	CBT	CUN2	7	1	A	PPM	NON-REF. COPPER METAL TYPE NEW OIL RUN 2 [<](PPM)
750	2	CBT	RPBN1	7	1	A	PPM	REF. LEAD METAL TYPE NEW OIL RUN 1 [<](PPM)
760	2	CBT	RPBN2	7	1	A	PPM	REF. LEAD METAL TYPE NEW OIL RUN 2 [<](PPM)
770	2	CBT	PBN1	7	1	A	PPM	NON-REF. LEAD METAL TYPE NEW OIL RUN 1 [<](PPM)
780	2	CBT	PBN2	7	1	A	PPM	NON-REF. LEAD METAL TYPE NEW OIL RUN 2 [<](PPM)
790	2	CBT	RSNN1	7	1	A	PPM	REF. TIN METAL TYPE NEW OIL RUN 1 [<](PPM)
800	2	CBT	RSNN2	7	1	A	PPM	REF. TIN METAL TYPE NEW OIL RUN 2 [<](PPM)
810	2	CBT	SNN1	7	1	A	PPM	NON-REF. TIN METAL TYPE NEW OIL RUN 1 [<](PPM)
820	2	CBT	SNN2	7	1	A	PPM	NON-REF. TIN METAL TYPE NEW OIL RUN 2 [<](PPM)
830	2	CBT	RISN1	7	1	A	PPM	REF. INTERNAL STANDARD METAL TYPE NEW OIL RUN 1 [<](PPM)
840	2	CBT	RISN2	7	1	A	PPM	REF. INTERNAL STANDARD METAL TYPE NEW OIL RUN 2 [<](PPM)
850	2	CBT	RISNA	7	1	A	PPM	REF. INTERNAL STANDARD METAL TYPE NEW OIL AVG. [<] (PPM)
860	2	CBT	ISN1	7	1	A	PPM	NON-REF. INTERNAL STANDARD NEW OIL RUN 1 [<](PPM)
870	2	CBT	ISN2	7	1	A	PPM	NON-REF. INTERNAL STANDARD NEW OIL RUN 2 [<](PPM)
880	2	CBT	ISNA	7	1	A	PPM	NON-REF. INTERNAL STANDARD NEW OIL AVERAGE [<](PPM)
890	2	CBT	RCUU1	7	1	A	PPM	REF. COPPER METAL TYPE USED OIL RUN 1 [<](PPM)
900	2	CBT	RCUU2	7	1	A	PPM	REF. COPPER METAL TYPE USED OIL RUN 2 [<](PPM)
910	2	CBT	CUU1	7	1	A	PPM	NON-REF. COPPER METAL TYPE USED OIL RIN 1 [<](PPM)
920	2	CBT	CUU2	7	1	A	PPM	NON-REF. COPPER METAL TYPE USED OIL RIN 2 [<](PPM)
930	2	CBT	RPBU1	7	1	A	PPM	REF. LEAD METAL TYPE USED OIL RUN 1 [<](PPM)
940	2	CBT	RPBU2	7	1	A	PPM	REF. LEAD METAL TYPE USED OIL RUN 2 [<](PPM)
950	2	CBT	PBU1	7	1	A	PPM	NON-REF. LEAD METAL TYPE USED OIL RUN 1 [<](PPM)
960	2	CBT	PBU2	7	1	A	PPM	NON-REF. LEAD METAL TYPE USED OIL RUN 2 [<](PPM)
970	2	CBT	RSNU1	7	1	A	PPM	REF. TIN METAL TYPE USED OIL RUN 1 [<](PPM)
980	2	CBT	RSNU2	7	1	A	PPM	REF. TIN METAL TYPE USED OIL RUN 2 [<](PPM)
990	2	CBT	SNU1	7	1	A	PPM	NON-REF. TIN METAL TYPE USED OIL RUN 1 [<](PPM)
1000	2	CBT	SNU2	7	1	A	PPM	NON-REF. TIN METAL TYPE USED OIL RUN 2 [<](PPM)
1010	2	CBT	RISU1	7	1	A	PPM	REF. INTERNAL STANDARD METAL TYPE USED OIL RUN 1[<](PPM)
1020	2	CBT	RISU2	7	1	A	PPM	REF. INTERNAL STANDARD METAL TYPE USED OIL RUN 2[<](PPM)
1030	2	CBT	RISUA	7	1	A	PPM	REF. INTERNAL STANDARD METAL TYPE USED OIL AVG.[<](PPM)
1040	2	CBT	ISU1	7	1	A	PPM	NON-REF. INTERNAL STANDARD USED OIL RUN 1 [<](PPM)
1050	2	CBT	ISU2	7	1	A	PPM	NON-REF. INTERNAL STANDARD USED OIL RUN 2 [<](PPM)
1060	2	CBT	ISUA	7	1	A	PPM	NON-REF. INTERNAL STANDARD USED OIL AVERAGE [<](PPM)
1070	2	CBT	REVAPLOS	5	2	N	%	REFERENCE EVAPORATION LOSS (%)
1080	2	CBT	EVAPLOS	5	2	N	%	NON-REFERENCE EVAPORATION LOSS (%)
1090	2	CBT	RCUWTCH	5	2	N	mg/cm2	REFERENCE COPPER WEIGHT CHANGE (mg/cm2)
1100	2	CBT	CUWTCH	5	2	N	mg/cm2	NON-REFERENCE COPPER WEIGHT CHANGE (mg/cm2)
1110	2	CBT	RPBWTCH	5	2	N	mg/cm2	REFERENCE LEAD WEIGHT CHANGE (mg/cm2)
1120	2	CBT	PBWTCH	5	2	N	mg/cm2	NON-REFERENCE LEAD WEIGHT CHANGE (mg/cm2)
1130	2	CBT	RSNWTCH	5	2	N	mg/cm2	REFERENCE TIN WEIGHT CHANGE (mg/cm2)
1140	2	CBT	SNWTCH	5	2	N	mg/cm2	NON-REFERENCE TIN WEIGHT CHANGE (mg/cm2)
1150	2	CBT	RBRWTCH	5	2	N	mg/cm2	REFERENCE BRONZE WEIGHT CHANGE (mg/cm2)

FIG. A2.5 Data Dictionary *(continued)*

18-jan-2001 Report: ASTM Data Dictionary

Sequence	Form	Test Area	Field Name	Field Length	Decimal Size	Data Type	Units/Format	Description
1160	2	CBT	BRWTCH	5	2	N	mg/cm2	NON-REFERENCE BRONZE WEIGHT CHANGE (mg/cm2)
1170	3	CBT	TOTCOM	3	0	Z		TOTAL LINES OF COMMENTS & OUTLIERS
1180	3	CBT	OCOMRxxx	70	0	C		OTHER DOWNTIME COMMENTS XXX

FIG. A2.5 Data Dictionary *(continued)*

```
###########################################################################
#                                                                         #
#          D a t a  D i c t i o n a r y  R e p e a t i n g                #
#               F i e l d  S p e c i f i c a t i o n s                    #
#                                                                         #
###########################################################################
# The following contains specifications and field groupings for fields in the
# Data Dictionary that are REPEATING Fields.  These fields can be identified
# in the Data Dictionary by the Hxxx or Rxxx in the last four positions of the
# field name.
#
# Repeating fields are used to specify repeating measurements.
#
# The format for a repeating field name is 4 descriptive characters followed
# by the letter H or R followed by 3 characters for the actual interval
# the measurement was taken. The field will always be a total of 8 characters.
#
# Example ABCDHxxx.
#
# The following is the format of this specification:
#
# Column 1 - 8:   Repeating Field Name
# Column 10 - 17: The Parent Field Name of the Group
# Column 19 - 26: The Measurement Interval Group Name
# Column 30 - 80: Comments about the Repeating Field Group.
#
# The lines following the Repeating Field Name Record will contain the required
# measurements for the particular field.  Multiple 80 characters lines
# can be specified.  A blank line marks the end of each specification.
#
# The Field Name in Column 10-17 designates the the Group in which the field
# belongs.  The First field name in a group is the Parent of the grouping
# and can be used to determine how fields should be grouped.
# The changing of the Parent Field marks the end of a repeating group
# specification.
#
# Example:
#
# VIS_Hxxx, DVISHxxx and PVISHxxx expanded for transmission (8 and 16 hours):
#
#          VIS_H008
#          DVISH008
#          PVISH008
#          VIS_H016
#          DVISH016
#          PVISH016
#
# Note:  During electronic transmission, repeating field groups must be kept
#        together within the specified group but the order within the group
#        does not have to be maintained.
#
###########################################################################
#                Start of Field Grouping Specifications                   #
###########################################################################
#
CBT VERSION 20010118
OCOMHxxx OCOMHxxx OCOMHxxx   OTHER DOWNTIME COMMENTS XXX
```

FIG. A2.6 Repeating Field Specifications CBT