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APPROVED BY ASTM D02.B 12/6/00
(DATE)

Sequence IIIF Information Letter 00-2
Sequence No. 2

October 13, 2000

ASTM consensus has not been obtained on this information letter. An appropriate ASTM ballot will be issued in order to achieve such consensus.

TO: Sequence IIIF Mailing List

SUBJECT: Used Oil Sample Testing
Revised Quality Index U&L Values
Revised Ring Sticking Definitions
Using Test Oil to Assemble Test Engines
Revised Oil Consumption Limits on Test Validity

This Information Letter implements action items approved by the Sequence IIIF Surveillance Panel. This Information Letter addresses specific parts and procedures pertaining to quality, consistency, performance, and accountability of test parts as part of the ongoing effort by the panel to ensure continual process improvement of the Sequence IIIF test. Updated replacement pages of the Sequence IIIF Test Procedure Draft are attached.

Used Oil Sample Testing

At the September 27, 2000 meeting of the Sequence IIIF Surveillance Panel, the panel approved several motions to revise when the Cold Crank Simulator test (Test Method D5293) and Mini Rotary Viscometer tests (Test Method D4684) are required on the end-of-test used oil sample. These motions stated that if the end-of-test Viscosity Increase is above 500%, the Cold Crank Simulator and Mini Rotary Viscometer tests are not required. Another motion stated that Cold Crank Simulator and Mini Rotary Viscometer tests are not required on straight-grade oils. The final motion stated that if the end-of-test oil sample fails the Cold Crank Simulator test at -5°C, the Mini Rotary Viscometer test does not need to be run. All these changes are effective for all tests completed on or after September 27, 2000. The data dictionary and report form set were modified to allow reporting of this data as a result of actions taken by the Surveillance Panel at the July 25, 2000 meeting of the panel. However, these two tests were never formally added to the Sequence IIIF Test Procedure Draft. Given the panel's actions on these items, the requirement to run these tests on all other end-of-test used oil samples is implicit. Therefore, the formal requirement to run these tests on the end-of-test used oil sample have been added to the Sequence IIIF Test Procedure Draft at this time.

Revised Quality Index U&L Values

At the September 27, 2000 meeting of the Sequence IIIF Surveillance Panel, the panel approved a motion to revise the Quality Index U&L Values used for calculation of the Quality Index results. These new values are in effect for all tests started on or after October 4, 2000.

Revised Ring Sticking Definitions

At the September 27, 2000 meeting of the Sequence IIIF Surveillance Panel, the panel approved a motion to revise the definitions of stuck rings in the Sequence IIIF Test Procedure. The definitions for both hot-stuck and cold-stuck rings from the Subcommittee B Glossary are to be included in the Test Procedure and the panel also decided to require that only hot-stuck rings be reported as the pass/fail parameter. This change is effective for all Sequence IIIF tests conducted to date on the current test procedure as well as all future Sequence IIIF tests.

Using Test Oil to Assemble Test Engines

At the September 27, 2000 meeting of the Sequence IIIF Surveillance Panel, the panel approved a motion to eliminate the usage of test oil for any parts of the engine build process. All engine builds should be done with build-up oil only. Laboratories should also bring this change into use laboratory-wide with their next reference oil test and also make a note in the "Comments" section of the final report of that reference oil test. This change is effective on September 27, 2000.

Revised Oil Consumption Limits on Test Validity

At the September 27, 2000 meeting of the Sequence IIIF Surveillance Panel, the panel approved a motion to revise Section 13.15.5 of the Sequence IIIF Draft Test Procedure to eliminate the oil consumption limit as a test validity criterion. This change was discussed at the July 25, 2000 meeting of the Surveillance Panel but no formal action was taken at that time. This change is effective for all tests completed on or after July 25, 2000.

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Attachments

c: ftp://tmc.astm.cmri.cmu.edu/docs/gas/sequenceiii/procedure_and_ils/IL00-2.pdf

Sequence IIIF
Test Procedure

Draft Number 3a
Updated with IL 00-2

October 4, 2000

2. Referenced Documents

2.1 ASTM Standards:

D 16 Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products[3]

D 86 Test Method for Distillation of Petroleum Products

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

D 156 Test Method for Saybolt Color of Petroleum Products (Saybolt Chronometer Method)

D 235 Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)

D 287 Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)[4]

D 323 Test Method for Vapor Pressure of Petroleum Products (Reid Method)

D 381 Test Method for Existent Gum in Fuels by Jet Evaporation

D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)

D 525 Test Method for Oxidation Stability of Gasoline (Induction Period Method)

D 1266 Test Method for Sulfur in Petroleum Products (Lamp Method)

D 2422 Classification of Industrial Fluid Lubricants by Viscosity System

D 2699 Test Method for Knock Characteristics of Motor Fuels by the Research Method

D 2700 Test Method for Knock Characteristics of Motor and Aviation Fuels by the Motor Method

D 2982 Test Methods for Detecting Glycol-Base Antifreeze in Used Lubricating Oils

D 3237 Test Method for Lead in Gasoline by Atomic Absorption Spectrometry

D 4175 Terminology Relating to Petroleum, Petroleum Products, and Lubricants

D 4485 Specification for Performance of Engine Oils

D 4684 Standard Test Method for Determination of Yield Stress and Apparent Viscosity of Engine Oils At Low Temperature

D 5119 Test Method for Evaluation of Automotive Engine Oils in the CRC L-38 Spark-Ignition Engine

D 5302 Test Method for Evaluation of Automotive Engine Oils for Inhibition of Deposit Formation and Wear in a Spark-Ignition Internal Combustion Engine Fueled with Gasoline and Operated Under Low-Temperature, Light-Duty Conditions

D 5293 Standard Test Method for Apparent Viscosity of Engine Oils Between -5 and -30°C Using the Cold-Cranking Simulator

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E 270 Definitions of Terms Relating Liquid Penetrant Examination

E 344 Terminology Relating to Thermometry and Hydrometry

E 380 Practice for Use of the International System of Units (SI) (The Modernized Metric System)
G 40 Terminology Relating to Wear and Erosion

2.2 Military Specification:
MIL-L-2104, Lubricating Oil, Internal Combustion Engine, Tactical Service

2.3 SAE Standards:
J183, Engine Oil Performance and Engine Service Classification (Other Than "Energy-Conserving")

J304, Engine Oil Tests

2.4 Sequence IIIF-specific Documents:
Sequence IIIF Engine Assembly Manual

Data Acquisition and Control Automation II Task Force Report

ASTM Test Monitoring Center, System Time Response Measurement Guidelines, 5/27/99

3. Terminology

3.1 Definitions:

3.1.1 blowby, n-in internal combustion engines, the combustion products and unburned air-and-fuel mixture that enter the crankcase.

3.1.2 BTDC, adj-abbreviation for Before Top Dead Center; used with the degree symbol to indicate the angular position of the crankshaft relative to its position at the point of uppermost travel of the piston in the cylinder.

3.1.3 calibrate, v-to determine the indication or output of a measuring device with respect to that of a standard. E 344

3.1.4 clogging, n-the restriction of a flow path due to the accumulation of material along the flow path boundaries.

3.1.5 cold-stuck piston ring, n-in internal combustion engines, a piston ring that is stuck when the piston and ring are at room temperature, but inspection shows that it was free during engine operation. Subcommittee B Glossary

3.1.6 corrosion, n-the chemical or electrochemical oxidation of the surface of metal which can result in loss of material or accumulation of deposits. E 270

3.1.7 debris, n-in internal combustion engines, solid contaminant materials unintentionally introduced into the engine or resulting from wear.

3.1.8 engine oil, n-a liquid that reduces friction or wear, or both, between the moving parts within an engine, and also serves as a coolant. D 4485

3.1.9 free piston ring, n-in internal combustion engines, a piston ring which will fall in its groove under the force of its own weight when the piston is moved from a vertical (axis orientation) to a horizontal position.
-In determining this condition, the ring may be touched slightly to overcome static friction.

3.1.10 hot-stuck piston ring, n-in internal combustion engines, a piston ring that is stuck when the piston and ring are at room temperature, and inspection shows that it was stuck during engine operation. Subcommittee B Glossary

3.1.11 lubricant, n-any material interposed between two surfaces that reduces the friction or wear, or both, between them.

3.1.12 noncompounded engine oil, n-a lubricating oil having a viscosity within the range of viscosities of oils normally used in engines, and that may contain anti-foam agents or pour depressants, or both, but not other additives. D 5119

3.1.13 non-reference oil, n-any oil other than a reference oil; such as a research formulation, commercial oil, or candidate oil. Subcommittee B Glossary

3.1.14 oxidation, n-of engine oil, the deterioration of the oil which is observed as increased viscosity, sludge formation, varnish formation, or a combination thereof, as a result of chemical and mechanical action. D 5119

3.1.15 reference oil, n-an oil of known performance characteristics, used as a basis for comparison. Subcommittee B Glossary

DISCUSSION-Reference oils are used to calibrate testing facilities, to compare the performance of other oils, or to evaluate other materials (such as seals) that interact with oils.

3.1.16 rust (coatings), n-the reddish material, primarily hydrated iron oxide, formed on iron or its alloys resulting from exposure to humid atmosphere or chemical attack. D 16

3.1.17 scoring, n-in tribology, a severe form of wear characterized by the formation of extensive grooves and scratches in the direction of sliding. G 40

3.1.18 scuffing, n-in lubrication, surface damage resulting from localized welding at the interface of rubbing surfaces with subsequent fracture in the proximity of the weld area. D 4175

3.1.19 sludge, n-in internal combustion engines, a deposit, principally composed of insoluble resins and oxidation products from fuel combustion and the lubricant, which does not drain from engine parts but can be removed by wiping with a cloth; see 3.1.18.

3.1.20 used oil, n-any oil that has been in a piece of equipment (for example, an engine, gearbox, transformer, or turbine), whether operated or not. D 4175

3.1.21 varnish, n-in internal combustion engines, a hard, dry, generally lustrous, deposit which can be removed by solvents but not by wiping with a cloth;

3.1.22 wear, n-the loss of material from, or relocation of material on, a surface. D 5302

DISCUSSION-Wear generally occurs between two surfaces moving relative to each other, and is the result of mechanical or chemical action, or of a combination of mechanical and chemical actions.

3.1.23 EOT time, n-end of test time, the end of test time will be twenty (20) minutes after the engine reaches 80 test hours of operation. This allows for the 90 second ramp down, the 15 minute wait for the oil to drain into the sump, and allows an operator 3.5 minutes to take the oil level.

3.2 Descriptions of Terms Specific to This Standard:

3.2.1 build-up oil, n-EF-411 noncompounded ISO VG 32 (SAE 20) oil used in lubricating the Sequence IIIF parts during engine assembly, and in coating parts following rating.

3.2.2 calibrated test stand, n-a test stand on which Sequence IIIF engine oil tests are conducted within the lubricant test monitoring system as administered by the ASTM TMC (see 11.1).

3.2.3 Central Parts Distributor (CPD), n-the manufacturer and supplier of many of the parts and fixtures used in this test method.

DISCUSSION-Because of the need for rigorous inspection and control of many of the parts used in this test method, and because of the need for careful manufacture of special parts and fixtures used, companies having the capabilities to provide the needed services have been selected as the official suppliers for the Sequence IIIF test method. These companies work closely with the original parts suppliers, with the Test Developer, and with the ASTM groups associated with the test method to help ensure that the equipment and materials used in the method function satisfactorily.

3.2.4 correction factor, n-a mathematical adjustment to a test result to compensate for industry-wide shifts in severity.

3.2.5 Special Test Parts (STP), n-parts that do not meet all the definitions of critical parts, non-production parts, or SPO parts, but must be obtained from the specified distributor.

3.2.6 critical parts (CP), n-those components used in the test, which are known to affect test severity.
-They must be obtained from the Central Parts Distributor or Special Parts Supplier, who will identify them with either a serial number or a batch lot control number.

3.2.7 EWMA, n-exponentially-weighted moving average.

3.2.8 Lubricant Test Monitoring System, LTMS, n-an analytical system in which ASTM calibration test data are used to manage lubricant test precision and severity (bias).

3.2.9 LTMS date, n-the date the test was completed unless a different date is assigned by the TMC.

3.2.10 LTMS time, n-the time the test was completed unless a different time is assigned by the TMC.

3.2.11 non-production parts (NP), n-these are components used in the test, which are available only through the Central Parts Distributor, Special Parts Supplier, or the Test Developer.

3.2.12 participating laboratory, n-a laboratory equipped to conduct Sequence IIIF tests, which conducts reference oil tests in cooperation with the ASTM TMC, in order to have calibrated test stands available for candidate oil testing.

3.2.13 quality index, n-a mathematical formula that uses data from controlled parameters to calculate a value indicative of control performance.

3.2.14 reference oil test, n-a standard Sequence IIIF engine oil test of a reference oil designated by the ASTM TMC.

3.2.15 SA, n-severity adjustment.

3.2.16 Service Parts Operations parts (SPO), n-these test components are obtained from Service Parts Operations a division of General Motors Corporation.

3.2.17 sluggish piston ring, n-one that is not free; it offers resistance to movement in its groove, but it can be pressed into or out of the groove under moderate finger pressure; when so moved, it does not spring back.

3.2.18 Special Parts Supplier,(SPS) n-the manufacturer and supplier of many of the parts and fixtures used in this test method.

3.2.19 Special Test Parts , n-parts that do not meet all the definitions of critical parts, non-production parts, or SPO parts, but must be obtained from the Special Parts Supplier.

3.2.20 standard test, n-an operationally-valid, full-length Sequence IIIF test conducted on a calibrated test stand in accordance with the conditions listed in this standard.

DISCUSSION-Such a test is also termed a valid test.

3.2.21 stuck lifter, n-a used lifter in which the plunger remains in a depressed position upon removal of the lifter from the engine, rather than being forced against the pushrod seat by the internal spring so that the pushrod seat bears against the lifter retainer clip.

3.2.22 stuck piston ring, n-one that is either partially or completely bound in its groove; it cannot be readily moved with moderate finger pressure.

3.2.23 Test Developer, n-the group or agency which developed the Sequence IIIF test method before its standardization by ASTM, and which continues to be involved with the test in respect to modifications in the test method, development of Information Letters, supply of test parts, etc.

DISCUSSION-As defined in Committee D02.B0.08 Regulations Governing the American Society for Testing and Materials Test Monitoring System, "`Test Developer' shall refer to those individual companies which have developed and/or are responsible for supplying the basic hardware for the tests referred to in Paragraph 2.1 (Article 2-Purpose of the Test Monitoring System)." In the case of the Sequence IIIF test, the Test Developer is General Motors Research and Development Center.

3.2.24 test full mark, n-the oil level established after the ten (10) minute initial run-in.

3.2.25 test oil, n-an oil subjected to a Sequence IIIF engine oil test.

DISCUSSION-It can be any oil selected by the laboratory conducting the test. It could be an experimental product or a commercially-available oil. Often, it is an oil which is a candidate for approval against engine oil specifications (such as manufacturers' or military specifications, etc.).

3.2.26 test stand, n-a suitable foundation (such as a bedplate) to which is mounted a dynamometer, and which is equipped with a suitable data acquisition system, fluids process control system, supplies of electricity, compressed air, etc., to provide a means for mounting and operating an engine in order to conduct a Sequence IIIF engine oil test.

3.2.27 test start, n-introduction of test oil into the engine after the final assembly and mounting in the test stand.

Note-37: Warning-For technical use only.

10.11.4 Measure the maximum pre-test dimension of each camshaft lobe, transverse to the camshaft axis to the nearest 0.001 mm (0.00004 in.). This dimension is at the rear edge of all lobe positions (lobes are numbered from the front to the rear of the camshaft). Record the measurements on internal laboratory forms. See 10.7

10.11.5 Measure the pre-test length of the lifters at the center of the lifter foot to the nearest 0.001 mm (0.00004 in.). Record the measurements on internal laboratory forms. See 10.7

10.11.6 Record the unique serial number for each lifter on internal laboratory forms. See 10.7 Do not use electro-mechanical scribing devices. Do not place any marks on the lifter body or foot.

10.11.7 Coat the camshaft and lifters with build-up oil to prevent rusting.

10.12 Camshaft Bearing Installation-The camshaft tunnel is specially processed and uses oversize bearings provided through the CPD. Install the camshaft bearings according to the engine assembly manual guidelines. Always inspect the lifter and main bearing oil galleries for splintered babbit materials that might have been shaved from the O.D. of the bearings during installation. Remove any materials from the oil galleries with clean dry shop air. (Warning-see Note 38)

Note-38: Warning-For technical use only.

10.13 Camshaft Installation-Install the camshaft according to the following procedure:

10.13.1 Coat the camshaft with a light film of build-up oil on the journals.

Note-39 Camshafts should not sit dry inside the engine block waiting for final assembly more than 24 hours.

10.13.2 Install the camshaft in the engine block, taking care to avoid damage to the lobes, journals, and bearings.

10.13.3 Installation of Camshaft Thrust Plate-Lubricate the thrust plate with build-up oil and install the thrust plate to the front of the engine block using the torx fasteners.

10.28.2 Install the test lifters in the test engine, coating each lifter foot with the build-up oil before installation into the lifter bore. Rotate the engine crankshaft slowly for 720° while insuring that the lifters follow the cam lobe profile. Remove each lifter and once again coat the lifter foot with build-up oil. Reinstall the lifter into the engine block with the ground flat on the lifter body facing inboard toward the center of the engine. See the Sequence IIIF Engine Assembly Manual section 6 sheet 1.

10.29 Pushrods-Clean the pushrods with aliphatic naphtha (Warning-see Note-44), and air (Warning-see Note-45) blow them dry prior to installation; make certain that the oil passages are open. Lubricate the ball ends of the pushrods with buildup oil and install the pushrods. See the Sequence IIIF Engine Assembly Manual section 6 sheet 2.

Note-44: Warning-Combustible. Health Hazard.
Note-45: Warning-For technical use only.

10.30 Valve Train Loading-Install the rocker arm pivot retainer and the precision roller rockers and torque the rocker arm pedestal bolts according to section 6 in the Sequence IIIF Engine Assembly Manual section 6 sheet 4.

Note-46 Once the valve train is loaded, the engine shall not be rotated until the start of test using the dynamometer air starter system.

10.31 Intake Manifold-Modify the intake manifold as shown in the Sequence IIIF Engine Assembly Manual. (See section 6 sheet 7)

10.31.2 Plug the EGR port using OHT3-024-1.

10.31.3 Install OHT3F-002-1 positive crankcase ventilation valve replacement plug in the intake manifold plenum.

10.32 Rocker Covers-Install two left side rocker covers part #25534751 on the cylinder heads.

10.33 Water outlet Adapter-Install a water inlet adapter made according to drawing OHT3F-034-1.

10.34 Breather Tube-Install a breather tube mounting bracket OHT3F-041-1 and breather tube ITT 5-142-08-036-001^{xx} with an adapter OHT3F-040-1 on the front of the engine using flexible hose to connect the adapter to the rocker cover bushings OHT3F-028-1.

13.4.2 Rate piston skirt deposits use CRC manual 14 rating scale and breakdown method under a lamp with two 15-watt cool-white fluorescent tubes which together produce 350 to 500 fc (3800 to 5400 lx) at the rating surface. These ratings will be used for IIIF deposit determinations.

13.4.3 Blank

13.4.3.1 Rate the oil pump screen for percent plugging (using CRC manual 12).

13.4.3.2 In addition to the ratings generated in section 13.4.2, rate each piston top groove, 2nd groove, oil ring groove, 2nd land, and undercrown (Band-Aid area) for deposits using CRC manual 14 rating techniques and breakdown method. Carbon deposit ratings will consist of only two levels: Heavy = 0.00 merit value or Light = 0.75 merit value. These ratings should be performed in a rating booth, using a 20-segment piston rating cap, a piston rating stand, and a 22watt circular rating lamp.

13.4.4 If multiple ratings are deemed necessary of a given part or parts, consensus rating may be used according to the following:

13.4.4.1 The raters shall be from the laboratory in question, no outside raters can be used unless requested and directed through the Sequence IIIF Surveillance Panel.

13.4.4.2 No averaging of ratings is permitted.

13.4.4.3 Only one rating value is to be reported and is to be agreed to by the raters involved.

13.5 Piston Ring Sticking-Rate the piston rings for hot-stick and cold-stuck rings as follows:

13.5.1.1 See Section 3 for the definition of hot-stuck and cold-stuck rings.

13.5.1.2 Determine which rings are hot-stuck or cold-stuck and record the piston number and ring identification (for example, piston No. 3, top ring) for such rings on Form 8, Summary of Oil Ring Land Deposit Rating, in standardized report form set (See Annex A6). Record the total number of hot-stuck rings on Form 4, Test Result Summary, in the standardized report form set (See Annex A6).

13.6 Intentionally left blank

13.11.4 Measurements on a camshaft and the lifters used in a given test must be made by the same person if the measurement equipment utilized is operator-sensitive (that is, if a micrometer is used with which the operator determines the spindle pressure).

13.11.5 When measuring the camshaft and the lifters, take precautions to prevent any influence of body heat on the measurements.

13.11.6 Measure the maximum dimension of each camshaft lobe, transverse to the camshaft axis. This dimension is at the rear edge of all lobes (lobes are numbered from the front to the rear of the camshaft).

13.11.7 Measure the length of the lifters at the center of the lifter foot.

13.11.8 Calculate the wear for each camshaft lobe and lifter by subtracting the after-test measurement from the before-test measurement.

13.11.8.1 Due to varnish accumulations on camshaft lobes of high wear resistant oils, post-test measurements may indicate a larger numeric value than pre-test measurements. In this situation, the end of test calculation equates to a negative value. All negative values shall be overridden and entered as "0.000 mm" wear for all calculations when determining post-test results.

13.11.9 Calculate the cam-plus-lifter wear by adding the values obtained in 13.11.8. Record the results on Form 7, Valve Lifter and Camshaft Wear Results, in standardized report form set (See Annex A6).

13.11.10 Determine the maximum, minimum, and average camshaft-lobe, valve-lifter, and cam-plus-lifter wear. Record the values on Form 7, Valve Lifter and Camshaft Wear Results, in standardized report form set (See A6).

13.12 Used Oil Sample Testing - With the following exceptions, conduct a Cold-Cranking Simulator test (Test Method D5293) and a Mini Rotary Viscometer test (Test Method D4684) on the end-of-test used oil sample. Report the results on Form 8, Used Oil Analysis Results, in the standardized report form set (See A6).

13.13.1 If the viscosity increase for the test is higher than 500% (See 13.13), the Cold-Cranking Simulator and Mini Rotary Viscometer tests are not required.

13.13.2 If the test oil is a straight-grade oil, the Cold-Cranking Simulator and Mini Rotary Viscometer tests are not required.

13.13.3 If the end-of-test used oil sample fails the Cold-Cranking Simulator test at -5°C, the Mini Rotary Viscometer test is not required.

13.13 Viscosity Test-Determine the viscosity of a sample of the fresh test oil and of the nine test samples by analysis according to the following instructions:

13.13.1 Do not filter the samples.

13.13.2 Use Test Method D 445.

13.13.3 Use either the Cannon-Fenske Routine Viscometer of the Ostwald Type for Transparent Liquids, or the Cannon-Fenske Opaque Viscometer of the Reverse-Flow Type for Transparent and Opaque Liquids.

13.13.4 Conduct the measurement at 40°C (104°F).

13.13.5 Record the results on Fig. A6.4

13.13.6 Critically examine the relationship of the viscosity of the initial oil sample to that of the new oil. The viscosity of the initial sample can legitimately be as much as 10 cSt less than that of the new oil, because of permanent shearing effects. If the difference is greater than 10 cSt, explore possible causes such as failure to purge the oil sample line [removing the 473-mL (16-oz) purge sample] prior to withdrawing the 237-mL (8-oz) analysis sample, or an excessive amount of build-up oil in the system.

13.13.7 Calculate the change in viscosity in centistokes, from the value for the initial sample, for the last eight samples. Record the changes on Form 6, Used Oil Analysis Results, in standardized report form set (See Annex A6). Record the final percent viscosity increase on Form 4, Test Result Summary, in standardized report form set (See Annex A6).

13.14 Blowby Flow Rate Measurements-Plot blowby flow rate measurements on Form 10, Blowby Results & Plot, in standardized report form set (See Annex A6).

13.15 Oil Consumption Computation-Compute the oil consumption for the test as follows:

13.15.1 Annex A10

13.15.2 Determine the total fresh oil added to the engine during the initial oil leveling run and 10-h test periods in Step 8 of Annex A10. Enter the total in the end-of-test total column on Annex A10.

13.15.3 Determine the total amount of oil discarded during the 80-h test periods in Step 11 of Annex A10. Enter the total in the end-of-test total column on Annex A10.

13.15.4 Determine the computed oil level in milliliters at the end of the test, Step 13 in Annex A10. Enter the number in the end-of-test total column on Annex A10.

13.15.5 Add the values determined in 13.15.2 and 13.15.4, and subtract the value determined in 13.15.3. Enter the remainder, which is the amount of oil consumed in the test, in the blank for Step 14 in the Figure shown in A10.

13.16 Photographs of Test Parts-Take color photographs of the test parts for inclusion in the test report, as follows:

13.16.1 Photograph pistons after all ratings have been completed.

13.16.2 Do not coat the pistons with build-up oil (for preservation) before the photographs are taken. Do not re-install piston rings.

13.16.3 Photograph all six piston thrust sides in one shot. No piston labels required. (see 13.16.13)

13.16.4 Photograph all six piston anti-thrust sides in one shot. No piston labels required. (see 13.16.13)

13.16.11 Size the final piston photographs for inclusion in the test report so that the overall piston height is not less than 5 cm (2 in.), but small enough that three photographs can be mounted in a column on the 28-cm (11-in.) dimension of a 22 by 28-cm (8 1/2 by 11 in.) sheet of paper.

13.16.12 Assemble the photographs on two pages, with the thrust side photographs on one page, and the anti-thrust photographs on the other page.

13.16.13 Mount the photographs on each of the two pages with the reciprocating axes of the pistons parallel to the 28-cm (11-in.) dimension of the page. Arrange the photographs in two vertical columns of three each, with the No. 1 piston in the upper left corner of the page, No. 2 piston in the upper right corner, No. 3 piston in the center of the left column, etc.

13.17 Retention of Representative Test Parts-Retain for at least 6 months, all pistons, camshaft, and lifters.

13.18 Severity Adjustments-Calculate severity adjustments (SA) for results of non-reference engine oil tests. Use the control chart technique, described in A5, for determining the laboratory bias for % viscosity increase, piston skirt varnish, and weighted piston deposits. Enter the adjustments on Form 4, Test Result Summary, in standardized report form set (See A6).

13.19 Determination of Operational Validity-Determine and document the operational validity of every Sequence IIIF test conducted, according to the following:

13.19.1 Complete the report forms to substantiate that the test stand, engine build-up, installation of the engine on the test stand, and the test operation conformed to the procedures specified in this test method.

13.19.2 Inspect the test records for instances of downtime (excluding the initial oil level run of the test), and record any such instances on Form 13, Downtime & Outlier Report Form, in standardized report form set (See A6). Enter the total downtime on Form 13, Downtime & Outlier Report Form, in standardized report form set (See A6). If the total downtime exceeds 24 h, note on Form 1, in standardized report form set (See A6) that the test is invalid.

13.19.3 Sequence IIIF tests must average higher than 23 l/m (0.812 cu.ft./m) blowby rate for hours 1 through 26 in order to be considered a valid engine build.

13.19.4 If the end of test quality index value is below 0.000, conduct an engineering review of the test operations. The engineering review will conducted by the test laboratory, and for reference oil tests the Test Monitoring Center. If needed, additional industry experts may be consulted. Document the results of the engineering review.

Annex A9
Sequence IIIF Quality Index U&L Values
(Effective 10/4/00)

Controlled Parameters	Quality Index U&L Values	
	L	U
Speed	3595	3605
Load	199.02	200.98
Air-to-Fuel Ratio	14.87	15.13
Condenser Coolant Outlet Temperature	39.77	40.23
Engine Coolant Outlet Temperature	121.54	122.46
Oil Filter Block Temperature	154.58	155.42
Exhaust Back Pressure	5.92	6.08
Intake Air Pressure	0.041	0.059
Condenser Coolant Flow	9.9	10.1
Engine Coolant Flow	158.57	161.43

Sequence IIIF Required Resolution for Data Acquisition

Controlled Parameters	Units	Required Resolution*
Speed	r/min	5.0
Load	N•m	5.1
Air-to-Fuel Ratio	--	5.2
Condenser Coolant Outlet Temperature	°C	5.1
Engine Coolant Outlet Temperature	°C	5.1
Oil Filter Block Temperature	°C	5.1
Exhaust Back Pressure	kPa	5.2
Intake Air Pressure	kPa	5.3
Condenser Coolant Flow	L/min	5.2
Engine Coolant Flow	L/min	5.1

*Decimal point is counted in format.

Maximum System Time Response - *for controlled (QI) parameters only.*
Speed - 0.10s
Torque - 0.60s
Coolant Flow - 8.0s
Intake Air Pressure - 0.75s
Exhaust Backpressure - 1.20s
Temperatures - 2.40s