Test Monitoring Center
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Sequence IIIG Information Letter 03-4
Sequence No. 4

November 13, 2003

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 III Mailing List

SUBJECT: Revised Fuel Pressure Specification
Automatic Parts Washing Machine Maintenance Requirement
Revised Main Bearing Bore Mandrel Procedure
Piston Ring Cleaning Requirements
Additional Allowable RTV Sealing Compound
Main Bearing Cap Bolt Replacement Specification
Revised Camshaft Measurement Procedure
Revised Camshaft Lubrication & Installation Procedure
Revised Oil Consumption Reporting Procedure
Fluid Conditioning Module Equipment Specifications
Revised Camshaft Measurement Equipment Specifications
Rating Workshop Attendance Requirement
Editorial Corrections
Creation of Sequence IIIGA Test Annex

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 IIIG test.

Revised Fuel Pressure Specification

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to revise the fuel pressure specification in the Sequence IIIG test procedure. The new specification is 377.5kPa ± 12.5kPa. This change is effective October 29, 2003. A revised Section 6.11 and A8.2 are attached.

Automatic Parts Washing Machine Maintenance Requirement

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to implement a maintenance requirement for automatic parts washing machines used to clean Sequence IIIG test parts. Laboratories are now required to change the soap and water solution used in these machines at least every six months. This change is effective October 29, 2003. A revised Section 10.5.3.1 is attached.

Revised Main Bearing Bore Mandrel Procedure

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to make usage of the main bearing bore mandrel optional during Sequence IIIG test engine assembly. This change is effective October 29, 2003. A revised Section 10.9.13 is attached.

Piston Ring Cleaning Requirements

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to require the removal of the paint marking dots on the piston rings prior to Sequence IIIG test engine assembly. This change is effective October 29, 2003. A revised Section 10.10.1 is attached.

Additional Allowable RTV Sealing Compound

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to allow an additional RTV sealing compound to be used during Sequence IIIG test engine assembly. This change is effective October 29, 2003. A revised Section 7.6.3 is attached.

Main Bearing Cap Bolt Replacement Specification

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to require the use of new main bearing cap bolts for each Sequence IIIG test engine assembly. This change is effective October 29, 2003. A revised Section 10.14, A2.1, and A2.2 are attached.

Revised Camshaft Measurement Procedure

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to require that the camshaft be coated with build-up oil after pre-test measurement to prevent rusting in the time between measurement and installation in the test engine. This change is effective October 29, 2003. Revised Sections 10.11.4, 10.11.5, and 10.11.6 are attached.

Revised Camshaft Lubrication & Installation Procedure

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to require that the camshaft lobes and lifters be lubricated with test oil, rather than build-up oil, during Sequence IIIG test engine assembly. This change is effective October 29, 2003. A revised Section 10.13.1 is attached.

Revised Oil Consumption Reporting Procedure

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to clarify the data to be recorded for the final dipstick oil level in a Sequence IIIG test. This change is effective October 29, 2003. A revised Section 13.10.4 is attached.

Fluid Conditioning Module Equipment Specifications

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to a list of equipment that has been found suitable for use in the Fluid Conditioning Module used in Sequence IIIG testing. This change is effective October 29, 2003. A revised Section 6.6 and new Section A13.2 are attached.

Revised Camshaft Measurement Equipment Specifications

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to change the precision requirements for camshaft and lifter measurement equipment used in the Sequence IIIG test to bring the procedural specifications in line with actual lab practices. This change is effective October 29, 2003. Revised Sections 10.11.1.1 and 13.5.3 are attached.

Rating Workshop Attendance Requirement

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to require all Sequence IIIG raters to attend a Rating Workshop annually. This change is effective October 29, 2003. A revised Section 13.4.3.4 is attached.

Editorial Corrections

Section 13.3.3 of the Sequence IIIG Test Procedure contains a reference to an incorrect section. A revised Section 13.3.3, with the correct section reference, is attached. Section 11.4.4 was also updated with the Test Developer's new mailing address for final test reports.

Creation of Sequence IIIGA Test Annex

At the October 29, 2003 meeting of the Sequence III Surveillance Panel, the panel approved a motion to create the Sequence IIIGA test and add it to the Sequence IIIG Test Procedure as an Annex. This new test consists of running a normal Sequence IIIG test, minus the rating and wear measurement portions of the Sequence IIIG test, and then performing CCS & MRV measurements on the final used oil sample. This change is effective November 3, 2003. A new Annex A.14 is attached.

Sidney L. Clark
Senior Contact Engineer
GM Powertrain Materials Engineering

John L. Zalar
Administrator
ASTM Test Monitoring Center

Attachments

c: ftp://ftp.astmtmc.cmu.edu/docs/gas/sequenceiii/procedure_and_ils/IIIG/IL03-4.pdf

Distribution: Email

6.6 Sequence IIIG Fluid Conditioning Module -Use the Kundinger Fluid Conditioning Module to control the following parameters: engine coolant, condenser coolant, oil cooler coolant, exhaust manifold coolant, and the test fuel supply. The system incorporates the following features: pumps, flow meters, flow control and three-way control valves, external heating and cooling systems, pressure regulator and low-point drains. The system integrates with the test stand data acquisition and control computer for process control. If a laboratory wishes to build it's own Fluid Conditioning Module, a list of suitable equipment can be found in A13.

6.11 Fuel System- Contained in the Fluid Conditioning Module, a pressurized, recirculating fuel system, including a pressure regulator to provide 377.5 kPa ± 12.5 kPa (54.75 ± 1.83 psi) fuel pressure. The system should be switched off so no fuel pressure is present at the injector rail during engine shutdowns.

7.6.3 Either GM Black RTV sealer[yy], part number 12346193, or Dow RTV Grade 3154 sealer[zz] is allowable for use on the oil pan gasket and intake manifold gasket only. See Sequence IIIG Engine Assembly Manual section 4 sheet 13 and section 6 sheet 6.

[yy] GM Black RTV Sealer is available from local GM dealers.

[zz] Dow RTV Grade 3154 sealer is available from commercial sources.

10.5.3.1 The block should be cleaned in a heated bath or temperature controlled automated parts washer before and after honing. Follow the suggested guidelines as listed below to ensure there is no oxidation flash over of the engine block after this process.

1) Use only NAT-50 or PDN-50 soap at a concentration of 16 pounds of soap per 100 gallons of water. The soap and water solution shall be changed at least every six months.
2) Set the temperature of the water to 140 degrees F.
3) Do not pre-condition the water that is being used in any way.
4) Prior to installing the engine in the parts washer, ensure that all coolant passages are blocked off to prevent cleaning solutions from entering the passages.
5) Allow the block to run through the cleaning cycle for a period of 30 to 40 minutes.
6) After the cycle is complete, immediately remove the block from the washer and spray it down with aliphatic naphtha.
7) Wipe cylinder bores out with a lint free towel.
8) Spray engine block with a mixture of 50/50 build-up oil and aliphatic naphtha.

10.9.13 If desired, check the main bearing bore clearances using a mandrel, part BX-398-1, according to the following procedure:

Starting from the front of the block, slide the mandrel through all four main bearing bores. If excessive resistance is encountered while inserting the mandrel, remove the mandrel from the engine block and inspect the main bearing bores for burrs, nicks, dirt, alignment problems, or any abnormalities. Use 400 grit paper or a fine stone to carefully remove any nicks, burrs, scratches, or dirt. Then use a clean shop towel with aliphatic naphtha to wipe the affected surfaces. Reinstall the mandrel to ensure that it can freely pass through all four main bearing bores. If the mandrel will not clear the bores after the above steps have been completed, the block should not be used. Notify the Test Developer of the problem. After honing, the above procedure should be repeated prior to final engine build. The mandrel is an alignment and clearance gage only, not an assembly tool. The mandrel should not be in the bores when installing the main bearing caps or torquing the main bearing bolts.

10.10.1 Piston Rings- The rings are pre-sized for each run and the gap shall be checked in the cylinder bore for each test. Prior to checking the piston ring gaps, any paint marks on the rings shall be removed using acetone and a soft cloth, followed by a mineral spirits rinse. The top ring gap shall be 0.635 mm ± 0.051 mm (0.025 in ± 0.002 in). The bottom ring gap shall be 1.067 mm ± 0.051 mm (0.042 in ± 0.002 in). The top ring gap shall be larger than the bottom ring gap and the difference between the two ring gaps shall be between 0.381 mm and 0.483 mm (0.015 in and 0.019 in). If the ring gap difference is below 0.381 mm (0.015 in) contact the Test Developer. Check the ring gap with a Starrett Ring Taper Gage No. 270[xx] with the ring positioned in the cylinder bore using a piston ring depth gage (drawing RX-118602-B). Rings shall be positioned at 23.67 mm (0.932 in) below the cylinder block deck surface during gap measurement.

Record the top and bottom ring gaps on Form 12, Hardware Information, in standardized report form set (See A6). Ring gaps shall be recorded and reported in mils (1 mil = 0.001 in).

[xx] A Starrett Ring Taper Gage No. 270 has been found suitable. It is available from commercial sources.

10.11.1.1 Use dimensional measuring equipment accurate to 0.01mm. Before each measurement session, use standards traceable to the National Institute of Standards and Technology, to ensure measuring equipment accuracy. Include standards having length values within 1.3 mm (0.05 in.) of the typical lifter and lobe measurements taken. Use the same equipment and standards for post-test measuring as were used for pre-test measuring. If a calibration shift between pre-test and post-test measurements is detected, evaluate the shift to determine its effect on the wear measurements. Record the results of the evaluation, and any corrective action taken.

10.11.4 After measuring, coat the camshaft with build-up oil.

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.

10.13.1 Coat the camshaft lobes and journals with a light film of test oil on the journals.
{Note 39 deleted}

10.14 Main Bearings-Verify that the main bearing bore areas in the engine block and bearing caps are clean. Install new main bearings, part number OHT3F-042-2, in the engine block and main bearing caps, and lightly oil the bearing surfaces with build-up oil. New main bearing cap bolts shall be used for each Sequence IIIG test engine build.

11.4.4 Send by mail one copy of the standard final report (Use the report forms supplied by the ASTM TMC. Report forms can be obtained from the TMC web site: *ftp://ftp.astmtmc.cmu.edu/datadict/* or by contacting the TMC.) to the Test Developer, and one copy of the report to the ASTM TMC, at the following addresses in order that the records are received within 30 days of test completion.

General Motors Corporation
Engine Engineering Building
Mail Code 483-730-322
Sequence IIIG Test Coordinator
823 Joslyn Road
Pontiac, MI 48340-2920

Test Report Clerk
ASTM Test Monitoring Center
6555 Penn Avenue
Pittsburgh, PA 15206

13.3.3 If the piston deposits cannot be rated immediately after the pistons are removed from the engine, store the pistons in a desiccator for no longer than 72 h from end of test before rating. Do not wipe the pistons before storing them. See 13.4.

13.4.3.4 All raters of Sequence IIIG engine parts shall attend a Rating Workshop annually. If a rater misses a scheduled workshop, they shall attend alternate training within 90 days, as directed by the TMC.

13.5.3 Use dimensional measuring equipment accurate to 0.01mm. Before each measurement session, use standards traceable to the National Institute of Standards and Technology, to ensure measuring equipment accuracy. Include standards having length values within 1.3 mm (0.05 in.) of the typical lifter and lobe measurements taken. Use the same equipment and standards for post-test measuring as were used for pre-test measuring. If a calibration shift between pre-

test and post-test measurements is detected, evaluate the shift to determine its effect on the wear measurements. Record the results of the evaluation, and any corrective action taken.

13.10.4 Determine the computed oil level in milliliters at the end of the test, in Fig. A10.1. The computed oil level is found by subtracting 708mL from the oil level as measured on the dipstick, to account for samples not returned (236mL oil sample and 472mL of new oil) to the engine as in previous shutdowns. Enter the number in the end-of-test total column on Fig. A10.1 in position "c."

Table A2.1 Parts to be Replaced Every Test

PART DESCRIPTION	PART NUMBER
Arm, Rocker with Pivot Bearing	OHT3F-058-1
BEARING, KIT, ENGINE	OHT3F-042-2
KIT INCLUDES:	
BEARING, CONNECTING ROD, KIT, UPPER AND LOWER, OH-106 ASSY	3F042-01
MAIN BEARING KIT, OH101 ASSY, INCLUDES:	3F042-02
Bearing, Balance Shaft Front (part of 24502388)	SKF6205-2ZNRJEM
BEARING, MAIN, LOWER, #1 AND 3	OH-102
BEARING, MAIN, LOWER, #4	OH-103
BEARING, MAIN, LOWER, FLANGE, #2	OH-104
BEARING, MAIN, UPPER, FLANGE, #2	OH-105
BEARING, CAM BUSHING, POSITIONS 1 & 4	3F028-09
BEARING, CAM BUSHING, POSITIONS 2 & 3	3F028-10
Bolt, Camshaft Sprocket	24501366
Bolt, Cylinder Head, Long	25527831
Bolt, Cylinder Head, Short	25533811
Bolt, Flywheel	24505092
Bolt, Main Cap	24503056
Bolt, Main Cap, Side	24505576
Bolt, Rear Cover Housing	24503970
Bolt, Rocker Arm, Special Test	3F-058-02
Camshaft, Special Test, including Manganese-phosphate coating	OHT3F-008-8
Cap, Valve Spring Retainer	24502257
Chain, Timing	24504668
Clip, Retainer, Piston Pin	OHT3F-012-1
COOLER, OIL, NICKEL PLATED, BYPASS CLOSED	OHT3F-030-2
Damper, Timing Chain (includes bolt, retaining ring)	24503893
FILTER, PRO TEC	OHT3F-057-3
Gasket kit, Intake Manifold lower	12539094
Gasket, Cylinder Head, left	24503802
Gasket, Cylinder Head, right	24503801
Gasket, Front Cover	24502252
Gasket, Oil Filter Adapter	25534742
Gasket, Oil Pan	24502397
Gasket, Oil Suction Tube	24501259
Gasket, Rear Cover Housing	24507388
Gasket, Rocker Cover	25532619
Gasket, Water Oulet	24502433
Gasket, Water Pump	24501565
Head, Cylinder	24502260
Key, Camshaft Sproket	24500618
Key, Valve Stem Keeper	1016634
Lifter, Test ACI w/Flat (25338738A)	OHT3F-029-3
PIN, PISTON WRIST, PKG. OF 6	OHT3F-014-1
PISTON, TEST, RUNS 1 & 2, GRADE 12	OHT3F-053-1
PISTON, TEST, RUNS 3 & 4, GRADE 34	OHT3F-054-1
PISTON, TEST, RUNS 5 & 6, GRADE 56	OHT3F-055-1
PLATE, CAMSHAFT THRUST, .1520" THICKNESS	OHT3F-011-2
Plug, Engine Block Core Hole	24500867
Plug, Cylinder Head Core Hole	3835577
Plug, Cylinder Head Cup	9427698
Plug, Engine Block, Oil Gallery	24500867
Plug, Ignition Spark	AC R42LTSM

PART DESCRIPTION	PART NUMBER
Plunger, Oil Relief	25530949
PUSHROD, SPECIAL LENGTH, PKG. OF 12	OHT3F-007-1
RETAINER CLIP, PISTON PIN PKG. OF 12	OHT3F-012-1
1 EA. RING, PISTON, RUN 1, ENGINE SET	OHT3F-050-RUN1
1 EA. RING, PISTON, RUN 2, ENGINE SET	OHT3F-050-RUN2
1 EA. RING, PISTON, RUN 3, ENGINE SET	OHT3F-051-RUN3
1 EA. RING, PISTON, RUN 4, ENGINE SET	OHT3F-051-RUN4
1 EA. RING, PISTON, RUN 5, ENGINE SET	OHT3F-052-RUN5
1 EA. RING, PISTON, RUN 6, ENGINE SET	OHT3F-052-RUN6
ROCKER ARM ASSEMBLY (Includes: 3F058-02)	OHT3F-058-1
Rod, Connecting	24501696
Seal, Crankshaft Front Oil (Lip Seal)	24504098
Seal, Crankshaft Rear Oil (Lip seal)	25534760
SEAL, EXHAUST VALVE STEM	OHT3F-061-1
SEAL, INTAKE VALVE STEM	OHT3F-060-1
Spring, Oil Relief Valve	1262505
SPRING, VALVE Special Test (COLOR CODE YELLOW)	OHT3F-059-5
Sprocket, Camshaft	24505306
Valve, Exhaust (STD)	24507423
Valve, Intake (STD)	12569550

Table A2.2 Parts to be Replaced As Needed (3 pages)

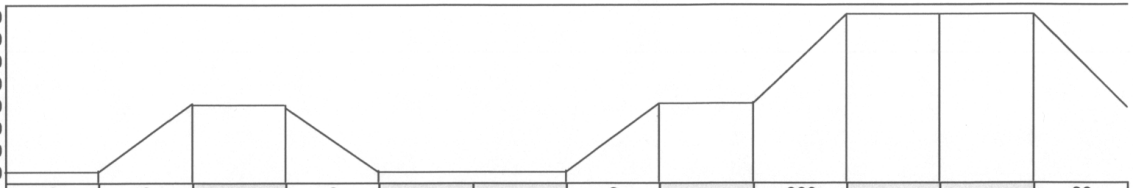
PART DESCRIPTION	PART NUMBER
ADAPTER, BLOWBY BREATHER TUBE	OHT3F-040-1
ADAPTER, OIL FILTER	OHT3F-035-1
Adapter, Throttle Body, Air Inlet	OHT3F-001-2
Balancer, Harmonic	24507058
Bearing, Balance Shaft Front (part of 24502388)	SKF6205-2ZNRJEM
Block, Engine Assembly	24506028
Bolt / Screw, Thrust Plate retainer	25519242
Bolt, Connecting Rod	25531956
Bolt, Counter Balance Gear	24501367
Bolt, Counter Balance Shaft retainer	24500055
Bolt, Harmonic Balancer	24506341
Bolt, Oil Filter Adapter	24504713
Bolt, Oil Pan	24502791
Bolt, Oil Suction Tube	24505570
Bolt, Rocker Cover W / Washer	25534748
Bolt, Screw Camshaft Sensor	25526395
Bolt, Screw, Oil Gearotor, Cover	25519242
Bolt, Stud Type, Front Cover & Crankshaft Sensor	24504717
Bolt, Upper Intake Long	24505205
Bolt, Upper Intake Short	24506498
Bolt, Upper Intake, Stud	24502453
BRACKET, BREATHER TUBE	OHT3F-041-1
BREATHER TUBE, S.S. MATERIAL	OHT3F-075-1
Bushing, Balance Shaft Rear	24503193
BUSHING, ROCKER COVER	OHT3F-028-1
CONNECTOR, MODIFIED FOR LENGTH, GM PN 24502883	OHT3F-039-2
COVER, FRONT, IMPREGNATED	OHT3G-085-1
Cover, Oil Gearotor	25521935
Cover, Rocker Arm Valve Cover Left Side Plastic	25534753
Crankshaft	34502168
DIP STICK, METRIC, EXTENDED LENGTH	OHT3G-064-1
FITTING, OIL FILTER ADAPTER	OHT3F-043-1
FLYWHEEL, MANUAL, MODIFIED P.N. 24503285	OHT3F-020-2
GASKET, EXHAUST, END PLATE	OHT3F-009-1
GASKET, EXHAUST, FLANGE, METAL	OHT3F-018-1
Gasket, Manifold, Upper Intake	17113137
GASKET, OIL COOLER, PKG. OF 50	OHT3F-074-1
GASKET, OIL FILTER, PKG. OF 50	OHT3F-062-1
Gear, Balanceshaft Drive	24504792
Gear, Balanceshaft Driven	24503524
Gear, Counter Balance Drive	24504792
Gear, Counter Balance Shaft	24503524
Grommet, Rocker Arm Valve cover bolt	25534749
HARNESS, COIL PACK SEGMENT	3F022-2
HARNESS, FUEL INJECTOR SEGMENT	3F022-1
HARNESS, WIRING, DYNO W/ OHT3F-056-1 SENSOR	OHT3F-022-1
HOUSING, ASSEMBLY, BYPASS VALVE	OHT3F-084-1
Injector, Fuel	17120601
Key, Crankshaft	25534912
Magnet, Camshaft Position Sensor	10456195
MANIFOLD, CAST IRON	OHT3F-003-0

PART DESCRIPTION	PART NUMBER
MANIFOLD, EXHAUST, WATER COOLED ASSY (ONE BANK)	OHT3F-003-1
ASSEMBLY INCLUDES:	
1 EA. RUNNER, EXHAUST MANIFOLD	OHT3F-004-1
1 EA. PLATE, REAR, EXHAUST MANIFOLD	OHT3F-005-1
1 EA. ELBOW, EXHAUST, MODIFIED	OHT3F-005A-1
1 EA. PLATE, FRONT, EXHAUST MANIFOLD	OHT3F-006-1
2 EA. GASKET, EXHAUST, END PLATE	OHT3F-009-1
1 EA. GASKET, EXHAUST, FLANGE, METAL	OHT3F-018-1
Manifold, Lower Intake	24505728
Manifold, Upper Intake	17096162
METER, BLOWBY	RX-116169-A1 REV N
Module, Assembly, Coil Pack	1103948
MOUNT FRONT ENGINE W/ BOLT PATTERN FOR COIL PACK	OHT3F-026-1
MOUNT, REAR ENGINE HOUSING W/ AIR STARTER, MUFFLER & SHIM PACK	OHT3F-025-1
ASSEMBLY INCLUDES:	
STARTER, AIR	3F025-03
MUFFLER, STARTER, AIR	3F025-04
SHIM PACK, STARTER, AIR	3F025-05
MUFFLER, STARTER, AIR	3F025-04
Nut, Throttle Body Fuel Rail Retainer	24506469
Nut, Throttle body Retainer	24506469
OIL FILTER HOUSING ASSEMBLY, NO BYPASS, IMPREGNATED	OHT3G-080-1
OUTLET, COOLANT	OHT3F-034-1
PAN, IIIF TEST, NICKEL PLATED	OHT3F-073-1
PCM, SPECIAL	OHT3F-021-1
PCV, DUMMY	OHT3F-002-1
Pin, Cylinder Head Locating	25536320
Pin, Front Cover Lower	25536323
Pin, Front Cover Upper	24501162
Pin, Transmission Locating	12338076
PLATE, EGR BLOCKOFF	OHT3F-024-1
PLATE, FRONT, EXHAUST MANIFOLD	OHT3F-006-1
PLATE, REAR, EXHAUST MANIFOLD	OHT3F-005-1
PLATE, WATER PUMP HOUSING	OHT3F-031-1
Plug, Auto Hex, Socket, (Main Oil Gallery Block Off)	444777
PLUG, DIP STICK	OHT3F-065-1
PLUG, DRAIN, MODIFIED	OHT3F-063-1
Pump, Oil, Gearoter Set	24505433
Rail, Fuel	17113198
Rail, Fuel Injector	17120601
REAMER, DIP STICK AND DIP STICK HOLE PLUG	OHT3F-071-1
Regulator, Fuel Pressure, on Rail	17113346
Retainer, Counter Balance, Timing Chain Oiler	2450055
RUNNER, EXHAUST MANIFOLD	OHT3F-004-1
Screen, Oil pump (w/suction pipe)	24505569
Seal, oil pan drain plug (o ring)	3536966
Sensor, Camshaft Position	10456148
Sensor, MAF	24503983
Sensor, Mass Air Flow (2 Bolt, Use with Throttle Body 24507235)	24503983
Sensor, Mass Air Flow (3 Bolt, Use with Throttle Body 24507230)	24504302
SENSOR, MODIFIED COOLANT TEMPERATURE	OHT3F-056-1
Shaft Assembly, Counter Balance	24502388
Shield, Crankshaft Position Sensor	24506440

PART DESCRIPTION	PART NUMBER
SHIM PACK, STARTER, AIR	3F025-05
SHIM, STEEL, .005" THICK, 10 PER PKG.	OHT3F-072-005
SHIM, STEEL, .010" THICK, 10 PER PKG.	OHT3F-072-010
SHIM, STEEL, .015" THICK, 10 PER PKG.	OHT3F-072-015
SHIM, STEEL, .020" THICK, 10 PER PKG.	OHT3F-072-020
SHIM, STEEL, .031" THICK, 10 PER PKG.	OHT3F-072-031
SLEEVE, VALVE STEM PROTECTORS (PKG. OF 100)	OHT3F-070-1
SPROCKET, CRANKSHAFT, SPECIAL 2 PC	OHT3F-036-1
STARTER, AIR	3F025-03
Throttle Body (2 Bolt Mass Air Flow Sensor)	24507235
Throttle Body (3 Bolt Mass Air Flow Sensor)	24504302
TOOL, CAMSHAFT BUSHING INSTALLATION	OHT3F-019-2
TOOL, OIL PUMP PRIMER	OHT3F-038-1

Seq. IIIF Test States **Annex A8.2**

Dyno Speed

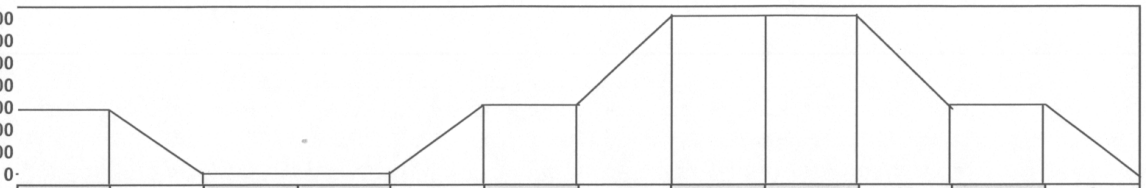


Ramp Time (seconds)	0	3		3			3		900			30
Dyno Speed Setpoint	0	1500	1500	0	0	0	1500	1500	3600	3600	3600	1500
Dyno Load Setpoint	0		40	0	0	0		40	200	200	200	40
Step Time (seconds)			600		900	300		90	900	900*	36000	30
State Name	Hold	Engine Start	Initial Run-in	Shut Down	Oil Level	Return Leveling Sample	Engine Start	Idle	Break-in Linear Ramp-up	Break-in Warm-up	On-Test Condition	Ramp Down
Temperature °C												
Oil Filter Block	50	50	50	50	50	50	50	50	155	155	155	50
Engine Coolant Out	50	50	50	50	50	50	50	50	122	122	122	50
Condenser Coolant Out	40	40	40	40	40	40	40	40	40	40	40	40
Pressure kPa												
Exh. Back Right/Left	3	3	3	3	3	3	3	3	6	6	6	3
Inlet Air	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Fuel	Off	377.5	377.5	377.5	Off	Off	377.5	377.5	377.5	377.5	377.5	377.5
Flow L/m												
Engine Coolant	160	160	160	160	160	160	160	160	160	160	160	160
Condenser Coolant	10	10	10	10	10	10	10	10	10	10	10	10
Oil Cooler (3-way)	12	12	12	12	12	12	12	12	12	12	12	12

* Typical warm-up transition time to on test condition about 8 minutes.
** Typical warm-up transition time to on test condition about 18 minutes.
All ramp times are linear with respect to dyno speed and load settings.
All temp., press., and flow settings are setpoint changes between states. Control systems should allow for overshoot and stabilization.

Seq. IIIF Test States — **Annex A8.2**

Dyno Speed



Ramp Time (seconds)		3			3		30			30		3
Dyno Speed Setpoint	1500	0	0	0	1500	1500	3600	3600	3600	1500	1500	0
Dyno Load Setpoint	40	0	0	0		40	200	200	200	40	40	0
Step Time (seconds)	90		900	300		90	30	1800**	36000	30	90	
State Name	Cool Down & Sample	Shut Down	Oil Level	Return Leveling Sample	Engine Start	Idle	Linear Ramp-up	Test Condition Warm-up	On-Test Condition	Ramp Down	Cool Down & Sample	Shut Down
Temperature °C												
Oil Filter Block	50	50	50	50	50	50	155	155	155	50	50	50
Engine Coolant Out	50	50	50	50	50	50	122	122	122	50	50	50
Condenser Coolant Out	40	40	40	40	40	40	40	40	40	40	40	40
Pressure kPa												
Exh. Back Right/Left	3	3	3	3	3	3	6	6	6	3	3	3
Inlet Air	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Fuel	377.5	377.5	Off	Off	377.5	377.5	377.5	377.5	377.5	377.5	377.5	Off
Flow L/m												
Engine Coolant	160	160	160	160	160	160	160	160	160	160	160	160
Condenser Coolant	10	10	10	10	10	10	10	10	10	10	10	10
Oil Cooler (3-way)	12	12	12	12	12	12	12	12	12	12	12	12

A13.2 A list of components that have been found suitable for use in the Fluid Condition Module are shown in Table A13.2.

System	Component	Make	Model	Comments
Fuel	**Pump**	KFI	10210	12 VDC
	Flow Meter	Micro Motion		
	Pressure Regulator (on-rack)	Weldon	2040-200-A-170	
	Heat Exchanger	Elanco	M11	
	Check Valve	Sharpe	FNW-16	
	Solenoid Valve	Skinner	72218RN4UV00N0H222P3	
	Filter	Racor	110A	
System	**Component**	**Make**	**Model**	**Comments**
Engine Coolant	**Pump**	Aurora	341ABF 1-1/2 x 2 x 9	
	Flow Meter	ABB/Fisher Porter	10VT1000	1111ADH11C12AA0A has been replaced
	Heat Exchanger	Elanco	M71FL	
	Heater	Chromalox	ARTMS-1250TL	
	3-Way Control Valve	SVF	T7-6666TT150-S1	2" Valve
	2-Way Control Valve	Orion/Badger Meter	9003GCW36SV3A29L36	2" Valve (same as used on Sequence VIB)
	Inlet Line I.D. / Total Length	2"	226"	Total run from Process Controller to Engine Inlet Adapter
System	**Component**	**Make**	**Model**	**Comments**
Breather Tube	**Pump**	Aurora	133-BF-E03 1-3/4 x 3/4	
	Flow Meter	Sparling	FM625*	
	Heat Exchanger	Elanco	M21	
	Heater	Chromalox	3CVCHS-151	
	3-Way Control Valve	SVF	T7-6666TTSE-S1	1/2" Valve
	2-Way Control Valve	SVF	V7-6666NTSE-V60	1/2" Valve
	Back Pressure Valve	???		
System	**Component**	**Make**	**Model**	**Comments**
Oil Cooler	**Pump**	Aurora	133-BF-E03 1-3/4 x 3/4	
	Flow Meter	Sparling	FM625*	
	3-Way Control Valve	SVF	T7-6666TTSE-S1	1/2" Valve
	2-Way Control Valve	SVF	V7-6666NTSE-V30	1/2" Valve

Table A13.2 Fluid Conditioning Module Components

A14. Sequence IIIGA Test Procedure

A14.1 *Overview*

A14.1.1 The Sequence IIIGA test was developed to generate a used oil sample for subsequent testing of Apparent Viscosity in the Mini Rotary Viscometer using Test Method D4684. (This Apparent Viscosity result will hereafter be referred to as the MRV result or MRV.) No parts ratings or measurements are required in the Sequence IIIGA test. A separate Sequence IIIGA Report Form Set is available from the TMC for reporting Sequence IIIGA test results. The Sequence IIIG Report Form Set shall not be used to report Sequence IIIGA test results.

A14.2 *Preparation of Apparatus* – Prepare the Sequence IIIGA test engine in the same manner as a Sequence IIIG test engine. The lone exceptions being that the pre-test camshaft and lifter measurements are not required. No special preparations, other than the exception outlined above, are required or permitted on test engines for Sequence IIIGA use.

A14.3 *Calibration*

A14.3.1 There is no stand-alone calibration system for the Sequence IIIGA test. For a stand to be considered calibrated for Sequence IIIGA testing it shall be calibrated for Sequence IIIG testing. A Sequence IIIGA test shall be conducted simultaneously with each Sequence IIIG test and an appropriate severity adjustment for MRV calculated from that test result.

A14.3.2 No special calibration of stand instrumentation is required for Sequence IIIGA testing.

A14.3.3 Severity adjustments for MRV shall be calculated for all Sequence IIIGA reference oil tests and shall be applied in the same manner as severity adjustments in the Sequence IIIG test.

A14.3.4 A Sequence IIIGA test counts as one run against the Sequence IIIG calibration period in which it is run. A test run as a combined Sequence IIIG/Sequence IIIGA test counts as only one run against the calibration period.

A14.4 *Test Procedure* – The Sequence IIIGA test can be conducted in one of two ways:

A14.4.1 *Stand-alone Sequence IIIGA Test* – If only a Sequence IIIGA test result is needed, conduct the test in the normal manner as listed in this Test Method with the exception of ratings, wear measurements, or assessment of stuck rings. The oil sampling required in the Test Method shall still be performed, but no subsequent analysis (kinematic viscosity, ICP analysis) of those samples is required. Perform MRV and Cold Crank Simulator (CCS) measurements, Test Method D5293, on the final oil sample taken from the engine. The CCS result shall be used to set the temperature for performing the MRV measurement.

A14.4.2 *Combined Sequence IIIG/Sequence IIIGA Test* – If both Sequence IIIG and Sequence IIIGA test results are desired on an oil, conduct the test in the normal manner as listed in this Test Method, including all ratings, measurements, and used oil analyses. Once completed, perform MRV and Cold Crank Simulator (CCS) measurements, Test Method D5293, on the final oil sample taken from the engine and report these results as the Sequence IIIGA results. Report the Sequence IIIG results in the normal manner.

A14.5 *Quality Index* – Calculations of quality index results for Sequence IIIGA test results shall be calculated in the same manner as Sequence IIIG test results.

A14.6 *Test Reporting* – Report Sequence IIIGA tests using the standard report form set, available from the TMC.

A14.7 *Precision & Bias* – The precision and bias of this test method for measuring Apparent Viscosity (MRV) are specified in Test Method D4684.