

**CUCV GLOW PLUG SYSTEM
DIAGNOSIS AND TROUBLESHOOTING**

**Service Operations – CUCV
August, 1985**



CUCV GLOW PLUG SYSTEM
IDENTIFICATION/OPERATION/TROUBLESHOOTING

PREFACE

The material contained in this manual, has been developed to assist the repair technician in creating a solid foundation of CUCV glow plug system knowledge. A firm understanding of how the CUCV glow plug system works will be very beneficial when attempting proper diagnosis or troubleshooting.

As an important first step, study the GLOW PLUG SYSTEM COMPONENT IDENTIFICATION SECTION. Knowing the description, function and location of each component will help tremendously in gaining an appreciation for the next step.

Once the individual components have been reviewed, proceed to the next section: GLOW PLUG SYSTEM OPERATION. Study the system operation and utilize the wiring diagram to understand how current flows throughout the entire glow plug system.

Now that the knowledge of identifying components has been combined with understanding the operation of the glow plug system, proceed with the TROUBLESHOOTING section.

When troubleshooting, the first thing to determine is if the glow plug system (or a part thereof) has actually failed by performing the CUCV PRELIMINARY DIAGNOSIS WITH AMMETER procedure.

CUCV GLOW PLUG SYSTEM
IDENTIFICATION/OPERATION/TROUBLESHOOTING

PREFACE (continued)

After the preliminary diagnosis, determine if a specific component in the glow plug system is at fault. Observe the operating characteristics of the glow plug "WAIT LAMP" and utilize one of the CONDITION CHART's that best fits the situation experienced.

If after completing an analysis of the CONDITION CHARTS the failure still exists, proceed to the GLOW PLUG POWER SYSTEM TROUBLESHOOTING PROCEDURES.

Finally, if the fault still exists, proceed to the TROUBLESHOOTING THE GLOW PLUG CONTROL SYSTEM procedure.

Reading this document alone will not make anyone a CUCV Glow Plug System expert; however, combining it with actual hands-on experience will provide any technician confronted with a Glow Plug System failure a systematic method of determining what failed, why it failed and how to fix it.

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I GLOW PLUG SYSTEM OVERVIEW

The glow plug system is made up of several electrical components all designed to work together to help start the 6.2 diesel under ordinary circumstances. The following list numerically identifies each electrical component as it will be called out in the, GLOW PLUG COMPONENT IDENTIFICATION Section, GLOW PLUG SYSTEM OPERATION Section and the GLOW PLUG CIRCUIT WIRING DIAGRAM:

<u>Component Number</u>	<u>Component Description</u>
1	Two batteries
2	Two ballast resistors
3	Glow plug relay
4	Eight glow plugs
5	Positive/Negative buss bar
6	Engine Ground strap
7	Ignition switch
8	Glow plug control module
9	Wait lamp
10	Engine Coolant Temperature sensor
11	Voltage sensing wire

II GLOW PLUG SYSTEM COMPONENT IDENTIFICATION

To help in identifying the various components in the glow plug system, it has been divided into two systems: The GLOW PLUG POWER system and the GLOW PLUG CONTROL system.

- GLOW PLUG POWER SYSTEM consists of: two batteries, two ballast resistors, one glow plug relay, eight glow plugs, one positive/negative buss bar, one engine ground strap and associated wiring.
- GLOW PLUG CONTROL SYSTEM consists of: an ignition switch, a glow plug control module, a wait lamp, an engine coolant temperature sensor, a voltage sensing wire and associated wiring.

A. Identifying The Glow Plug Power System Components

It is important to know the description, function and location of each component in the glow plug POWER system. A basic knowledge of these three areas will help in understanding each component's integral role in the operation and diagnosis of the glow plug system.

NOTE: In regards to the location of various parts or components: All locations are given as one would view them from the driver's seat. i.e. the steering wheel is located on the left, forward interior of the vehicle.

GLOW PLUG POWER SYSTEM COMPONENTS

BATTERIES ①

Description: Two rectangular 12 volt maintenance free batteries containing calcium alloy grids and electrolyte.

Function: The batteries are wired in series to supply 24 volts to the glow plug system. (It is important to ensure both batteries are fully charged and all battery connections are properly cleaned and tightened prior to diagnosing any glow plug system problem.)

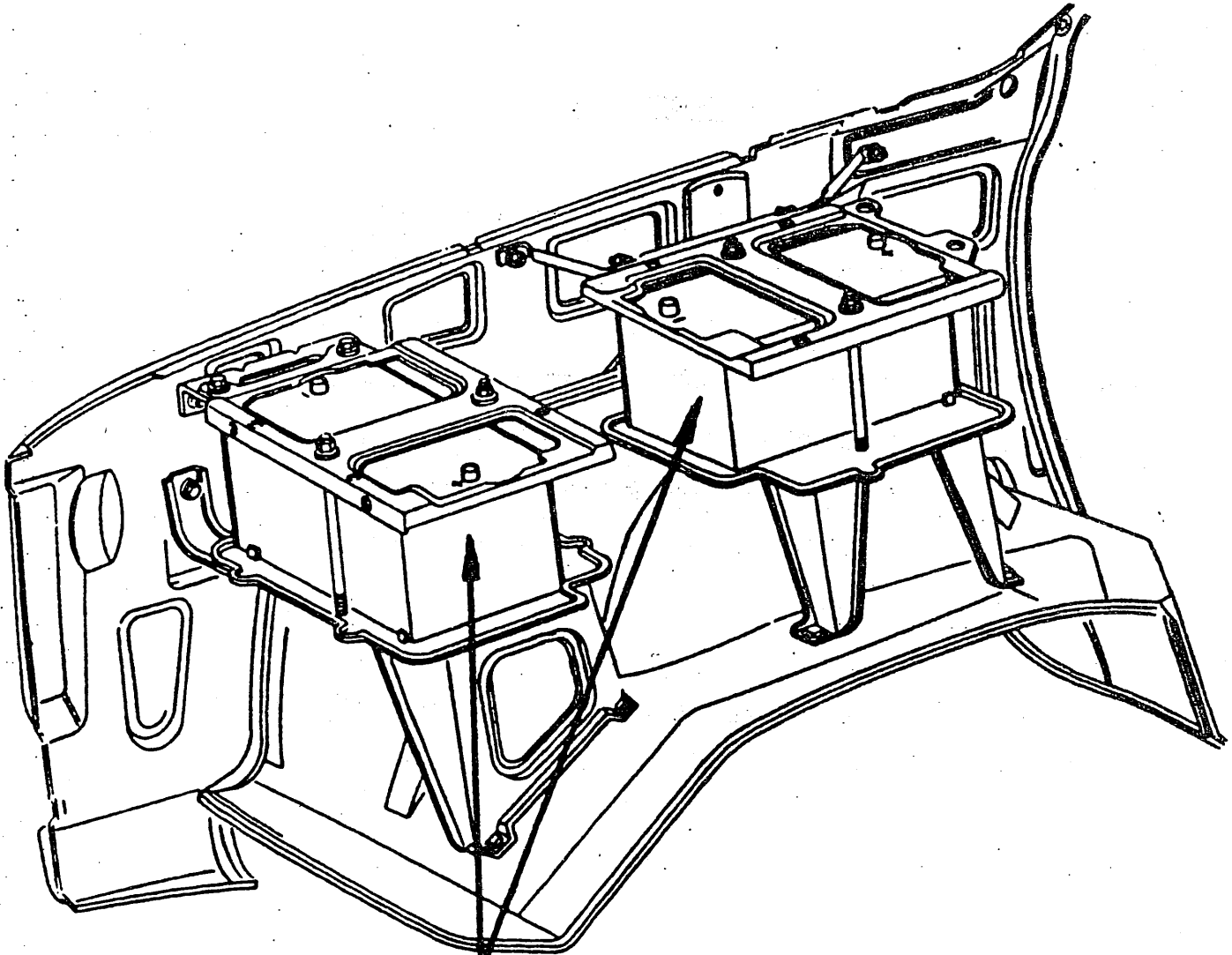
Location: The batteries are located in the engine compartment on the passenger side of the vehicle (see Figure 1).

BALLAST RESISTORS ②

Description: Two 300 watt, .28 ohm resistors wired in parallel.

Function: Reduces the 24 volts coming from the positive buss bar to 12 volts and directs it to the glow plug relay.

Location: The resistors are attached to the engine compartment bulkhead and covered by a protective metal shield (see Figure 2).



① Batteries

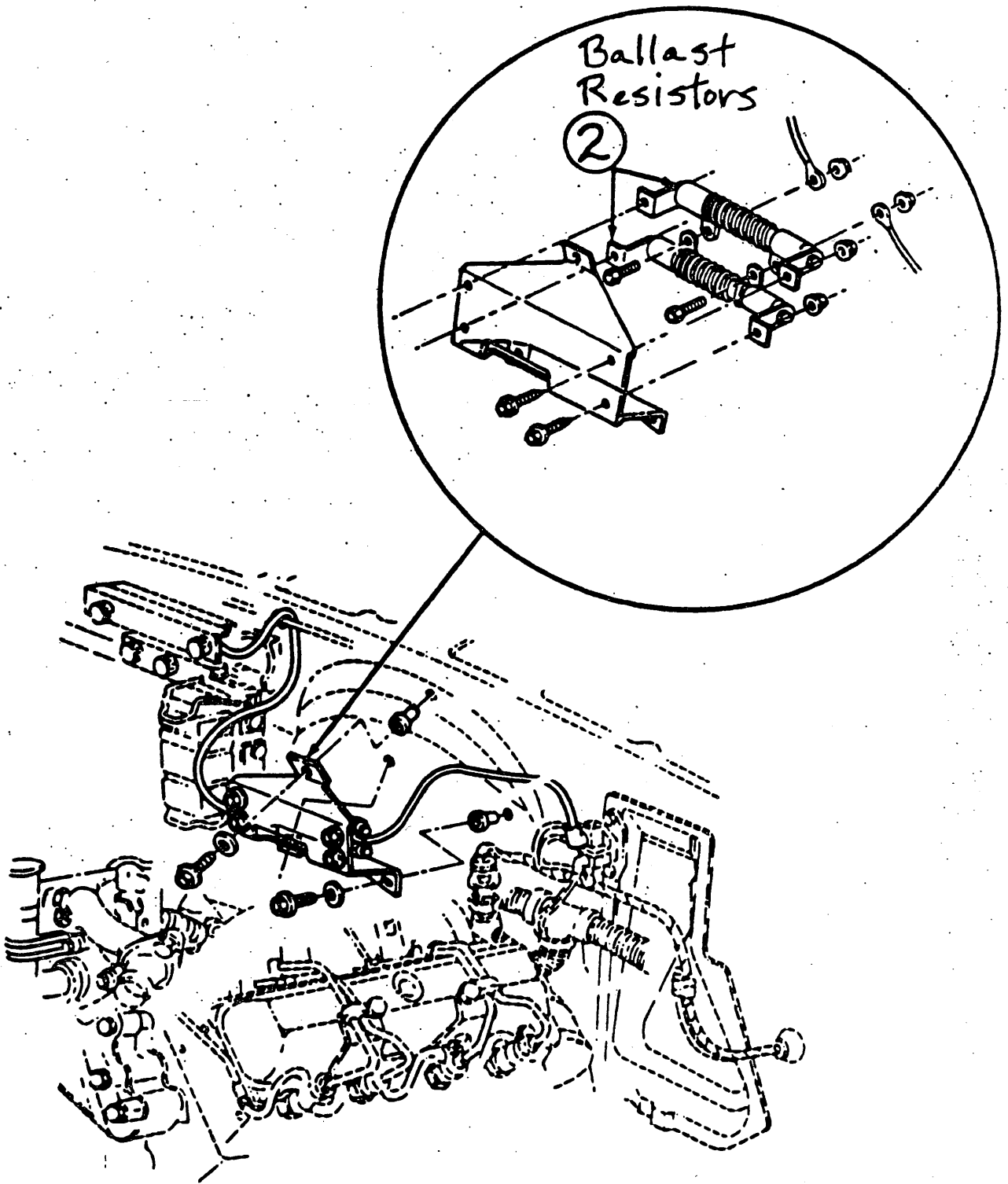


FIGURE 2

GLOW PLUG RELAY

③

Description: The glow plug relay is an electro-mechanical switching device with two large copper electrical studs and two small electrical steel studs.

Function: When the glow plug relay coil is activated (at the two small steel studs) by the glow plug control module, electrical current creates a magnetic force in the coil that kicks the plunger out against two large copper terminals. This, in turn, allows current to flow from the ballast resistors to the glow plugs.

Location: The glow plug relay is attached to the engine compartment bulkhead, left of the vehicle's center line (see Figure 3).

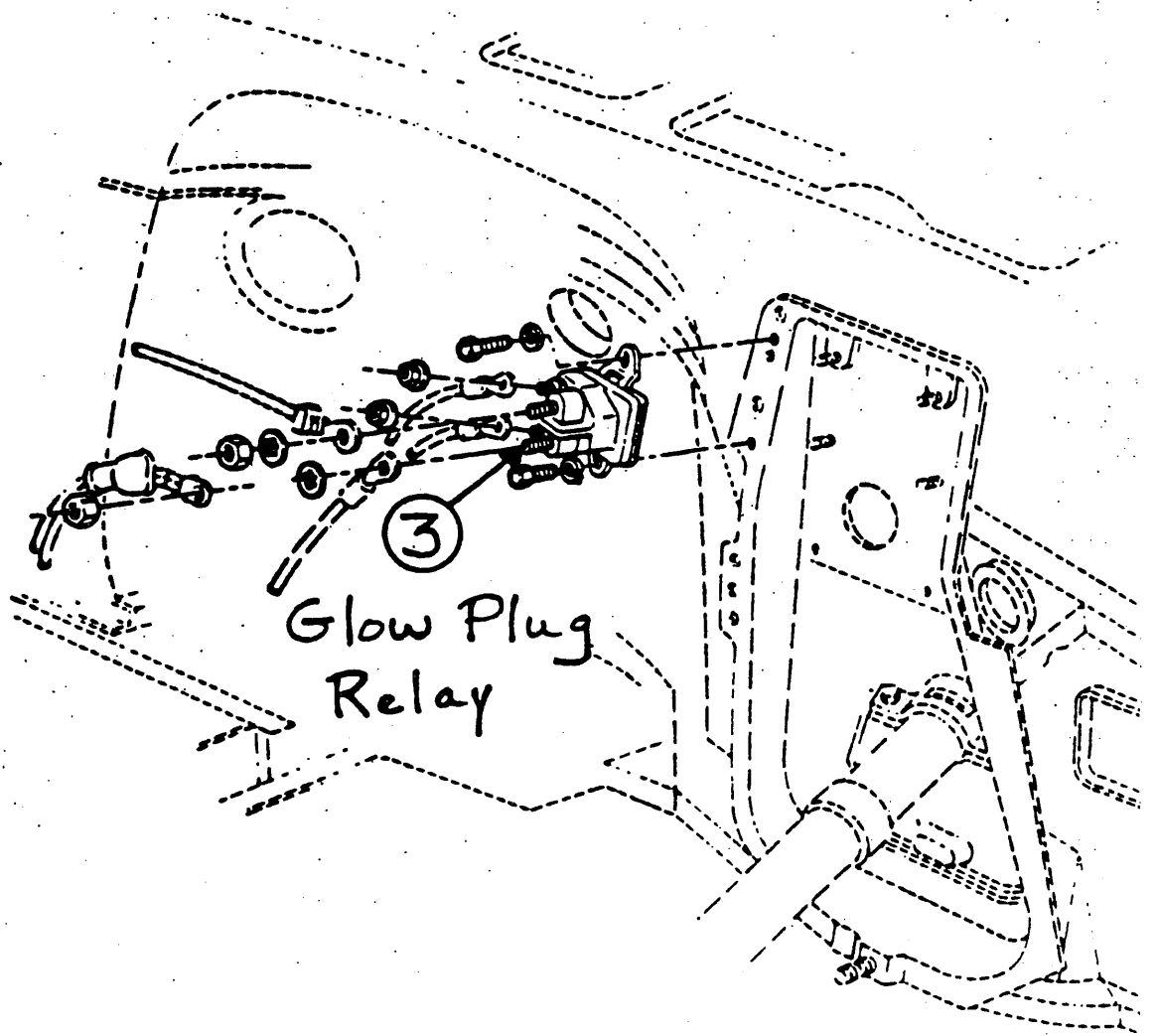


FIGURE 3

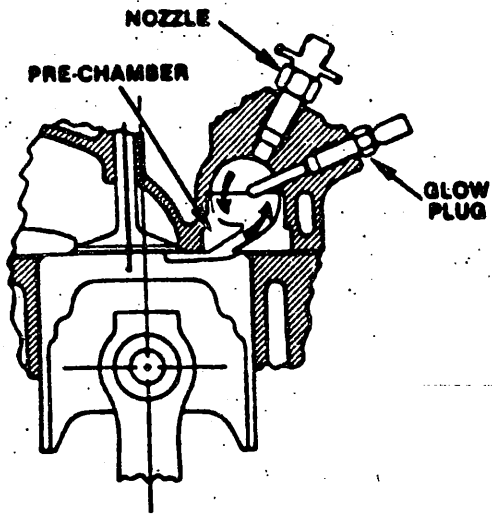
GLOW PLUG (4)

Description: The CUCV 6.2 diesel engine glow plugs are temperature self-regulating. This offers a rapid glow plug temperature rise, but does not require the critical shut-off timing and cycling that a commercial glow plug system does.

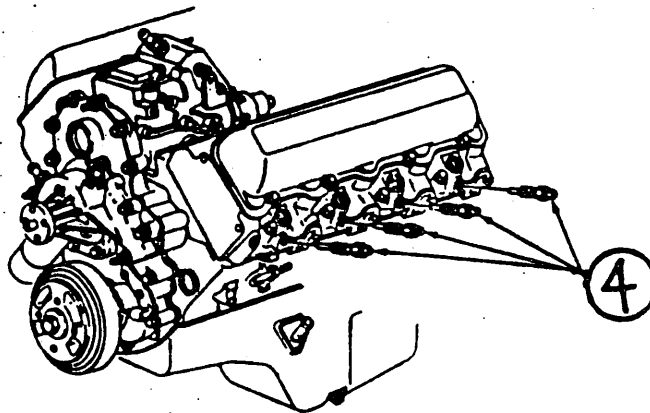
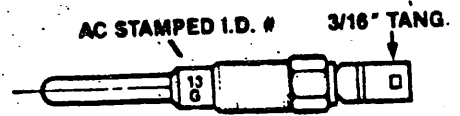
Function: To rapidly heat the cylinder prechamber to aid in starting a cold engine (not at operating temperature).
The glow plugs are designed to operate under three conditions:

- "PRE-GLOW"..... cycle during the amount of time that the "WAIT" Light is on.
- "CRANKING GLOW"... glow plugs remain on during the engine cranking period.
- "AFTER GLOW"..... depending on engine temperature, the glow plugs can remain cycling for up to 90 seconds after engine start-up.

Location: The glow plugs (eight in all) are threaded into each of the cylinder prechambers (four in each head) between the fuel injection nozzle and the exhaust manifold (see Figure 4).



CVCV MILITARY GLOW PLUG



GLOW PLUGS

FIGURE 4

POSITIVE/NEGATIVE BUSS BARS

⑤

Description: One row of positive terminals and one row of negative terminals.

Function: Provide a central location for 24 volt wiring.

Location: Engine compartment, passenger side, on the bulkhead (see Figure 5).

ENGINE GROUND STRAP

⑥

Description: Braided copper wire (with large, flat terminal ends).

Function: Provides a direct high capacity, path to ground for engine electrical components. A good example of this would be the completion of the glow plug circuitry.

Location: Between the right side of the engine bulkhead (dash and cowl panel) and the right rear portion of the engine's air inlet manifold (see Figure 6).

NOTE: A WORD ABOUT WIRING

The insulated electrical conductors or wiring used on the CUCV come in different sizes (gauges) and colors. The wires are used to carry current from the source of electricity (i.e. battery, relay) to various components, completing the glow plug electrical circuit.

THIS COMPLETES THE GLOW PLUG POWER SYSTEM COMPONENT IDENTIFICATION SECTION

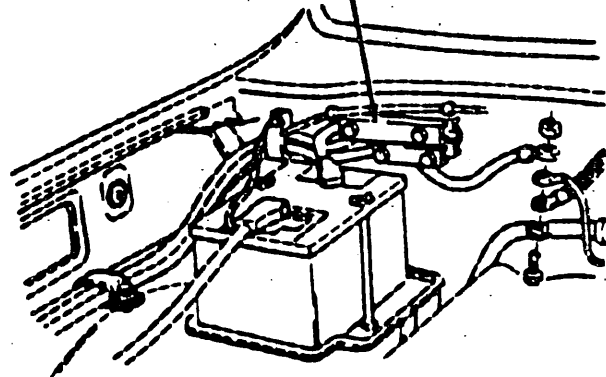
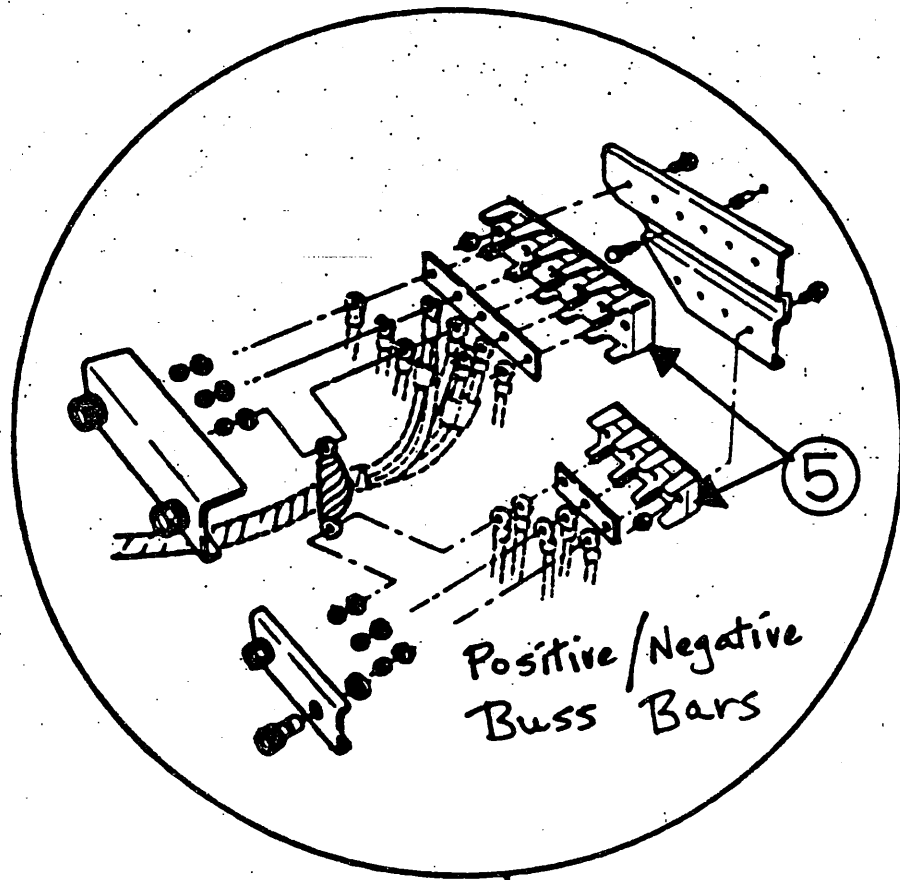


FIGURE 5

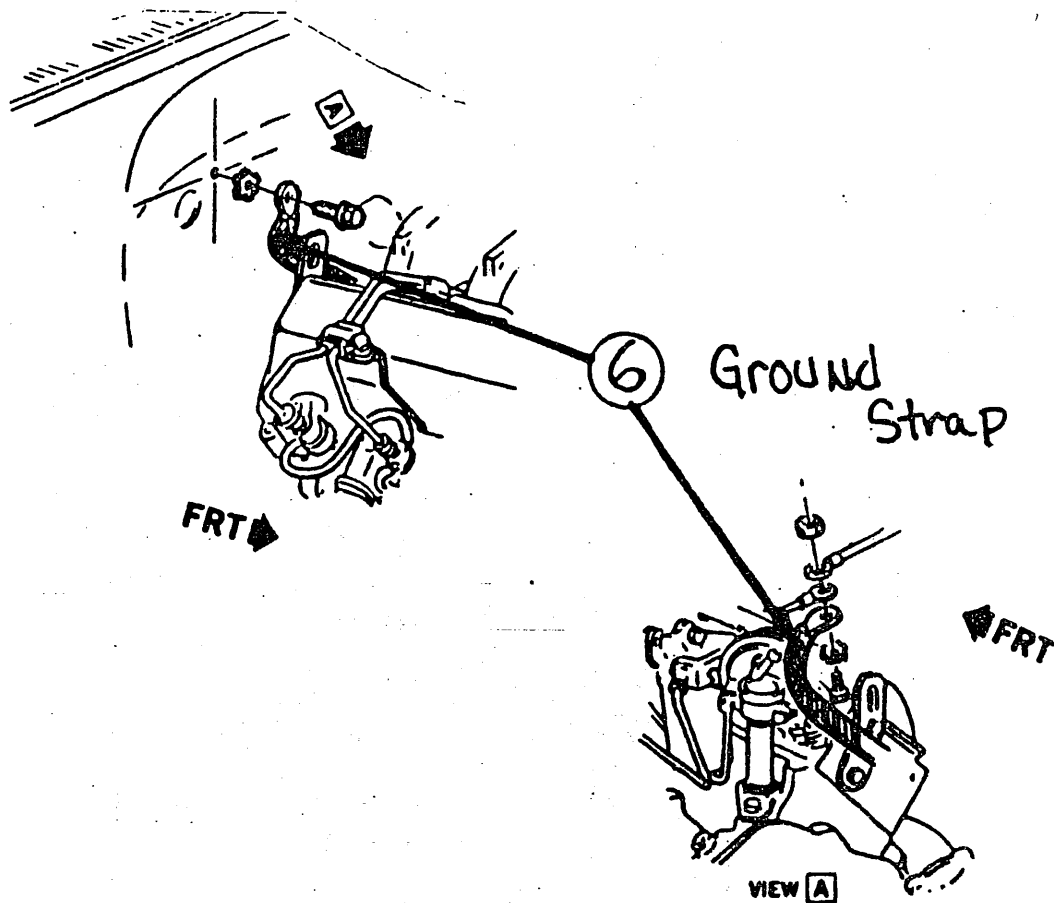


FIGURE 6

B. Identifying The Glow Plug CONTROL System Components

Just as with the Glow Plug Power system, it is also important to know the description, function and location of each component in the GLOW PLUG CONTROL system. A basic knowledge of these three areas will help in understanding each component's integral role in the operation and diagnosis of the glow plug system.

GLOW PLUG CONTROL SYSTEM COMPONENTS

IGNITION SWITCH

7

Description: An electro-mechanical device that is used to select four different modes of operation. These four different modes are achieved by rotating the ignition key/lock cylinder assembly to certain positions:

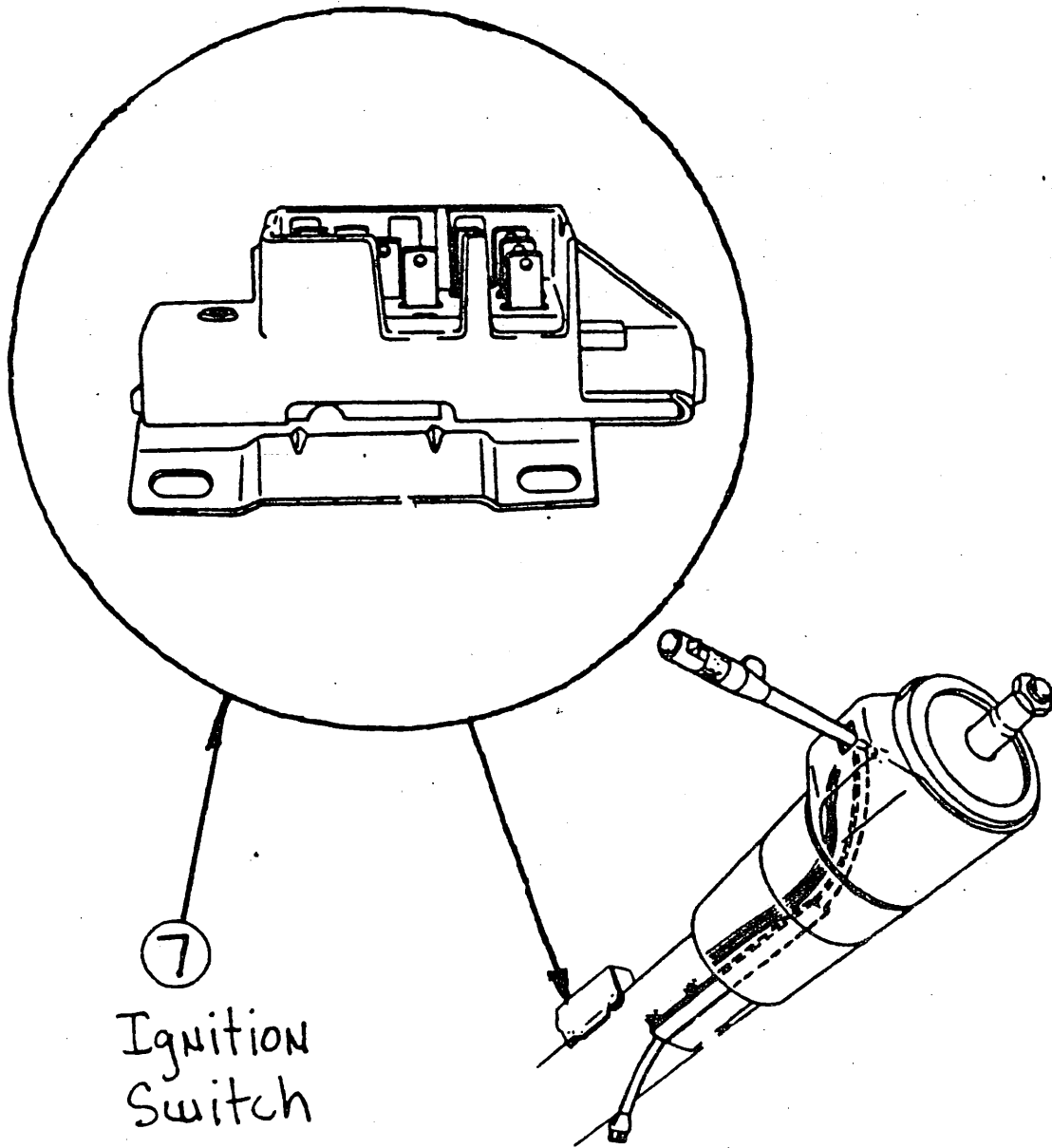
- Accessory
- Off
- Run (or On)
- Start

The lock cylinder is, in-turn, connected to the actual ignition switch (located further down the steering column) by a small steel rod.

Function: The ignition switch has as many functions as it does modes. Briefly they are:

- Assesory Position - Supplies current to components that may operate while the engine is off.
- Off or Locked Position - This position is used to turn the engine off and lock the steering wheel.
- Run (or On) Position - To supply current to electrical components as needed while the engine is running.
- Start Position - To supply current to the starting circuit.

Location: The ignition switch is located on top of the steering column, behind the instrument panel (see Figure 7).



GLOW PLUG CONTROL MODULE (8)

Description: The glow plug control module is a circuit board, composed of many electronic components, used to control the glow plug system.

Function: The glow plug module's primary function is to monitor and control the glow plug system. It does this whether the engine is "HOT" or "COLD" by receiving feedback signals from the voltage and temperature sensors. Basically, the module provides a completion of the ground circuit for the glow plug relay.

Location: The glow plug module is located in a "black box" at the end of a harness underneath the dash panel, to the left of the steering column (see Figure 8).

"WAIT" LAMP (9)

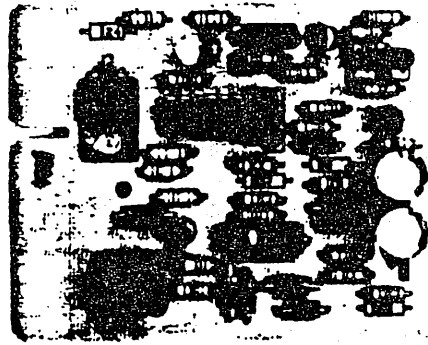
Description: The "WAIT" Lamp is actually a bulb that is energized by the glow plug module after the ignition switch has been turned to "ON".

Function: The "WAIT" Lamp is used to show the operator:

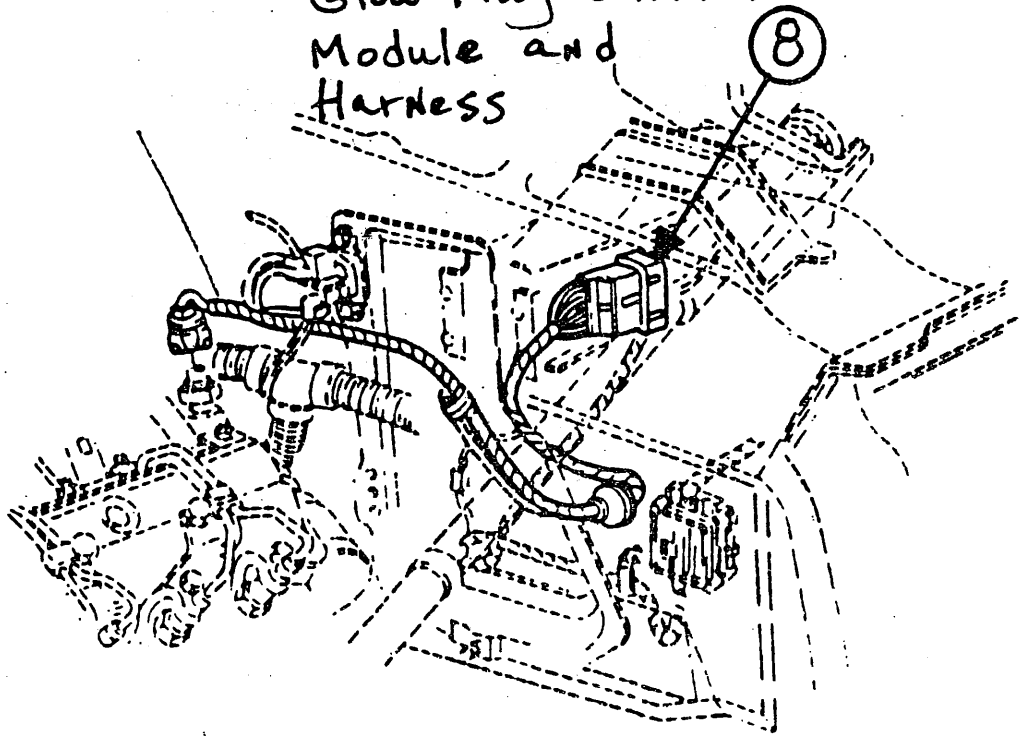
1. The system is functioning.
2. The amount of time needed to "WAIT" before starting the vehicle.
3. A problem in the system exists.

Location: The "WAIT" Lamp is located in the center of the top half of the instrument cluster (see Figure 9).

Glow Plug Module



Glow Plug Control Module and Harness



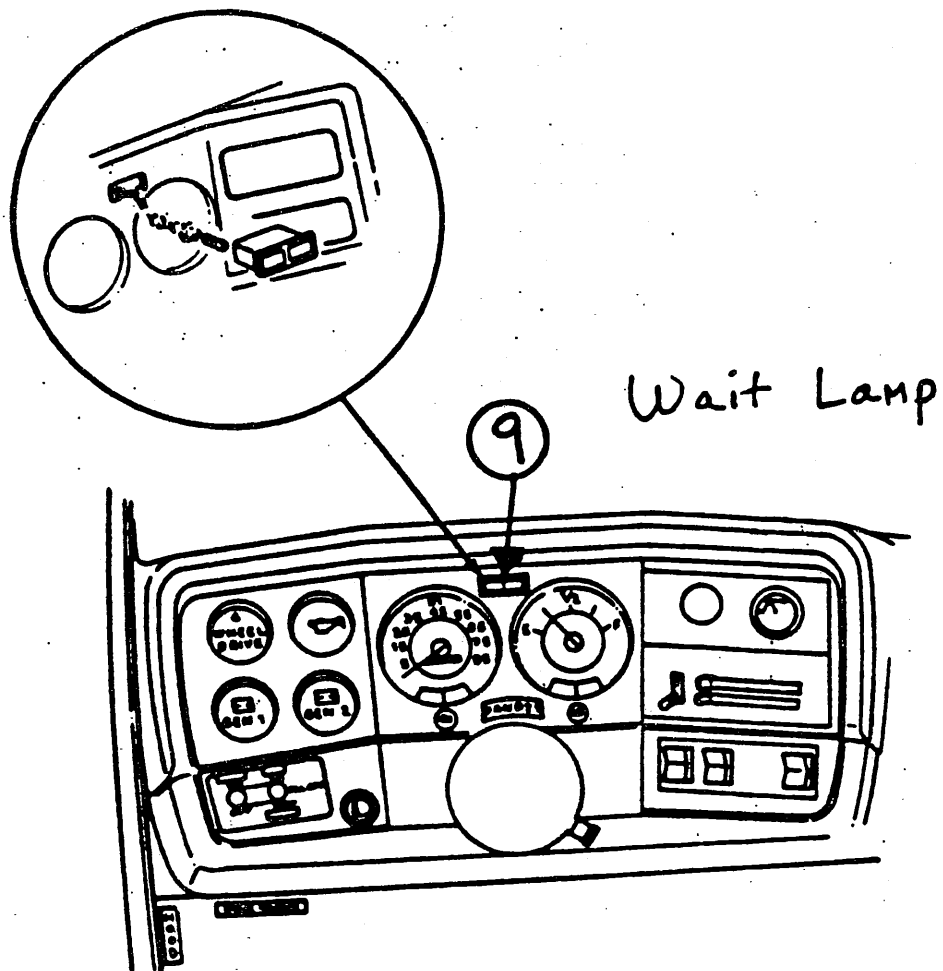


FIGURE 9

ENGINE COOLANT TEMPERATURE SENSOR (10)

Description: A thermally regulated resistor, encased in a hex nut-like body. With a threaded portion and sensing tip on one end and a connecting pin on the other.

Function: To provide engine coolant temperature information to the electronic glow plug control module. The module uses this information to monitor and control the glow plug operation as well as calculate the "WAIT" Light time.

Location: Left rear of left cylinder head (see Figure 10).

VOLTAGE SENSING WIRE (11)

Description: An 18 guage orange wire.

Function: To sense collective glow plug voltage and send a message to the glow plug control module. The control module uses this information to monitor and control glow plug system operation. Specifically, the glow plug relay.

Location: Between the large copper stud of the glow plug relay and the glow plug control module (see Figure 11).

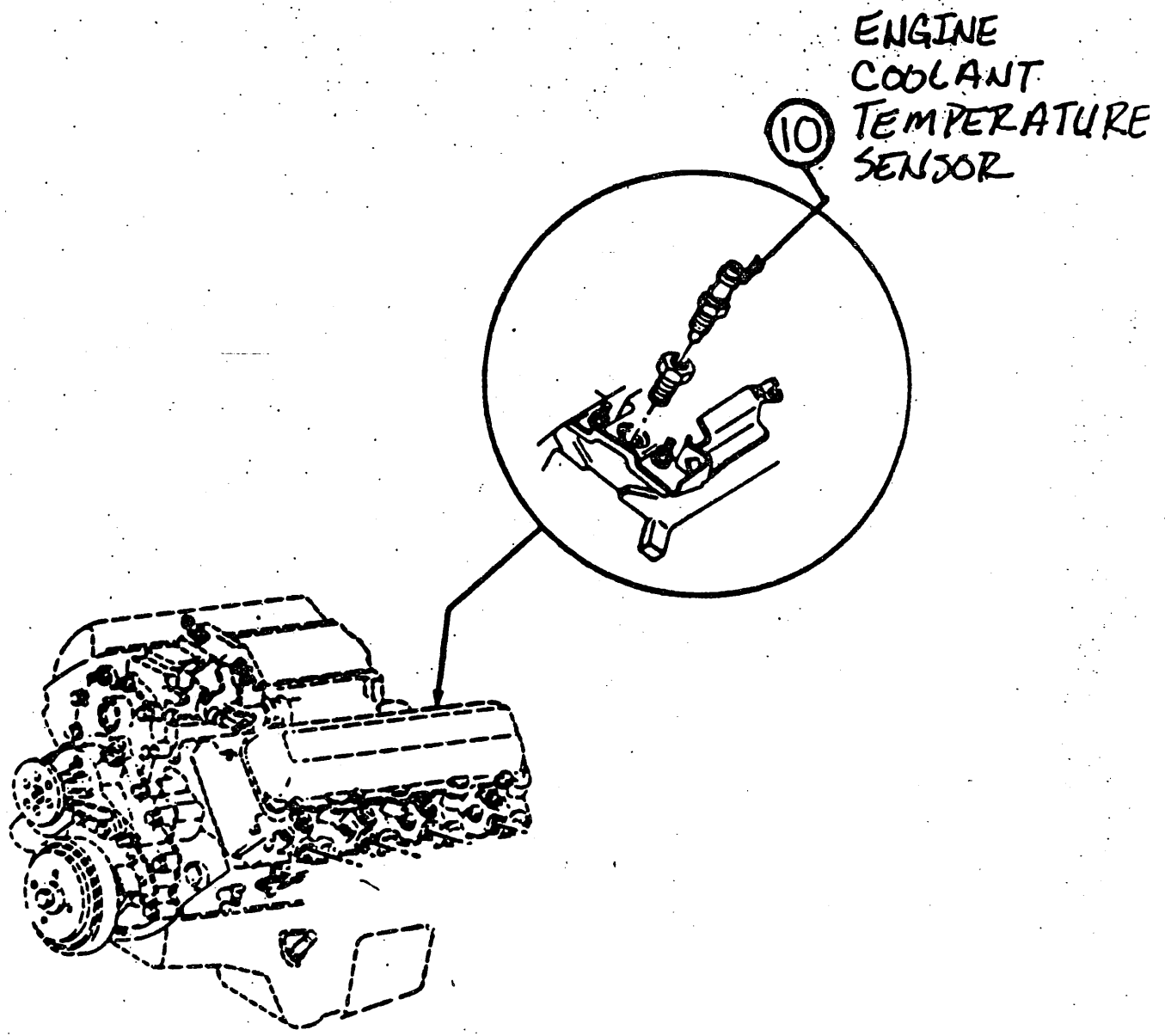
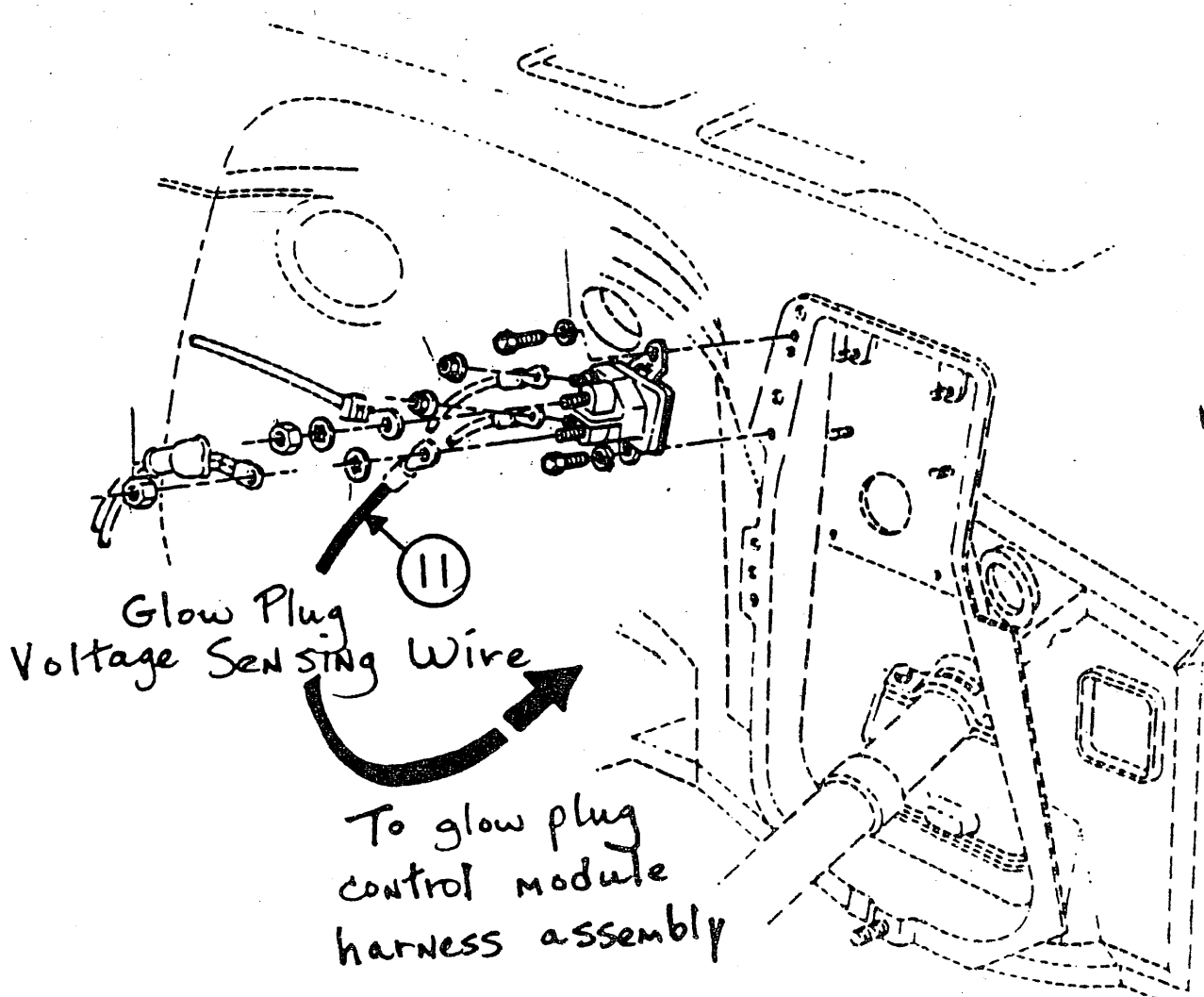


FIGURE 10



III GLOW PLUG SYSTEM OPERATION

This GLOW PLUG SYSTEM OPERATION section has been written so the sequence of events may be followed in the GLOW PLUG SYSTEM WIRING DIAGRAM (see Figure 12). As Each component is introduced during the explanation, take a moment to locate it in the wiring diagram to see how it relates to the overall glow plug system operation.

A. "PRE-GLOW" Time Period

This time period involves approximately 10-12 seconds. Here is what happens:

The glow plug system is activated by turning the ignition switch ⑦ to the "ON" position. This action allows 2.0 amps of current to flow from the ignition side of the fuse panel to the glow plug control module ⑧. The glow plug control module provides the electrical ground to energize the wait lamp ⑨ for the "PRE-GLOW" time period (approximately 10-12 seconds). During this period, the glow plug control module ⑧ also provides a ground circuit for the glow plug relay coil. This causes the internal plunger to move outward and make contact with the two large copper studs. When the glow plug relay ③ is activated, (plunger is connecting the two large copper studs) current flows from the batteries ① through the positive buss bar ⑤, through the ballast resistors ②, through the glow plug relay copper studs ③, through glow plugs ④ and then to ground.

B. "CRANKING GLOW" Time Period

This time period normally involves a short span of just a few seconds. Here is what happens: (Assume the PRE-GLOW step was followed).

When the wait lamp ⑨ has turned off, the operator will then turn the key to the start position. The glow plug module ⑧ receives a message from the ignition switch ⑦ while it is in the crank position and provides a ground to the glow plug relay ④ during the "CRANKING GLOW" time period.

NOTE: If this process of cranking to start takes more than just a few seconds there is usually something wrong with either the "PRE-GLOW" activity, the fuel supply system or some other part of the vehicle's operational system.

C. "AFTER GLOW" Time Period

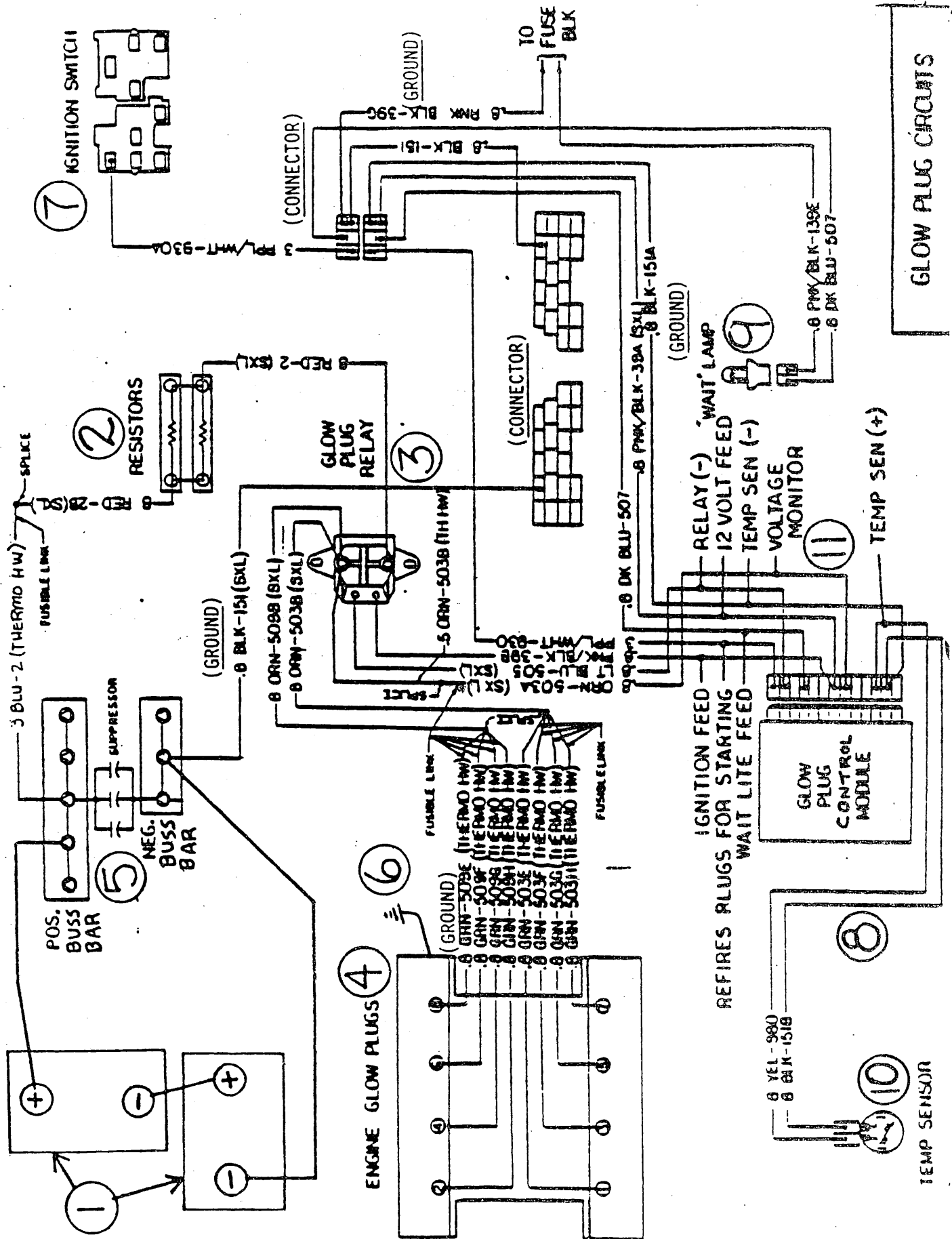
This time period can involve up to approximately 90 seconds. Here is what happens: Once the engine has started and the ignition switch ⑦ has been allowed to return to the ON position, the glow plugs ④ will continue to cycle during the "AFTER GLOW" time period (for up to approximately 90 seconds). This helps ensure smooth, even cylinder firing until the engine has had a chance to approach normal operating temperature.

D. SUMMARY OF GLOW PLUG "ON TIME"

Throughout the PRE/CRANKING/AFTER GLOW time periods, the entire glow plug "ON TIME" is regulated by four separate and distinct conditions.

They are:

- BATTERY VOLTAGE - When the battery voltage is low, glow plug "ON TIME" during cold start can seriously inhibit the vehicle from starting.
- COMBUSTION CHAMBER TEMPERATURE - High combustion chamber temperatures create higher electrical resistance in the glow plugs. This is why during "HOT" start attempts, high resistance in the glow plugs will cause the voltage sensing wire to signal the glow plug module not to energize the glow plug relay.
- GLOW PLUG VOLTAGE - Glow plug voltage is detected by the glow plug sensing wire (11). Just as with "HOT" start attempts, when the glow plugs have reached 16.2 volts maximum, the sensing wire signals the glow plug module that the glow plugs are ready to be turned off.
- ENGINE COOLANT TEMPERATURE - Engine coolant temperature is detected by the engine coolant sensor (10). When the engine coolant temperature has reached above 49°C or 118°F, it signals the glow plug module (8) to turn off the glow plug relay (3) thus, totally disconnecting the glow plug system from engine operation.



GLOW PLUG CIRCUITS

FIGURE 12

IV TROUBLESHOOTING THE GLOW PLUG SYSTEM

This entire TROUBLESHOOTING section has been developed to be utilized in a very systematic manner. That is, the steps should be followed very closely being sure not to take "short cuts" or jumping out of sequence from one step to another. This will ensure an effective diagnosis and repair in the quickest possible time.

A. Troubleshooting Overview

It is important to check/correct any one or more of the conditions listed below prior to diagnosing any part of the glow plug system.

- Check the battery for a proper state of charge by following the specific guidelines given in the CUCV 1200 SERIES DELCO FREEDOM BATTERY DIAGNOSIS AND CHARGING document, (if Delco batteries are not used in the vehicle, follow Army PMCS for Military batteries).

NOTE:

For your convenience, we have included a copy of CUCV 1200 SERIES DELCO FREEDOM BATTERY DIAGNOSIS AND CHARGING.

-
- Check to be sure all battery connections are clean and tight (including those connections at the terminal board).
 - Inspect all glow plug system electrical connectors, fusible links, terminals, and ground connections for security and proper condition.

When troubleshooting the glow plug system, it is important to establish whether a "hard start" or a "no-start" problem is glow plug system related or not. Therefore, begin with the CUCV Preliminary Diagnosis With Ammeter Chart that follows this page to:

- Avoid erroneously diagnosing a well functioning glow plug system.
- Save time in locating a possible malfunction in the glow plug system.

If you establish it is not a glow plug problem, naturally, there is no need to go any further in diagnosis; but rather, proceed to the suspected system.

B. Proper Sequence Of Diagnostic Steps

Here are the diagnostic steps to follow in troubleshooting the glow plug system:

Step One Use the CUCV PRELIMINARY DIAGNOSIS WITH AMMETER CHART and follow the "Logic tree" to determine whether or not the glow plug system is functioning properly.

Step Two If the glow plug system is not functioning properly, observe the failure conditions and use the CONDITION CHART that describes the failure.

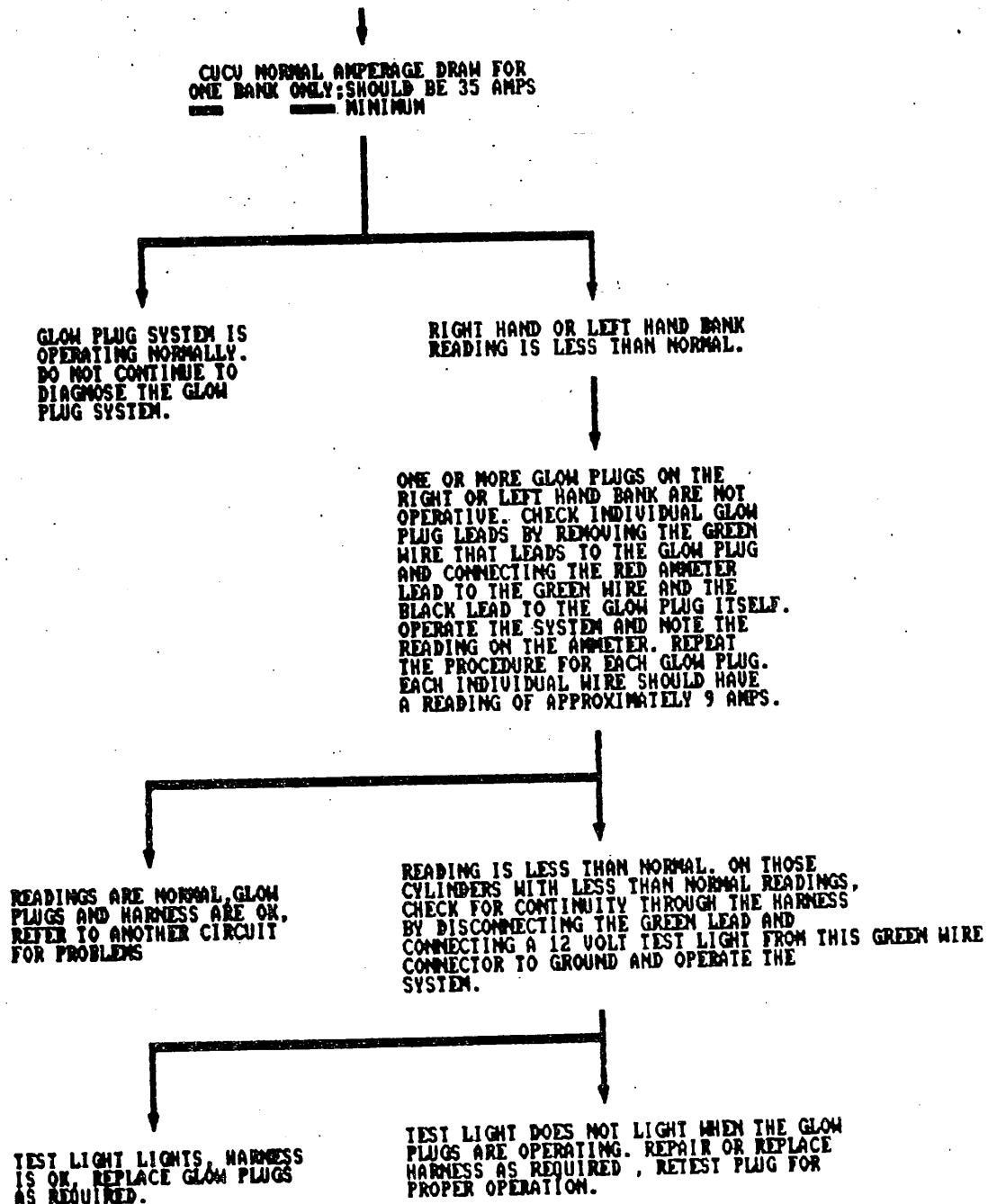
Step Three If the failure still exists and there was no condition on the CHART that applied, then complete the GLOW PLUG POWER SYSTEM TROUBLESHOOTING PROCEDURE.

Step Four If the failure still cannot be identified by troubleshooting the POWER System, then complete the GLOW PLUG CONTROL SYSTEM TROUBLESHOOTING PROCEDURE.

STEP ONE - CUCU PRELIMINARY DIAGNOSIS WITH AMMETER

THE FOLLOWING PROCEDURE PROVIDES A QUICK WAY TO DETERMINE WHETHER THE GLOW PLUG SYSTEM IS FUNCTIONING CORRECTLY OR IF YOU HAVE ANOTHER CONDITION TO COME UP WITH. IT IS SUGGESTED THAT THIS PROCEDURE BE PERFORMED WHENEVER THERE IS DOUBT ABOUT CORRECT GLOW PLUG SYSTEM OPERATION. IF THE GLOW PLUG SYSTEM FAILS TO OPERATE IN THE CORRECT MANNER, THEN REFER TO THE DIAGNOSIS CHARTS THAT FOLLOW TO PINPOINT THE CONDITION.

REMOVE THE ORANGE WIRE LEADING FROM THE GLOW PLUG RELAY TO THE LEFT BANK OF GLOW PLUGS. USING AN AMMETER THAT IS CAPABLE OF READING 40 AMPS MINIMUM, CONNECT THE RED AMMETER LEAD TO THE ORANGE WIRE AND THE BLACK LEAD TO THE GREEN WIRE SPLICE THAT LEADS TO THE GLOW PLUGS ON THE LEFT BANK (THIS WILL READ THE AMPERAGE TO ALL FOUR PLUGS). TURN THE IGNITION SWITCH TO THE "ON" POSITION AND NOTE THE AMMETER READING. REPEAT THE SAME PROCEDURE FOR THE RIGHT SIDE GLOW PLUGS.



NOTE: IN THE EVENT OF A MULTIPLE GLOW PLUG FAILURE, REFER TO THE GLOW PLUG SYSTEM POWER AND CONTROL TROUBLESHOOTING PROCEDURES.

STEP TWO - GLOW PLUG SYSTEM FAILURE CONDITION CHARTS

STEP TWO - CUCV GLOW PLUG FAILURE CONDITION CHART

- 2A. CONDITION NUMBER ONE: *** WAIT LIGHT ON
- * RELAY CYCLING RAPIDLY**
 - * NO START**

**MAKE SURE THE IGNITION IS OFF.
SET A VOLTMETER TO READ ON THE
LOWEST RANGE THAT CAN MEASURE
30 VOLTS.**

**TO MEASURE THE VOLTAGE ACROSS
THE GLOW PLUGS, CONNECT THE RED
VOLTMETER LEAD TO THE LOWER
LARGE COPPER STUD ON THE GLOW
PLUG RELAY AND CONNECT THE BLACK
VOLTMETER LEAD TO GROUND.**

**TURN THE IGNITION SWITCH
TO THE "ON" POSITION**

**DOES THE VOLTMETER READ
24 VOLTS?**

YES

**CHECK THE BALLAST RESISTORS
(SEE FIG. 2) USING AN OHMMETER
FOR .148 OHMS OF RESISTANCE ACROSS
BOTH RESISTORS. CHECK AND REPLACE
BAD GLOW PLUGS AS NECESSARY.**

NO

**GO TO TROUBLE SHOOTING
GLOW PLUG POWER SYSTEM
PROCEDURE**

STEP TWO - CUCU GLOW PLUG FAILURE CONDITION CHART

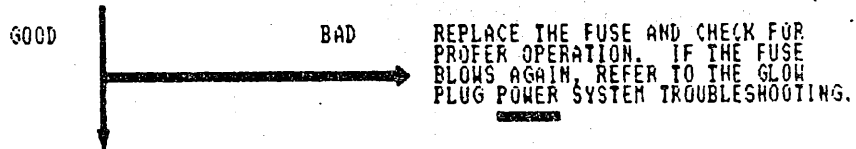
2B. CONDITION NUMBER TWO * NO WAIT LIGHT

* NO RELAY CYCLING

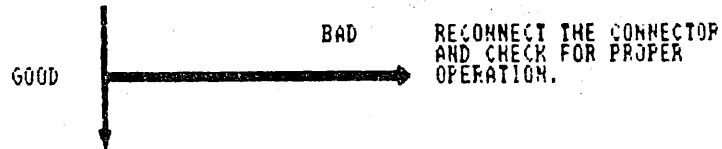
* NO START

FIRST:

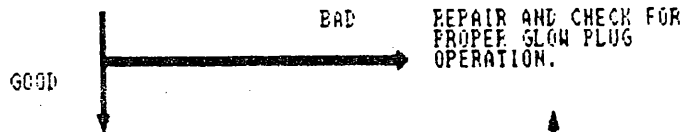
CHECK FOR BLOWN 20 AMP (YELLOW) FUSES IN THE FUSE PANEL MARKED "ENG. CON." (ENGINE CONTROL) AND "IGN." (IGNITION).



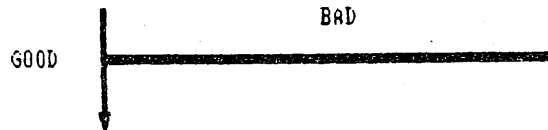
CHECK THE SIX WAY CONNECTOR LEADING TO THE GLOW PLUG CONTROL MODULE LOCATED NEAR THE FUSE PANEL.



CHECK FOR A GOOD GROUND WHERE THE BLACK GROUND WIRE (COMING FROM THE ENGINE HARNESS) ATTACHES TO THE RIGHT REAR INTAKE MANIFOLD STUD/BOLT.



CHECK FOR A GOOD GROUND CONNECTION THROUGH THE 12 VOLT JUNCTION BLOCK.



REFER TO THE GLOW PLUG POWER SYSTEM TROUBLESHOOTING PROCEDURE.

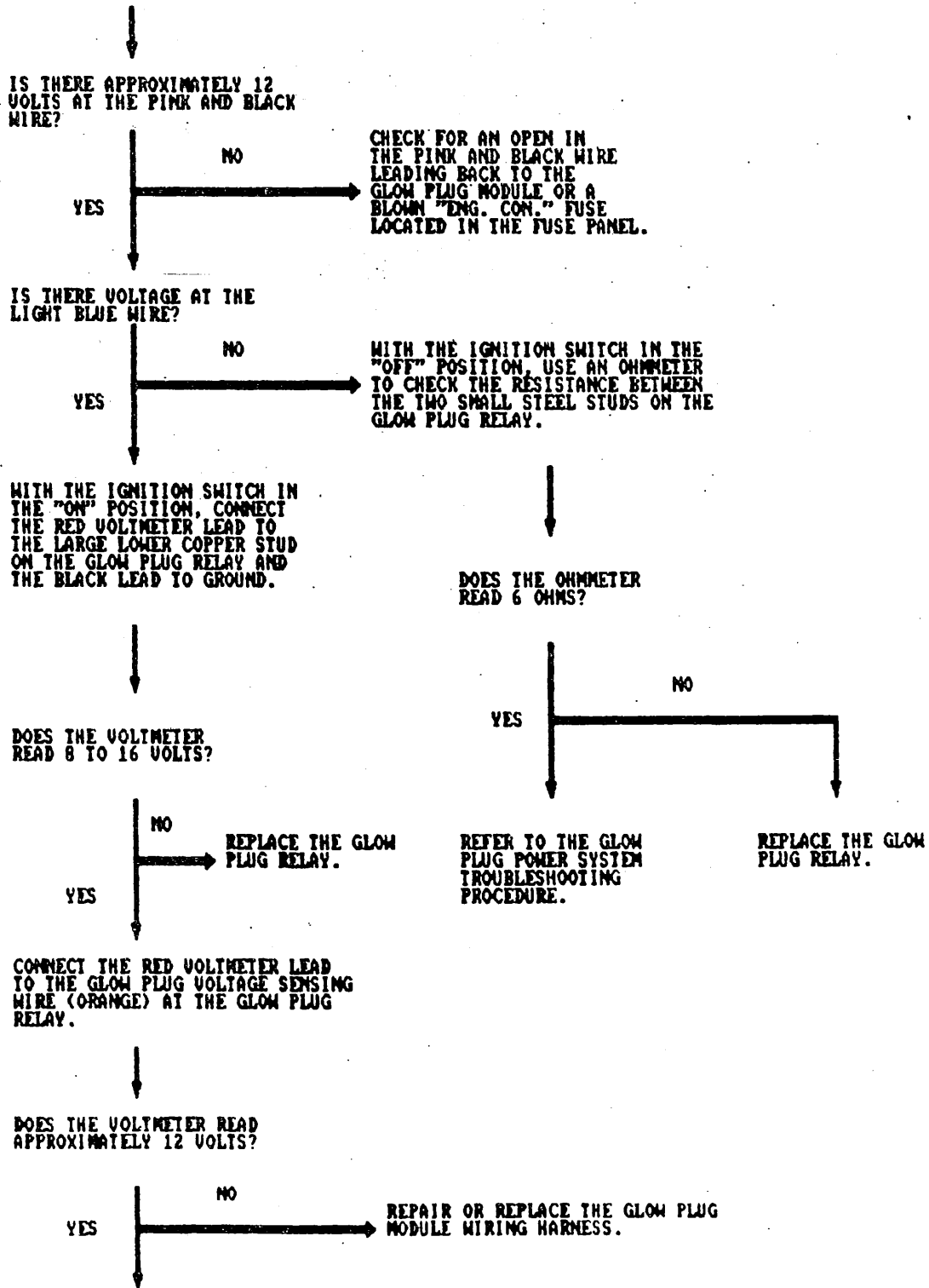
STEP TWO - CUCV GLOW PLUG FAILURE CONDITION CHART

2C. CONDITION NUMBER THREE * WAIT LIGHT ON CONTINUOUSLY.

*** WITH OR WITHOUT RELAY CYCLING**

*** NO START**

TO CHECK THE GLOW PLUG RELAY COIL FOR CONTINUITY, WITH THE IGNITION "ON" CONNECT A BLACK VOLTMETER LEAD TO A KNOWN GOOD SOURCE OF GROUND, CHECK THE VOLTAGE AT EACH SMALL STEEL STUD ON THE GLOW PLUG RELAY WITH THE RED VOLTMETER LEAD.



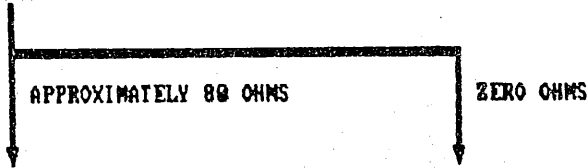
STEP TWO - CUCU GLOW PLUG FAILURE CONDITION CHART

2D. CONDITION NUMBER FOUR * EXCESSIVE WAIT LAMP "ON" TIME
(MORE THAN ONE MINUTE)

* WAIT LAMP "ON" WHEN VEHICLE IS AT
OPERATING TEMPERATURE

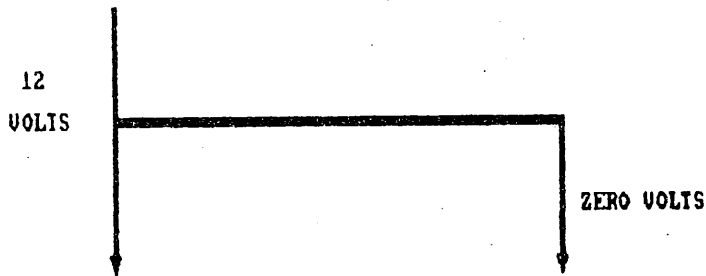
* NO EFFECT ON STARTING CONDITION

USING AN OHMMETER THAT IS
SET TO READ 80 OHMS MINIMUM,
CHECK THE RESISTANCE IN THE
ENGINE COOLANT TEMPERATURE
SENSOR (WITH THE SENSOR REMOVED)



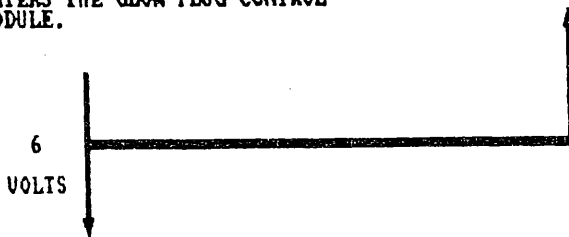
WITH THE IGNITION "ON", CHECK
FOR 12 VOLTS AT THE ENGINE
COOLANT SENSOR BY CONNECTING
THE RED LEAD OF THE VOLTMETER
TO THE SENSOR CONNECTOR AND
THE BLACK LEAD TO GROUND.

REPLACE THE ENGINE COOLANT
TEMPERATURE SENSOR.



WITH THE IGNITION SWITCH IN
THE "ON" POSITION, CHECK FOR
6 VOLTS AT THE GLOW PLUG
VOLTAGE SENSING WIRE AS IT
ENTERS THE GLOW PLUG CONTROL
MODULE.

REPAIR OR REPLACE THE GLOW
PLUG CONTROL MODULE HARNESS.



REFER TO THE GLOW PLUG POWER
SYSTEM TROUBLESHOOTING
PROCEDURE.

STEP THREE - THE GLOW PLUG POWER SYSTEM TROUBLESHOOTING PROCEDURE


THE PROPER METHOD FOR TROUBLESHOOTING THE POWER SYSTEM IS ILLUSTRATED IN THE FLOW CHART FORM ON THE FOLLOWING PAGE. IN THIS PROCEDURE, IT IS IMPORTANT TO NOTE THAT THE GROUND SIDE (BROWN WIRE) OF THE GLOW PLUG RELAY'S INTERNAL COIL HAS BEEN DISCONNECTED FROM ITS HARNESS (THIS IS DONE TO PREVENT THE GLOW PLUG CONTROL MODULE FROM TURNING THE CIRCUIT "ON" AND "OFF" DURING THE TEST). ALSO, A DC VOLTMETER IS CONNECTED ACROSS THE BALLAST RESISTOR ASSEMBLY, AND AT ONE POINT, THE GLOW PLUG RELAY COIL IS BRIEFLY TURNED "ON" BY RECONNECTING THE BROWN WIRE GROUND TERMINAL.

DEPENDING ON THE FINDINGS IN THIS THIRD STEP, THE TECHNICIAN IS DIRECTED TO A FAULT PATH IN THE POWER SYSTEM TROUBLESHOOTING FLOW CHART WHICH WILL ISOLATE THE PROBLEM TO A PARTICULAR COMPONENT.


3A. GLOW PLUG POWER SYSTEM TROUBLESHOOTING CHART

NOTE: BEFORE BEGINNING, ENSURE THAT THE BATTERIES ARE FULLY CHARGED, THAT THE BALLAST RESISTORS ARE OKAY (SEE STEP TWO CONDITION ONE) AND THAT ALL POSITIVE/NEGATIVE TERMINAL CONNECTIONS ARE SECURE.


BE SURE THAT THE
IGNITION SWITCH
IS "OFF"



DISABLE THE GLOW PLUG
RELAY BY DISCONNECTING
THE LIGHT BLUE WIRE FROM
THE SMALL STUD ON THE
GLOW PLUG RELAY.



SET A VOLTMETER TO
READ ON THE LOWEST
RANGE THAT CAN MEASURE
30 VOLTS.



TO MEASURE THE VOLTAGE ACROSS
THE GLOW PLUGS, CONNECT THE RED
VOLTMETER LEAD TO THE LOWER LARGE
COPPER TERMINAL ON THE GLOW PLUG
RELAY AND THE BLACK LEAD TO GROUND.

TURN THE IGNITION SWITCH TO THE "ON" POSITION.

WHAT DOES THE VOLTMETER READ?

NO VOLTAGE

TO TURN THE RELAY ON, LEAVE THE IGNITION SWITCH "ON" AND CONNECT A SUITABLE JUMPER WIRE TO THE DISCONNECTED TERMINAL ON THE GLOW PLUG RELAY. BRIEFLY TOUCH THE OTHER END OF THE JUMPER WIRE TO GROUND.

1 TO 15 VOLTS

15 TO 24 VOLTS

REPLACE THE GLOW PLUG RELAY.

REPLACE THE GLOW PLUG RELAY AND ALL FAILED GLOW PLUGS.

DOES THE VOLTMETER SHOW MORE THAN 1 VOLT?

YES

NO

TO MEASURE THE SLEEPY VOLTAGE TO THE GLOW PLUG RELAY, CONNECT THE RED VOLTMETER LEAD TO THE TERMINAL ON THE RELAY WITH THE PINK AND BLACK WIRE ATTACHED TO IT AND CONNECT THE BLACK VOLTMETER LEAD TO GROUND.

DOES THE VOLTMETER SHOW MORE THAN 15 VOLTS?

NO

CHECK THE VEHICLE FOR PROPER OPERATION.

YES

ONE OR MORE GLOW PLUGS ARE BURNED OUT. REPLACE AS REQUIRED.

WITH THE IGNITION SWITCH IN THE "OFF" POSITION, DISCONNECT THE GREEN WIRE FROM THE TOP OF EACH GLOW PLUG AND MEASURE THE OHMS OF RESISTANCE BETWEEN THE TERMINAL OF EACH GLOW PLUG AND GROUND.

THE GLOW PLUG RESISTANCE SHOULD BE 1 TO 3 OHMS EACH.

DOES THE VOLTMETER READ 12 VOLTS?

NO

YES

RECONNECT THE LIGHT BLUE WIRE TO THE SMALL STEEL TERMINAL ON THE GLOW PLUG RELAY. CONNECT THE RED VOLTMETER LEAD TO THE SAME TERMINAL AND CONNECT THE BLACK VOLTMETER LEAD TO GROUND.

CHECK FOR A BLOWN FUSE. IF FUSES ARE NOT BLOWN, WIRING HARNESS IS OPEN. REPAIR (OR REPLACE) AS REQUIRED AND CHECK CONTINUITY.

YES

NO

REPLACE THE GLOW PLUG MODULE.

REPLACE THE GLOW PLUG RELAY.

CHECK FOR PROPER OPERATION.

STEP THREE - THE GLOW PLUG POWER SYSTEM TROUBLESHOOTING PROCEDURE (CONT.)

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DO THE GLOW PLUGS
CHECK OUT OK?

NO

YES

REPLACE THE BAD
GLOW PLUGS AND
CHECK THEM FOR
CONTINUITY.

WITH AN OHMMETER, CHECK
FOR CONTINUITY BETWEEN
EACH GREEN GLOW PLUG
WIRE AND THE ORANGE
WIRE THAT FEEDS EACH
BANK OF GLOW PLUGS
(THE ORANGE WIRE
COMES FROM THE RELAY.)

↓

DO ALL GLOW PLUG WIRES
TEST OK?

YES

NO

↓

TROUBLESHOOT THE
GLOW PLUG CONTROL
SYSTEM.

ENGINE GLOW PLUG HARNESS
IS BAD. REPAIR (OR REPLACE)
AS REQUIRED AND CHECK FOR
CONTINUITY.

4. STEP FOUR - THE GLOW PLUG CONTROL SYSTEM TROUBLESHOOTING PROCEDURE:

Due to the location of the glow plug control module, no direct measurements will be taken from it. Instead, the following procedure will be used:

1. Connect a DC voltmeter between any ground and the orange wire connector on the relay.
2. Disconnect the pink wire from the fuel shut-off solenoid on the injector pump to keep the engine from starting.
3. Turn the ignition switch to "ON". The "WAIT" Lamp should remain lit for 10-12 seconds. Glow plugs should turn on and off at irregular intervals, lasting several seconds (10-15V displayed on the voltmeter indicates that the plugs are being energized).
4. When the "WAIT" Lamp turns OFF, crank the engine. The glow plugs should come on and stay on for the duration of cranking. The "WAIT" Lamp should remain OFF.
5. The glow plugs should cycle for several seconds after engine starts. Once the plugs have stopped cycling the "WAIT" Lamp should go out and remain out (until the glow plugs are needed again to start a "COLD" engine).

If the plugs and lamp act as described during this sequence, the system can be assumed to be okay and in good working order. Any major deviation is usually assumed to be the fault of the glow plug control module or wiring harness (unless the "WAIT" Lamp never comes on, whereupon the light bulb is suspected).

The technician should first replace the glow plug control module. If this does not solve the problem, the wiring harness should be replaced.