

## Glow Plug and Light Circuit Operation

### Function:

To provide an added source of heat for the combustion chamber during cold starts, especially below **0°C (32°F)**, and to illuminate a light on the ICC that indicates power is being provided to the glow plugs.

### Operating Conditions:

- Key switch must be in the start or run position or pushed in to the AID position.

### Theory of Operation:

The ignition system is designed to inject diesel fuel into the piston cylinder where heat from compression ignites the fuel and air mixture. When starting a cold engine, compression may not provide enough heat to ignite the fuel. Glow plugs are installed to provide added heat to the combustion chamber.

The glow plugs are energized (heated) when the key switch is placed in the AID position (key pushed into switch), the ECU temperature sensors determine that glow plug operation is warranted prior to cranking the engine, or the ECU temperature sensors determine that the engine is not warm enough after starting the machine.

The engine preheat light on the ICC provides a visual indication that the glow plugs are being energized. A battery voltage signal is sent through the 383A Org wire to connector X6, terminal C, and switches on the preheat light circuitry in the ICC.

A ground circuit path for the ICC circuit board is provided through the X7 and X11 connectors (terminals P and H), and 050AF, 050AE and 050AA Blk wires.

### Aid Position:

The key can be pushed into the AID position with the key in either the start or run position. The combustion chamber may be preheated by pushing in the key, with the switch in the run position, before turning the key to the start position.

When the key switch is in the aid position, power is provided to the K5 glow plug relay coil (terminal 86) through the 385A Grn wire. When the relay coil is energized, the relay contacts close and power the glow plugs via the 002K Red and 383B Org wires.

### Timed Preheat:

If the T6 fuel temperature sensor and the T9 engine coolant temperature sensor determine the engine or ambient air temperature is below 0°C (32°F), the glow plugs will turn on the display WAIT indicator before cranking the engine. The length of time the ECU energizes the glow plugs is dependent on temperature.

### Reheat Cycles:

After the engine starts, the ECU may re-energize (reheat) the glow plug relay for several seconds to reheat the combustion chamber in order to reduce white smoke and stabilize the engine speed. After the reheat period expires, the ECU may energize the glow plug relay again for a minute or more (reheat cycle) to help stabilize the engine speed if it is fluctuating excessively.

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002D— Fusible Link  
002G— Fusible Link  
002J— Fusible Link  
F1— Fuse 30A  
F3— Fuse 30A  
F5— Fuse 20A  
F17— Fuse 30A  
G1—Battery

K5—Glow Plug Relay  
M1—Starting Motor  
R1—Glow Plug  
R2—Glow Plug  
R3—Glow Plug  
R4—Glow Plug  
S1—Key Switch  
W1—Battery/Frame Ground

X1—W1 Main Wiring  
Harness-to-Glow Plugs  
Connector  
X27— W13 ECU Harness-to-W1  
Main Wiring Harness  
Connector  
X41— W1 Main Wiring  
Harness-to-Engine Wiring  
Harness Connector

Y1— Starting Motor Solenoid

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A3—ECU (Engine Control Unit)	X27— W13 ECU Harness-to-W1 Main Wiring Harness Connector	X39— W13 ECU Harness-to-CAN Interconnect Connector	X41— W1 Main Wiring Harness-to-Engine Wiring Harness Connector
T6— Fuel Temperature Sensor		X40— W13 ECU Harness-to-CAN Interconnect Connector	
T9— Coolant Temperature Sensor			
T11— Engine Crank Sensor	X38— W13 ECU Harness-to-A3 ECU Connector		

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## System: Glow Plug and Light Circuit Diagnosis

### Test Conditions:

- Fully-charged battery

- Key switch in the run position, engine not running.
- ICC is powered on. [See System: Power Circuit Diagnosis](#) in Section 40, Group 25.
- Key switch pushed in to the aid position.

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## Glow Plugs Indicator Check

AA95137,00028E7 -19-14SEP10-2/9

### Step 1

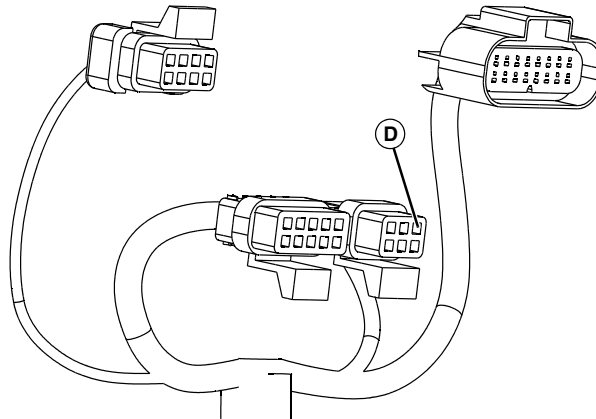
Is the engine preheat light on?

**YES:** Engine preheat light circuit is functional. [Go to Glow Plugs Circuit Checks.](#)

**NO:** Go to next step.

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### Step 2



LVAL11279 —UN—24AUG10

#### D—Terminal C of Connector X6; 383A Org Wire

Disconnect X6 connector from the ICC. Is battery voltage present at terminal C, 383A Org wire (D) of X6 connector?

**YES:** Replace ICC.

**NO:** Check 383A Org wire and connections.

If 383A Org wire and connections ok, [go to Glow Plugs Circuit Checks.](#)

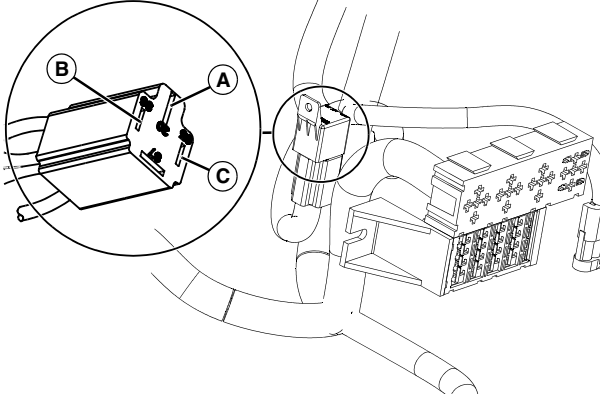
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## Glow Plugs Circuit Checks

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## Operation and Diagnostics

<b>Step 1</b>	Disconnect X1 connector to the glow plugs. Is battery voltage present at X1 connector, 383B Org wire?	<b>YES:</b> Connect X1 connector. Test glow plugs. <b>NO:</b> Check 383B Org wire and connections.  If 383B Org wire and connections are ok, go to next check.
AA95137,00028E7 -19-14SEP10-6/9		
<b>Step 2</b>	 <p>LVAL11278 —JUN—24AUG10 <b>A—Terminal 30; 002K Red Wire</b> <b>B—Terminal 86; 385A Grn Wire</b> <b>C—Terminal 85; 010AG Blk Wire</b> Remove K5 glow plug relay. Is battery voltage present at K5 glow plug relay terminal 30, 002K Red wire (A)?</p>	<b>YES:</b> Go to next step.          <b>NO:</b> Test power circuit. <u>See System: Power Circuit Diagnosis</u> in Section 40, Group 25.
AA95137,00028E7 -19-14SEP10-7/9		
<b>Step 3</b>	Is battery voltage present at K5 glow plug relay terminal 86, 385A Grn wire (B)?	<b>YES:</b> Go to next step. <b>NO:</b> Test key switch. Check 385A and 385B Grn wires and connections.
AA95137,00028E7 -19-14SEP10-8/9		
<b>Step 4</b>	Is continuity to ground present at K5 glow plug relay terminal 85, 010AG Blk wire (C)?	<b>YES:</b> Test glow plug relay. Replace if necessary. <b>NO:</b> Check 010AG and 010AC Blk wires and connections.
AA95137,00028E7 -19-14SEP10-9/9		

## Fuse Test

### Reason:

To verify that fuse has continuity.

### Equipment:

- Ohmmeter or continuity tester

### Procedure:

1. Park machine safely in neutral with park brake locked.
2. Open plastic panel below steering column support.
3. Remove fuse from load center.
4. Check visually for broken element (A).
5. Connect ohmmeter or continuity tester to each end of fuse.
6. Check for continuity.



A—Element

### Results:

- If continuity is not indicated, replace the fuse.

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LVAL-10236—UN—23JUL10

## Glow Plug Test

### Reason:

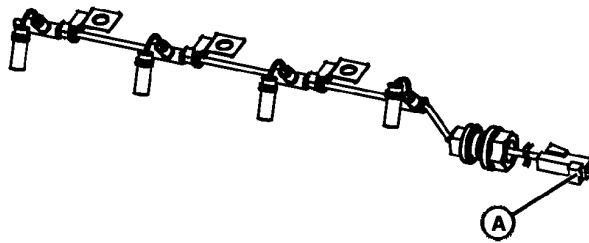
To test operation of glow plugs.

### Equipment:

- Ohmmeter

### Procedure:

1. Park machine safely in neutral with park brake locked.
2. Raise hood and secure with prop rod.
3. Disconnect glow plugs connector (A) from main wiring harness.
4. Check resistance between glow plugs connector (A) and frame ground. Resistance must be within specification.



A—Glow Plugs Connector

### Results:

- If resistance is not correct, remove and test each individual glow plug.

### Specification

Glow Plugs	
Connector-to-Frame	
Ground—Resistance.....	0.2—0.4 ohms

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LVAL-10237—UN—23JUL10

**Procedure:**

**NOTE:** Cover glow plug hole to prevent debris from entering cylinder when glow plug is removed.

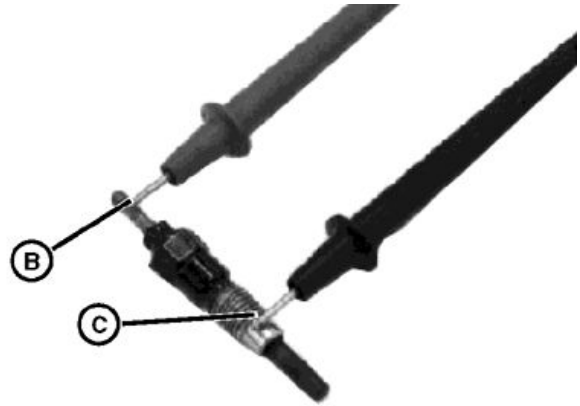
1. Remove rocker arm cover. See Engine section.
2. Remove glow plug lead. Remove glow plug.
3. Check resistance between glow plug terminal (B) and glow plug body (C). Resistance must be within specification.

**Specification**

Glow Plug Terminal  
to Glow Plug  
Body—Resistance..... 0.5—1.7 ohms

**Results:**

- If glow plug does not have proper resistance, replace glow plug.



B—Glow Plug Terminal

C—Glow Plug Body

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LVAL10238—UN—23JUL10

**Engine Crank or Cam Sensor Test**

**Reason:**

To verify that the crank (or cam) sensor has continuity.

**Equipment:**

- Ohmmeter

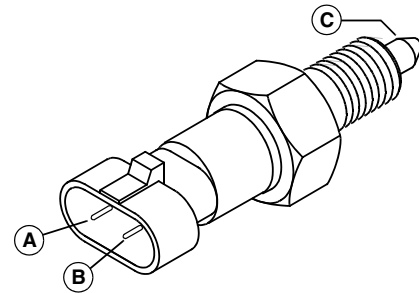
**Procedure:**

**NOTE:** Perform test with engine at room temperature.

1. Park machine safely in neutral with park brake locked.
2. Raise hood and secure with prop rod.
3. Unplug the connector from the T11 crank sensor (or T10 cam sensor).
4. Measure resistance between sensor terminals A and B. Resistance must be within specification.

**Specification**

Engine Crank  
and Engine Cam  
Sensors—Resistance..... 2500—3500 ohms (Typical)



A—Terminal  
B—Terminal

C—Tip

**Results:**

- If engine crank (or cam) sensor does not have proper resistance, replace the sensor. Inspect the tip (C) of old sensor; if damaged, identify source of problem and correct before proceeding.

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LVAL11336—UN—24AUG10