MAXXFORCE ADVANCED DIESEL POWER

Performance Diagnostics

International® MaxxForce® 11 and 13
Beginning with 2010 Model Year

Technician _____ Date _____ ECM Calibration _____ EFRC _____ Hours _____

VIN _____ Unit No. _____ ACM Calibration _____ Engine SN _____ Miles _____

Complaint _____ Transmission: Manual _____ Auto _____

WARNING

To prevent personal injury or death, read all safety instructions in the Safety Information section of *Engine Diagnostics Manual* EGES-470 before doing form procedures.

Notes: Look up the VIN on the ISIS® network for build date, engine hp, engine serial number, ECM calibration, and transmission.

See Hard Start and No Start Diagnostics in EGES-470 for additional information to do each test or procedure. Record results on this form.

Do all checks in sequence unless otherwise stated. Doing a check or test out of sequence could cause incorrect results.

See EGES-470 Appendix A for Performance Specifications and Electronic Control Systems Diagnostics for DTCs.

1. Initial Key On Check

☐ Check Integral Digital Display for WATER IN FUEL indicator.

Comments

- If WATER IN FUEL stays on, go to Fuel Quality Check.

2. Visual Inspection

☐ Check all fluid levels.
☐ Inspect electrical connectors.
☐ Inspect air filter minder.
☐ Inspect CAC.
☐ Inspect for visible exhaust damage.
☐ Inspect primary fuel filter.
☐ Perform Fuel Quality Check (take a fuel sample).

Comments

3. EST Connection and Data Recording

☐ Use ServiceMaxx™ software to record KOEO pressure and temperature values.

Sensor	Spec.	Actual
Air Inlet Temp		
Engine Coolant Temp1		
Engine Oil Temp		
Fuel Rail Pressure		
TC1 Turbine Outlet Pressure		
Fuel Delivery Pressure		
Intake Manifold Pressure		
Barometric Pressure		
DPF Differential Pressure		

- If sensor is out of specification, go to suspect sensor in Electronic Control Systems Diagnostics.

☐ Use ServiceMaxx™ software to record KOEO position values.

Signal	Spec.	Actual
EGR Valve Position		
Engine Throttle Position		
Exhaust Back Pressure Valve		

- If actuator is out of specification, go to suspect actuator in Electronic Control Systems Diagnostics.

☐ Monitor DPF status signal value.

DPF Status

- If DPF status is “Regen needed-critical level”, disconnect exhaust system and determine if engine will start.

4. Check for DTCs

☐ Use ServiceMaxx™ software to record DTCs.

Active SPN/FMI	Previously Active SPN/FMI

- Correct any active DTCs. See Electronic Control Systems Diagnostics.

5. Engine Low Idle to High Idle

☐ Use ServiceMaxx™ software to open Performance session.
☐ Monitor APP signal and press accelerator to floor.

Signal	Low Idle	High Idle
Accelerator Pedal Position		

- If APP signal does not go from 0% to 99.6%, see APP Sensor in Electronic Control System Diagnostics.
- If APP signal does go from 0% to 99.6%, go to next step.

☐ Press record button and start engine.
☐ Allow engine to idle for five seconds. Push accelerator pedal to floor and hold for 30 seconds, return to low idle.
☐ Review results with accelerator pedal at 99.6%.

Signal	Low Idle	High Idle
Fuel Rail Pressure		
Fuel Delivery Pressure		
Engine Speed		
Intake Manifold Pressure		
TC1 Turbine Outlet Pressure		

- If FDP is below specification, go to High Pressure Fuel System Test.
- If engine does not accelerate smoothly, feels unbalanced (not running on all cylinders), perform Fuel Aeration and Restriction Test, Relative Compression Test, and Cylinder Cutout Test to isolate unbalanced cylinder (sequential order).
- If FRP is below specification, go to High Pressure Fuel Pump Test.
- If TC1TOP is above specification, see Exhaust Back Pressure Valve (EBPV). If no problems are found with EBPV, inspect DOC for face plugging.

☐ If IMP is below specifications, check for following conditions.

Condition		
CAC and tubing leaks	Yes ☐	No ☐
Intake restriction	Yes ☐	No ☐
Wastegate malfunction	Yes ☐	No ☐
Back pressure performance loss	Yes ☐	No ☐
Low compression	Yes ☐	No ☐
Turbocharger damage	Yes ☐	No ☐

- If IMP is within specifications, perform Crankcase Pressure Test.

6. High Pressure Fuel Pump Test

☐ Use ServiceMaxx™ software to run High Pressure Pump test.

Comments

- If high pressure pump fails this test, go to High Pressure Fuel System Test.

7. KOER Air Management Test

Note: Truck air tank must be full before running this test.
☐ Turn ignition switch to ON, engine OFF.
☐ Use ServiceMaxx™ software to open Hard Start No Start session.
☐ Start engine and run KOER Air Management Test.

Active DTCs

- If DTC is set, go to Electronic Control Systems Diagnostics.

8. Air Control Valve (ACV) Tests

Note: Truck air tank must be full before running these tests.

Exhaust Back Pressure Valve (EBPV)

☐ Use ServiceMaxx™ software to open 2010 BB Actuator session.
☐ Check for DTCs.

Active DTCs

- If DTC is present, see Electronic Control System Diagnostics.
- Select EBPV from Actuator drop-down menu and set to 100%.

Note: Test will command the actuator on for five seconds, then will return to default closed position.
☐ Press Start Test button while visually monitoring valve movement.
- If actuator rod moves full travel, no action is required.
- If actuator rod does not move, continue to next step.

☐ Remove air supply line from actuator and repeat actuator test.
- If air cannot be heard leaving the open air supply line when running test, see Air Control Valve Assembly in Electronic Control System Diagnostics.
- If air cannot be heard leaving the open air supply line, see EBPV, TC1WC, TC2WC, and TC1TOP in Electronic Control Systems Diagnostics.

☐ Remove actuator rod from valve arm. Check if valve arm moves freely.
- If valve arm moves freely, replace air actuator.
- If valve arm does not move freely, replace valve.

Turbocharger 1 Wastegate Control (TC1WC)

☐ Use ServiceMaxx™ software to open 2010 BB Actuator session.
☐ Check for DTCs.

Active DTCs

- If DTC is present, see Electronic Control System Diagnostics.
- Select TC1WC from Actuator drop-down menu and set to 100%.

☐ Select TC1 Wastegate Control from Actuator drop-down menu and set to On (95% Duty Cycle).

Note: Test will command actuator on for five seconds, then will return to default closed position.
☐ Press Start Test button while visually monitoring valve movement.
- If actuator rod moves full travel, no action is required.
- If actuator rod does not move, continue to next step.

☐ Remove air supply line from actuator and repeat actuator test.
- If air cannot be heard leaving the open air supply line when running test, see Air Control Valve Assembly in Electronic Control System Diagnostics.
- If air cannot be heard leaving the open air supply line, see TC1WC, TC2WC, EBPV, and TC1TOP in Electronic Control Systems Diagnostics.

☐ Remove actuator rod from valve arm. Check if valve arm moves freely.
- If valve arm moves freely, replace air actuator.
- If valve arm does not move freely, replace valve.

Turbocharger 2 Wastegate Control (TC2WC)

☐ Use ServiceMaxx™ software to open 2010 BB Actuator session.
☐ Check for DTCs.

Active DTCs

- If DTC is present, see Electronic Control System Diagnostics.
- Select TC2WC from Actuator drop-down menu and set to 100%.

Note: On a cold engine, the TC2 Wastegate Control defaults to open (100.00%) to prevent turbocharger damage.
☐ Select TC2 Wastegate Control from Actuator drop-down menu and set to On (95% Duty Cycle).

Note: If TC2 Wastegate CTL displays a value of 100.00% before test is started, duty cycle must be set to Off (5% duty cycle) for actuator rod to move.
Note: Test will command actuator on for five seconds, then will return to default closed position.
☐ Press Start Test button while visually monitoring valve movement.
- If actuator rod moves full travel, no action is required.
- If actuator rod does not move, continue to next step.

☐ Remove air supply line from actuator and repeat actuator test.
- If air cannot be heard leaving the open air supply line when running test, see Air Control Valve Assembly in Electronic Control System Diagnostics.
- If air cannot be heard leaving the open air supply line, see TC2WC, TC1WC, EBPV, and TC1TOP in Electronic Control Systems Diagnostics.

☐ Remove actuator rod from valve arm. Check if valve arm moves freely.
- If valve arm moves freely, replace air actuator.
- If valve arm does not move freely, replace valve.

9. Road Test (Full load, rated speed)

☐ Use ServiceMaxx™ software to open Performance session.
☐ Start engine.
☐ Find an open stretch of road. Start recording. When driving conditions are safe, select a suitable gear, press accelerator pedal fully to the floor, and accelerate to rated speed at 100% load.
☐ When road test is complete, stop recording.
☐ Review recorded results with engine at rated speed and 100% load.

Signal	Engine @ rated speed and 100% load
Fuel Rail Pressure	
Fuel Delivery Pressure	
Engine Speed	
Intake Manifold Pressure	
TC1 Turbine Outlet Pressure	

- If FDP is below specification, go to Fuel Delivery Pressure Test.
- If engine does not accelerate smoothly or feels unbalanced, perform Fuel Aeration and Restriction Test, Relative Compression Test, and Cylinder Cutout Test (sequential order).
- If FRP is below specification, go to High Pressure Fuel System Test.
- If TC1TOP is above specification, see Exhaust Back Pressure Valve (EBPV). If no problems are found with EBPV, inspect PDOC and DOC for face plugging.
- If IMP is below specifications, check for CAC and tubing leaks. If okay, perform Crankcase Pressure Test.

Special Test Procedures

Fuel Level Check

☐ Check instrument panel gauge and look into tank to verify fuel level.
- If fuel gauge reads above empty, but tank is empty, diagnose gauge.
- If fuel tank is empty, add fuel and prime fuel system. See Fuel System Priming in Hard Start and No Start Diagnostics.

Fuel Quality Check

☐ Route clear hose from fuel drain valve on filter housing to approved container. Open valve and fill.
☐ Check for water, waxing, icing, sediment, gasoline, or kerosene.
☐ Inspect fuel strainer for debris.

Comments

- If fuel quality is questionable, correct problem. Take another sample to verify fuel quality is satisfactory.

Fuel Delivery Pressure Test

☐ Use ServiceMaxx™ software to open Performance session.
☐ Start engine and monitor FDP. Press accelerator to floor for five seconds, then return to low idle.

	Specification	Actual
psi		

- If FDP drops below specification, continue to next step.
- If FDP stays within specification, go to Fuel Filter Test.

☐ Turn engine OFF. Disconnect fuel supply line at LP fuel pump inlet and cap off supply line.
☐ Connect alternative fuel source to LP fuel pump inlet.
☐ Start engine and monitor FDP. Press accelerator to floor for five seconds, then return to low idle.

	Specification	Actual
psi		

- If FDP drops below specification, go to Fuel Dead Head Test.
- If FDP stays within specification, go to Fuel Aeration and Restriction Test.

Fuel Dead Head Test

☐ Retain alternative fuel supply connection to LP fuel pump inlet.
☐ Disconnect fuel line from LP fuel pump outlet and connect Fuel Inlet Restriction/Aeration tool.
☐ Use compu check fitting to connect Fuel Pressure Gauge to Fuel Inlet Restriction/Aeration Tool.
☐ Connect Fuel Restriction/Aeration Tool to Fuel Block Off Tool.
☐ Crank engine while monitoring Fuel Pressure Gauge.

	Specification	Actual
psi		

- If pressure is within or above specification, replace fuel filter housing stand pipe.
- If pressure is below specification, replace fuel pump.

Fuel Filter Test

☐ Disconnect fuel supply to DSI valve assembly.
☐ Use Fuel Line Coupler to connect Fuel Inlet Restriction/Aeration Tool to DSI fuel supply line.
☐ Connect Fuel Block Off Tool to Fuel Inlet Restriction/Aeration Tool.
☐ Use compu check fitting to connect Fuel Pressure Gauge to Fuel Inlet Restriction/Aeration Tool.
☐ Start engine while monitoring Fuel Pressure Gauge.

	Specification	Actual
psi		

- If gauge pressure is 20% below FDP sensor measurement, replace secondary fuel filter.

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Complaint _____ Transmission: Manual _____ Auto _____

Fuel Aeration and Restriction Test
☐ Remove alternative fuel supply from LP fuel pump inlet.
☐ Remove fuel line between LP fuel pump inlet and primer pump outlet. Connect Fuel Inlet Restriction/Aeration Tool between LP fuel pump inlet and primer pump outlet.
☐ Use compu check fitting to connect Pressure Test Kit vacuum gauge to Fuel Inlet Restriction/Aeration Tool.
☐ Prime fuel system by pumping primer pump.
☐ Start engine while visually monitoring for fuel supply restriction and fuel aeration.
● If supply restriction is above specification, continue to next step.
● If supply restriction is within specification, but fuel is aerated, skip to "Disconnect Fuel Inlet Restriction/Aeration Tool and reconnect LP fuel pump supply line" step.
☐ Turn engine OFF and disconnect vacuum gauge from test line.
☐ Connect vacuum gauge to compu check fitting on primer pump.
☐ Start engine while monitoring vacuum gauge.
● If supply restriction is above specification, repair restriction in supply line between primer pump and tank.
● If supply restriction is within specification, clean out fuel strainer.
☐ Turn engine OFF.
☐ Disconnect Fuel Inlet Restriction/Aeration Tool and reconnect LP fuel pump supply line.
☐ Disconnect fuel supply line at primer pump.
☐ Connect Fuel Inlet Restriction/Aeration Tool between primer pump outlet and LP fuel pump inlet.
☐ Prime fuel system by pumping primer pump.
☐ Start engine while monitoring for fuel aeration.

Aerated	Yes ☐	No ☐

● If fuel is aerated, repair open in fuel supply line between primer and tank.
● If fuel is not aerated, replace primer pump.

High Pressure Fuel System Test
☐ Use ServiceMaxx™ software to open Performance session.
☐ Start engine while monitoring FDP and FRP.

Signal	Spec.	Actual
Fuel Delivery Pressure		
Fuel Rail Pressure		

● If FDP is below specification, go to Fuel Delivery Pressure Test.
● If FDP is within specification but RFP is not, continue to next step.
☐ Turn engine OFF. Disconnect fuel injector return line at rear of cylinder head.
☐ Connect High Pressure Return Line tester to cylinder head and route other end to measuring container.
☐ Start engine and run at low idle for one minute. Start timer and begin measurement when fuel begins to drip into diesel fuel container. Shut engine OFF after one minute. Continue measurement until fuel stops dripping.

	Specification	Actual
Fuel Volume		

● If fuel volume is above specification, go to next test.
● If fuel amount is below or within specification, continue to next step.
☐ Reconnect fuel injector return line at rear of cylinder head.
☐ Disconnect fuel rail return line at fuel rail.
☐ Connect High Pressure Return Line Tester to fuel rail return port.
☐ Using ServiceMaxx™ software to run High Pressure Pump test.
● If fuel flows from test line, replace fuel rail pressure relief valve.
● If fuel is not flowing from test line, replace fuel pump.

Fuel Rail Pressure Leak Isolation
☐ Retain High Pressure Return Line Tester connection to cylinder head from previous test.
☐ Start engine and run at low idle for one minute. Start timer and begin measurement when fuel begins to drip into diesel fuel container. Shut engine OFF after one minute. Continue measurement until fuel stops dripping.

	Specification	Actual
Fuel Volume		

● If fuel amount is above specification, continue to next step.
● If fuel amount is below or within specification, replace fuel pump.
☐ Disconnect number six injector fuel line and cap off rail with High Pressure Rail Plug.
☐ Start engine and run at low idle for one minute. Start timer and begin measurement when fuel begins to drip into diesel fuel container. Shut engine OFF after one minute. Continue measurement until fuel stops dripping.

	Specification	Actual
Fuel Volume		

● If fuel amount is above specification, leave High Pressure Rail Plug installed and continue to next step.
● If fuel amount is within specification, replace injector tube and high-pressure connector body.
☐ Disconnect number five injector fuel line and cap off rail with High Pressure Rail Plug.
☐ Start engine and run at low idle for one minute. Start timer and begin measurement when fuel begins to drip into diesel fuel container. Shut engine OFF after one minute. Continue measurement until fuel stops dripping.

	Specification	Actual
Fuel Volume		

● If fuel is leaking out of test line, leave High Pressure Rail Plug connected and continue capping off one injector supply port at a time until excessive leak is isolated. Replace injector tube and high-pressure connector body on any injectors that are out of flow specification.

Injectors Connected	Specification	Actual
All 6 INJs	27 ml	
5 INJs	22 ml	
4 INJs	18 ml	
3 INJs	16 ml	
2 INJs	14 ml	

Crankcase Oil Breather Separator Test
Note: Ensure engine temperature is above 158 °F and oil level is in specification.
☐ Use ServiceMaxx™ software to open Performance session.
☐ Start engine and run up to normal operating temperature.
☐ Monitor CCOSS signal.

	Specification	Actual
rpm		

● If within specification, crankcase breather system is operating correctly.
● If reading zero rpm with engine running, continue to next step.
☐ With engine running, place Ultrasonic Ear near CCOSS sensor.
☐ Turn engine OFF and quickly monitor for centrifugal noise.
● If centrifuge noise is not heard, go to *Engine Service Manual* for removal and replacement procedures.
● If centrifuge noise can be heard, go to CCOSS sensor in Electronic Control Systems Diagnostics.

Crankcase Pressure Test
Note: Ensure engine temperature is above 158 °F and oil level is in specification.
☐ Disconnect breather outlet tube from top of oil separator.
☐ Connect Crankcase Pressure Test Tool to 90° breather elbow.
☐ Connect manometer to Crankcase Pressure Test Tool.
☐ Run engine at high idle. Allow manometer reading to stabilize before taking pressure reading.

Pressure	Specification	Actual
In H_20		

● If within specification, no repair is required.
● If above specification, continue to next step.
☐ Pump brake pedal until pressure is removed from air system.
☐ Remove air line from remote mounted centrifugal filter and cap using Air Cap, Fuel Cap and Plug Kit.
☐ Start engine and run at high idle. Allow manometer reading to stabilize before recording pressure reading.

Pressure	Specification	Actual
In H_20		

● If within specification, no repair is required.
● If above specification, continue to next step.
☐ If engine has an air compressor, remove discharge line and test again.

Pressure	Specification	Actual
In H_20		

● If above specification, go to Relative Compression Test to pinpoint suspect cylinder.
● If below specification, repair or replace air compressor.

Relative Compression Test
☐ Use ServiceMaxx™ software to run Relative Compression test.
☐ Follow on-screen instructions.

	Compression Difference
Cylinder 1	rpm
Cylinder 2	rpm
Cylinder 3	rpm
Cylinder 4	rpm
Cylinder 5	rpm
Cylinder 6	rpm

● If one cylinder is significantly faster than the other cylinders, the faster cylinder is suspect.

Cylinder Cutout Test
Note: Run Relative Compression Test and verify fuel system pressure is within specification and not aerated.
☐ Start engine.
☐ Use ServiceMaxx™ software to run Cylinder Cutout Test.
☐ Follow on-screen instructions.
☐ Listen to tone changes from cylinder to cylinder.
☐ Use ServiceMaxx™ software to open Performance session.

Comments

● If no suspect cylinder is identified, no action is required.
● If test identifies a suspect cylinder and Relative Compression Test does not, replace failed injector. See Injector Replacement.

Injector Replacement
☐ Follow *Engine Service Manual* procedure for replacing failed injector.
☐ Use ServiceMaxx™ software to open Injection Quantity Adjustment procedure.
☐ Type in new IQA code (stamped on top portion of Injector) into proper cylinder location.
☐ When Undo button appears, Program Engine button will become active.
☐ Press Program Engine button to program new ECM.

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