

Topic No.	Rev. Level	Topic Date	Group No.	
94T13-2	–	01-May-1994	13	
Expiration Date (U.S. and Canada): –		Expiration Date (International): –		
Engine Family	Fuel System	Plant	Build Date	
			From	To
6B, ISB, QSB5.9, B5.9	All	Default	01-Jan-1900	31-Dec-9999
Design Application		Market Application		
All		All		

Grid Heater Starting Aid (T000)

This service parts topic introduces to the field an intake air electric grid heater system developed for 12 volt B Series charge air cooled, turbocharged and naturally aspirated engines (6BTAA, 6BT, 6B) as a cold weather starting aid. There is no electric grid heater system for the water jacket aftercooled ratings (6BTA) or 24 volt electrical system at this time and this system is **not** compatible with marine applications.

The grid heater system benefits include:

- Quicker start times
- Smoother engine running after starting
- Replaces ether as a starting aid
- Extends starter and battery life through less cranking

The electric grid heater system is very similar to the popular light-duty truck application grid heater system in use since 1988. This system electronically controls the two grid heating elements to optimize cold weather starts and improved cold engine running.

Engine mounted hardware includes the grid heater and temperature sensor. The controller and contactors are vehicle chassis mounted. An engine wiring harness connects all engine system components. The kit does **not** include the 6 AWG wire or ring terminals needed between the battery and connections.



Ether **MUST NOT** be used with this system. Severe personal injury or property damage may result

The three enclosed warning labels, Part No. 3927335, **must** be installed in a location obvious to the operator, near the most likely point of entry of ether and on a visible side of the grid. An example of the first two locations would be on the sun visor and at the air cleaner intake.

Operation:

The grid heater system works in a preheat and post heat mode. The preheat mode heats the grid prior to starting to aid in starting. The post heat mode heats the intake air after starting to improve cold engine running. The following is a summary of the normal operations.

Preheat

Key switch on (intake manifold temperature sensor must be below 45°F).

WTS (wait to start) light on, grid is in preheat mode (reference Table 1).

WTS light goes out, engine is ready to start.

Start engine within 10 seconds after wait to start light OFF.

Grid in post heat mode (reference Table 1).

Vehicle Electrical System Requirements

The vehicle **must** have at least a 95 AMP alternator and batteries with cold cranking amp (CCA) and reserve capacity per Table 2. This system is compatible with 12 volt electrical systems **only** and is **not** compatible with 24 volt systems.

Hardware

The sales option or aftermarket kit (3802592) contains the following:

Part Name	Part No.	Quantity	Comments
Harness	3926914	1	4.5 ft. long
Controller	3926828	1	
Grid	3924594	1	
Temperature Sensor	3926903	1	
Contractor	3916301	2	
Instruction Tag	3927335	3	
Gasket	3913352	2	
Lamp (WTS Light)	C0322030200	1	
One Way Tower	3824004	1	
Connector			
Cavity Plugs	3823343	3	
Wire, Male	3822922	4	
Three Way	3823340	1	

Connector			
Three Way	3823339	1	
Connector			

⚠ WARNING ⚠

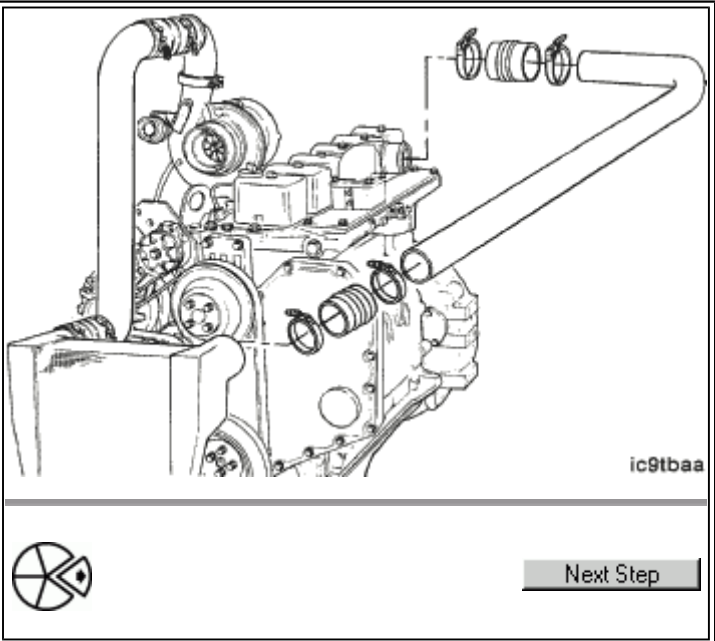
Always lock and tag-out the ignition before working on the engine.

▼ [Click here to align step.](#) ▼

Installation

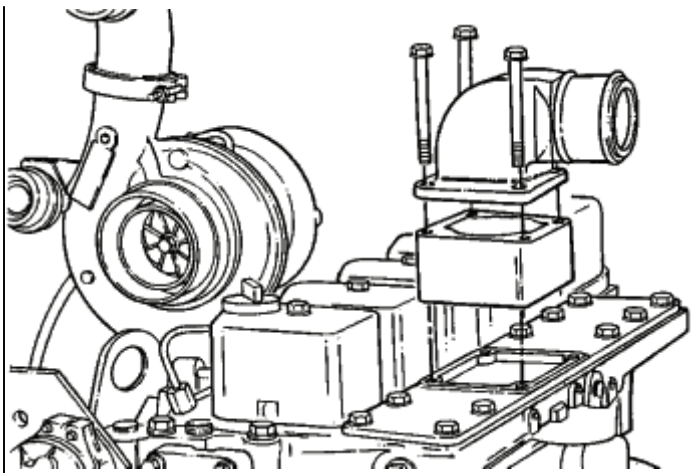
Engine Hardware:

Remove the air intake elbow from the cover.



Remove the air intake spacer, Part No. 3917938, from the intake cover and discard. If a manifold spacer is **not** used,

replace the elbow with a 3918982 elbow or equivalent



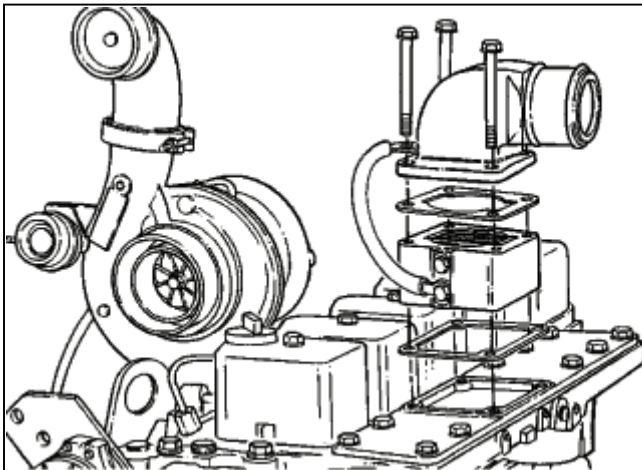
Previous Step

Next Step

Install the two gaskets, Part No. 3913352, above and below the grid, Part No. 3924594, with the ground strap under the grid mounting capscrews.

Torque Value:

24 N•m [18 ft-lb]

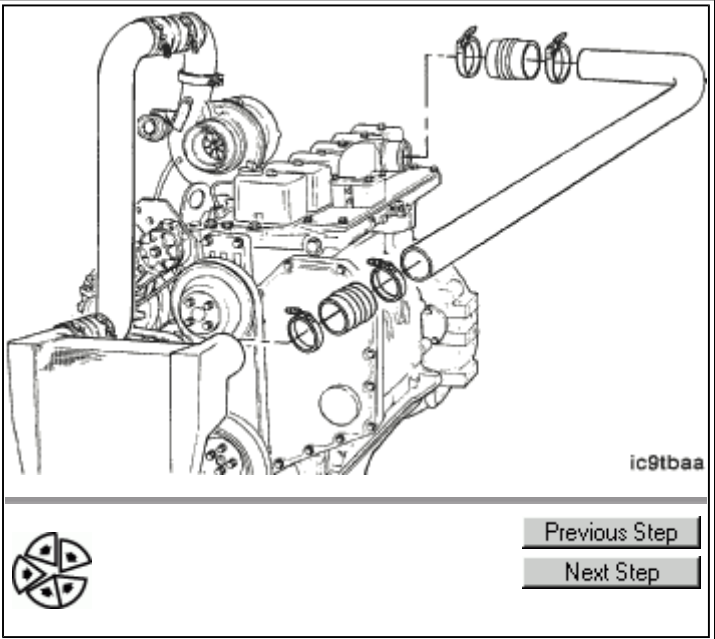


Previous Step

Next Step

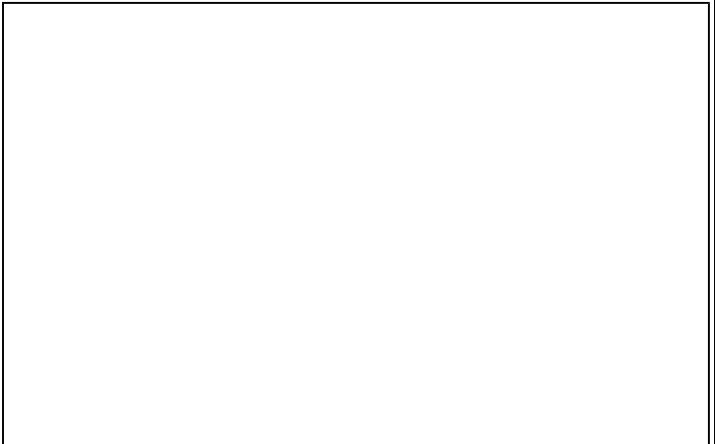
Install the air intake clamps.

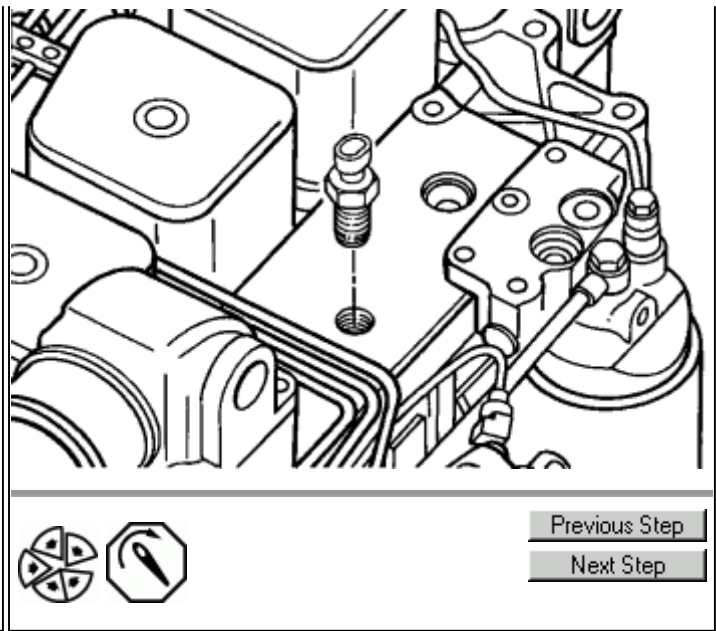
Torque Value:
8 N•m [75 in-lb]



Install the temperature sensor in the intake cover nearest the intake elbow.

Torque Value:
35 N•m [25 ft-lb]

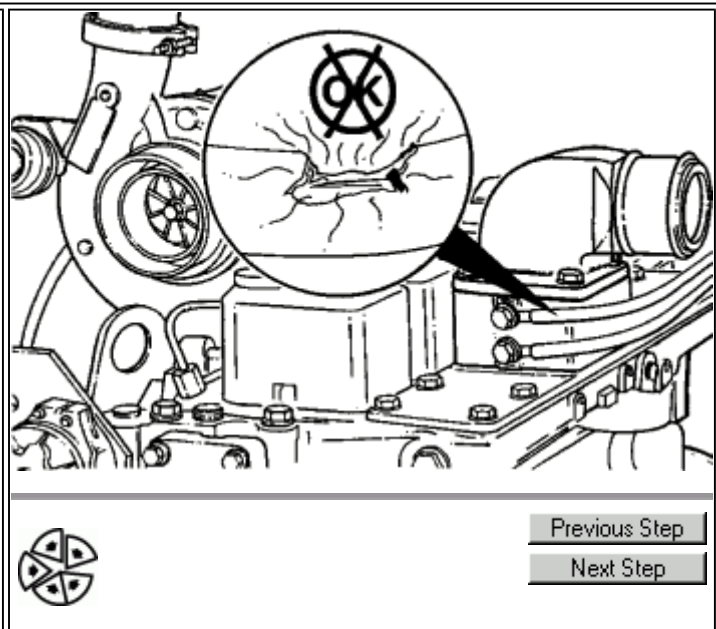




Install the wiring harness and secure to avoid chafing or burning.

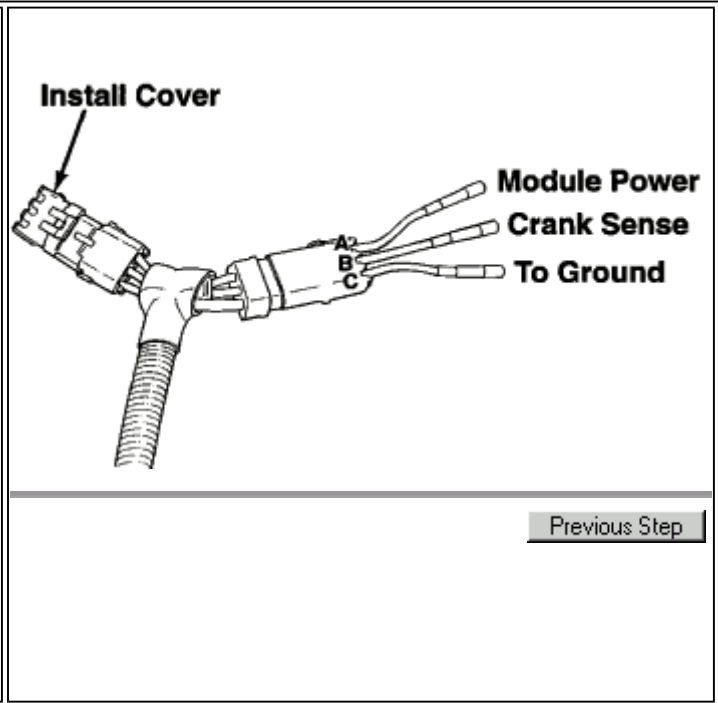
NOTE: The wiring harness should be secured within 6 inches of any connection to avoid connector or ring terminal damage.

See the wiring harness diagram for connections to the grid components, page 12.



If the engine does **not** have an electrical shut down solenoid, or it has a timer module for the shut down solenoid, use the three pin connector "Tee" to wire the vehicle as illustrated. Refer to the table below.

Connector Letter	Function	Recommended Location
A	Module Power	Key Switch "ON" Power Supply
B	Crank Sensor	"S" Terminal On Starter or Key Switch "Crank"
C	Ground	Engine, Chassis or Battery Ground



Chassis Hardware:

Install a customer supplied **wait-to-start** (WTS) light in the cab at an obvious location for the operator. Label the lamp with a **wait-to-start** label. A single pin female weather pack connector is provided from the engine wiring harness.

NOTE: The controller provides the ground signal to the WTS light. A 12 volt source of power from the key switch is required.

Install the controller, Part No. 3926828, either on the vehicle fire wall or inside the vehicle cab.

NOTE: Do **not** install the controller in a location with temperatures greater than 105°C [220°F].

Install the contactors, Part No. 3916301, in the horizontal or straight up position.

Install the 125 amp fusible link or fuse between the relay and battery in each 6 gauge wire. To be effective the fusible links should be installed as close to the battery as possible.

Install the battery cable(s) between the fusible links and the relays. The battery cables **must**

be at least 6 gauge wire. Cover the exposed battery cables with appropriate shielding to avoid short circuits to ground.

The three enclosed warning labels, Part No. 3927335, **must** be installed in a location obvious to the operator and near the most likely point of entry of ether and on a visible side of the grid. An example of the first two locations would be on the sun visor and at the air cleaner intake.

Troubleshooting:

WTS Light not Functioning	Check wiring, socket, bulb, ground signal from controller and bulb power supply from key switch. Correct any electrical problems with the WTS light. WTS light will flash one time a second if the temperature sensor is detected open circuit.
Temperature Sensor Failed	Check resistance across the temperature sensor pins J1A and J1B at room temperature and in an ice bath (0°C [32°F]). The resistance should be approximately 800 ohms at room temperature and 2000 ohms for the ice bath. Check the resistance to ground for an open circuit.
.	Note: Make resistance checks with the key switch in the "ON" position to make sure there are no ground problems.
.	Replace defective sensor.
Relays or Contactors Failure	Check relays or contactors for an audible click during operation. Check for pitting or burning in the relay by measuring resistance across the high current terminals when relay is closed. Replace relay(s) if the resistance is high or an audible click is not heard when it is actuated.
Insufficient Ground Connections	Check pin J1B for ground to controller and check the ground strap to the grid for high resistance. Repair or replace wiring.
Controller Malfunctioning	Check pin J2A for 12 volt signal, inspect the wiring harness for shorting, chafing, or burning. The controller operates between 6.5 volts and 16 volts. Check the connectors for good connections. Replace the controller if necessary.
.	Note: The controller will abort post heat if it senses a voltage below 9.5 volts during preheat or a 10 second delay or more between WTS light off and cranking or an open temperature circuit.

SRT Times

		R	A	B	C	D	S
13 - 124	Grid Heater - Remove and Install	—	4.2	4.2	4.2	4.2	—
.	Includes:	.	.	.	.	.	.
.	•Disconnect and connect batteries	.	.	.	.	.	.
.	•Remove and Install	.	.	.	.	.	.
.	Intake Elbow	.	.	.	.	.	.

	Mounting Capscrews	.	.	.	.	.	.
	Gaskets	.	.	.	.	.	.
	Cross Over Tube Clamps	.	.	.	.	.	.
	Wiring Harness	.	.	.	.	.	.
	Temperature Sensor	.	.	.	.	.	.
	Grid	.	.	.	.	.	.
	Contactors	.	.	.	.	.	.

		R	A	B	C	D	S
00 - 658	Troubleshoot - Grid Heater System	.	.	.	.	.	.
	Includes:	.	.	.	.	.	.
- 01	•Check:	—	0.9	0.9	0.9	0.9	—
	WTS Light	.	.	.	.	.	.
	Temperature Sensor	.	.	.	.	.	.
	Wiring Harness	.	.	.	.	.	.
	Contactors	.	.	.	.	.	.
	Controller	.	.	.	.	.	.
	Ground Circuits	.	.	.	.	.	.
	Grid	.	.	.	.	.	.

Warranty

All these components are covered under the base engine warranty or parts warranty except for the customer or OEM supplied hardware.

Attachments:

Controller wiring diagram
 Grid harness and sensor installation drawing
 Grid components connections

Table 1

Temperature	Condition	Elements	Duration	Duty Cycle % ON % OFF
< -19° C	Preheat	Both	30 Sec.	Continuous
< -2° F	Post Heat	Both	15 Sec.	Continuous
.	.	One	15 Sec.	Continuous
.	.	One	40 Sec.	50/50
.	.	One	106 Sec.	25/75

-19° C to 8° C	Preheat	Both	20 Sec.	Continuous
-2° F to 17° F	Post Heat	Both	20 Sec.	Continuous
.	.	One	20 Sec.	Continuous
.	.	One	40 Sec.	50/50
.	.	One	106 Sec.	25/75
-8° C to 8° C	Preheat	Both	10 Sec.	Continuous
17° F to 46° F	Post Heat	Both	10 Sec.	Continuous
.	.	One	10 Sec.	Continuous
.	.	One	40 Sec.	50/50
.	.	One	106 Sec.	25/75
> 8° C	Preheat	None	.	.
> 46° F	Post Heat	None	.	.
.
Current Draw - 95 amps per element				

To prevent excessive drain on the batteries, the electric grid heater controller has incorporated a battery monitoring feature. If the battery voltage were to dip too low, the grid heater controller will curtail the post heat cycle preventing further drain on the batteries. This battery protection feature is only activated on vehicles with weak or drained batteries.

Battery Size Requirements For B Series Engines

Automotive and Industrial Ratings

1991 and 1994 6BTAA and 4BTAA Automotive Ratings

Unaided Starting Down + 32° F or Intake Heater Equipment *

	6BTAA		4BTAA	
	CCA	Reserve Minutes	CCA	Reserve Minutes
Heavy Acc.	1000	160	900	160
Light Acc.	850	160	750	169

*Intake heater equipment option requires 95 amp alternator or larger.

Unaided Starting Down to +10° F

	6BTAA		4BTAA	
	CCA	Reserve Minutes	CCA	Reserve Minutes
Heavy Acc.	1500	320	1350	320

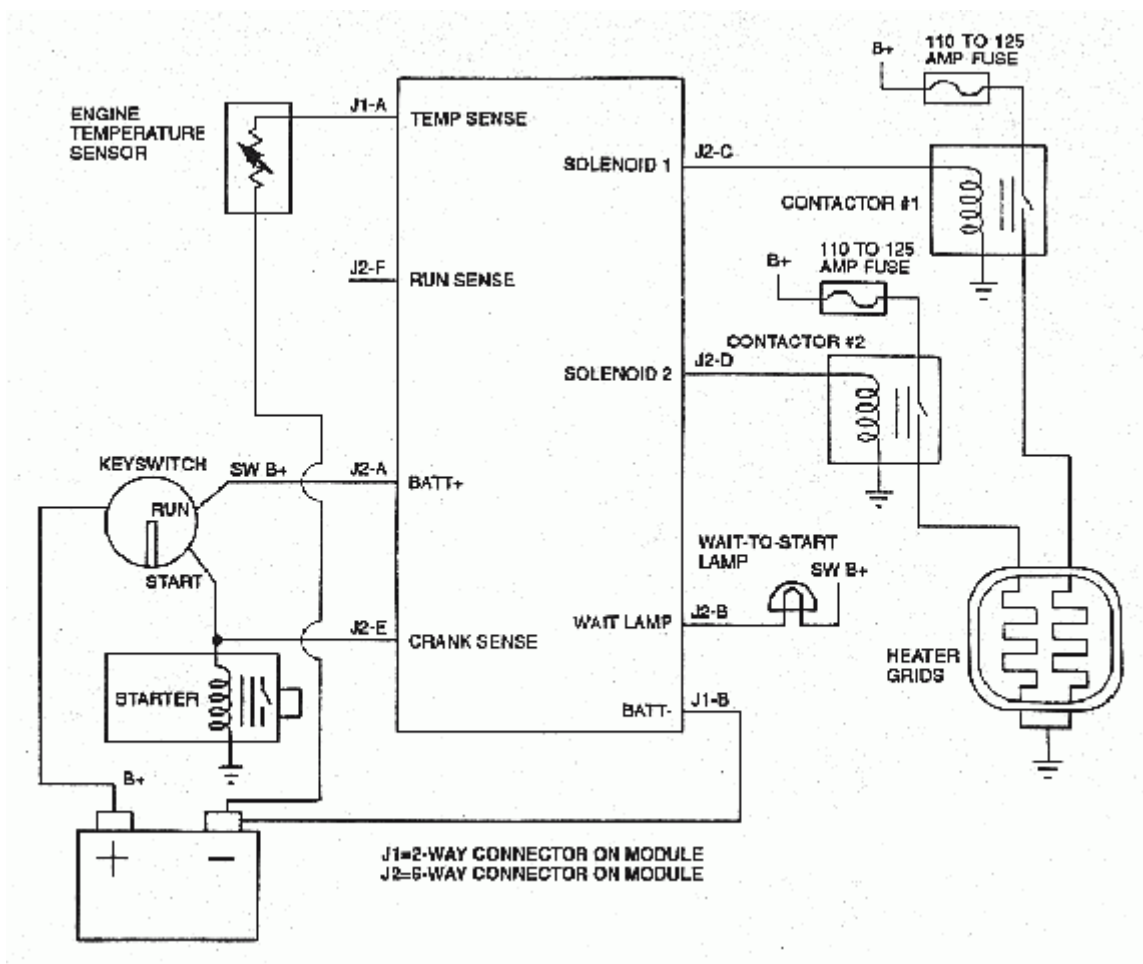
Light Acc.	1250	320	1125	320
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1994 6BTAA and 4BTAA Industrial Ratings

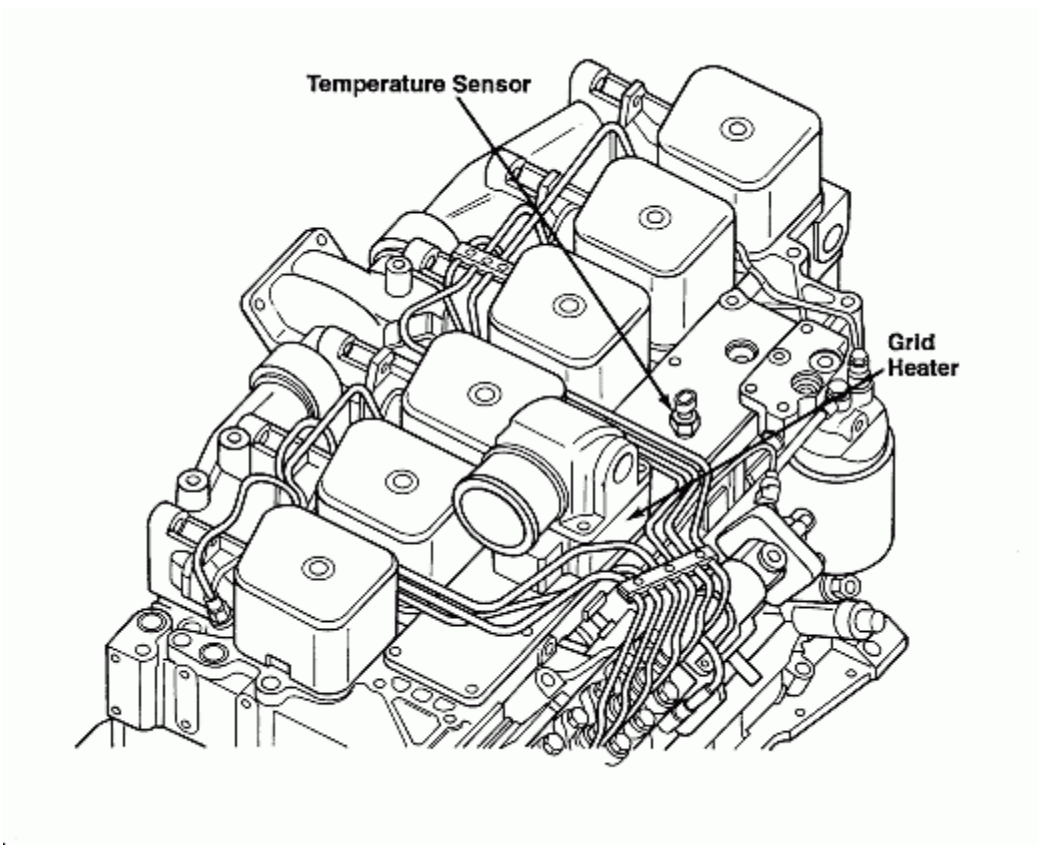
	6B		4B	
	CCA	Reserve Minutes	CCA	Reserve Minutes
Heavy Acc.	950	160	800	160
Light Acc.	800	160	625	160

NOTE: Typical "light accessories" include alternator, small steering pump, and disengaged clutch. Typical "heavy accessories" include hydraulic pump and torque converter.

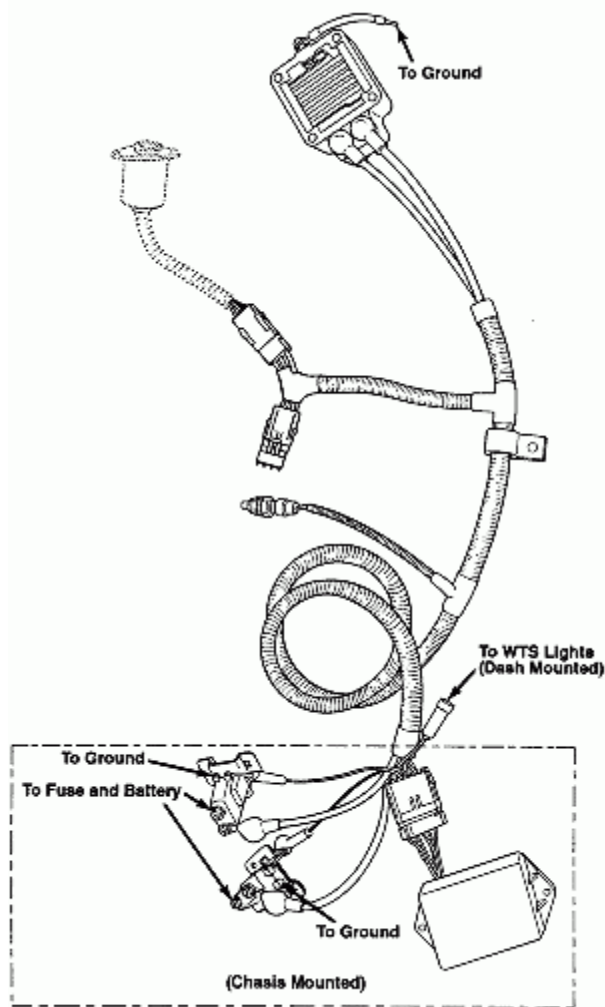
Intake Heater Controller Interconnection Diagram



'94 B Series Layout With Cold Starting System



Grid Component Connections



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