USING THE G2 INJECTOR DIESEL TESTER

INTRODUCTION
The G2 Injector Diesel Diagnostic Suite is a stand-alone tool that gives you complete G2 injector diagnostics. It is designed to test both the upper, electrical half of the injector and the lower half, or mechanical side of the injector. It will also test the high pressure oil system and scan for DTC’s. It is the ONLY tool that will test the spool valve delay in these style injectors. This delay is referred to as STICKTION.

Sticktion occurs when the flat surfaces of the spool valve are commanded to open and are delayed due to sticking. The G2 Injector Tester will test the International VT 365, VT 275, DT 466 as well as the Ford Powerstroke 6.0 and LCF V-6.

There are 4 tests available within the Diagnostic Suite to aid in effectively repairing injector problems on applicable diesel engines.

The G2 Suite works on Ford 6.0 Powerstroke Diesels, Ford and Navistar 4.5L V-6 Low Cab Forward engines and Navistar VT 365 and DT466/570 engines. G2 Suite can also test MaxxForce 5 and MaxxForce DT Engines using the MaxxForce adapter cable.

ACRONYMS USED

PID – Parameter I.D. IDM – Injector Driver Module
ECM – Electronic Control Module PCM – Powertrain Control Module
IPR – Injector Control Pressure Regulator HEUI – Hydraulic Electronic Unit Injector
DLC – Diagnostic Link Connector DTC – Diagnostic Trouble Code
CF – Cab Forward LCF – Low Cab Forward
EOT – Engine Oil Temperature VDA – Vehicle Diagnostic Adapter

G2 – Second Generation Diesel Injector
MCU – Main Control Unit
ECT – Engine Coolant Temperature

HOW A G2 INJECTOR WORKS

G2 stands for Second Generation Injector. It is a Hydraulic/Electrical injector, often referred to as HEUI. HEUI stands for Hydraulic Electronic Unit Injector.

The lower half of the injector is the fuel delivery component utilizing a plunger and return spring to deliver the fuel. The upper half of the injector is the high-pressure oil delivery component of the injector.

Fuel fills the barrel of the injector and waits for the plunger to drop and inject it into the cylinder. High-pressure oil is fed into the top of the injector through the high-pressure oil rail. The pressure is controlled by the IPR, or Injector Control Pressure Regulator.

There is a sensor on the rail called the ICP, or Injector Control Pressure Sensor. This sensor provides feedback to the PCM to enable proper pressure regulations using the IPR. The IPR is a variable duty cycle solenoid and pressure is controlled by varying the on off time of the solenoid. The longer it is on, the higher the pressure.

The control for the injectors is done through the FICM, or Fuel Injector Control Module as Ford refers to it, and the IDM, or Injector Driver Module as it is referred to by Navistar. MaxxForce vehicles are tested through the PCM 36 pin connector. These modules will set codes if there is an electrical malfunction in the injector such as a short to power or ground, or an open condition. A delay in the opening of the spool valve will not set a code.
GETTING STARTED

Your kit includes the following:

- 1 Main Control Unit
- 1 MaxxForce PCM Connector
- 1 USB to Serial Adapter
- 1 Installation CD
- 1 Injector Control Module Main Harness Connector
- 1 MCU to PC cable
- 1 Ford Interface Cable (International interface cable not included)

Install the G2 Diagnostic Software on your PC using the CD provided. This CD has all the software you need to use this tool. You may need to install the DOTNET Framework to run this application if your PC doesn’t already have it. You will be prompted to do the install automatically if your PC needs it. It is located on the installation CD in a folder named DOTNET. The drivers are located in a folder named USB Drivers. You will need to install the drivers but you may not need to install the DOTNET files.

Install the USB to Serial Drivers from the CD provided. These drivers are named Prolific PL 2303. Once loaded, they will automatically install when you first plug the USB to Serial adapter into your PC. You will be prompted to perform this step when preparing to launch the G2 Injector Tester test.

The drivers for the Ford Diagnostic Connector will self install when you plug it into your PC and the vehicle. It gets it’s power from the OBDII connector and your PC will not see the device until it is connected to the vehicle.

The first thing you will see is a vehicle selection screen. First select the type of vehicle you are working on. Your choices are Ford, Ford LCF (06-07), Ford LCF (08-10) and Navistar (International)

Once the vehicle is selected the Engine Type selection box becomes active. Select the engine type at this time. This is critical to having the correct engine displayed in the pass fail screen on the graph. The engine buttons that become active are dependent on which type of vehicle you selected.

Next, select the interface device you will be using to plug into the vehicle’s under-dash connector. Navistar/International uses the IC4 USB, IC4 COM (IC3), Nexiq, Dearborn Group (DG) or Movimento (Nav-Com and Nav-Link)

For Fords, use the Hickok VDA that is provided in the kit. If you are using the G2 tester on a Navistar/International vehicle, you should already have one of the devices listed.

Next click the submit tab and the diagnostic suite will display your test selections screen.

G2 can be used in a stand-alone mode if you only want to display the graph test option and are not concerned with the other tests during your current diagnostic session. Simply select the vehicle and engine as in the steps above and click on the G2 Standalone Mode button and then submit.

You will only see the G2 Injector Tester available in this mode.

You only need the G2 Injector Tester Main Control Unit to be hooked up to run the G2 graph. You only need the vehicle’s VDA connector to run the ICP Graph, Cylinder Kill and DTC scan.
The following screenshots will display the tests available in the G2 Diagnostic Suite. With each screenshot is the basic diagnostics you will follow to arrive at your conclusions.

G2 INJECTOR TESTER

After clicking on the G2 Injector Tester tab on the opening screen, you will see the graph displayed. The following description of the screen will explain the display and its components.

The left vertical graph line is the spool valve delay, measured in microseconds. The scale reads from 200 to 1000 microseconds.

The bottom graph line is the timeline. The timeline uses the PC’s clock to populate the values. 5 minutes of data can be displayed on the screen at any one time. The tool can be used for longer than 5 minutes at a time if needed. If more than 5 minutes of data is collected, you can click on the timeline to see a scroll bar. You can record data for as long as you need.

Each tick on the timeline represents 10 seconds.

The representative cylinders will be displayed on the right side of the screen. The options, as selected when launching the PC app, are a V-8, V-6 and Inline 6.

• Click ACQUIRE DATA to start graphing
• Click STOP to stop graphing.
• Click CLEAR DATA to clear the graph and start over.
• Click PRINT SCREEN to send a screenshot of the graph to an installed printer. If no printer is active the graph screenshot will be saved as a .jpg in a screencaptures folder.
• The folder is located in C:\Program Files\Hickok G2\G2 Injector Diesel Diagnostic Suite V1.00\Injector Tester\ScreenCaptures
• Click EXIT to return to the test selection screen.
• There is an editable text field you can add any additional information you might want to the test record.
• The TEST CONDITIONS buttons will light red or green during the test. These conditions will be discussed in the OPERATION section.

Once delay values are collected the cylinders will light up with a red light if the value is out of spec or green if it is in spec. The actual delay value in microseconds will be displayed for each cylinder. The default specs are the values that have been determined to be the proper operating range for the selected engine. You can change these values if needed by clicking on up or down arrows next to the value then clicking ENTER. This will only change whether the cylinder is green or red.
HOO K UP

Before starting any testing, make sure you have installed the USB to Serial Adapter Drivers that are provided on the installation CD.

Install the Injector Control Module Main Harness Connector to the vehicles IDM or FICM.

Note: It is recommended to use a tie strap to secure the connector to the module and the harness to the connector, so engine vibrations will not cause it to come loose.

If you are testing a MaxxForce vehicle, install the Maxxforce cable to the 36 pin connector on the PCM/ECM, and secure the harness to the module and the vehicle connector to the harness using the lock bars on the connector.
Connect the other end of the harness to the G2 Tester Main Control Unit.

Connect the other end of the serial cable to the USB to Serial Adapter.

Plug the USB to Serial Connector to your PC (You will see a new hardware found box pop up. You do not need to do anything except wait until it closes).

Start vehicle.
Once started you must indicate the engine type on the G2 Main Control Unit by pressing the appropriate button. Failure to do this step will result in a “G2 Tester Not Found – Check Connections” message in the bottom left of the graph screen.

Note that in this picture three engines are shown (V8 V6 I6) that are possible when using the IDM/FICM Cable. If the optional MaxxForce Adapter cable was used a different selection would appear (V6 I6) for MaxxForce engines.

After making your selection you should see the following display on the G2 Main Control Unit:
Click the ACQUIRE button on the G2 Graph.

You will see the connection status in the bottom left corner of the screen if properly connected. If the G2 is unable to connect, you will see a message indicating this. If this occurs, check all your connections and make sure the USB drivers are loaded properly.

Once the ACQUIRE button is activated, the G2 Main Control Unit begins sampling the injectors to measure the spool valve delay. In a few seconds the first sampling will be displayed below each cylinder on the engine diagram on the right side of the screen. The cylinder will light up green if the value is in the pass threshold or red if out of spec.

A few seconds after this, the graph will begin to display these values and the timeline will begin scrolling.

The graph will continue to display as long as the G2 Main Control Unit is connected and active and the engine is running. You can run the graph as long as needed to diagnose the concern. G2 will work under different engine RPM conditions, cold or warm. Specific diagnostic scenarios will be discussed in the Diagnostic Strategies & Interpreting Results section.

If more than 5 minutes of data is collected you can scroll back through the timeline after stopping graphing.

To review the data collected older than 5 minutes simply click on the timeline and a scroll bar will be displayed.
There is a PCM/ECM strategy that can occur that will interfere with the collection of data. It is called Inductive Heating. It was an attempt by the manufacturer to combat the spool valve delay.

What happens typically is during engine warm up, a high frequency signal is generated and sent down the harness to the injector during its “off” time. This high frequency heats up the wiring in the spool valve, which causes it to stick less than it normally would. It does not fix stiction does reduce the effect on performance.

G2 cannot take readings while inductive heating is on. If this occurs you will see a white pop up that blocks your view of the screen with instructions on how to make the strategy go away, (turn off) and the green “Test Conditions” button will turn off and the red light will come on.

You can make inductive heating stop by increasing the vehicles RPM (or decreasing if already at a high RPM) or unplugging ECT and EOT. Both must be unplugged. The cylinders will no longer display values or turn red or green. This should only occur if the vehicle is not at full operating temperature.

Once inductive heating is gone the graph will resume automatically and data will begin to be displayed again. You will not see a graph line for the time inductive heating is on.
INTERPRETING THE GRAPH

Interpreting the readings that the G2 Injector Tester returns is key to getting to the root of the problem and repairing your vehicle. The following guide is to help you in the interpretation of the data. Keep in mind that although stiction will be present under any driving condition, the symptoms will vary. Some of the more common symptoms of Stiction are hard start, no start, white smoke and loss of power, typically under load.

Factors other than Stiction can cause or contribute to these symptoms. There are also other tools in the Diagnostic Suite can help pinpoint if the injector(s) are causing the symptom.

A vehicle that does not have a Stiction problem will have all graph lines near nearly identical and with stable delay values (200-250 microseconds) All cylinder buttons will be green. The exact delay value can vary some depending on conditions such as clean or dirty oil, engine temperature, but the key is that they are all close to each other and not jumping around (stable).

A cylinder with Stiction will stand out above the other cylinders on the graph (longer delay) and the corresponding cylinder buttons will be red. Also in most cases injectors with Stiction will have delay values that bounce around much more than good injectors.

In this example both cylinder 3 and 8 have excessive delay. Cylinder 2 is slightly above Pass standards. Cylinder 3 and 8 would cause a moderate to severe misfire and cylinder 2 might only be noticeable at cold start. Loss of power under load and white smoke would also be noticed.

If an injector is non-functioning due to extreme sticking, (a short or open circuit can do this but the ECM should report a DTC), you will see a value of 65535 reported for the delay value below the cylinder button. This indicates it did not open at all. Check for injector related DTCs if not already done.

Check FICM voltage. This can be located in the Cylinder Kill test. It is available for Ford vehicles only. Navistar does not support IDM voltage PIDs in the ECM.

If all the injectors display 65535, check harness connections to FICM/IDM and to the injectors.

If the Crank Sensor is unplugged or open/shorted this will also cause all injectors to not open. The PCM/ECM cuts out the signal if it cannot determine cylinder positions.

Low FICM/IDM voltages can affect the delay times also. A lower than normal voltage will cause all delay values to be longer in duration and appear as all 8 injectors having excessive spool valve delay. Be sure to check the voltage before replacing all injectors.

If this is the cause, injector replacement will not correct the concern.

Higher than normal FICM/IDM voltages will cause delay values to be too low, or fast.

Temperature will have an affect on delay values. A cold engine typically starts with slightly higher values that drop into spec soon after starting. An injector with Stiction will be much worse and easier to spot when a cold engine is started.
DIAGNOSTICS BY SYMPTOM

Note: These steps are not intended to replace normal diagnostic routines. They are intended to be used after the tech determines the problem may be fuel or injector related, or to rule out injector or fuel delivery issues.

No Start –
- Hook up the G2 Injector Tester as described.
- Turn key on, engine off.
- Select proper engine on the G2 LCD display.
- Click Acquire and immediately begin cranking engine until enough data is collected to populate the cylinder representation with delay values. If these values are good or even borderline, the injector spool valve is not the cause. As mentioned above, if all values are 65535 this indicates no spool valve motion was detected. A bad IDM/FICM, a bad ECM/PCM, missing crank signal, or other PCM starting criteria could cause this.
- Check ICP using the ICP Graph. The ICP Graph is one of the tools in the Diagnostic Suite. See Using ICP Graph Section.

Low or no ICP will not affect the spool valve delay but will cause starting concerns.

If the spool valve delays are in the normal or pass range the problem is not in the upper part of the injector. Check high-pressure oil and fuel systems.

Hard Start –
Follow the same procedure as No Start but continue monitoring the Graph after the vehicle starts. Look for one or more cylinders to have excessive delays.

If delay values are within specs they are not he cause of the symptom.
- Check ICP.
- Connect to the vehicles under dash DLC.
- Turn key on, engine off.
- Launch Oil Pressure Monitor
- Click Acquire tab.
- Begin cranking engine until it starts. If ICP reaches correct starting spec (per shop manual) before vehicle starts, ICP is not the cause. If ICP takes a long time to reach proper starting spec, check ICP system for leaks or any other malfunction that would prohibit proper pressure to be reached. Using a scan tool monitor IPR PID. Normal IPR is around 25% to attain proper pressure spec at start and idle.
- If IPR is normal run the Cylinder Kill test.
- Check fuel system.
- Check for DTCs.
**Engine Miss**

Engine miss is the most common symptom of stiction. It is typically worse when cold and often disappears within the first minute of starting the vehicle. Even though the symptom may disappear the stiction will still be detectable using the G2 graph. To catch the problem cylinder while cold you can start and run the G2 graph while cranking and through the first moments of running. If stiction is the cause of the misfire you will see the offending cylinder’s graph line above the good cylinders and the cylinder lights will be red. In this example cylinder 3 and 8 are out of specs and have excessive stiction. This is typical of a cold start miss that is less noticeable after running a short while.

If the graph shows good delay values during the miss condition run the Cylinder Kill test to check the lower half of the injector.

- Check for DTCs if not already done.
- For Fords, check FICM voltage PIDs located in the cylinder kill test.

**Lack Of Power**

Hook up G2 tester and harness as described above.

- Use tie straps to secure the Main Harness Connector to the IDM/FICM and the vehicle’s harness to the Main Connector. This is to ensure it does not separate during the road test.
- Start vehicle and begin graphing as described above.
- Begin road test and drive the vehicle in the manner needed to duplicate the symptom.
- Return to the shop and look at the graph. Click on the timeline to scroll back through the graph if needed. If stiction is not the problem run the cylinder kill test.
- Check for DTCs.

**Any other driveability symptoms**

Hook up and launch the G2 graph as described above. Run vehicle to duplicate the concern or complaint. Inspect the graph when finished.

If stiction is the cause it will be displayed under any temperature or RPM.

**DTC SCAN**

If no scan tool is available or if a scan for DTCs has not been done, this tool allows the technician to do a scan of fuel/injector related DTCs. This scan will only display fuel related DTCs. If a code is present usually the check engine light will be illuminated. Along with the code or codes the screen will also display if the code is active or in memory as well as a description. If codes are returned it is recommended that the appropriate pinpoint tests be followed per the shop manual to fix these codes. Once fixed, be sure to clear the codes before proceeding. All tests in the suite can be selected and run if codes are present.

All test screens can be printed if needed. Selecting PRINT SCREEN will send the screenshot to a connected printer and save it as a JPEG in the G2 Program File folder. The location path will be displayed for ease in locating the file.
ICP GRAPH
High pressure oil is critical to the proper function of the injector. Problems in the high pressure oil system can cause many of the same driveability concerns as a sticking spool valve. The G2 Diagnostic Suite allows the tech to monitor and display the ICP PID and IPR percentage values in real time. IPR values are not available on MaxxForce vehicles.

ICP Related Symptoms
No start – Monitor ICP pressure during crank mode. Compare ICP pressures to the proper specifications listed in the shop manual for this value. Minimum pressures must be met to enable the vehicle to start. Typically for these types of engines, 400-600 PSI is needed. If the pressure meets the proper spec for starting ICP pressure is not the cause of the No Start condition.

Long crank time – Follow the same steps as above for a No Start condition. Monitor the ICP pressure to see how long it takes to achieve proper starting pressure. If the correct pressure is achieved before the vehicle starts, ICP pressure is not the cause of the long crank time.

In this example there is no driveability symptom but the vehicle has an intermittent check engine light coming on. A code check with a scan tool indicates an ICP problem. Due to the fact there is no driveability symptom, the problem would be a faulty sensor or wiring to the sensor. Proper pinpoint tests would indicate replacing the sensor. If the vehicle actually dropped pressure as indicated there would be a stall or severe stumble and loss of power while driving.
The Cylinder Kill Test is used to determine if the drivability problem is caused by the lower half of the injector. It should be run after stiction is tested for and ruled out. This test is the same as the cylinder kill test in International’s diagnostic software. It is fully automated.

NOTE: This test will run if the oil temperature is under 160 F but it is highly advisable to bring the vehicle up to temperature before running. Deviations in values can vary at a much higher rate if run cold. The box will remain red if under 160 F. it will turn green when optimum temperature is reached.

Information displayed includes FICM voltages if the vehicle is a Ford.

If running this test cold it may be necessary to increase and hold the RPM to prevent stall when the injector’s start dropping out. This test can be run at any RPM.

The test will take a baseline measurement of RPM, Fuel Rate (International) or Torque (Ford) and Load. It will then drop one cylinder at a time and remeasure these values. Once complete the software will calculate the deviations and display them both numerically and graphically. Look for deviations out of range as described in your shop manual. In the above example we see a problem in fuel delivery on a bank of injectors.

In this example you see no deviation in fuel rate but a slight deviation in Engine Load. This is caused by the cold temperature of the vehicle during testing and does not show any problem in this area of the injector. If the vehicle was at full operating temperature and had these results it would indicate no fuel delivery problem and a possible mechanical problem such as valves or compression.

If for any reason during the test you find the need to cancel the test simply click on the Abort Test button and the test will stop. Once you click the Abort Test button you must close the test and re-open it to re-test. FICM/IDM voltages are not supported by Navistar ECMs.
**Result**—All good

**Interpretation**—No stiction issues with this vehicle

**Action**—Run other tests in the Suite to determine if the problem is in another area of the injector and/or fuel delivery.

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**Result**—Cylinder 3, 5 and 8 are out of specs.

**Interpretation**—This vehicle would have moderate to severe engine miss that would be easily felt as a rough idle. This is due to cylinders 3 and 8 being out of spec by a large degree.

Cylinder 5 is not out of spec by much so it would not be felt as an engine miss.

Cylinder 5 would cause a lack of power or white smoke.

**Action**—Run engine with oil cleaner and re-test or replace all 3 injectors.

Replace all 3 injectors if cleaning doesn’t correct the stiction issue.

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**Result**—No injector spool valve opening

**Interpretation**—No start. Readings taken during crank. All values report as 65535.

**Action**—Check for FICM/IDM codes. Check for DTCs Check wiring between PCM, FICM/IDM and injectors Check power and grounds to PCM, FICM/IDM Check for missing crank signal to PCM
USING G2 IN STAND ALONE MODE (WITHOUT PC APPLICATION)

It is recommended to use the G2 tester with the PC application for the enhanced diagnostic value it presents. That being said, if you are comfortable identifying incorrect spool valve delay values without using the graph G2 is capable of being run in a stand alone mode using the LCD display on the main unit to display delay values. The LCD will not graph or interpret the data for you. It will only display the raw delay values. It is up to the tech to determine if the value is good or bad in this mode.

Hook up the G2 main harness and connect it to the tester.

Start the vehicle.

Select the correct engine.

Press the SEL (Select) button
You may select Single Capture or Continuous Capture.

Single Capture gives you one delay value for each cylinder.

Continuous Capture gives you a continually running reading

Press the GO Button.
You will see the delay value in the upper right of the screen. The center number indicates how many samples were taken to get the value. Use the SCROLL button to change the cylinder you are displaying.

If you are on a V-6 diesel (VT 275 or Ford LCF) you will see the value 65535 reported for cylinder 7 and 8.

You can exit this mode and return to the screen needed to use the PC application by pressing the HOME button.
If you have any questions about our products including technical assistance, call our customer care department during standard business hours EST. If a customer care representative directs you to return any equipment, be sure to include these items:

- a written description of the problem;
- the name and telephone number of your contact person;
- your shipping address, and
- our return authorization number (from customer care).

Customer care and tech support: 800/342-5080
Service and repair center: 662/453-6212
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