

SEQUENCE IVB TEST INSTRUCTIONS

GASW438

DOCUMENT REVISION LOG

REVISION LEVEL	DATE APPROVED	ISSUED BY	REVISION DESCRIPTION
0	04-27-2015	CHTM	In-service on this date.
1	04-30-2015	CHTM	Removed instructions to turn the coolant heater breaker "on" and "off". Added instructions for charging the engine coolant.
2	05-13-2015	CHTM	Modified document based on feedback from 1 st Sequence IVB Prove-Out matrix test (TRNS9TF7C).
3	05-27-2015	CHTM	Added instructions to take E.O.T. lifter clearance measurements.
4	06-05-2015	CHTM	Modified document after feedback from 2 nd Sequence IVB Prove-Out matrix test (TRNX713KB).
5	08-17-2015	CHTM	Continue to modify document based on revisions to ASTM procedure and experience gained from running prove-out matrix testing.
6	10-01-2015	CHTM	Includes updates to LTR and ET2 Data Viewer.
7	10-07-2015	CHTM	Changed E.O.T. oil sample volume to 4-oz.

8	12-17-2015	CHTM	Added instructions for resetting throttle control, operator initials for oil charge, disconnect ignition coils for compression checks, cleaning and LTR.
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DOCUMENT REVISION LOG

REVISION LEVEL	DATE APPROVED	ISSUED BY	REVISION DESCRIPTION
9	03-10-2016	CHTM	Clarified the naming convention for the flush hours.
10	04-01-2016	CHTM	Added provisions for the new OHT oil pan.
11	04-12-2016	CHTM	Clarified instructions for calibrating load cell. Updated set points with new coolant flow control strategy.
12	05-18-2016	CHTM	Coolant flow set points updated (FRAC = 120 L/min, FCLEO = 50 L/min). Also added instructions to take pre-test and post-test dipstick measurements.
13	06-03-2016	CHTM	FCLEO set point changed to 80 L/min.
14	07-27-2016	CHTM	Added a field to record the official ACC start time. Also updated the test conditions to include blowby temperature.
15	08-12-2016	CHTM	Eliminate pre-test coolant warming procedure. Added additional engine flush (oil pan only).
TMC	08-15-2016	CHTM	This version of the work instructions was provided to the TMC as a temporary IVB test procedure.

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1. NOTES:

- 1.1. This work instruction form is to be completed during the course of a Sequence IVB test.
 - 1.1.1. This completed form needs to be included in the test packet.

2. CONFIRM THE FOLLOWING ITEMS:

- 2.1. Confirm that the following hardware is installed in the engine:
 - 2.1.1. Test intake camshaft Complete:
 - 2.1.2. Test exhaust camshaft Complete:
 - 2.1.3. Test bucket lifters Complete:
 - 2.1.4. High-tension intake valve springs (P/N DDU43-10535) Complete:
 - 2.1.5. OHT water-cooled rocker arm cover Complete:
 - 2.1.6. OHT front cover Complete:
 - 2.1.7. OHT rear cover Complete:
 - 2.1.8. OHT oil pan with dipstick Complete:
 - 2.1.9. New spark plugs (90919-01258) with a gap of 1.1mm or 0.043-inches Complete:

2.2. Confirm that the correct fuel hose is connected in the fuel shed and record the fuel batch number:

2.2.1. **Fuel Batch Number:**

- 2.3. Confirm that the PCM is plugged in. Complete:
- 2.4. Confirm that the fuel injector wires are connected correctly. Complete:
 - 2.4.1. *NOTE:* The connector colors should be brown for Cylinder #1, gray for Cylinder #2, brown for Cylinder #3 and gray for Cylinder #4.
- 2.5. Confirm that the ignition coil wires are connected correctly. Complete:
 - 2.5.1. *NOTE:* The connector colors should be black for Cylinder #1, gray for Cylinder #2, black for Cylinder #3 and gray for Cylinder #4.
- 2.6. Open up the front door to the blue computer cabinet and confirm that the **Dynamometer** and **Throttle** indicator lights on the **DyneSystems** unit are both green. Complete:

3. CHARGE THE ENGINE COOLANT:

- 3.1. *NOTE:* The engine coolant must be changed after each engine replacement, cylinder head replacement, or any time the coolant system hardware was serviced (i.e. replacing a coolant pump).

- 3.2. Confirm that the test stand has the proper LO/TO equipment installed. **N/A:** **Complete:**
- 3.3. Confirm that the coolant system is no longer pressurized. **N/A:** **Complete:**
- 3.4. Remove the cap from the engine coolant reservoir. **N/A:** **Complete:**
- 3.5. Set the engine coolant flow control valve to the fully open position and verify that all drains are closed and all hoses are connected. **N/A:** **Complete:**
- 3.6. Prepare approximately **12-gallons** of 30% Havoline Extended Life Dex-Cool coolant and 70% deionized or distilled water. **N/A:** **Complete:**
- 3.7. Charge the coolant by filling the system from the top or by pumping coolant into the system from the bottom drain of the heat exchanger. **N/A:** **Complete:**
 - 3.7.1. Fill the system until the coolant is 2-inches from the top of the vertical sight glass located on the side of the main coolant reservoir.
 - 3.7.2. Secure the coolant reservoir cap once the system is full.
- 3.8. Adjust the system pressure to approximately 10psi. **N/A:** **Complete:**
- 3.9. After 1-hour, turn off the coolant pump and reduce the coolant pressure to 0psi.
 - 3.9.1. Remove the reservoir cap and add additional coolant as needed to return the level to within 2-inches from the top of the vertical sight glass. **N/A:** **Complete:**
- 3.10. Secure the coolant reservoir cap.
 - 3.10.1. Pressurize the system to 10psi. **N/A:** **Complete:**

4. CHARGE THE ROCKER ARM COVER COOLANT:

- 4.1. *NOTE:* The rocker arm cover coolant must be changed after each engine replacement, cylinder head replacement, or any time the coolant system hardware was serviced (i.e. replacing a coolant pump).
- 4.2. Confirm that the test stand has the proper LO/TO equipment installed. **N/A:** **Complete:**
- 4.3. Verify that all drains are closed and all hoses are connected. **N/A:** **Complete:**
- 4.4. Remove the pressure cap from the valve cover coolant reservoir. **N/A:** **Complete:**

- 4.5. Prepare approximately **23-liters** of 30% Havoline Extended Life Dex-Cool coolant and 70% deionized or distilled water. N/A: Complete:

- 4.6. Charge the coolant by filling the system from the top or by pumping coolant into the system from the bottom drain of the heat exchanger. N/A: Complete:
 - 4.6.1. Fill the system until the coolant is 2-inches from the top of the vertical sight glass located on the side of the main coolant reservoir.
 - 4.6.2. Secure the coolant reservoir cap once the system is full.

- 4.7. Allow the coolant to circulate for approximately 1-hour. N/A: Complete:

- 4.8. After 1-hour, turn off the coolant pump and reduce the coolant pressure to 0psi.
 - 4.8.1. Remove the valve cover reservoir cap and add additional coolant as needed to return the level to within 2-inches from the top of the vertical sight glass. N/A: Complete:

- 4.9. Secure the coolant reservoir cap. N/A: Complete:

5. FLUSH THE EXTERNAL OIL SYSTEM:

- 5.1. Disconnect the supply and return lines from the remote oil filter housing adapter that is mounted on the engine. Complete:

- 5.2. Connect the supply and return lines to a portable flush cart (with a minimum capacity of 1-gallon) that is equipped with a pump. Complete:
 - 5.2.1. Charge the flush cart with clean Stoddard solvent.

- 5.3. Activate the pump on the cart and allow Stoddard to circulate through the test stand's oil system for approximately 1-hour. Complete:

- 5.4. After the solvent circulates through the oil circuit for 1-hour, deactivate the pump and place empty containers underneath the two oil heat exchanger drain valves.
 - 5.4.1. Open the two heat exchanger drain valves.
 - 5.4.2. Allow the heat exchanger to completely drain. Complete:

- 5.5. Disconnect the supply and return lines from the portable flush cart. Complete:

- 5.6. Connect the supply and return lines to a clean, dry compressed air source that is operating at approximately 20psi. Complete:
 - 5.6.1. Leave the two drain valves open and keep the Stoddard collection containers in place.

5.6.2. Allow compressed air to flow through the oil circuit for approximately 15-minutes to remove any residual Stoddard from the lines.

5.7. Disconnect the supply and return lines from the compressed air source. **Complete:**

5.8. Connect the supply and return lines back on the remote oil filter housing adaptor located on the engine. **Complete:**

5.9. Close the two heat exchanger drain valves. **Complete:**

5.10. Remove the Oberg oil filter element for cleaning. **Complete:**

5.10.1. *NOTE:* The Oberg oil filter housing is located underneath the front of the engine cradle.

5.10.2. Take the Oberg oil filter element to the Spray Room and remove any debris using Stoddard solvent and compressed air.

5.10.3. Confirm that the correct Oberg filter is being used (**OHT6A-013-2**, 28µm).

5.10.4. Once the Oberg oil filter element is dry, reinstall it in the Oberg oil filter housing and secure the four bolts.

5.11. Dispose of the used Stoddard and remove the two collection containers. **Complete:**

5.12. Disconnect the oil sample and oil pressure transducer lines and take them to the Spray Room to clean them with Stoddard solvent. **Complete:**

5.12.1. Dry the lines with compressed air.

5.13. Open the oil sample valve to allow any trapped oil to drain. **Complete:**

5.13.1. Then close the valve and reconnect the oil sample and oil pressure transducer lines.

6. CALIBRATE THE DYNAMOMETER LOAD CELL:

6.1. Confirm that the dynamometer coolant flow indicator is green. **Complete:**

6.2. Allow the load cell temperature parameter (**TLOADCELL**) to remain at a stable temperature of 45°±1°C for 1-hour before performing the calibration. **Complete:**

6.3. Calibrate the dynamometer load cell at the four reference points shown in Table 1. **Complete:**

Table 1 - Dynamometer Load Cell Calibration

Calibration Point Description	Actual Mass (kg)	Actual Torque (Nm)	Permissible Error (%)

No Load	0	0	0.5%
Low Load (Hanger and Small Weight)	2.535	9.94	0.5%
Mid-Range Load (Hanger and Medium Weight)	7.130	27.97	0.5%
Full Range Span (Hanger and Large Weight)	11.335	44.47	0.5%

7. PRE-FLIGHT CHECKLIST:

- 7.1. Obtain and label each of the sample jars for the test. Complete:
- 7.2. Lubricate the driveshaft. Complete:
- 7.3. Drain the three pressure transducer condensation traps. Complete:
- 7.4. Confirm that the DyneSystems PAU throttle controller is not in alarm. Complete:
 - 7.4.1. Press the red **RESET** button shown in Figure 1.
 - 7.4.2. Then press the green **SATC ON** button shown in Figure 1.
 - 7.4.2.1. *NOTE:* The green button should be illuminated and both fields should read 24%.
 - 7.4.3. Confirm that the display screen is not displaying an error.



Figure 1 - DyneSystems PAU Throttle Controls

8. CONDUCT OIL PAN FLUSH:

- 8.1. Install two new Motorcraft FL-1A oil filters on the flush cart. Complete:
- 8.2. Remove the oil pan drain plug to confirm that there is no residual oil in the sump.

- 8.2.1. Reinstall the drain plug after any residual oil has drained from the pan. **Complete:**

- 8.3. Confirm that the sump on the IVB flush cart is clean. **Complete:**

- 8.4. Connect the wand (used to fill the sump) to the **outlet line** of the flush cart. **Complete:**
 - 8.4.1. Turn on the **outlet pump** of the flush cart.
 - 8.4.2. Use the wand to transfer approximately 1-gallon of EF-411 into the flush cart sump.

- 8.5. Remove the rear oil pan drain plug. **Complete:**
 - 8.5.1. Connect the **outlet line** of the flush cart to the rear drain plug boss of the oil pan.

- 8.6. Remove the flush port cap on the side of the oil pan. **Complete:**
 - 8.6.1. Connect the **inlet line** of the flush cart to the flush port cap on the side of the oil pan.

- 8.7. Turn on the **inlet pump** of the flush cart.
 - 8.7.1. Then turn on the **outlet pump** of the flush cart approximately 30-seconds later.
 - 8.7.2. Let the flush cart run in this configuration for approximately 10-minutes. **Complete:**
 - 8.7.3. *NOTE:* Periodically monitor the oil level in the flush cart to make sure that the sump does not become fully drained.

- 8.8. After 10-minutes, turn of the **inlet pump**. **Complete:**
 - 8.8.1. Continue to run the **outlet pump** until oil stops flowing into the sump of the flush cart.

- 8.9. Disconnect flush cart from engine. **Complete:**
 - 8.9.1. Disconnect **outline line** of the flush cart and replace the rear drain plug.
 - 8.9.2. Disconnect the **inlet line** of the flush cart and replace the cap on the side of the oil pan.

- 8.10. Properly dispose of the used EF-411 and oil filters. **Complete:**

9. CONDUCT 1ST "FIRED" ENGINE OIL FLUSH:

- 9.1. Verify that the oil sump drain plug is tight. **Complete:**

- 9.2. Measure 3000mL of new test oil and add this oil charge to the engine. **Complete:**
 - 9.2.1. **Enter the Time and Date:**
 - 9.2.2. *NOTE:* This time and date is to be considered the official ACC start time of the test.

- 9.3. Confirm that the engine coolant system is charged with a mixture of 30% Dexcool and 70% deionized water. **Complete:**
- 9.4. Confirm that the coolant system pressure cap is secure. **Complete:**
- 9.5. Switch on the pressurized air valve to the coolant system pressure regulator and then apply 10-11psi of pressurized air to the coolant system. **Complete:**
- 9.6. Remove the LO/TO equipment from the stand. **Complete:**
- 9.7. Start the engine. **Complete:**
- 9.8. *NOTE:* The 1st engine flush is 6-minutes in duration and will utilize the following set points (Table 2):

Table 2 - Flush Operating Conditions

Engine Speed	1500 rpm
Torque	10 N*m
Engine Coolant In Temperature (Approx.)	49°C
Engine Oil Gallery Temperature	49°C
Exhaust Back Pressure	103.5 kPaa
Intake Air Pressure	0.07 kPag
Intake Air Temperature	32°C
Fuel Temperature	24°C
Rocker Cover Outlet Temperature	20°C
Coolant Flow Rate (Engine)	80 L/min
Coolant Flow Rate (Rocker Arm Cover)	120 L/min
Load Cell Temperature	45°C
Blowby Gas Temperature	24°C
Coolant Temperature Heater	OFF

- 9.9. At approximately 3-minutes into the 1st flush, please inspect the stand and record the actual values of the controlled parameters in Table 3:

Table 3 – 1st Engine Flush Inspection Sheet

Parameter Name	Target Value	Actual Value
AFR	14.7:1	: 1
Engine Speed	1500 RPM	RPM

Humidity	11.5 ± 0.5	g/kg
Intake Air Pressure	0.07±0.03 kPag	kPag
Coolant Pressure	70±10 kPag	kPag
Exhaust Backpressure	103.5±1.0 kPaa	kPaa
Fuel Pressure	325±75 kPag	kPag
Oil Gallery Pressure		kPag
Intake Air Temperature	32.0±2.0 °C	°C
Engine Coolant Flow	80±2 L/min	L/min
RAC Coolant Flow	120±2 L/min	L/min
Blowby Gas Temperature	24.0±2.0 °C	°C
Coolant Temperature (Inlet)	49.0 °C (Approximate)	°C
Fuel Temperature	24.0±3.0 °C	°C
Load Cell Temperature	45.0 °C	°C
Oil Gallery Temperature	49.0 °C	°C
Torque	10.0 N-m	N-m
RAC Coolant Temperature (Outlet)	20.0 °C	°C

OPERATOR INITIALS:

DATE:

9.10. Once the engine has stopped, perform a compression and leak-down check on all four cylinders and record the measurements in Table 4.

9.10.1. Disconnect ignition coils.

Complete:

9.10.2. *NOTE:* When conducting the compression and leak-down check do not manually open the throttle body.

9.10.3. *NOTE:* Instead, remove the large rubber plug located near the rear of the intake manifold to provide adequate airflow through the engine.

Table 4 – S.O.T. Cylinder Compression and Leak-Down Results

Cylinder Number	Compression (kPa)	Leak-down Rate (%)
#1		
#2		
#3		
#4		

OPERATOR INITIALS:

DATE:

9.11. After the cylinder compression and leak-down checks are complete, use the appropriate LO/TO procedure to secure the stand. **Complete:**

9.12. Remove the oil pan drain plug and drain the engine’s oil charge into a clean container.
 9.12.1. Also, open both oil heat exchanger drain valves at the front of the stand and drain this oil into a clean container as well.

9.12.2. Allow all three locations to drain for 30-minutes. **Complete:**

9.13. Take the 1-oz FL1 sample from this oil drain. **Complete:**

10.CONDUCT 2nd “FIRED” ENGINE OIL FLUSH (FL2 DR, 0.20 TEST HOURS):

10.1. Verify that the sump drain plug is tight and the two heat exchanger valves are closed. **Complete:**

10.2. Measure 3000mL of new test oil and add this oil charge to the engine. **Complete:**

10.3. Remove the LO/TO equipment from the stand. **Complete:**

- 10.4. Start the engine. Complete:
- 10.5. *NOTE:* The 2nd engine flush is 38-minutes in duration.
- 10.6. Approximately 5-minutes before the end of the flush, please inspect the stand and record the actual values of the controlled parameters in Table 5:

Table 5 – 2nd Engine Flush Inspection Sheet

Parameter Name	Target Value	Actual Value
AFR	14.7:1	: 1
Engine Speed	1500 RPM	RPM
Humidity	11.5 ± 0.5	g/kg
Intake Air Pressure	0.07±0.03 kPag	kPag
Coolant Pressure	70±10 kPag	kPag
Exhaust Backpressure	103.5±1.0 kPaa	kPaa
Fuel Pressure	325±75 kPag	kPag
Oil Gallery Pressure		kPag
Intake Air Temperature	32.0±2.0 °C	°C
Engine Coolant Flow	80±2 L/min	L/min
RAC Coolant Flow	120±2 L/min	L/min
Blowby Gas Temperature	24.0±2.0 °C	°C
Coolant Temperature (Inlet)	49.0 °C (Approximate)	°C
Fuel Temperature	24.0±3.0 °C	°C
Load Cell Temperature	45.0 °C	°C
Oil Gallery Temperature	49.0 °C	°C

Torque	10.0 N-m	N-m
RAC Coolant Temperature (Outlet)	20.0 °C	°C

OPERATOR INITIALS:

DATE:

- 10.7. Use the appropriate LO/TO procedure to secure the stand. **Complete:**
- 10.8. Remove the oil pan drain plug and drain the engine’s oil charge into a clean container.
 - 10.8.1. Also, open both oil heat exchanger drain valves at the front of the stand and drain this oil into a clean container as well.
 - 10.8.2. Allow all three locations to drain for 30-minutes. **Complete:**
- 10.9. Take the 1-oz FL2 sample from this oil drain. **Complete:**

11. CONDUCT 3rd “FIRED” ENGINE OIL FLUSH (FL3 DR, 0.30 TEST HOURS):

- 11.1. Verify that the sump drain plug is tight and the two heat exchanger valves are closed. **Complete:**
- 11.2. Measure 3000mL of new test oil and add this oil charge to the engine. **Complete:**
- 11.3. Remove the LO/TO equipment from the stand. **Complete:**
- 11.4. Start the engine. **Complete:**
- 11.5. *NOTE:* The 3rd engine flush is 38-minutes in duration.
- 11.6. Approximately 5-minutes before the end of the flush, please inspect the stand and record the actual values of the controlled parameters in Table 6:

Table 6 – 3rd Engine Flush Inspection Sheet

Parameter Name	Target Value	Actual Value
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AFR	14.7:1	: 1
Engine Speed	1500 RPM	RPM
Humidity	11.5 ± 0.5	g/kg
Intake Air Pressure	0.07±0.03 kPag	kPag
Coolant Pressure	70±10 kPag	kPag
Exhaust Backpressure	103.5±1.0 kPaa	kPaa
Fuel Pressure	325±75 kPag	kPag
Oil Gallery Pressure		kPag
Intake Air Temperature	32.0±2.0 °C	°C
Engine Coolant Flow	80±2 L/min	L/min
RAC Coolant Flow	120±2 L/min	L/min
Blowby Gas Temperature	24.0±2.0 °C	°C
Coolant Temperature (Inlet)	49.0 °C (Approximate)	°C
Fuel Temperature	24.0±3.0 °C	°C
Load Cell Temperature	45.0 °C	°C
Oil Gallery Temperature	49.0 °C	°C
Torque	10.0 N-m	N-m
RAC Coolant Temperature (Outlet)	20.0 °C	°C

OPERATOR INITIALS:

DATE:

- 11.7. Use the appropriate LO/TO procedure to secure the stand. **Complete:**
- 11.8. Remove the oil pan drain plug and drain the engine’s oil charge into a clean container.
 - 11.8.1. Also, open both oil heat exchanger drain valves at the front of the stand and drain this oil into a clean container as well.
 - 11.8.2. Allow all three locations to drain for 30-minutes. **Complete:**
- 11.9. Take the 1-oz FL3 sample from this oil drain. **Complete:**

12.CONDUCT 4th “FIRED” ENGINE OIL FLUSH (FL4 DR, 0.40 TEST HOURS):

- 12.1. Verify that the sump drain plug is tight and the two heat exchanger valves are closed. **Complete:**
- 12.2. Measure 3000mL of new test oil and add this oil charge to the engine. **Complete:**
- 12.3. Remove the LO/TO equipment from the stand. **Complete:**
- 12.4. Start the engine. **Complete:**
- 12.5. *NOTE:* The 4th engine flush is 38-minutes in duration.
- 12.6. Approximately 5-minutes before the end of the flush, please inspect the stand and record the actual values of the controlled parameters in Table 7:

Table 7 – 4th Engine Flush Inspection Sheet

Parameter Name	Target Value	Actual Value
AFR	14.7:1	: 1
Engine Speed	1500 RPM	RPM
Humidity	11.5 ± 0.5	g/kg
Intake Air Pressure	0.07±0.03 kPag	kPag
Coolant Pressure	70±10 kPag	kPag
Exhaust Backpressure	103.5±1.0 kPaa	kPaa

Fuel Pressure	325±75 kPag	kPag
Oil Gallery Pressure		kPag
Intake Air Temperature	32.0±2.0 °C	°C
Engine Coolant Flow	80±2 L/min	L/min
RAC Coolant Flow	120±2 L/min	L/min
Blowby Gas Temperature	24.0±2.0 °C	°C
Coolant Temperature (Inlet)	49.0 °C (Approximate)	°C
Fuel Temperature	24.0±3.0 °C	°C
Load Cell Temperature	45.0 °C	°C
Oil Gallery Temperature	49.0 °C	°C
Torque	10.0 N-m	N-m
RAC Coolant Temperature (Outlet)	20.0 °C	°C

OPERATOR INITIALS:

DATE:

- 12.7. Use the appropriate LO/TO procedure to secure the stand. **Complete:**
- 12.8. Remove the oil pan drain plug and drain the engine’s oil charge into a clean container.
 12.8.1. Also, open both oil heat exchanger drain valves at the front of the stand and drain this oil into a clean container as well.
 12.8.2. Allow all three locations to drain for 30-minutes. **Complete:**
- 12.9. Take the 1-oz FL4 sample from this oil drain. **Complete:**

13.MEASURE THE INITIAL TEST OIL CHARGE:

- 13.1. *NOTE:* The next section will require the operator to record data on the **Oil Consumption Record**.
- 13.2. Take the 2-oz 0-HR oil drain. **Complete:**
- 13.3. Obtain and weigh a clean container and record the value under **(A)** of the **Oil Consumption Record**. **Complete:**
- 13.4. Measure 2400mL of new test oil using the clean container, weigh the container and oil charge, and record the value under **(B)** of the **Oil Consumption Record**. **Complete:**
- 13.5. Calculate the initial oil charge weight and enter the value under **(C)** of the **Oil Consumption Record**. **Complete:**
 - 13.5.1. *IMPORTANT NOTE:* The weight of the test oil charge should never be significantly less than 2000g.
- 13.6. Remove and clean the Oberg filter.
 - 13.6.1. Replace the Oberg filter after it has dried. **Complete:**
- 13.7. Verify that the engine oil sump drain plug is tight. **Complete:**
 - 13.7.1. Add the oil charge to the engine.
 - 13.7.2. *IMPORTANT NOTE:* The operator that weighed and added the initial test oil charge must complete the fields below.

OIL PAN DIPSTICK (mm):

OPERATOR INITIALS:

DATE:

- 13.8. Remove the LO/TO equipment from the stand. **Complete:**
- 13.9. Start the engine. **Complete:**
- 13.10. Confirm that the Horiba unit is displaying a realistic AFR measurement. **Complete:**
- 13.11. Proceed with the test macro. **Complete:**

14. RUNNING THE TEST:

14.1. *NOTE:* EasyTest will run the following test program for 200-hours or 24,000 cycles (Table 8):

Table 8 - Sequence IVB Test Conditions

Parameter	Units	Stage 2→ 1	Stage1	Stage 1 →2	Stage 2
Duration	Sec.	8	7	8	7
Engine Speed	r/min	4300 to 800	800 ± 25	800 to 4300	4300 ± 25
Engine Torque	N-m	25 ± 2	25 ± 2	25 ± 2	25 ± 2
Coolant In Temperature	°C	49 ± 3 (Approx.)	49 ± 3 (Approx.)	49 ± 3 (Approx.)	49 ± 3 (Approx.)
Coolant Flow (Engine)	L/min	80 ± 2	80 ± 2	80 ± 2	80 ± 2
Coolant Flow (RAC)	L/min	120 ± 2	120 ± 2	120 ± 2	120 ± 2
Oil Gallery Temperature	°C	55 to 53	53 ± 3	53 to 55	55 ± 3
RAC Coolant Out Temperature	°C	20 ± 2	20 ± 2	20 ± 2	20 ± 2
Fuel Rail Temperature	°C	24 ± 3	24 ± 3	24 ± 3	24 ± 3
Load Cell Temperature	°C	45 ± 3	45 ± 3	45 ± 3	45 ± 3
Intake Air Temperature	°C	32 ± 3	32 ± 3	32 ± 3	32 ± 3
Blowby Gas Temperature	°C	24 ± 2	24 ± 2	24 ± 2	24 ± 2
Intake Air Pressure	kPa(g)	0.07 ± 0.07	0.07 ± 0.07	0.07 ± 0.07	0.07 ± 0.07
Intake Air Humidity	g/kg	11.5 ± 0.5	11.5 ± 0.5	11.5 ± 0.5	11.5 ± 0.5
Exhaust Pressure	kPa(a)	104.5 to 103.5	103.5 ± 1	103.5 to 104.5	104.5 ± 1
Engine Coolant Pressure	kPa	70 ± 10	70 ± 10	70 ± 10	70 ± 10
Fuel Rail Pressure	kPa	335 ± 10	335 ± 10	335 ± 10	335 ± 10
Air-to-Fuel Ratio	:1	Record	14.5 ± 0.5	Record	14.5 ± 0.5

14.2. Table 9 shows the intermediate oil sampling schedule.

Table 9 - Sequence IVB Oil Sampling Schedule

Test Hours	Sample Size	Comments or Special Instructions
FL1, FL2, FL3, FL4	1-oz	These are the oil flush samples.
0	2-oz	Take sample from oil can.

105, 110, 115, 120, 130, 135, 140, 145, 155, 160, 165, 170, 180, 185, 190, 195	3 ml	
25, 50, 75, 100, 125, 150, 175	1-oz	Pour-back required.
200 (E.O.T.)	4-oz	Take sample while engine is running.

14.3. *NOTE:* Check the stand once an hour for mechanical problems, leaks or warning lights.

15.OIL SAMPLING INSTRUCTIONS:

15.1. *NOTE:* Oil samples need to be taken during the test at 25-hour increments (3,000 cycles) between 0HR and 100HR.

15.2. *NOTE:* Oil samples need to be taken during the test at 5-hour increments (600 cycles) between 100HR and 200HR.

15.3. Use the oil sample valve to remove an 8-oz purge sample from the engine. **Complete:**

15.4. Once the purge is removed, draw the correct intermediate sample. **Complete:**

15.4.1. *IMPORANT:* Review the Sequence IVB Oil Sampling Schedule to determine the correct sample volume.

15.5. Label the oil sample bottle. **Complete:**

15.6. Return the 8-oz purge sample to the engine through the rocker arm cover using the appropriate purge return device. **Complete:**

15.6.1. The purge return port is located near the left-front corner of the rocker arm cover and is held in place with a removable pin.

15.7. Proceed with the test macro. **Complete:**

16.END OF TEST INSTRUCTIONS:

16.1. Once the engine has stopped, perform a compression and leak-down check on all four cylinders and record the measurements in Table 10.

16.1.1. Disconnect ignition coils. **Complete:**

16.1.2. *NOTE:* When conducting the compression and leak-down check do not manually open the throttle body.

16.1.3. *NOTE:* Instead, remove the large rubber plug located near the rear of the intake manifold to provide adequate airflow through the engine.

Table 10 – E.O.T. Cylinder Compression and Leak-Down Results

Cylinder Number	Compression (kPa)	Leak-down Rate (%)
#1		
#2		
#3		
#4		

OIL PAN DIPSTICK (mm):

OPERATOR INITIALS:

DATE:

- 16.2. Use the appropriate LO/TO procedure to secure the stand. Complete:
- 16.3. Perform the necessary E.O.T. lifter clearance measurements (Table 11). Complete:

Table 11 - End of Test (E.O.T.) Lifter Clearances

Intake Side of Engine								
Position	1	2	3	4	5	6	7	8
Grade								
Clearance (in)								
Exhaust Side of Engine								
Position	1	2	3	4	5	6	7	8
Grade								
Clearance (in)								

OPERATOR INITIALS:

DATE:

- 16.4. Obtain and weigh a clean container and record the value under **(E)** of the **Oil Consumption Record**. Complete:
- 16.5. Remove the oil pan drain plug and drain the oil charge into the clean and weighed container.
16.5.1. Also, open both oil heat exchanger drain valves and allow any trapped oil to drain into the same container. Complete:
- 16.6. Drain all three locations for 30-minutes. Complete:
- 16.7. Weigh the final oil drain and container and record the value under **(F)** of the **Oil Consumption Record**. Complete:
- 16.8. Calculate the weight of the E.O.T. drain oil and record the value under **(G)** of the **Oil Consumption Record**. Complete:
- 16.9. Place the final drain in a 1-gallon container. Complete:
- 16.10. Unplug the PCM. Complete:
- 16.11. Remove the test camshafts and lifters and place them in a clean Sequence IVB test kit tray.
- 16.12. Clean the hardware and deliver it to the Metrology Lab. Complete:

17. HOUSEKEEPING:

- 17.1. Clean the inside of the rocker arm cover to remove any emulsion or oil. Complete:
- 17.2. Clean the oil sampling hardware and glassware. Complete:
- 17.3. Drain all four condensation traps. Complete:
- 17.4. Perform the necessary housekeeping around the stand. Complete:

18.OIL CONSUMPTION RECORD:

Description	Equation	Weight (g)
A. Clean and Empty Container Weight (S.O.T.)	A	
B. Oil Charge and Container Weight (S.O.T.)	B	
C. Initial Oil Charge (S.O.T.)	$C = B - A$	
IMPORTANT NOTE: The initial oil charge should never weigh less than 2000g.		
E. Clean and Empty Container Weight (E.O.T.)	E	
F. Drain Oil and Container Weight (E.O.T.)	F	
G. Drain Oil (E.O.T.)	$G = F - E$	

OPERATOR INITIALS:

DATE: