

SECTION 06: ELECTRICAL

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1. GENERAL DESCRIPTION

This vehicle uses a dual voltage system to obtain two different voltages (12 and 24 volts) for various electrical controls and accessories. The main power source incorporates four maintenance-free "Volvo" model 20359831 batteries connected in parallel-series. All batteries are kept uniformly charged by means of a 100 amp battery equalizer (standard), giving a maximum possible output supply of 100 amps on the 12 volt system. Both the 12 and 24 volt systems are controlled through individual main battery relays. One or two 24 volt self-rectified alternators are belt driven from the engine, and can be reached through the engine compartment door.

1.1 WIRING DIAGRAMS

A master wiring diagram of the electric circuits, covering standard and optional accessories and systems, is located in the technical publications box. Usually, a separate wiring diagram page is provided for each major function or system. In some cases, more than one circuit may appear on one wiring diagram page; when this occurs, each circuit covered in this page is listed in the wiring diagram index. Moreover, a circuit may appear on several pages; in such case, the number(s) at the extremity of the diagram title will indicate the sheet reference number. Refer to the "*Wiring Diagram Index*" to ensure that the correct diagram is being used to trace the circuit in question. In addition to the major functions page reference, the wiring diagram index contains the following information pages.

- The Multiplexed Device Index,
- The Arrangement-Harness drawing showing the harnesses arrangement and harness number on the vehicle,
- Glossary,
- Circuit number listing,
- Circuit breaker code,
- Connector code,
- Diode number code,
- Resistor number code,
- Fuse code.

1.1.1 Using Wiring Diagram

Three methods are used to "work" with electric wiring diagrams.

Situation: You have identified the defective part (breaker, diode, relay, etc.), and you wish to locate its corresponding circuit.

Problem: Circuit breaker CB6 is released (open circuit) and you don't know which circuit is affected.

- a) Refer to wiring diagram index, and look for "*Circuit breaker code*", pages F.
- b) At item CB6, you will find the location, the Prevost number, the breaker function, the breaker ampere rating and the page on which to find the corresponding diagram.
- c) Refer to page 3.1.
- d) When you have located CB6, follow the wiring up to the end and find the diagram page number and function on which the circuit continues.

Situation: You have a problem with a specific system and you want to find the corresponding diagram.

Problem: The level low system of the vehicle is inoperative and you must trace the electric circuit.

- a) Refer to wiring diagram index and look for "*Level Low*".
- b) You will find on page 28.1 the components as well as the electric wiring, thus providing you with a complete understanding of this circuit.

Situation: Using the message center display (MCD), you check on arrival if there are active errors in the vehicle electrical system. With the SYSTEM DIAGNOSTIC menu, highlight FAULT DIAGNOSTIC, highlight ELECTRICAL SYSTEM to request a diagnostic of the electrical system and then press the enter key. If applicable, the MCD shows the fault messages or fault codes recorded. When more than one fault is recorded, an arrow pointing down appears on the right of the display. Use the down to see all the fault messages.

Problem: MCD displays the fault "Low docking lights SW102; shorted to ground" as being active.

- a) Refer to wiring diagram index, and look for "*Multiplexed Device Index*", pages B1-B3.

- b) In first column DEVICE ID, look for device SW102.
- c) At device SW102, find the fault message, the minimum condition to activate, other inputs involved in logic, the multiplex module related to switch 102, the connector and pin number on the module and the page on which to find the corresponding diagram.
- d) Once the problem corrected, the MCD still shows the fault as being active. You have to leave the FAULT DIAGNOSTIC menu, wait approximately 20 to 30 seconds and then return to FAULT DIAGNOSTIC to request a new diagnostic of the ELECTRICAL SYSTEM from the CECM. The MCD should display the fault as being inactive.

1.1.2 Testing Circuits

A careful study of the wiring diagrams should be made to determine the source and flow of current through each circuit. When a circuit is thoroughly understood, a point-to-point check can be made with the aid of the applicable wiring diagrams. Any circuit can be tested for continuity or short circuits with a multimeter or a suitable voltmeter.

All electrical connections must always be kept clean and adequately tight. Loose or corroded connections can result in discharged batteries, difficult starting, dim lights and improper functioning of other electric circuits. Inspect all wiring connections at regular intervals. Make sure knurled nuts on all amphenol-type plugs are securely tightened. Knurled nuts on the plastic amphenol-type connectors will click into a detent when properly tightened. Line connectors, who have the side locking tabs, must have the locks latched in place to ensure a proper electrical connection.

1.2 WIRE SIZES AND COLORS

Each wire in the electrical system has a specific size as designated on the wiring diagram. When replacing a wire, the correct size must be used. Never replace a wire with one of a smaller size. The vehicle electrical system is provided with different voltages. The insulation on each wire is distinctly colored in order to determine visually the wiring voltage and to assist in making connectors. The wires are color coded as follows:

Yellow	Multiplex modules communication CAN-H (twisted with green)
Green	Multiplex modules communication CAN-L (twisted with yellow)
Orange	Connected to multiplex outputs
White	Connected to multiplex inputs
Red	24 volt system
Yellow	12 volt system
Black	grounded wire
Blue	110 V ac system (live)
Green	110 V ac system (ground)
White	110 V ac system (neutral)
Grey	spare wire

NOTE
Wires are identified at each 2-4 inch (5-10 cm) intervals by a printed number.

Each wire on a diagram is patterned to assist in tracing and testing circuits. The wire number identifies the voltage rating, the wire identification number and the basic wire gauge as illustrated in figure 1.

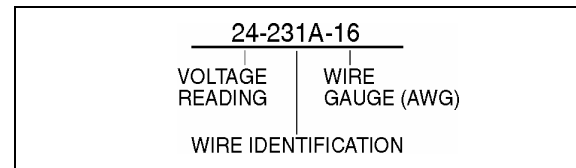


FIGURE 1: WIRE IDENTIFICATION 06048

1.3 SPARE WIRES

When the vehicle leaves the factory, and even in the case of a fully-equipped vehicle, an important number of unconnected spare wires are routed between the junction boxes. Consequently, for any connection of an additional accessory, refer to page D "Spare wires" in master wiring diagram to determine the number, the gauge and location of these wires.

CAUTION
Wire size is calibrated according to the breaker or fuse that protects it. When using a spare wire to replace a damaged wire, assure that the spare wire size is equal or larger than the wire being replaced. Using a wire too small for the breaker or fuse amperage might cause overheating of the wire.


NOTE
Spare wires are identified by a wire identification number and by the letters "SP", to designate "spare".

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1.4 CLEANING CONNECTORS

When the pins and sockets of connectors become dirty, clean them with a good quality solvent containing HFC 134A refrigerant as its active ingredient. HFC 134A has two qualities that recommend it. First, it does not conduct electricity and therefore, will not cause shorting between connector pins and sockets. Second, it evaporates quickly, eliminating the possibility of condensation within the connectors.

Always shake out or gently blow out any excess HFC 134A before assembling a connector to its mating connector or hardware. HFC 134A trapped in the connector can affect the connector seal.



DANGER

HFC 134A is toxic. HFC 134A bases compounds should always be used in a well-ventilated area, never in a confined space. Use outdoor whenever possible.

1.5 CIRCUIT BREAKERS

Most electric circuits are protected by circuit breakers of the "Manual Reset" type. The main circuit breakers, as well as those protecting the A/C system, are located in the engine compartment, on R.H. side of the vehicle.

CIRCUIT BREAKERS			
CB1	Distribution	12 VD	150 amps
CB2	Distribution	24 VD	50 amps
CB3	Front distribution	24 VI	70 amps
CB4	HVAC - evaporator	24 VI	90 amps
CB5	HVAC - condenser	24 VI	70 amps
CB6	Slide-Out	24 VI	35 amps
CB7	Distribution	24 VI	60 amps
CB8	HVAC - condenser	12 VI	40 amps
CB9	Distribution	12VI	70 amps

VD= volts direct. The electrical components connected to these circuit breakers are direct-connected to the battery.

VI= volts indirect. Electrical power is supplied via master relay R1 which engages when ignition key is in the ON or ACC position.

This type of circuit breaker deenergizes the circuit without disconnecting any wire. Circuit breakers CB1 & CB2 are different in the fact that you may open the circuit manually, to do so simply press down the blue tab on breaker to trip the circuit breaker, repair defective circuit,

and afterwards toggle yellow lever upwards to reset the circuit breaker and close the circuit.

1.6 MULTIPLEX FUSES

The multiplex outputs are protected in current by an internal "soft-fuse". Each output has programmed specific maximum amperage. When an output is shorted, the current gets above the limit and the soft-fuse intervenes to turn the output OFF. The output stays OFF until the "soft-fuse" is reset.

Turn the ignition key to the OFF position and turn to the ON position again. This resets all "soft-fuses".

There is also hardware fuses used to protect the incoming power to the multiplex modules. These fuses are located inside the VECF (Vehicle Electrical Center Front) and VECR (Vehicle Electrical Center Rear).

1.7 RELAYS

Relays are used to automatically energize or deenergize a circuit from a remote location. The relay draws a very low current to energize its coil. Once the coil is energized, it develops a magnetic field that pulls a switch arm closed or open, to either energize or deenergize a given component. As the control current required for the coil is very low, the relay allows a remote station to control a high energy circuit without running great lengths of costly high capacity cable, and also eliminates the need for high amperage switches and heavy connectors.

Many systems on this vehicle are provided with control relays, which are all, located in or on the junction boxes, figures 6, 9, 10 and 12.

NOTE

Each relay is identified with "12V" or "24V" printed on its casing in order to identify the coil operating voltage.



CAUTION

The Multiplex vehicle uses a VF4 relay designed specially for Volvo that has different internal characteristics than the current VF4 relay. It is important to use only the new part marked Volvo as a replacement in Multiplex vehicles. Regular relays have an inadequate lifespan for Multiplex vehicles.

1.8 PRECAUTIONS

**DANGER**

Prior to working on a system inside vehicle, make sure to cut electrical power and air supply. A component could be supplied with electricity even if the ignition switch is set to the OFF position and/or a component could be pressurized even if air tanks are emptied. Always refer to the appropriate wiring and pneumatic diagrams prior to working on electrical and/or pneumatic systems.

NOTE

When the ignition switch is set to the OFF position, the electrical components are not energized except for the CECM (Chassis Electronic Control Module), engine ECM, transmission TCM, instrument cluster module, the battery equalizer and some Multiplex modules which are energized during 15 minutes after the ignition has been set to the OFF position. If the vehicle will not be operated for a long period (more than 2 weeks), it is recommended, in order to prevent the batteries from discharging, to trip main circuit breakers (1 and 2) located in the rear circuit breakers panel to stop the small current drawn by the radio preset station memory, the CECM memory and the instrument cluster clock. Note that the radio station presets will be erased, same thing for the diagnostic codes history and the instrument cluster clock will have to be reset.

**CAUTION**

Prior to arc welding on the vehicle, refer to "Multiplex Modules Disconnection Procedure Prior To Welding" in section 00 GENERAL of this manual to avoid serious damage to the vehicle components.

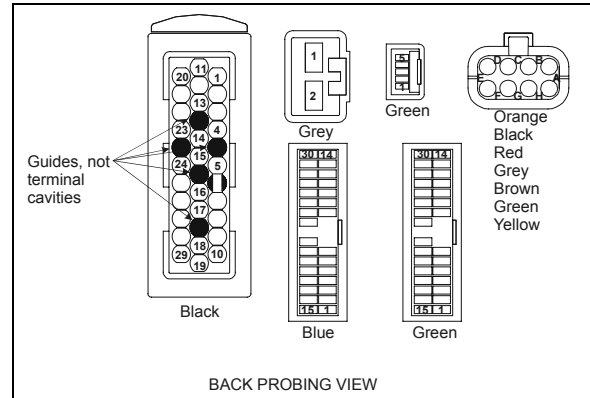
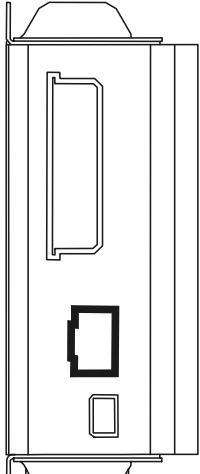
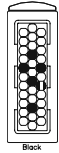
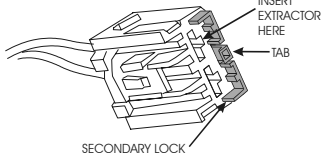

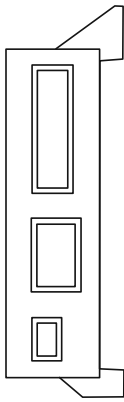
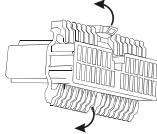
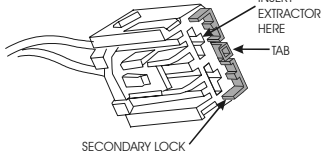

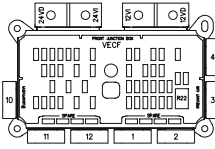
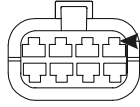


FIGURE 2: MULTIPLEX MODULE CONNECTORS PIN-OUT

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Multiplex modules	Connector type	Terminal removal
 <p>IO-B 06625</p>	 <p>Back AMP 06628</p>	<p>EXTRACTOR/TOOL: Prevost #683594</p> <p>Insert the extractor on the front of the connector. Remove the terminal by disengaging the flexible lock tabs on the terminal. Gently remove the terminal from the connector by pulling on the wire.</p>
	 <p>INSERT EXTRACTOR HERE TAB SECONDARY LOCK grey 06629 YAZAKI</p>	<p>EXTRACTOR/TOOL: Packard #12094430</p> <p>Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</p>
	 <p>green 06630 JAE</p>	<p>EXTRACTOR/TOOL: Prevost #683766</p> <p>Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</p>
 <p>IO-A 06626</p>	 <p>green, blue (CECM) JAE 06631</p>	<p>EXTRACTOR/TOOL: Prevost #683766</p> <p>Using a small flat blade screwdriver, open both hinged secondary locks. Insert the extractor on the front of the connector, over the terminal cavity. Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</p>
	 <p>INSERT EXTRACTOR HERE TAB SECONDARY LOCK grey 06629 YAZAKI</p>	<p>EXTRACTOR/TOOL: Packard #12094430</p> <p>Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</p>
	 <p>green 06630 JAE</p>	<p>EXTRACTOR/TOOL: Prevost #683766</p> <p>Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</p>
 <p>VECF 06627</p>	 <p>INSERT EXTRACTOR HERE Orange Black Red Grey Brown Green Yellow BUSSMAN 06632</p>	<p>EXTRACTOR/TOOL: Prevost #682256 (Packard 12094429)</p> <p>Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</p>

2. XLII MOTORHOMES ELECTRICAL COMPARTMENTS AND JUNCTION BOXES

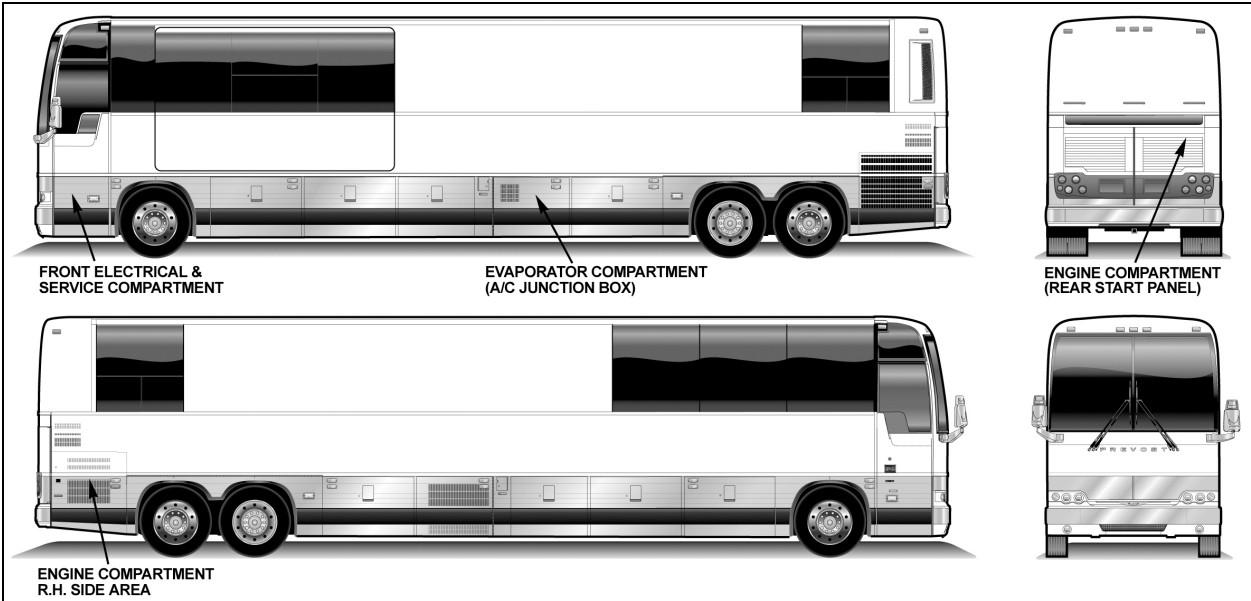


FIGURE 3: ELECTRICAL COMPARTMENTS (XLII-45E BUS SHELLS)

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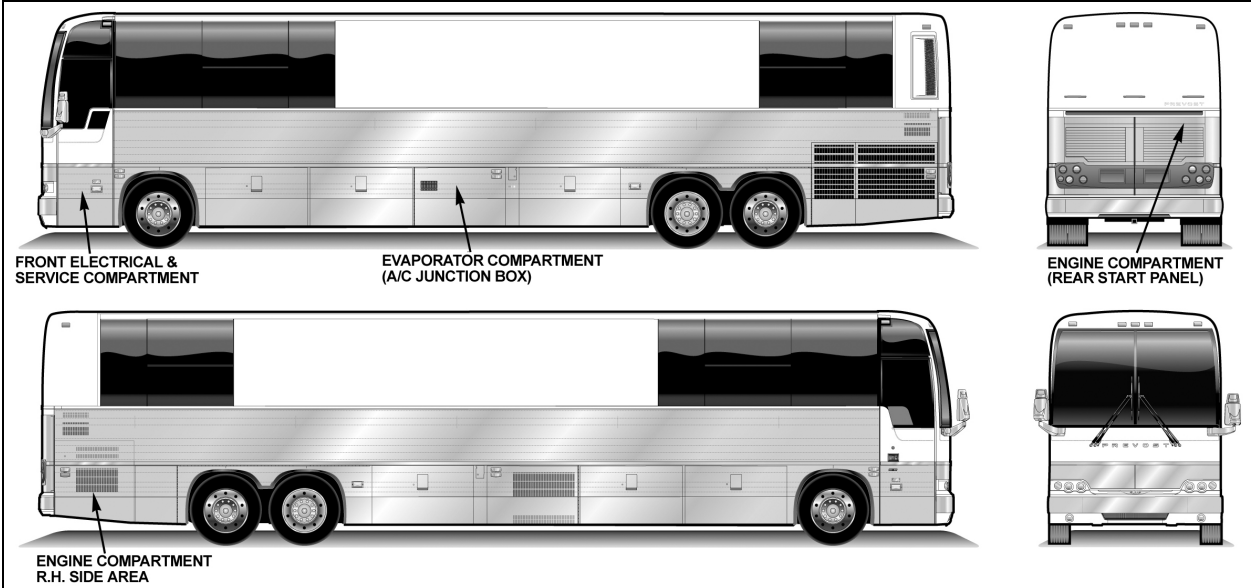



FIGURE 4: ELECTRICAL COMPARTMENTS (XLII-45 BUS SHELLS)

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2.1 MAINTENANCE

A Cortec VCI-238 corrosion inhibitor has been sprayed in all electrical compartments to protect components from corrosion. The life expectancy of this product is five years, so it is recommended to reapply it every five years. It is also recommended to spray it on new components when added or replaced.



DANGER

Use VIC-238 in a well ventilated area. Do not smoke. Avoid prolonged contact with skin and breathing of spray mist. Harmful or fatal if swallowed. Do not induce vomiting. Call physician immediately.

2.2 REAR JUNCTION BOX

The rear junction box is located in the engine compartment, on R.H. side of the vehicle. The rear junction box provides access to the following:

- Multiplex Modules: I/O-A, I/O-B;
- Voltage Regulator;
- Vehicle Electrical Center Rear (VECR);
- Relays and Fuses;
- Transmission ECU;
- Diagnostic Data Reader (DDR Receptacle);
- Electronic Ground Stud;
- Rear Junction Box Temperature Sensor.

Rear Junction Box			
Multiplex Modules			
A49	I/O-A	A52	I/O-B
A50	I/O-B	A53	I/O-B
A51	I/O-B		
Relays			
R1	24V IGN	R30	24V Door lock/Unlock
R3	12V IGN	R31	24V Door lock/Unlock
R8	Service Brake	R32	24V Door lock/Unlock
R11	Not Used	R33	24V Door lock/Unlock
R17	12V wake-up mode		
R21	Emergency		
R25	Engine ECM		
Fuses			
F50	Delco Regulator	F71	Spare
F51	24VD Customer	F72	12VI A50
F52	Lugg. Lock/Unlock	F73	Spare
F53	Cabin area Liq. Valve	F74	12VI ECM Motor
F54	Window ajar & Awning	F75	12VI Trans.
F55	Spare	F76	12VI Customer
F56	Spare	F77	12V Wake-up Transmission

F57	Spare	F78	12V Wake-up ECM
F58	Spare	F79	12V Wake-up ECM
F59	Spare	F80	12V Wake-up A51
F60	Lugg. Lock/Unlock	F81	24V Excitation
F61	Lugg. Lock/Unlock	F85	Not Used
F62	Spare	F86	Spare
F63	Priming Pump	F87	12VI Trailer
F64	Spare	F88	Spare
F65	24VI A49, A52, A53	F89	Spare
F66	Power Fan Clutch	F90	Spare
F67	24VI A54	F91	Spare
F68	24VI A54	F96	Spare
F69	24VI R8	F98	Spare
F70	24 VI Customer	F99	Spare
Resistors			
RES13	Excitation	RES16	Current Reducer
RES14	Excitation	RES17	Current Reducer
Diodes			
D15	Ignition	D46	Service Brakes
D28	Suppression	D67	Upper Rear Light
D29	Suppression	D68	Upper Rear Light
D31	Suppression	D69	Upper Rear Light
D36	Suppression	D70	Upper Rear Light
D37	Suppression		

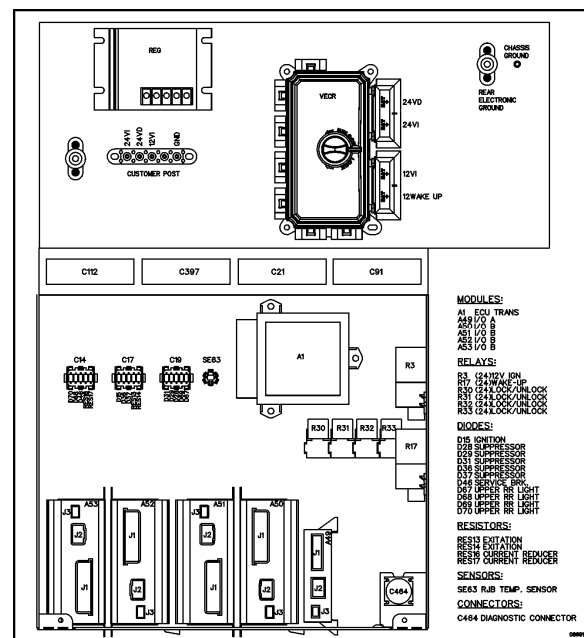



FIGURE 5: REAR JUNCTION BOX

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DANGER

During repair or maintenance periods, set ignition key switch to the "OFF" position in order to avoid personal injury. This ensures that power from the batteries is automatically cut off.

NOTE

When ignition key switch is set to the "OFF" position, the electrical supply from the batteries is cut off, with the exception of the Fire Detection System, the Engine & Transmission Electronic Controls, the Auxiliary Heating System, the Battery Equalizers and the Digital Clock.

2.3 CIRCUIT BREAKERS

All manually-resettable circuit breakers are located in the engine compartment R.H. side area. An identification decal is affixed on the inside face of the door.

MTH WE and W5 may be equipped with nine (9) main breakers; six (5) of which are standard (CB1, CB2, CB3, CB7 & CB9). Three (3) are supplied only on vehicles equipped with central A/C system (CB4, CB5 & CB8); and one (1) is supplied only on vehicles equipped with slide-out (CB6).

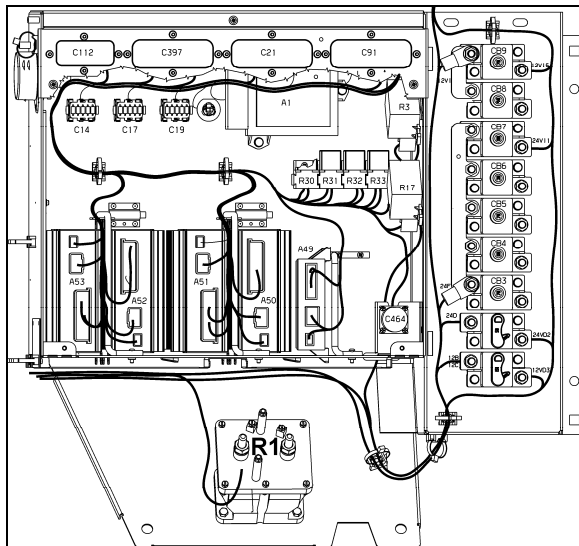


FIGURE 6: REAR JUNCTION BOX & CIRCUIT BREAKER PANEL

On all vehicles, breakers CB1 to CB9 are installed on circuit breaker panel in engine compartment R.H. side area (Fig. 6). They are accessible through engine R.H. side door and can be identified as follows:

1. Distribution (CB1) 150 A - 12 volts;
2. Distribution (CB2) 50 A - 24 volts;
3. Front Distribution (CB3) 70 A - 24 volts;
4. Distribution (CB7) 60 A - 24 volts;
5. Distribution (CB9) 70 A - 12 volts;

On all vehicles equipped with central A/C, breakers CB4, CB5 and CB8 are installed on breaker panel in engine compartment R.H. side area (Fig. 6). They are accessible through engine R.H. side door and are identified as follows:

1. HVAC - Evaporator (CB4) 90 A - 24 volts;
2. HVAC - Condenser (CB5) 70 A - 24 volts;
3. HVAC - Condenser (CB8) 40 A - 12 volts.

On all vehicles equipped with one or two slide-outs, breaker CB6 is installed on breaker panel in engine compartment R.H. side area (Fig. 6). It is accessible through engine R.H. side door and is identified as follows:

1. Slide-Out (CB6) 35 A - 24 volts.

2.4 A/C JUNCTION BOX

The following components are located in the Evaporator Compartment (HVAC). They are mounted inside the A/C junction box.

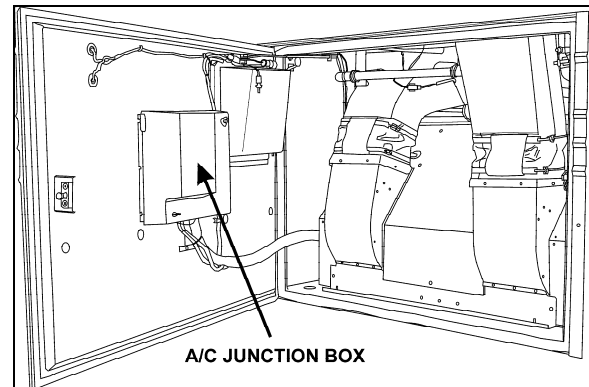


FIGURE 7: LOCATION OF A/C JUNCTION BOX IN EVAPORATOR COMPARTMENT

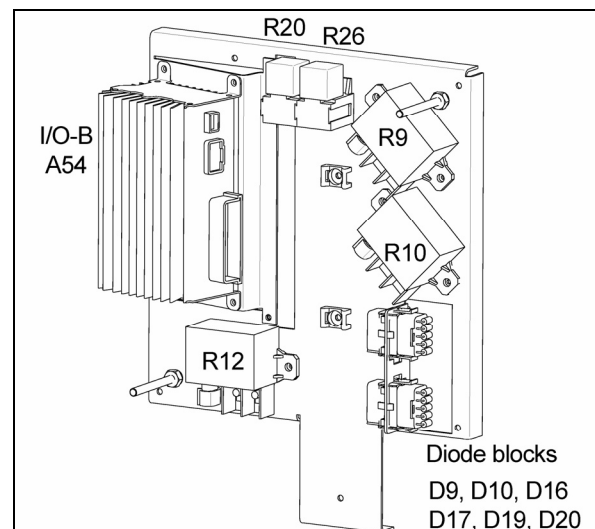


FIGURE 8: A/C JUNCTION BOX

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Evaporator Compartment			
Multiplex Module			
A54	I/O-B		
Relays			
R9	24V Condenser fan R.H	R20	Water pump
R10	24V Condenser fan L.H	R26	Pre-heating
R12	24V Evaporator fan		
Diodes			
D9	Pre-heating	D19	Baggage compartment -2
D10	Pre-heating	D20	Baggage compartment -1
D16	Baggage compartment -3	DXX	Not used
D17	Baggage compartment -5		

2.5 FRONT ELECTRICAL & SERVICE COMPARTMENT

The front electrical & service compartment is located on L.H. side of vehicle, under the driver's window. It contains the following components (Fig. 9):

- Multiplex Modules;
- CECM;
- Common Powertrain Controller (CPC);
- Vehicle Electrical Center Front (VECF);
- Relays and fuses;
- Diodes;
- ABS Electronic control unit (ECU).

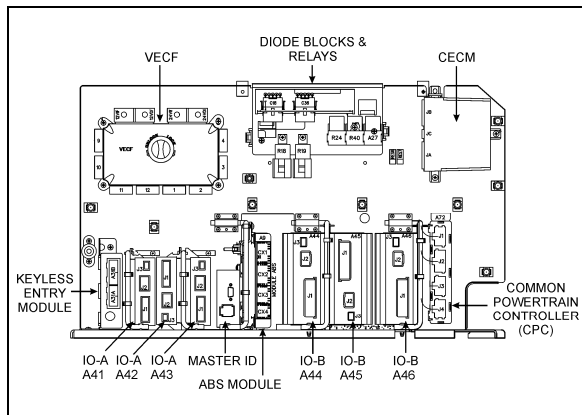


FIGURE 9: FRONT ELECTRICAL COMPARTMENT 06319

The light in the front electrical & service compartment turns *ON* automatically when the door is opened.

Front Electrical & Service Compartment			
Multiplex Modules			
VECF	Vehicle Electrical Center Front	A41	I/O-A
A9	ABS-ECU	A42	I/O-A
A13	Master ID	A43	I/O-A
A27	ZF Steering Ctrl	A44	I/O-B
A31	Keyless	A45	I/O-B
A36	CECM	A46	I/O-B
A72	CPC		
Relays			
R18	24V Wake-up mode	R22	Engine ECU Power
R19	12V Wake-up mode		
Fuses			
F1	CECM Power	F24	Mirror
F2	Front start main switch	F25	Spare fuse
F3	Driver liquid solenoid valve	F26	Spare fuse
F4	Spare fuse	F27	12VI Customer
F5	24 volts Wake-up mode	F28	Driver's seat
F6	24VD Customer	F29	Instrument cluster & data reader
F7	Spare fuse	F30	Driver's window
F8	Multi function switch	F31	Keyless module
F9	Spare fuse	F32	Spare fuse
F10	Pneumatic cut-out solenoid	F33	12VD Wake-up mode
F11	Sun visor	F34	12VD Wake-up mode
F12	PWR MUX modules	F35	12-volt accessory outlet
F13	PWR MUX modules	F36	HVAC module & telltale panel
F14	24VI Customer	F37	Spare fuse
F15		F38	PWR A41 multiplex module
F16	Defroster unit	F39	Spare fuse
F17	Level low	F40	Entrance door window
F18		F41	12-volt accessory outlet & lighter
F19		F82	Lower windshield wipers
F20	Witness red LED	F83	Spare fuse
F21	PWR A44 multiplex module	F84	12VD Customer
F22	ZF steering control	F104	Spare fuse
F23	ABS brake system	F105	Spare fuse
Diodes			
D1	Accessories	D13	ABS
D2	Driver unit liquid solenoid valve	D22	Service brake
D12	Engine brake	D44	ignition

2.6 ENGINE COMPARTMENT (REAR START PANEL)

The rear start panel is located over the engine in the engine compartment. Switches to start and stop the engine from inside the engine compartment are mounted on that panel. (Fig.10):

- engine compartment light switch;
- starter selector switch;
- Rear start (push button switch);

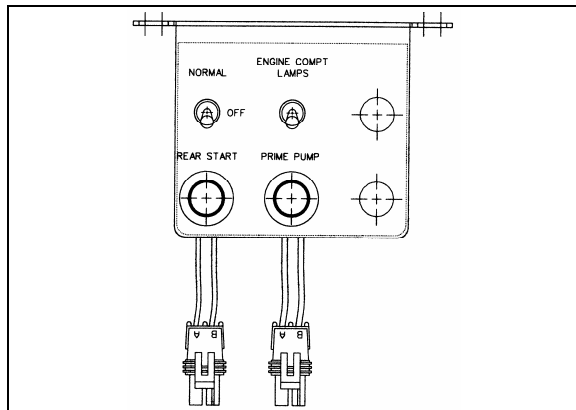


FIGURE 10: REAR START PANEL 06622

2.7 WIPER CONTROL PANEL

To access the wiper control panel of the right console, remove the panel under the larger utility compartment at the right of the dashboard.

Wiper Control Panel Inside Right Console			
Multiplex Modules			
A47	I/O-B	A48	I/O-B
Relays			
R23	Lower windshield wipers		
Diodes			
D4	Lower windshield wipers speed 2	DXX	Not Used
D5	Lower windshield wipers speed 1	DXX	Not Used
DX	Not Used		

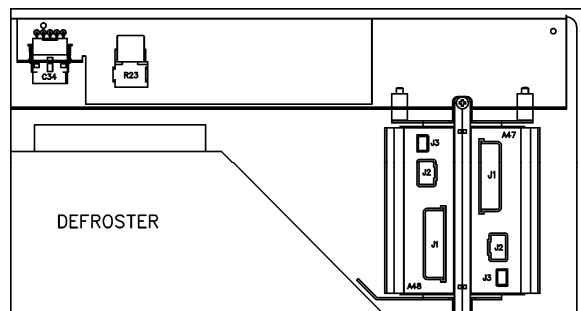


FIGURE 11: WIPER CONTROL PANEL

3. BATTERIES

The vehicle is provided with four (4) maintenance-free 12 volt heavy-duty batteries connected in series-parallel (Fig. 13). The top-mounted negative and positive terminals are tightly sealed to prevent leaks. Water never needs to be added to this type of battery. There are no filler caps in the cover. The battery is sealed, except for small vent holes in the cover. The vents must not be restricted as they allow small amounts of gases produced in the battery to escape. The special chemical composition inside the battery reduces gassing to a very small amount at normal charging voltages. Besides reducing gassing, the special chemistry greatly reduces the possibility of overcharge damage.

The vents require keeping the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent holes.

WARNING

DO NOT tip battery by more than 45° when carrying or installing the battery.

NOTE

Evidence of electrolyte leakage does not necessarily mean the battery is defective.

With special cables properly attached to the batteries, the metal surfaces that carry the current are completely sealed from the atmosphere. This prevents terminal oxidation and corrosion that may cause starting and charging problems. If new cables are required, sealed terminal cable replacements should be used to retain the reliability of the original maintenance-free connections.

DANGER

All lead-acid batteries generate hydrogen gas, which is highly flammable. If ignited by a spark or flame, the gas may explode violently, causing spraying of acid, fragmentation of the battery, which may result in severe personal injuries. Wear safety glasses and do not smoke when working near batteries. In case of contact with acid, flush immediately with water.

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The battery has four (4) major functions:

1. Providing a source of current for starting the engine.
2. Stabilizing the voltage in the electrical system.
3. Supplying current for a limited time, when electrical demands of the equipment exceed the power output of the alternator.
4. Providing a limited source of power for connected accessories, when the engine is not running.

The batteries are located in the engine compartment R.H. side (Fig. 13).

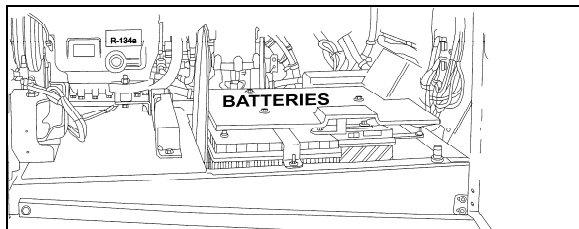


FIGURE 12: ENGINE COMPARTMENT R.H. SIDE 18513

3.1 BATTERY DISCHARGE PROTECTION

To prevent discharge of the batteries when the engine is not running, some functions are automatically switched off if the batteries voltage drops below 24.4 volts for more than 30 seconds. The "BAT" telltale light blinks while this protection mode is active. Set the ignition key to the OFF position and then turn the ignition key to the ON position to reactivate the functions for a period of 30 seconds before they switch off again. If a prolonged use of the functions with the engine not running is necessary, connect the battery to a charger.

3.2 MAIN BATTERY RELAYS

Main battery relays (24V & 12V) are provided for this vehicle. The relays are located in the rear junction box (R1 & R3). The 24-volt battery relay engages when ignition key is in the ON or ACC position.

When the main battery relays are turned to the OFF position, all electrical supply from the batteries is cut off, with the exception of the following items.

- Battery equalizer check module;
- ECM;
- Transmission Control Module (TCM);
- Preheater electronic timer;

- Preheater and water recirculating pump;
- Radio memory;
- CECM;
- Cluster memory.

3.3 BATTERY REMOVAL AND INSTALLATION

The batteries are located in the engine compartment R.H. side area (Fig. 13).

1. Remove the three (3) plastic protective cover retaining bolts. Remove the plastic protective cover.
2. Remove the support retaining bolt.



DANGER

To prevent possible electric shocks or sparking, trip circuit breakers CB1 & CB2 and turn the ignition key switch in the "Off" position before disconnecting cables from the batteries.

3. Remove the support (if necessary, remove battery cables). To remove battery cables, unscrew terminal nuts and remove cables.
4. Remove battery cables from defective batteries.

NOTE

When the battery cables have been removed from the batteries, wrap the battery terminals and cable ends with electric tape to prevent accidental grounding. The ground cables should always be disconnected first and replaced last.

5. Remove defective batteries.
6. Installation is the reverse of removal.

NOTE

In replacing batteries, only batteries of the same specification should be used. Refer to "Specifications" at the end of this section for further details.



CAUTION

Ensure that connections are not reversed when reinstalling batteries, since damage to electrical system components will result.

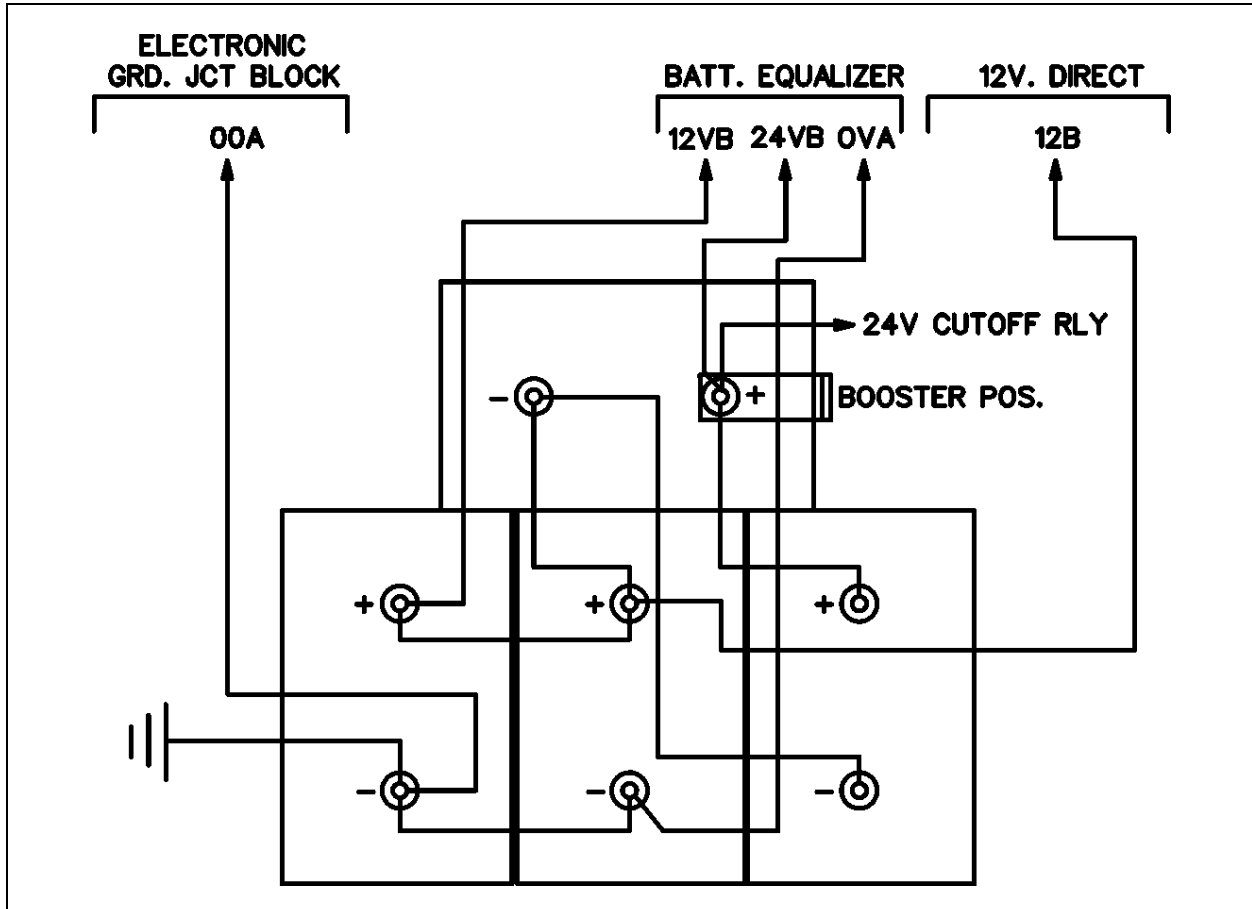


FIGURE 13: BATTERIES CONNECTIONS

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NOTE

When reinstalling batteries, battery connections must be tightened to 13-15 lbf-ft (18-20 Nm). A torque wrench is required to ensure an accurate tightening torque.

**DANGER**

To prevent possible electric shock or sparking, trip circuit breakers CB1 & CB2 and turn the ignition key switch in the "Off" position before tightening an electrical connection.

NOTE

A protective silicone free, coating should be applied on all terminals that have been disconnected. We recommend the use of Cortec VCI-238 (Prévost #682460) on all electrical connections.

3.4 BATTERY RATING

Each of the 12 volt batteries used on the vehicle has the following rating:

- Reserve capacity: 195 minutes
- Cold cranking (amps): 950 @ 0°F (-18°C)
- Weight (filled): 59 lb (26,7 kg)

The reserve capacity is defined as the number of minutes a new, fully charged battery at 80°F (26,6°C) can be discharged at 25 amperes and maintain a minimum of 1.75 volts per cell (10.5 volts total for one 12 volts battery). This rating can be used as a basis for determining how long a vehicle might run after an alternator failure. The cold cranking rating is defined as the minimum discharge current a battery will deliver in amperes for 30 seconds at 0°F (-18°C) while maintaining a minimum of 1.2 volts per cell (7.2 volts total for one 12 volts battery). This rating can be used as a basis for comparing starting performance.

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3.5 BATTERY TESTING

The maintenance-free battery has a strong ability to withstand the damaging effects of overcharge. The test indicator in the cover is used only to determine if the battery can be tested in case of a cranking problem.

The test indicator in the battery cover is to be used with accepted diagnostic procedures only. It must not be used to determine if the battery is good or bad, charged or discharged. The test indicator is a built-in hydrometer in one cell that provides visual information for battery testing (Fig. 15).

It is important when observing the test indicator, that the battery be relatively level and has a clean indicator top to see the correct indication. Some lighting may be required in poorly lit areas. Under normal operation, two indications can be observed.

Green Dot Visible

Any green appearance is interpreted as a "green dot", and the battery is ready for testing. On rare occasions, following prolonged cranking, the green dot may still be visible when the battery is obviously discharged. Should this occur, charge the battery as described under "Charging Procedure" in "Battery Charging" later in this section.

Dark - Green Dot Not Visible

If there is difficulty cranking the engine, the battery should be tested as described in this section. On rare occasions, the test indicator may turn light yellow. In this case, the integral charging system should be checked. Normally, the battery is capable of further service; however, if difficult start has been reported, replace the battery. **DO NOT CHARGE, TEST, OR JUMP-START.**

3.5.1 Visual Inspection

1. Check the outside of the battery for a broken or cracked cover or case that could permit loss of electrolyte. If obvious physical damage is noted, replace the battery.
2. Check for loose terminal posts, cable connections, damaged cables, and for evidence of corrosion. Correct conditions as required before proceeding with tests.

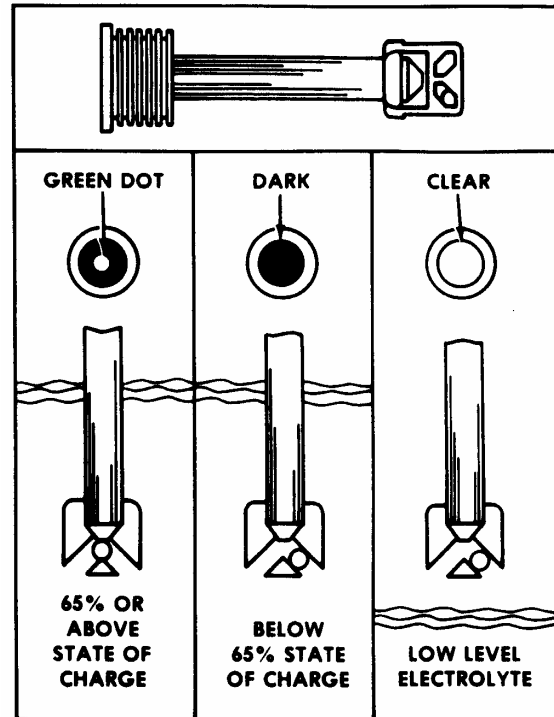


FIGURE 14: TEST INDICATOR

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3.5.2 Removing Surface Charge

Disconnect cables from the battery and attach alligator clamps to the contact lead pad on the battery as shown in figure 17. Connect a 300 ampere load across the terminal for 15 seconds to remove surface charge from the battery.

3.5.3 Load Test

This test is one means of checking the battery to determine its ability to function as required in the vehicle.

To make this test, use test equipment that will withstand a heavy electrical load from the battery, such as a carbon pile resistor or other suitable means.

1. Connect a voltmeter, ammeter, and a variable load resistance as illustrated in figure 15.



CAUTION

Observe polarity of the meters and the battery when making connections, and select the correct meter range.

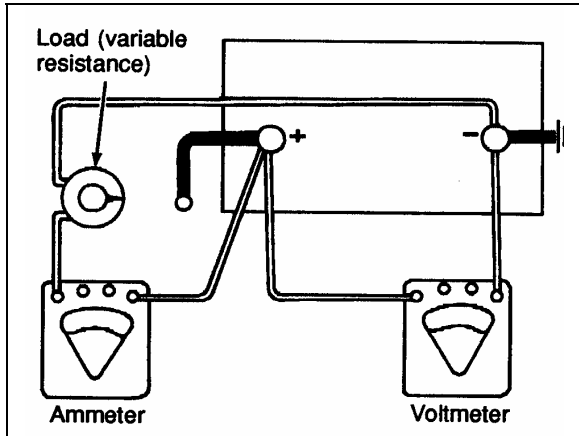


FIGURE 15: LOAD TEST 06064

2. Apply a 290 amperes load to the battery for 15 seconds.
3. With an ammeter reading specified load, read voltage. The voltage should be at least 9.6 volts. Disconnect the load. If the voltmeter indicates 9.6 volts or more, the battery is good. If the voltmeter reading is less than 9.6 volts, replace the battery. This voltage is to be used for battery ambient temperatures of 70°F (21°C) and above. For temperatures below 70°F (21°C), refer to the following "Voltage and Temperature Chart".

Voltage and Temperature Chart

Ambient Temperature	Minimum Voltage
70°F (21°C) and above	9.6
60°F (16°C)	9.5
50°F (10°C)	9.4
40°F (4°C)	9.3
30°F (-1°C)	9.1
20°F (-7°C)	8.9
10°F (-12°C)	8.7
0°F (-18°C)	8.5

NOTE

The accuracy of this test procedure is dependent upon close adherence to the proper load, time and temperature specifications.

3.5.4 Testing Battery Cables

Check all cable ring terminals and connections to determine if they are in good condition. Excessive resistance, generally caused by poor connections, produces an abnormal voltage drop which may lower voltage at the starter to such a low value that normal operation of the starter will not be obtained. An abnormal voltage drop can

be detected with a low-reading voltmeter as follows:

DANGER

To prevent the engine from starting, the DDEC engine circuits, which are protected by breakers (CB-1 & CB-2) located in the circuit breaker panel, must be deenergized during these tests; afterward toggle yellow lever upwards to reset the circuit breakers.

1. Check voltage drop between grounded (negative) battery terminal and vehicle frame by placing one prod of the voltmeter on the battery terminal and the other on a good ground (unpainted surface) on the vehicle. With the starter cranking the engine at a temperature of 70°F (21°C), voltage reading should be less than 0.3 volt. If the voltage reading exceeds 0.3 volt, there is excessive resistance in this circuit.
2. Check voltage drop between the positive battery terminal and the starter positive terminal stud while the motor is operated. If the reading is more than 2.5 volts, there is excessive resistance in this circuit.

NOTE

If it is necessary to extend the voltmeter lead for this test, use a #16 (AWG) or larger wire.

3. Check voltage drop between the starter housing and a good ground on the vehicle. The reading should be less than 0.2 volt.

DANGER

Any procedure other than the following could cause personal injury or damages to the charging system resulting from battery explosion or electrical burns.

Wear adequate eye protection when working on or near the batteries. Ensure that metal tools or jumper cables do not contact the positive battery terminal (or a metal surface in contact with it) as a short circuit will result. Do not attempt to jump start a vehicle suspected of having a frozen battery because the battery may rupture or explode. Both the booster and discharged batteries must be treated carefully when using jumper cables. Follow exactly the procedure outlined later in this section, being careful not to cause sparks.

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3.6 BATTERY CHARGING

The batteries used on this vehicle can be charged either on or off the vehicle; however, when they are removed from the vehicle, it is recommended that an adapter kit, which is available from any "A/C DELCO" dealer, be used in charging sealed-terminal batteries. Use the booster terminals to charge the batteries when they are left on vehicle and **make sure that the ignition key switch is set to the "On" position.**

The alligator clamps of the tester or charger must be placed between the terminal nuts and the lead pads of the terminal studs (Fig. 17) after the vehicle cables are detached. The alligator clamps should make firm contact with the lead pads.



DANGER

During charging of the batteries, an explosive gas mixture forms in each cell. Part of this gas escapes through the vent holes and may form an explosive atmosphere around the battery itself if ventilation is poor. This explosive gas may remain in or around the battery for several hours after it has been charged. Sparks or flames can ignite this gas causing an internal explosion, which may shatter the battery.

1. Do not smoke near a battery which is being charged or which has been recently charged.
2. Do not break live circuits at battery terminals because a spark usually occurs at the point where a live circuit is broken. Care must always be taken when connecting or disconnecting booster leads or cable clamps on chargers. Poor connections are a common cause of electric arcs, which cause explosions.
3. The electrical system on this vehicle is negative ground. Installing the batteries with the positive terminals grounded or incorrect use of the booster battery and jumper cables will result in serious damage to the alternator, batteries and battery cables.

NOTE

If this connection cannot be made because of the alligator clamp design, the load value for testing must be reduced from 290 to 260 amperes.

On rare occasions, such as those that occur following prolonged cranking, the green dot in the test indicator may still be visible when the battery is obviously discharged. Should this occur, a boost charge of 20 amperes-hour is recommended. Under normal operating conditions, do not charge battery if the green dot is visible. The battery should never be charged if the test indicator (hydrometer) is clear or light yellow. If this occurs, replace the battery.

A charge rate between 3 and 50 amperes is generally satisfactory for any maintenance-free battery as long as spewing of electrolyte does not occur or the battery does not feel excessively hot (over 125°F (52°C)). If spewing or violent gassing of electrolyte occurs or battery temperature exceeds 125°F (52°C), the charging rate must be reduced or temporarily stopped to allow cooling and to avoid damaging the battery. Battery temperature can be estimated by touching or feeling the battery case. The battery is sufficiently charged when the green dot in the built-in hydrometer is visible. No further charging is required. Shake or tilt the battery at hourly intervals during charging to mix the electrolyte and see if the green dot appears.



WARNING

Always turn off the charger before connecting or disconnecting to a battery.

NOTE

The charge rate must be doubled when the batteries are charged by the booster terminals, because of the series-parallel circuit.

Battery charging consists of a charge current in amperes for a period of time in hours. Thus, a 25 ampere charging rate for 2 hours would be a 50 ampere-hour charge to the battery. Most batteries, whose load test values are greater than 200 amperes, will have the green dot visible after at least a 75 ampere-hour charge. In the event that the green dot does not appear, replace the battery.

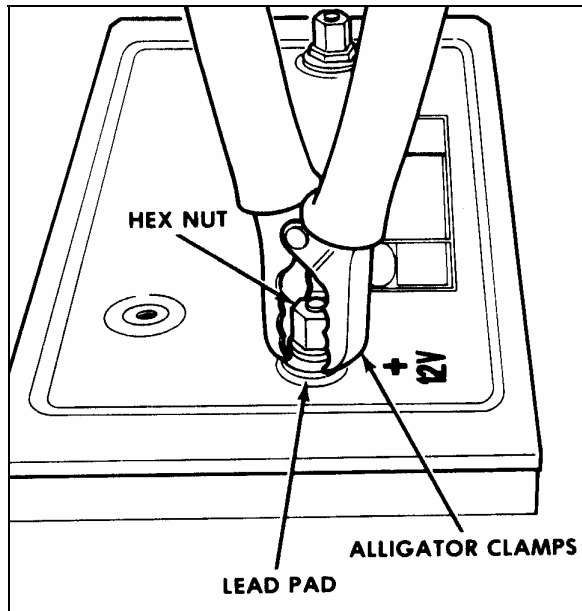


FIGURE 16: ALLIGATOR CLAMPS AND BATTERY 06065

3.6.1 Battery Charging Guide

Fast Charging Rate

20 amps @ 3-¾ hours
 30 amps @ 2-½ hours
 40 amps @ 2 hours
 50 amps @ 1-½ hours

Slow Charging Rate

5 amps @ 15 hours
 10 amps @ 7-½ hours

The time required for a charge will vary according to the following factors:

Size of Battery

For example, a completely discharged large heavy-duty battery requires more than twice the recharging time of a completely discharged small passenger car battery.

Temperature

For example, a longer time will be needed to charge any battery at 0°F (-18°C) than at 80°F (27°C). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first, and then in time, the battery will accept a higher rate as it warms up.

State of Charge

For example, a completely discharged battery requires more than twice as much charge than a half-charged battery. Since the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted is very low at first. Later, as the charging current causes the electrolyte acid

content to increase, the charging current will likewise increase.

Charger Capacity

For example, a charger which can supply only 5 amperes will require a much longer period of charging than a charger that can supply 30 amperes or more.

3.6.2 Emergency Jump Starting With Auxiliary (Booster) Battery.



DANGER

Do not jump start vehicles equipped with maintenance-free batteries if the test indicator is light yellow.

Both booster and discharged batteries should be treated carefully when using jumper cables. A vehicle with a discharged battery may be started by using energy from a booster battery or the battery from another vehicle.



DANGER

Jump starting may be dangerous and should be attempted only if the following conditions are met:

The booster battery or the battery in the other vehicle must be of the same voltage as the battery in the vehicle being started, and must be negative grounded.

If the booster battery is a sealed-type battery without filler openings or caps, its test indicator must be dark or a green dot must be visible. Do not attempt jump starting if the test indicator of the booster battery or the discharged battery has a light or bright center.



DANGER

Follow the procedure exactly as outlined hereafter. Avoid making sparks.

1. Wear eye protection and remove rings, watches with metal bands and other metal jewelry.
2. Apply parking brake and place the transmission shift lever or push-button pads in Neutral (N) position in both vehicles. Turn off lights, heater and other electrical loads. Observe the charge indicator. If the indicator in the discharged battery is illuminated,

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replace the battery. **Do not** attempt jump starting when indicator is illuminated. If the test indicator is dark and has a green dot in the center, failure to start is not due to a discharged battery and the cranking system should be checked. If charge indicator is dark but the green dot does not appear in center, proceed as follows:

3. Connect one end of one red jumper cable to the positive (+) terminal of the booster power source and the other end to the positive (+) terminal bar on the battery, located in the engine compartment R.H. side area (refer to fig. 18).
4. Connect one end of the remaining negative jumper cable (black) to the negative (-) terminal of the booster power source and the other end of the black jumper cable to the negative (-) terminal on the structure.
5. Make sure the clips from one cable do not inadvertently touch the clips on the other cable. Do not lean over the battery when making connections. The ground connection must provide good electrical conductivity and current carrying capacity.
6. Start the engine in the vehicle that is providing the jump start. Let the engine run for a few minutes, then start the engine in the vehicle that has the discharged batteries.
7. When removing the jumper cables, perform the above procedure exactly in reverse order.

On all XLII MTH, booster terminals are located in the engine compartment on the R.H. side and are accessible through engine compartment R.H. side door (Fig. 18).

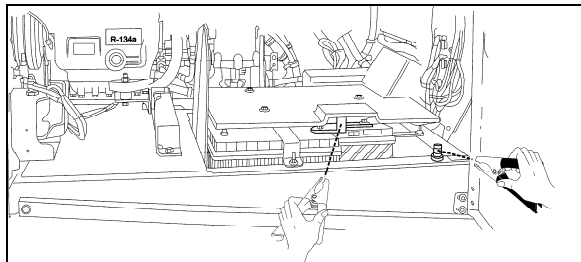


FIGURE 17: JUMP STARTING

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DANGER

Any procedure other than the above could result in personal injury, property damage due to battery explosion, or damage to the

charging system of the booster vehicle or of the boosted vehicle.

NOTE

Jumper cables must withstand 500 cranking amperes. If cable length is 20 feet (6m) or less, use 2/0 (AWG) gauge wires. If cable length is between 20-30 feet (6-9m), use 3/0 (AWG) wires.

3.7 CLEANING AND INSPECTION

The external condition of the battery and the battery cables should be checked periodically. The top of the battery should be kept clean and the battery hold-down clamp bolts should be kept properly tightened. For best results when cleaning the battery, wash first with a diluted solution of ammonia or soda to neutralize any acid present then wash out with clean water. The battery hold-down bolts should be kept tight enough to prevent the batteries from moving, but they should not be tightened to the point that excessive strain is placed on the battery hold-down cover (proper tightening torque: 45-55 lbf-in (5-6 Nm).

To insure good contact, the battery cable ring terminals should be tight on the battery posts. If the posts or cable ring terminals are corroded, the cables should be disconnected and the posts and clamps cleaned separately with a soda solution and a wire brush. Install cable ring terminals on battery posts and tighten to a torque of 10-15 lbf-ft (13-20 Nm). Replace protective caps to prevent corrosion and sparks.

3.8 COMMON CAUSES OF BATTERY FAILURE

When a battery fails, the cause of failure may be related to something other than the battery. For this reason, when a battery failure occurs, do not be satisfied with merely recharging or replacing the battery. Locate and correct the cause of the failure to prevent recurrence. Some common external causes of battery failure are as follows:

1. A defect in charging system such as high resistance or a faulty alternator or regulator.
2. A malfunction within the 12 volts system (equalizer).
3. Overloads caused by a defective starter or excessive use of accessories.

4. Dirt and electrolyte on top of the batteries causing a constant drain.
5. Hardened battery plates, due to battery being in a low state of charge over a long period of time.
6. Shorted cells, loss of active material from plates.
7. Driving conditions or requirements under which the vehicle is driven for short periods of time.
8. A constant drain caused by a shorted circuit such as an exposed wire or water infiltration in junction boxes causing ground fault.
9. Extended operation of preheating system with engine not running.
10. Failing to close disconnect switches during the night.

3.9 TROUBLESHOOTING

If a battery is known to be good and then has not performed satisfactorily in service for no apparent reason, the following factors may reveal the cause of trouble:

1. Vehicle accessories and disconnect switches inadvertently left on overnight.
2. Defects in the charging system, such as high wiring resistance, faulty alternator, regulator or battery equalizer.
3. A vehicle electrical load exceeding the alternator (or battery equalizer) capacity, with the addition of electrical devices, such as CB radio equipment, a cellular phone or additional lighting systems.
4. Defects in the electrical system, such as shorted or pinched wires.
5. Extended driving at a slow speed while using many accessories.
6. Loose or poor battery cable-to-post connections, previous improper charging of a run-down battery, or loose hold-down clamp bolts.
7. High-resistance connections or defects in the cranking system.

3.10 "BAT" BATTERY VOLTAGE INCORRECT TELLTALE LIGHT

If the "BAT" (battery voltage incorrect) telltale light is illuminated, check the 24-volt voltmeter to

determine if the battery voltage is too high or too low.

NOTE

According to the battery charging condition, it is normal that "BAT" telltale light illuminates upon starting the engine and stays illuminated for a few seconds. This is caused by the normal voltage drop of the battery during starting.

3.10.1 "Bat" Telltale Light Definitions

Voltmeter drops below 24.4 volts dc

- Check alternator output.
- Check voltage regulator.
- Check battery connections.
- Check battery cells.
- Check battery equalizer connections.

Voltmeter exceeds 30 volts dc

- Check alternator output.
- Check voltage regulator.
- Check battery connections.

Battery Balance

NOTE

Allow at least 15 minutes to balance batteries after any corrective measure has been taken.

1. Batteries out of balance (difference greater than 1.5 volts between the two battery banks).
 - Check battery equalizer connections.
 - Check equalizer cables for proper gauge.
 - Check battery connections.
2. Demand for 12-volt power exceeding rated amperage output of battery equalizers causing batteries to go out of balance.
 - Reduce 12-volt load or install additional battery equalizer(s).

4. TROUBLESHOOTING AND TESTING THE MULTIPLEX VEHICLES

4.1 ELECTRICAL SYSTEM DIAGNOSTIC

Using the message center display (MCD), check if there are active errors in the vehicle electrical

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system. With the SYSTEM DIAGNOSTIC menu, highlight FAULT DIAGNOSTIC and then highlight ELECTRICAL SYSTEM to request a diagnostic of the electrical system from the CECM. Press the enter key. If applicable, the MCD shows the multiplex device ID, the fault messages or fault codes recorded. When more than one fault is recorded, an arrow pointing down appears on the right of the display. Use the down arrow to see all the fault messages.

Once the problem corrected, the MCD still shows the fault as being active. You have to leave the FAULT DIAGNOSTIC menu, wait approximately 20 to 30 seconds and then return to FAULT DIAGNOSTIC to request a new diagnostic of the ELECTRICAL SYSTEM from the CECM. The MCD should display the fault as being inactive. The CECM can store up to 20 faults, i.e. the first 10 and the last 10. Middle faults will be erased. If the breakers are tripped, the fault history will be erased from the CECM memory.

NOTE

When performing an electrical system diagnostic with the MCD (message center display), the message "No Response ModA41" indicates either module A41 is not responding due to a CAN link problem or module A41 is not powered. Similar messages exist for all modules (A42, A43, A44, etc.).

Because it is easier to do, check first if the module is powered by probing on its gray connector. If it is, then you can conclude that there is a CAN link problem. Refer to paragraph 4.6: CAN NETWORK LAYOUT AND TROUBLE-SHOOTING in this section.

NOTE

It is of the utmost importance to have a MCD (message center display) in working condition because it is the most important tool to achieve troubleshooting on a multiplex vehicle.

4.2 PROBING VOLTAGE ON THE MULTIPLEX CIRCUITS

Some Multiplex modules are supplied by 12 volts while others are supplied by 24 volts. The 12-volt or 24-volt information is found on the modules symbol in the wiring diagram. Before taking voltage readings to track the source of a problem, first verify if the module is supplied by 12V or 24V, if not, residual voltage on the

module inputs/outputs can draw an erroneous conclusion.

Inactive Multiplex output = Residual voltage of 18% to 33% of supply voltage.

Inactive Multiplex input = Residual voltage of 50% of supply voltage.

NOTE

- *Verify on the wiring diagram whether the voltage is 12V or 24V,*
- *For a 12V module: an active voltage would be 12V or 0V but not in between. If you measure the intermediate tensions (ex. 6V, 2V, or 4V) this must be interpreted as if the input or the output is inactive.*
- *For a 24V module: an active voltage would be 24V or 0V but not in between. If you measure the intermediate tensions (ex. 12V, 4V, or 8V) this must be interpreted as if the input or the output is inactive.*

4.3 CAN NETWORK

The CAN link wiring is separated in sections and uses connectors that are not shared with other circuits. This allows sections of the network to be isolated to help locate short-circuit on the CAN.

In case of a short-circuit on the CAN link, this affects all the modules and they all show « No Response » in the error messages of the « ELECTRICAL SYSTEM » menu. To locate a short-circuit, proceed by disconnecting one module zone at a time while verifying if this makes inactive the errors in the modules still connected. Connector C1 (front electrical & service compartment) disconnects all the modules at the rear of the vehicle from the network. Connector C5 (front electrical & service compartment) disconnects all the modules from the wiper control panel. Connector C100 disconnects the module from the evaporator compartment. Connector C3 (rear junction box) disconnects the modules from the battery compartment.

Example: Disconnect C5 and C1 and then verify the status of the errors. If the front modules (A41 to A46) now give inactive errors, which means short-circuit is elsewhere than in the front electrical & service compartment.

4.3.1 Can Connection On The Telltale Panel And The Hvac Control Unit

The telltale panel module and HVAC module are linked to the CECM by a CAN connection. In case of a CAN connection default, the telltale panel LCD display shows "CAN", and on the HVAC control unit, the temperature display indicates "---". To confirm a CAN connection default, check that the fan speed on the driver's section HVAC control unit cannot be adjusted.

Moreover, specific error messages from these 2 modules can be read in the ELECTRICAL SYSTEM menu.

NOTE

While downloading a new vehicle program in the CECM from a computer, the CAN network is temporarily interrupted and therefore a CAN reference appears in the telltale panel LCD display.

4.3.2 Spare Can

A spare CAN network is installed between the front and the rear of the vehicle. It has connectors installed at each end to facilitate swapping from the regular CAN network to the spare CAN network. Refer to the vehicle wiring diagram and paragraph 4.6 for more information.

4.4 TEST MODE FOR SWITCHES AND SENSORS

The switch/sensor test mode provides useful information to diagnose problems complimentary to the electrical system diagnosis.

To enter this mode, activate the dashboard "Telltale Light Test" switch 3 times within 4 seconds. To exit the switch/sensor test mode, reactivate the test switch 1 time or turn OFF the ignition.

4.4.1 Information Available And Impact On The Functions In Switch/Sensor Test Mode

Telltale panel audible alarm emits a *beep* each time an OFF/ON transition is detected on a multiplex input. This allows quick verifying if the switches and sensors are detected or seen by the multiplex modules. When the vehicle is parked, the back-up alarm also emits a sound that allows verification of the sensors at the rear of the vehicle.

Certain inputs are doubled (ex. turn signal switch on multi-function lever) and also other inputs activate at the same time. For these inputs, 2 *beeps* are emitted. If only one *beep* is heard, one of the inputs is defective.

SWITCHES AND SENSORS SUPPORTED BY THE SWITCH/SENSOR TEST MODE
HVAC control unit driver's section ON/OFF
A/C door ajar open sensor
HVAC control unit driver recirculate switch
HVAC control unit cabin area ON/OFF
Engine ether start switch
Radiator fan clutch switch
Engine front start enable switch
Engine rear start enable switch
Engine ignition front switch
Engine ignition rear switch
Entrance door electric window down switch
Entrance door electric window up switch
Electric horn button
Interior lighting switch, 2 positions
Driver's area lighting switch
Reading lights switch
Multi-function lever LH turn signal
Multi-function lever RH turn signal
Fog lights switch
Hazard warning flashers switch
Multi-function lever courtesy blinkers switch
Headlights switch, 2 positions
Multi-function lever headlights beam toggle switch
Baggage compartment door lock/unlock switch
Tag axle signal
Windshield lower wiper
Multi-function lever windshield wipers intermit.
Multi-function lever windshield wipers speed 1,2
Lower windshield wipers backup switch
Lower windshield washer switch

The following inputs, either certain options or sensors which are difficult to activate, are not supported by the switch/sensor test:

- Starter Sensor;
- ABS Warning input;
- Driver's Power Window Switch (up & down);
- Fog Lights Switch;
- Alternator Sensors 1 & 2;
- Retarder Active Signal;
- Radiator fan speed 1 & 2 signals.

When in switch/sensor test mode, the A/C compressor HI and LO pressure values are displayed one after the other instead of the outside temperature in the telltale panel LCD display. This feature can be used when the

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vehicle is traveling to check the A/C compressor pressure values, but no *beep* can be heard.

In test mode, with the parking brake applied and the cabin area (passenger) set point set to a value higher than 64°F (18°C), the circulator pump is not set to OFF as it would normally do when the outside temperature gets above 50°F (10°C). This feature allows verification of the pump when inside a garage. This is also useful when working on the heating system to remove air pockets trapped in the system.


When performing an A/C cooling test and having the water pump shut off in switch/sensor test mode is required, just set the cabin (passenger) set point temperature to the minimum 64°F (18°C) to shut off the pump.

4.5 TEST MODE FOR ELECTRIC MOTORS

The test mode allows testing the motors and electric contactors without the need to have the engine running. Note that while in test mode, the engine cannot be started.

Prerequisite conditions for the motor test mode:

- A. The battery charger must be connected to a 110-120 volt power supply. If not, the test will be interrupted when the voltage drops below 24.4 volts,
- B. Engine not running,
- C. Parking brake applied,

 **DANGER**

Before starting the test sequence, make sure nobody is working in the evaporator or condenser compartment.

NOTE

A delay of 15 seconds during which the back-up alarm will sound is introduced prior the test start to advise people that may be working on the vehicle.

To enter this mode:

- Activate the dashboard Telltale Light Test switch 3 times within 4 seconds;
- Push the ON/OFF button on the driver's side HVAC control module 5 times (that makes 3 transitions from OFF to ON),

- A *beep* can be heard indicating the motor test mode has started.

Using the test mode:

During the entire test, the telltale panel audible alarm gives a signal each second to remind that the motor test mode is underway.

4.5.1 Test Sequence – MTH Equipped With Central HVAC System

- Driver's & cabin units fresh air damper opening. *[20 seconds delay]*
- Go to the condenser compartment and check the fans. The condenser motors start at speed 1 for 3 seconds, then after a short pause, speed 2 activates. *[3 seconds delay]*
- The cabin unit refrigerant solenoid valve activates 3 times. *[10 seconds delay]*

Then 5 beeps can be heard from the back-up alarm to indicate to go to the engine compartment.

In the engine compartment, the sequence is as follows:

- A/C compressor clutch activates 3 times.
- Left compressor unloader activates 3 times.
- Right compressor unloader activates 3 times. *[5 seconds delay]*
- Radiator fan clutch is disengaged (fan can be turned freely by hand). *[3 seconds delay]*
- Fan clutch engages in speed 1 (fan can be turned by hand but with a certain resistance). *[3 seconds delay]*
- Fan clutch engages in speed 2 (cannot be turned but hand). *[10 seconds delay]*

5 beeps from the back-up alarm indicate to go to the evaporator compartment.

In the evaporator compartment:

- Evaporator fan motor runs at speed 1 for 3 seconds then runs at speed 2 for 2 seconds.
- Hot water pump starts running for 5 seconds and hot water pneumatic valve cycles 3 times. *[20 seconds delay]*

5 beeps from the back-up alarm indicate to go to the reclining bumper compartment behind the reclining bumper.

Inside the reclining bumper compartment:

- Driver's unit refrigerant solenoid valve activates 3 times.
- Driver's unit hot water pneumatic valve cycles 3 times.
- Closing of the fresh air dampers.

This ends the test. Activate the dashboard Telltale Light Test switch one time to leave the motor test mode.

4.5.2 Test Sequence – MTH Equipped With Small HVAC System

- Driver's unit fresh air damper opening.
[20 seconds delay]

Then 5 beeps can be heard from the back-up alarm to indicate to go to the engine compartment.

In the engine compartment, the sequence is as follows:

- A/C compressor clutch activated 3 times.
[5 seconds delay]
- Radiator fan clutch is disengaged (fan can be turned freely by hand). *[3 seconds delay]*
- Fan clutch engages in speed 1 (fan can be turned by hand but with a certain resistance).
[3 seconds delay]
- Fan clutch engages in speed 2 (cannot be turned but hand). *[10 seconds delay]*

5 beeps from the back-up alarm indicate to go to the reclining bumper compartment behind the reclining bumper.

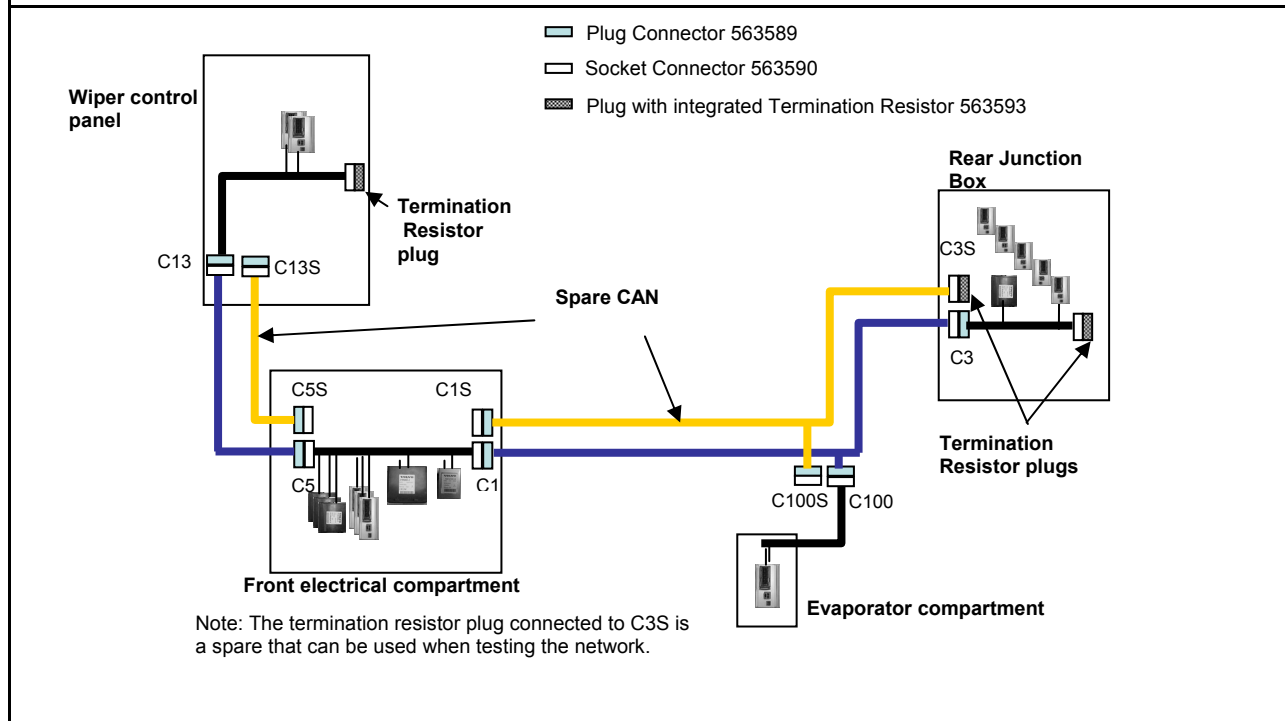
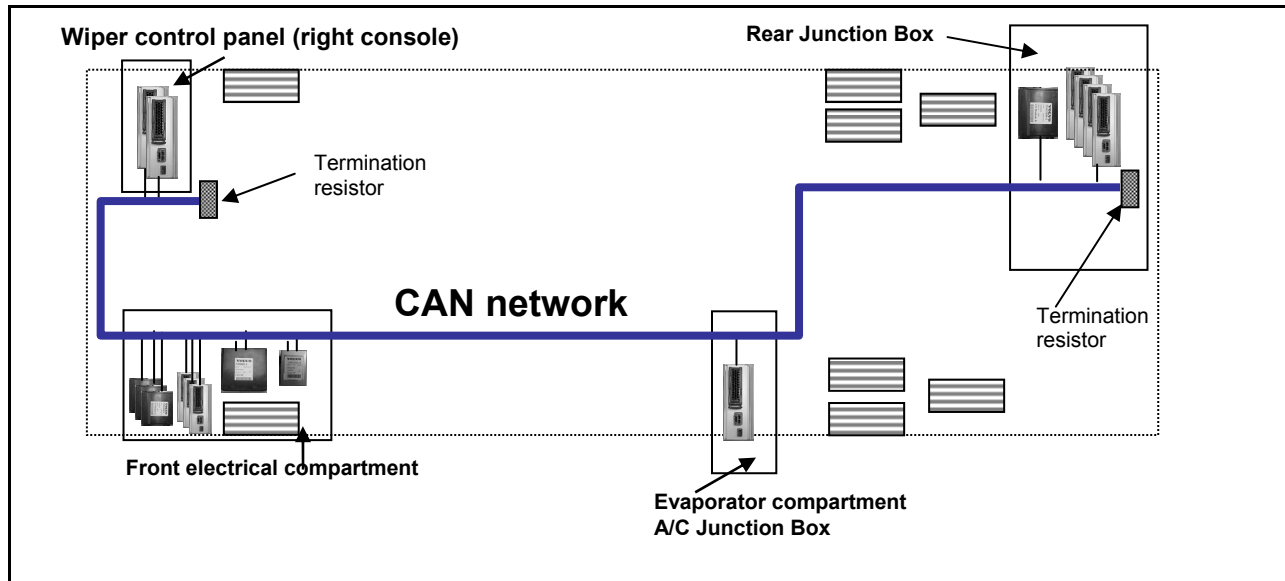
Inside the reclining bumper compartment:

- Hot water pump starts running for 5 seconds.
- Driver's unit refrigerant solenoid valve activates 3 times.
- Driver's unit hot water pneumatic valve cycles 3 times.
- Closing of the fresh air dampers.

This ends the test. Activate the dashboard Telltale Light Test switch one time to leave the motor test mode.

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4.6 CAN NETWORK LAYOUT AND TROUBLESHOOTING



If all 14 modules (A41 to A54) are showed as Not Responding and Active Fault, the problem could be:

- A short circuit somewhere on the CAN network.
- The network is completely open circuit. That means none of the two termination resistors are connected.

Several simple tests can be done to locate the problem.

4.7 ROADSIDE TROUBLESHOOTING

Problem/Symptom	Probable Causes	Actions
Vehicle does not Start	Rear Start selector switch is not in the NORMAL position.	<ol style="list-style-type: none"> 1. Check that the rear start selector switch is flipped up to NORMAL start position and retry cranking. 2. Flip the rear start selector switch to "Rear Start" and start the vehicle from the rear.
	<p>CAN network problem (Multiplex)</p> <p>Module A53 not powered or is defective</p> <p>Engine MCM does not receive the ignition signal</p> <p>Engine MCM is not powered</p>	<p>If the vehicle does not start from the rear:</p> <ol style="list-style-type: none"> 1. Verify that module A53 is powered: <ol style="list-style-type: none"> a) Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA53, Active", indicates a power problem on the module or a CAN network problem. b) Check / reset circuit breakers CB1 and CB9. c) Check / replace fuse F74 and F80. d) Probe gray connector on module to see if it is powered. 2. Verify that the engine MCM is powered and get the ignition signal. Check / replace fuse F78 and F79.
	<p>None of the Multiplexed functions are operating, including the basic limp-home functions (door opening, flashers, wipers in speed 1)</p> <p>Three dashes "---" appear in the telltale panel instead of the outside temperature</p> <p><i>Note: The sunshades are still functioning since these are not multiplexed</i></p>	<p>The program version in the CECM is different than the program in the I/O modules and the CECM is forcing all I/O modules to stay inactive</p>

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Problem/Symptom	Probable Causes	Actions
<p>Many secondary functions (not essential for driving) not functioning (interior lighting, driver's area lighting, wiper speed 2 and intermittent).</p> <p>Outside temperature display in the telltale LCD panel displays three dashes "---"</p> <p>Marker lights and clearance lights are turned ON when setting ignition to the ON position.</p>	<p>The CECM module does not receive 24 V power.</p> <p>The CAN network is not working. It could be caused by a short on the network, an open circuit, a problem with the CECM or the CECM being disconnected from the network.</p>	<ol style="list-style-type: none"> 1. Check / reset circuit breaker CB2 (2nd from the bottom). Check / replace fuse F1. 2. Operate in limp-home mode by starting the vehicle from the engine compartment (REAR START). All functions essential to drive are available.
<p>No temperature control in the cabin area.</p> <p>Cabin temperature display indicates two dashes "--"</p>	<p>Problem with the temperature sensor located in the evaporator compartment air intake or the sensor wiring.</p>	<p>Manually control the temperature by playing with the cabin (passenger) set point. Set above 22°C (72°F) to heat and below 22° C (72°F) to cool.</p>
<p>Defroster fan not functioning</p> <p>Windshield wipers not functioning in speed 1 or intermittent</p>	<p>Module A47 is not powered or is faulty</p>	<ol style="list-style-type: none"> 1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA47, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB3. 3. Check / replace fuse F5 and F16. 4. Probe gray connector on module to see if it is powered.
<p>Windshield wipers not functioning in speed 1 or intermittent</p>	<p>No power on R23</p>	<p>Check / replace fuse F82</p>
<p>HVAC condenser fans not functioning in speed 1</p>	<p>Circuit breaker CB7 tripped and not reset</p>	<p>Check / reset circuit breaker CB8</p>
<p>HVAC condenser fans not functioning in speed 2</p>	<p>Circuit breaker CB7 tripped and not reset</p>	<p>Check / reset circuit breaker CB5</p>
<p>Windshield washer not functioning</p>	<p>Module A46 is not powered or is faulty</p>	<ol style="list-style-type: none"> 1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM.

Problem/Symptom	Probable Causes	Actions
Defroster fan is functioning but no heat or cooling available in the driver area.		<p>The message “No Response ModA46, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms).</p> <ol style="list-style-type: none"> 2. Check / reset circuit breaker CB3. 3. Check / replace fuse F12 or F13. 4. Probe gray connector on module to see if it is powered.
<p>Low beam headlights and front flasher on left side not functioning</p> <p>Electric horn not functioning</p>	Module A45 is not powered or is faulty	<ol style="list-style-type: none"> 1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “No Response ModA45, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB1. 3. Check / replace fuse F33 and F34. 4. Probe gray connector on module to see if it is powered.
Low beam headlights and flasher on right side not functioning	Module A48 is not powered or is faulty	<ol style="list-style-type: none"> 1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “No Response ModA48, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB1. 3. Check / replace fuse F33 and F34. 4. Probe gray connector on module to see if it is powered.
<p>Rear flashers not functioning</p> <p>Stoplights and center stoplights not functioning</p>	Module A51 is not powered or is faulty	<ol style="list-style-type: none"> 1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “No Response ModA51, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom).

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Problem/Symptom	Probable Causes	Actions
		<ol style="list-style-type: none"> 2. Check / reset circuit breaker CB1. 3. Check / replace fuse F80. 4. Probe gray connector on module to see if it is powered.
<p>Engine is overheating and radiator fan clutch does not engage</p> <p>The A/C compressor clutch does not engage</p>	<p>Module A52 is not powered or is faulty</p>	<ol style="list-style-type: none"> 1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA52, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom). 2. Check / reset circuit breaker CB7. 3. Check / replace fuse F65. 4. Probe gray connector on module to see if it is powered.
<p>Evaporator fan not functioning</p>	<p>Circuit breaker CB4 tripped</p> <p>Module A54 is not powered or is faulty</p>	<ol style="list-style-type: none"> 1. Check / reset circuit breaker CB4. 2. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA54, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom). 3. Check / reset circuit breaker CB7. 4. Check / replace fuse F67, F68. 5. Probe gray connector on module to see if it is powered.
<p>HVAC condenser fans not functioning in speed 1</p>	<p>Module A54 is not powered or is faulty</p>	<ol style="list-style-type: none"> 1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA54, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom). 2. Check / reset circuit breaker CB7. 3. Check / replace fuse F67, F68. 4. Probe gray connector on module to see if it is powered.

Problem/Symptom	Probable Causes	Actions
Fire alarm telltale light and audible alarm always ON and there is no fire or high temperature in the engine compartment	Short-circuited fire sensor or defective sensor	Prior to start the vehicle, cycle the ignition key to the ON position, OFF position and then ON position again and then start the vehicle. This will deactivate the fire alarm function. This has to be repeated each time the vehicle is re-started.
The vehicle is parked and the electrical horn is activated to indicate a fire in the engine compartment but there is no fire	Short-circuited fire sensor or defective sensor	Cycle the ignition key between the ON and OFF position twice within 3 seconds. This will deactivate the fire alarm function. This has to be repeated each time the vehicle is parked.
A single light, a group of LED lights or another function of the vehicle is not functioning	The multiplex outputs are protected in current by an internal "soft-fuse". When an output is shorted, it turns OFF and stays OFF until the "soft-fuse" is reset	Turn the ignition key to the OFF position and turn to the ON position again. This resets all "soft-fuses".
No backlighting in the instrument cluster	Circuit breaker CB9 is tripped or fuse F21 blown.	Check / reset circuit breaker CB9 Check / replace fuse F21.
The radiator fan clutch does not function and the engine is overheating		<ol style="list-style-type: none"> 1. Set the ignition key to the ON position. 2. Activate the dashboard Telltale Light Test switch 3 times within 4 seconds. 3. In the engine compartment, set the starter selector switch to REAR START and then start the engine from the rear. <p>While in this mode, the rear start push-button can be used to manually engage the fan clutch. The Multiplex system knows when the engine is already running, and it will not activate the starter.</p> <ol style="list-style-type: none"> 4. Press the push-button one time to engage the clutch in 1st speed, press a second time to engage in 2nd speed, press a third time to stop the fan, press once again to return to 1st speed. <p>If the fan clutch does not engage using this procedure then the clutch is faulty or the wiring between the multiplex module and the clutch is faulty. Mechanically lock the fan clutch as described in section 05: COOLING SYSTEM of the maintenance manual.</p>

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4.8 ESSENTIAL FUNCTIONS TO OPERATE THE VEHICLE

Even with a defective CECM (Chassis Electronic Control Module) or a CAN network problem, essential base functions are maintained to rear start the vehicle from the engine compartment and drive in a secure manner.

However, many secondary functions are lost. In this case, the following directives must be followed.

- Never connect a battery charger when the ignition is in the ON position on a vehicle with a CAN defective or certain functions will start up by themselves,
- Disconnect the charger before starting the vehicle, if not the default functions will not activate,
- If the default mode does not activate, try to turn the ignition OFF while ensuring that no charger is connected and then restart the vehicle.

4.8.1 Available Functions

- Startup: Turn on the ignition in the driver's area and rear start the vehicle from the engine compartment,
- Windshield wipers: Wipers functions at 1st speed only,
- Windshield washer fluid,
- Headlights: Low beams only,
- Directional signals: Rear and front only,
- Stoplights: 2 upper stoplights + high-mounted stoplight are functional,
- HVAC: Functional with set point fixed at 70°F (22°C), evaporator and condenser fixed at speed 1, defroster fixed at speed 4.

4.9 LOWER PRIORITY MODULES FOR BREAKDOWN SERVICE

Modules A43 (IO-A) and A44 (IO-B) affect lower priority functions. These modules can therefore be used as spare parts for breakdown service while on the road.

Functions lost if A43 is removed and used as spare part:

- High beams,
- Ability to turn on the parking lights only,

- Driver's area lighting,
- Tag axle activation,
- Courtesy blinkers.

Functions lost if A44 is removed and used as spare part:

- Fresh air damper mix trap control,
- Driver's area and entrance overhead light,
- Front clearance lights.

4.10 MULTIPLEX MODULES

4.10.1 CECM

The CECM plays the role of interface between the engine ECM, the Transmission Control Module TCM, the telltale panel module and other IO-A, IO-B modules. When a multiplex module is being replaced, the CECM will inform the new module of its role and function accordingly to the vehicle options.

4.10.2 MASTER ID

The Master ID works in conjunction with the CECM. It keeps the specific back-up program of the vehicle. So, a specific Master ID cannot be removed from a vehicle and installed on another vehicle.

4.10.3 IO-A

IO-A modules receive inputs and control outputs. IO-A's are used for all outputs of 1 amp or less.

4.10.4 IO-B

IO-B modules receive inputs and control outputs. IO-B's are used for outputs up to 30 amps.

4.11 MULTIPLEX MODULES REPLACEMENT

IO-A, IO-B and CECM multiplex modules can be replaced and reprogrammed without having to connect a computer to the vehicle.

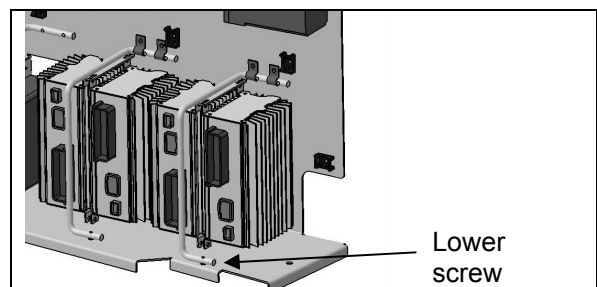


FIGURE 18: IO-B MODULE REMOVAL

4.11.1 Replacing IO-A Or IO-B Modules

- Set the ignition key to the ON position and leave it in that position at all time while performing this procedure.
- Open engine compartment R.H. side door, trip circuit breaker CB2.
- Replace the module (for IO-B modules, disconnect the green connector first, then the grey one and finish with the black connector. To disconnect the black connector, slide downwards the red latch. Remove the lower screw that holds the cable attachment rod onto the floor portion of the panel and flip the rod up, this will relieve the IO-B module, see figure 19).
- Reset circuit breaker CB2. This engages the automatic reprogramming.
- The telltale panel LCD display indicates "CAN" until the reprogramming is complete. Once completed, "CAN" disappears and the temperature reappears.
- Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. Verify the fault message to be certain the module is reprogrammed. If the module is not reprogrammed, the message "Axx Not Responding" appears where Axx is the module number (Ex: A41, A42...etc).

4.11.2 Replacing CECM Module

- Set the ignition key to the ON position and leave it in that position at all time while performing this procedure.
- Open engine compartment R.H. side door, trip circuit breaker CB2.
- Replace the module.
- Reset circuit breaker CB2. This engages the program transfer from the Master ID to the CECM module (the back-up program is inside the Master ID. The Master ID will identify the CECM as being new and will send the correct program to it). The telltale panel LCD display indicates "CAN" during 3 minutes approximately. "CAN" disappears and "----" is displayed alternately with "CAN" (during that sequence, "----" will be displayed up to 6 times and the audible alarm will ring). Wait until "CAN" is replaced by "----" that remains for more than 10 seconds. At


this point the MasterID module has finished loading the program in the CECM.

- Go to the engine compartment R.H. side area and trip circuit breaker CB2 once again. Wait 1 second and reset it. This engages I/O's modules automatic reprogramming.
- The telltale panel LCD display indicates "CAN" until the reprogramming is completed. Once completed, "CAN" disappears and the temperature reappears. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. Check the error messages. All modules appear in error but are not active. If an active error appears for a module, this one was not reprogrammed. In this case, trip CB2 once again. Wait 1 second and reset CB2. Re-verify the error messages when "CAN" disappears from the telltale panel LCD display.
- Do an error reset to remove all errors (requires Password) from non-active modules, leave the SYSTEM DIAGNOSTIC menu and reopen to verify there are no more errors.

5. BOSCH ALTERNATOR

Two 24 volt 140 amp., self regulated, belt driven, air-cooled BOSCH alternators may be used in the 24 volt electrical system.

An auxiliary BOSCH 12-volt 200 ampere may also be installed.

	<h2>MAINTENANCE</h2>
<p>Change the brushes and voltage regulator as per "Repair and Testing Instructions for T1 Alternator 0120 69 552" every 100,000 miles (160 000 fm) or once every two years, whichever comes first.</p> <p>Replace bearings as per "Repair and Testing Instructions for T1 Alternator 0120 69 552" every 200,000 miles (320 000 fm) or once every four years, whichever comes first.</p> <p>Refer to Bosh T1 Alternator Maintenance Manual Annexed at the end of this section.</p> <p>Refer to Bosh T1 Alternator Maintenance Manual Annexed at the end of this section.</p>	

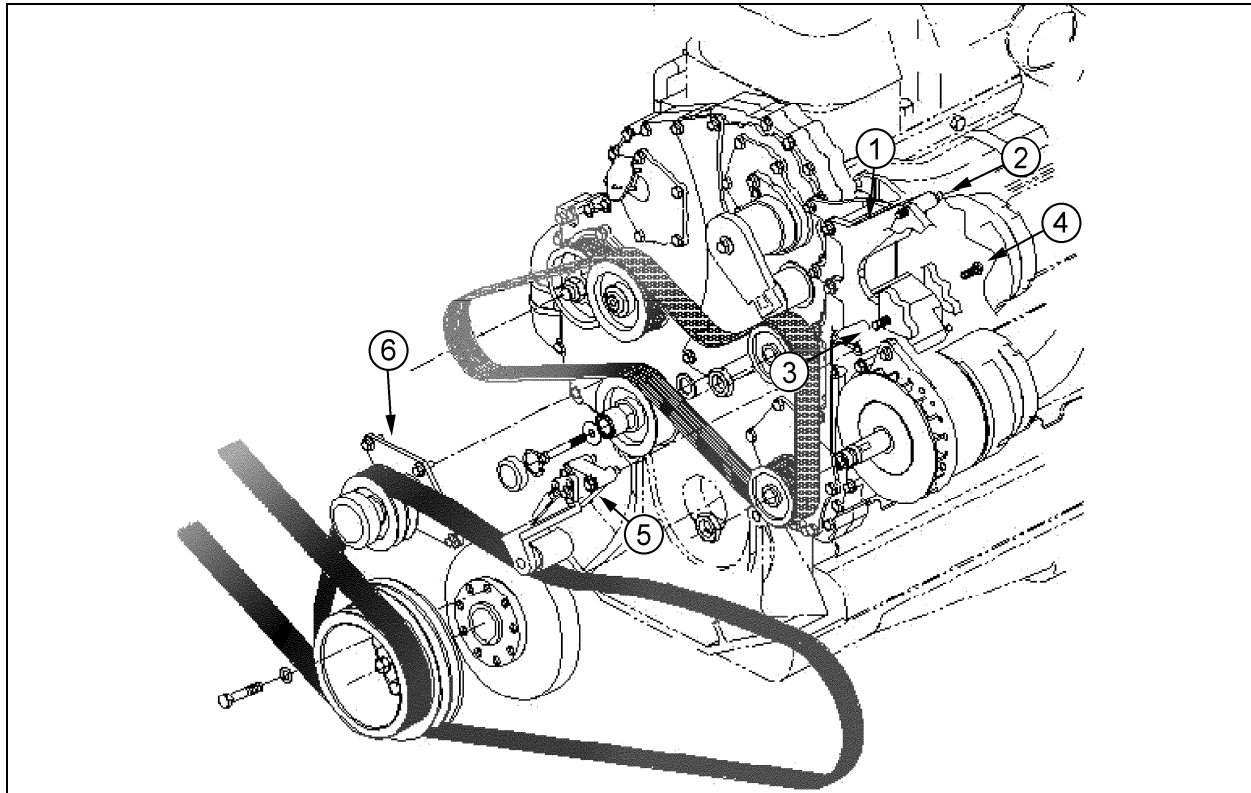


FIGURE 19: TWIN BOSCH ALTERNATORS INSTALLATION

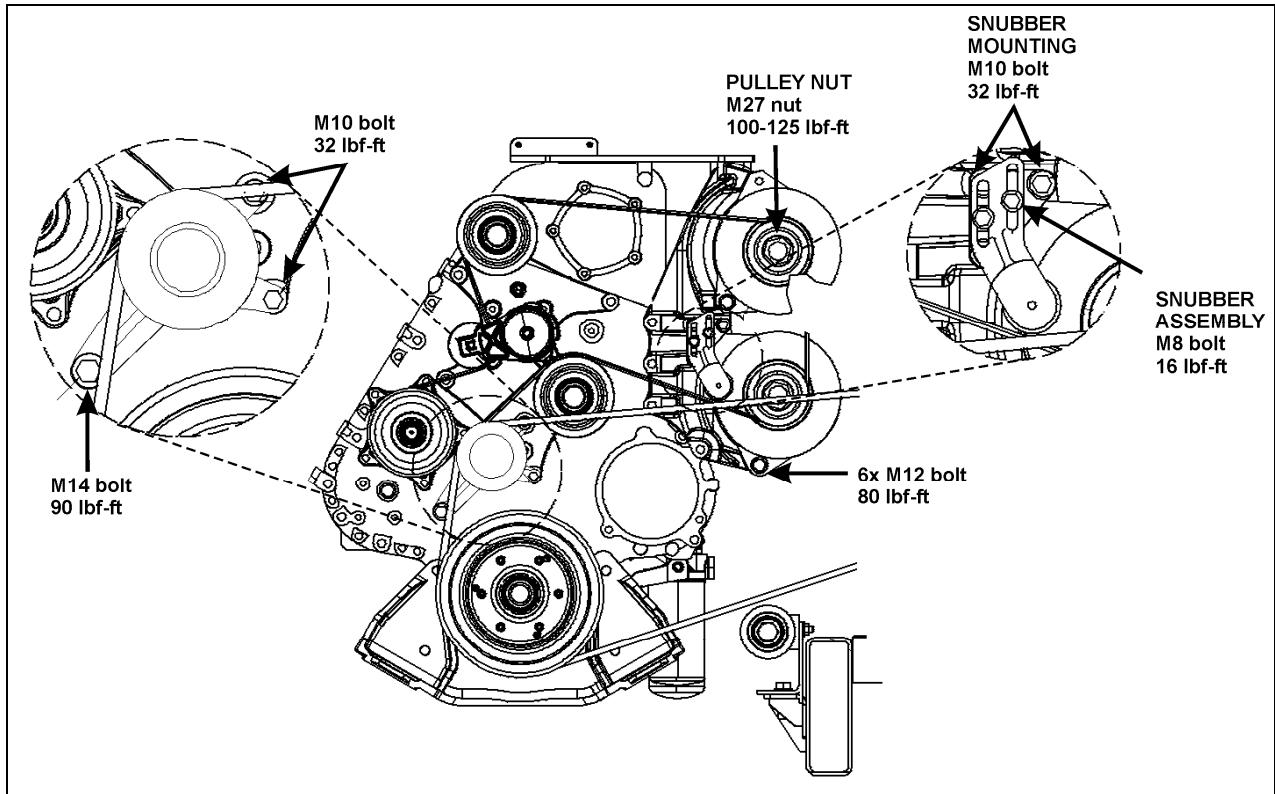


FIGURE 20: ALTERNATORS AND ACCESSORIES MOUNTING TORQUES

NOTE

Use Polyrex EM grease (684922) when repacking the bearings. Grease comes in 14.1 oz (400gr) cartridges.

5.1 TWIN BOSCH ALTERNATORS INSTALLATION

If the alternators needed to be removed, reinstall as follows. Refer to figure 19 for installation and to figure 20 for tightening specifications:

1. Install alternator mounting bracket (1, figure 19) to the gear case. Use the four flanged phosphor alloy bolts on the pulley end of the bracket and the flanged nuts at the transmission end of the bracket;
2. Bolt the alternators to the bracket using the three inch bolt at the top of the upper alternator (2, fig 19) and flanged bolts at the other mounting bosses (3 and 4, figure 19). Tighten the bolts in the sliding sleeves (4, figure 19) last as they will adjust to prevent breaking the alternator mounting bosses upon final tightening. Repeat for the second alternator;
3. On the drive shafts of both alternators, install key, pulley, spring washer and nut. Tighten to 220 Lbf-ft (300 Nm);

NOTE

Final tightening of the pulleys can be performed once the belt is installed. This will help keep the pulley from turning when tightening.

4. Install the snubber bracket (5, fig. 19) using three flanged bolts. Do not tighten the adjustment bolts on the snubber until after final tightening;
5. Install the compressor belt idler pulley (6, fig. 19) as shown. A stud inserts into one of the mounting holes of the pulley assembly. Fasten this one using a nut and bolts for the other two.

5.2 ALTERNATORS ARRANGEMENT

An auxiliary BOSCH 24-volt 140 amperes, an auxiliary BOSCH 14-volt 200 ampere or an auxiliary DELCO-REMY 24-volt 75 amperes may also be installed (Refer to figures 21 to 24).

Possible Alternators Arrangement

W5 with central HVAC system
2x Bosch 24V-140A
2x Bosch 24V-140A + 1 aux. Bosch 24V-140A
2x Bosch 24V-140A + 1 aux. Bosch 14V-200A
W5 with small HVAC system
2x Bosch 24V-140A
2x Bosch 24V-140A + 1 aux. Bosch 24V-140A
2x Bosch 24V-140A + 1 aux. Delco 24V-75A
1x Delco 24V-75A

WE with central HVAC system
2x Bosch 24V-140A
2x Bosch 24V-140A + 1 aux. Bosch 14V-200A
WE with small HVAC system
2x Bosch 24V-140A
1x Delco 24V-75A

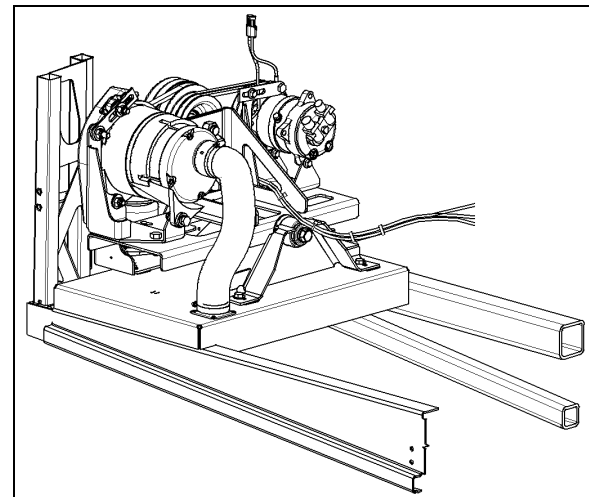


FIGURE 21: BOSCH 24V-140A WITH SMALL HVAC SYSTEM

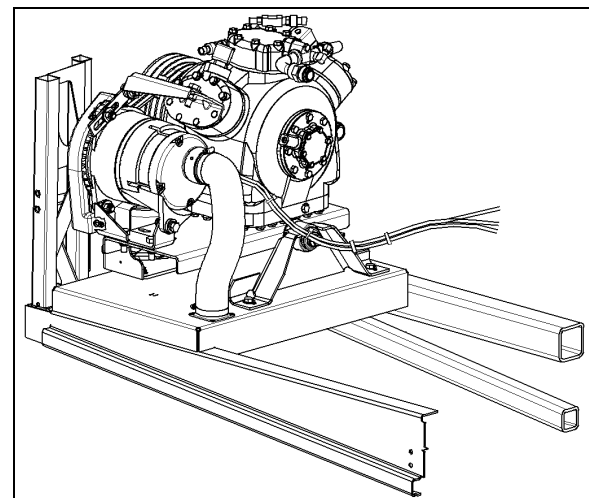


FIGURE 22: BOSCH 24V-140A WITH CENTRAL HVAC SYSTEM

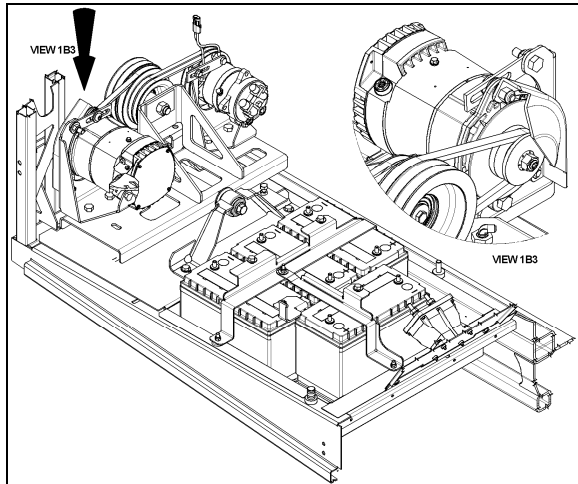


FIGURE 23: DELCO 24V-75A WITH SMALL HVAC SYSTEM

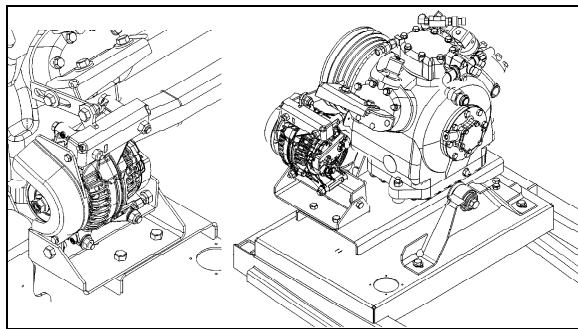


FIGURE 24: BOSCH 14V-200A WITH CENTRAL HVAC SYSTEM

5.3 ALTERNATOR DRIVE BELT

Removal

1. Insert a 3/4" socket drive into the automatic belt tensioner opening (Fig. 25).
2. Twist the tensioning arm to slacken belt.
3. Remove belt.

NOTE

Belts specifications may vary. For proper belt selection, always consult your vehicle Coach Final Record.

Installation

Installation of the alternator drive belt is the reverse of removal.

5.3.1 Adjustment

Correct belt tension is required to maximize belt life. The tensioning arm maintains proper belt tension, no adjustment is required.



MAINTENANCE

Check for wear and proper tension every 6,250 miles (10 000 km) or twice a year, whichever comes first.

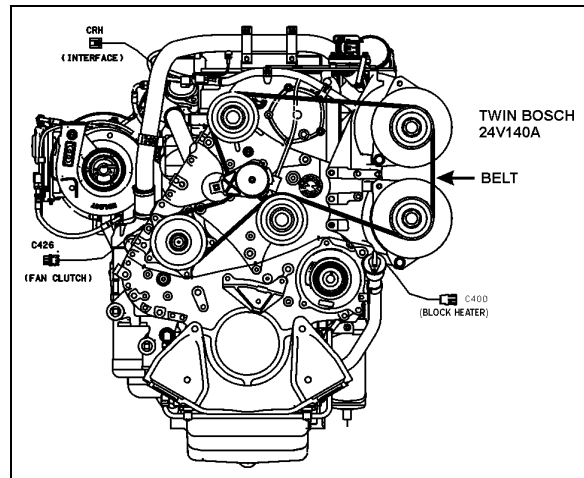


FIGURE 25: ALTERNATOR DRIVE BELT

01180

6. BATTERY EQUALIZER

VoltMaster Battery Equalizer Owner's Manual (100 amps) is annexed at the end of this section.

Refer to "Electrical Compartments and Junction Box" in this section, for location.

7. STARTER

Refer to Mitsubishi Electric Corporation (MELCO) Service bulletin ME003-P annexed at the end of this section for information and maintenance instruction on MELCO 105P70 starter.



CAUTION

Prior to the installation of the Mitsubishi starter, the Flywheel Ring Gear must be examined for excess wear or damage. Service Bulletin A1-M1N-1729EN included at the end of Section 06 shows acceptable levels of wear, and illustrates the proper measuring procedure. Maximum wear is 0.5mm. Ring Gears with more than 0.5mm of wear or damage must be replaced before installing the new starter to prevent engagement and/or disengagement problems. Failure to do so will render the Warranty null and void.

**CAUTION**

Do not engage starter for more than 15 seconds at a time. If engine does not start within 15 seconds, release ignition key and let starter cool for one minute before attempting to restart.

8. ENGINE BLOCK HEATER

The vehicle may be equipped with an engine immersion-type electric block heater to assist cold weather starting. The heater male electric plug is easily accessible through the engine compartment R.H. side door (Fig. 26). To use it, connect the female plug of an electrical extension cord to the heater plug. The extension cord must be plugged into a 110-120 V AC power source only. The engine block heater should be used whenever the vehicle is parked for an extended period of time in cold weather and a suitable power source is available.

8.1 MAINTENANCE

This heater is non-serviceable except for the cord, and if faulty, must be replaced as a unit.

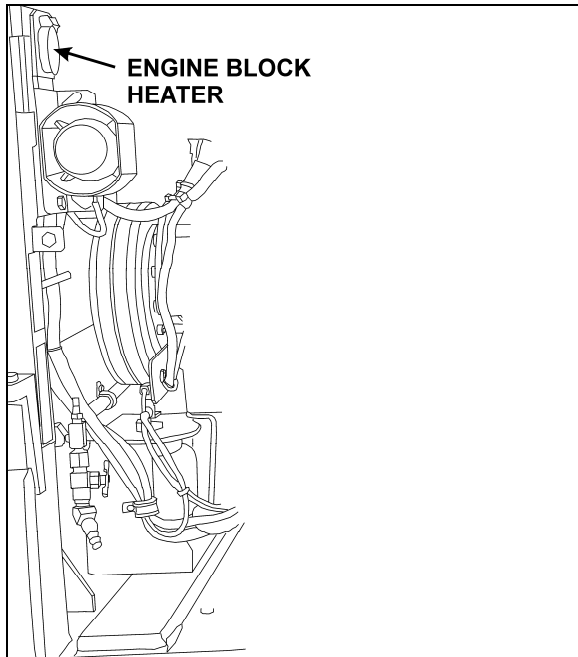


FIGURE 26: ELECTRIC HEATER PLUG LOCATION 18647

9. EXTERIOR LIGHTING

The circuit for exterior lights, as well as their control switches, relays and circuit breakers are shown on the applicable wiring diagrams. Wiring

diagrams are located in the technical publication box.

9.1 HEADLIGHTS

Each headlight assembly consists of two headlamp module 90 mm (3½ inch) equipped with a 12-volt halogen bulb and one 100 mm (4 inch) 12-volt LED turn/signal lamp. Outer lamps have a double function (both low and high beam). Inner lamps are used for high beam or daytime running light. The inner or outer lamp uses the same single filament halogen bulb part number.

NOTE

If vehicle is equipped with optional Xenon headlamps, refer to paragraph 12.1.6.

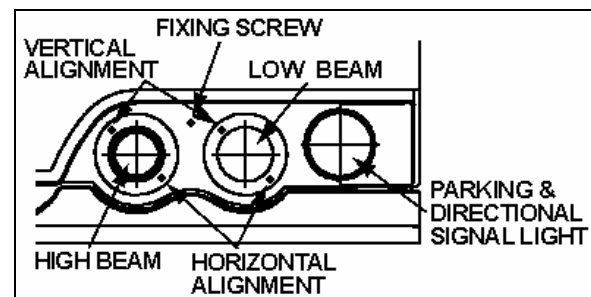


FIGURE 27: HEADLIGHT ASSEMBLY

06546

9.1.1 Headlight Beam Toggle Switch

The multifunction lever located on the steering column is used to select proper lighting. High beams or low beams can be selected by pulling the lever rearward. A high beam indicator on the central dashboard panel is illuminated when the high beam circuit is energized.

NOTE

Pulling the lever rearward while the lights are off will flash the headlights.

9.1.2 Maintenance

Clean headlights with soap and water and a good glass cleaner whenever dirty. For maximum illumination, headlight connections must be coated with a dielectric grease to prevent oxidation and proper voltage must be maintained. Low battery voltage, loose or dirty contacts in wiring system and poor ground contribute to a decrease in voltage. Check wiring and connections regularly and keep battery properly charged. When a headlight burns out, a new bulb must be installed. Headlights must be properly aimed to provide

Section 6: ELECTRICAL

maximum allowable road illumination. When using mechanical aiming devices, follow manufacturer's instructions.

Headlight aim should be checked after installing a new bulb. Aiming can be performed without opening headlight assembly. Horizontal and vertical aiming of each module is provided by two adjusting screws that pivot the module in the housing for proper alignment (fig. 27). There is no adjustment for focus since the module is set for proper focus during manufacturing assembly.

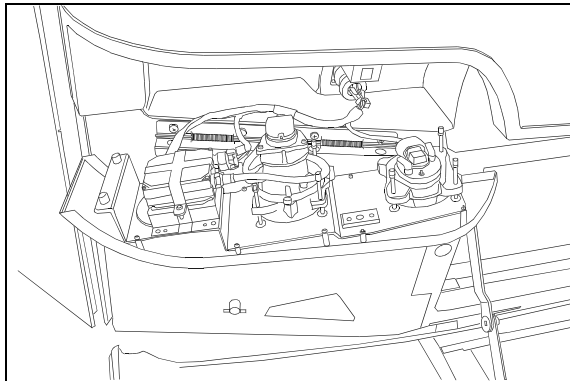


FIGURE 28: OPENING HEADLIGHT ASSEMBLY 06547

NOTE

Make sure headlight assembly is properly positioned into its housing before securing using fixing screw.



CAUTION

Use a soft cloth to clean the parking and front turn signal lamp.

9.1.3 Headlight Adjustment

1. Headlight aiming and inspection can be accomplished by visual means. This is done on a screen located at a distance of 25 feet (7,6 m) of the headlights. It should be of adequate size with a matte-white surface well shaded from extraneous light and properly adjusted to the floor area on which the vehicle stands. Provisions should be made for moving the screen or its vertical centerline so that it can be aligned with the vehicle axis. In addition to the vertical centerline, the screen should be provided with four laterally adjustable vertical tapes and two vertically adjustable horizontal tapes.

2. The four movable vertical tapes should be located on the screen at the left and right limits called for in the specification with reference to centerlines ahead of each headlight assembly.
3. The headlight centerlines shall be spaced either side of the fixed centerline on the screen by $\frac{1}{2}$ the lateral distance between the light source centers of the pertinent headlights. The horizontal tapes should be located on the screen at the upper and lower limits called for in the specification with reference to the height of beam centers and the plane on which the vehicle rests, not the floor on which the screen rests (Fig. 29).
4. The nominal vertical aim position on lower beam headlights shall be adjusted based on the headlight mounting height, from the ground to the light source center of the headlight, according to table 1.

TABLE 1 – VERTICAL BEAM AIM GUIDELINES

Headlight (centerline) Mounting Height	Nominal Vertical Aim	Aim Inspection Limits for Vertical Aim
56 to 90 cm (22 to 36 inch)	0 Vertical	10 cm (4 inch) up to 10 cm (4 inch) down
90 to 120 cm (36 to 48 inch)	5 cm (2 inch) down	5 cm (2 inch) up to 15 cm (6 inch) down
120 to 140 cm (48 to 54 inch)	6.4 cm (4 inch) down	4 cm (1.5 inch) up to 16.5 cm (6.5 inch) down

5. High beam headlights are aimed so that the center of the high-intensity zone is located at the horizontal and straight ahead vertically (Fig. 30).
6. Low beam headlights are aimed so that the top edge (the cutoff) of the high-intensity zone is at the vertical location as per Table 1 and the left edge of the high-intensity zone is at the vertical centerline of the headlight (Fig. 31).

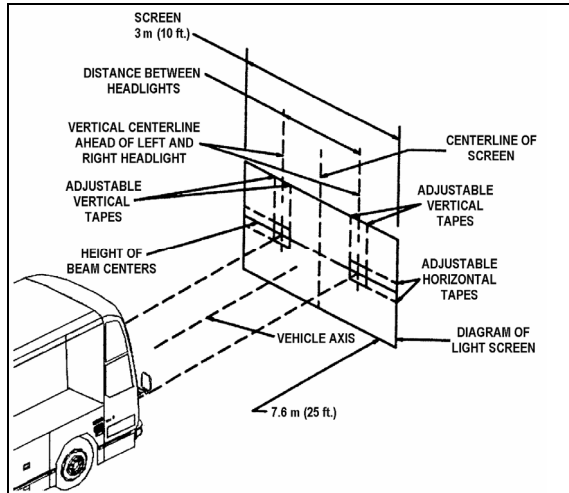


FIGURE 29: ALIGNMENT OF HEADLIGHT AIMING SCREEN 06502

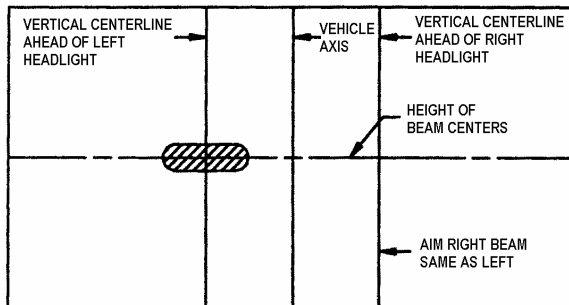


FIGURE 30: HIGH-INTENSITY ZONE (SHADED AREA) OF A PROPERLY AIMED UPPER BEAM ON THE AIMING SCREEN 7.6 M (25FT) IN FRONT OF VEHICLE 06503

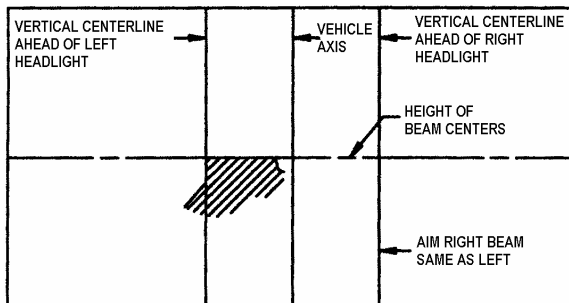


FIGURE 31: HIGH-INTENSITY ZONE (SHADED AREA) OF A PROPERLY AIMED LOWER BEAM ON THE AIMING SCREEN 7.6 M (25FT) IN FRONT OF VEHICLE 06504

7. The inspection limits for high-beam headlights shall be with the center of the high-intensity zone from 10 cm (4 in) up to 10 cm (4 in) down; and, from 10 cm (4 in) left to 10 cm (4 in) right on a screen at 7.6 m (25 ft) (Fig.32).

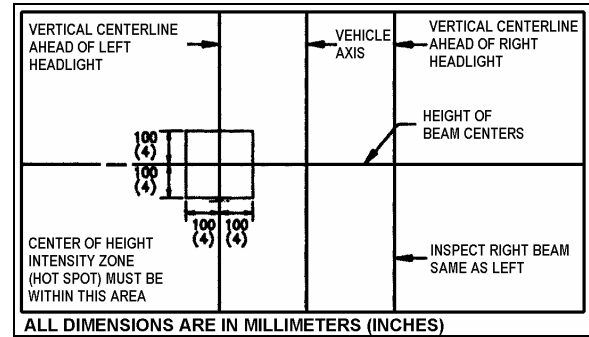


FIGURE 32: AIM INSPECTION LIMITS FOR UPPER-BEAM HEADLIGHTS 06505

8. The inspection limits in the vertical direction for low-beam headlights or the low beam of a dual-beam headlight, shall be as described in Table 1. In the horizontal direction, the left edge of the high-intensity zone shall be located from 10 cm (4 in) left to 10 cm (4 in) right of the vertical centerline of the beam. The viewing screen shall be located 7.6 m (25 ft) in front of the vehicle (Fig. 33).

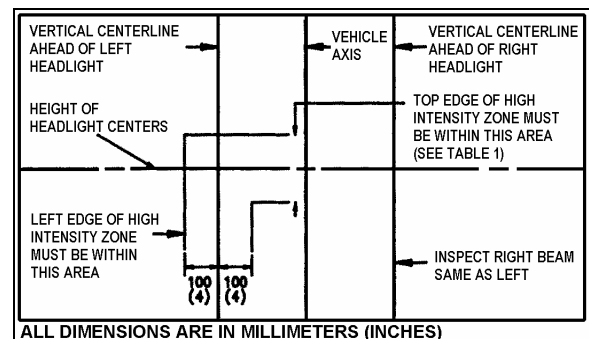


FIGURE 33: AIM INSPECTION LIMITS FOR LOWER-BEAM HEADLIGHTS 06506

9.1.4 Sealed-Beam Unit

Bulb Removal and Replacement

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.
2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Fig. 27 and 28).
3. Remove connector from headlight bulb.
4. Remove the bulb by pushing and rotating it out of the socket.
5. Install the new bulb by reversing the previous procedure.

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CAUTION

During this step, avoid contacting the bulb with the fingers not to alter the bulb life.

NOTE

Do not disrupt headlight adjustment screws.

Module Replacement

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.
2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Fig. 27 and 28).
3. Remove connector from headlight bulb.
4. Unfasten three metal clips attaching headlight unit to support.
5. Install new module and fasten metal clips.
6. Install wiring connector on back of new sealed beam unit.
7. Tilt headlight assembly up into its housing then secure using fixing screw.

NOTE

Make sure headlight assembly is properly positioned into its housing before securing using fixing screw.

8. Perform alignment procedure.

NOTE

The headlight aim must be checked and adjusted even if it was properly adjusted before the sealed beam unit was replaced.

9.1.5 Front Turn Signal

The front turn signal is part of the front headlight assembly. The turn signal is a sealed unit (LED) located on each front corner and should be replaced as an assembly. Turn signal is visible from both front and side.

Removal and Replacement

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.

2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Fig. 27 and 28).
3. Partially unfasten back plate fixing screws, then remove signal lamp.
4. Remove socket from signal lamp.
5. Install wiring connector on back of new signal lamp then install signal lamp.
6. Fasten back plate fixing screws then tilt headlight assembly up into its housing then secure using fixing screw.

NOTE

Make sure headlight assembly is properly positioned into its housing before securing using fixing screw.

9.1.6 Optional Xenon Headlamp

The outer lamps of each headlight assembly may be equipped with the optional Xenon lamps. These lamps improve visibility and provide better lifespan.

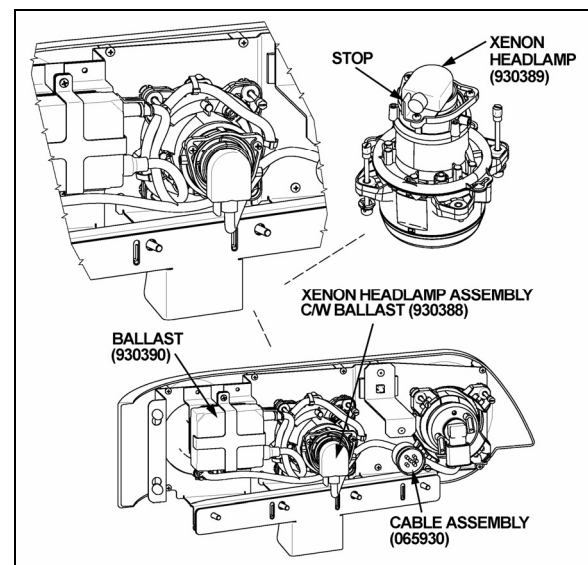


FIGURE 34: XENON HEADLAMP LOCATION

06549

Bulb Removal and Replacement

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.
2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Fig. 27 and 28).
3. Remove main cable connector (066011).

4. Remove connector from headlamp bulb by turning counterclockwise.
5. Unscrew the three Phillips head screws, pull the retainer and bulb out.

**CAUTION**

To avoid breaking the bulb, make sure the socket is in proper position against the stop.

6. Install the new bulb by reversing the previous procedure.

**CAUTION**

During this step, avoid contacting the bulb with the fingers not to alter the bulb life.

NOTE

Do not disrupt headlight adjustment screws.

**CAUTION**

Never connect a voltmeter or V.O.M. to measure bulb voltage as instrument will be destroyed.

Troubleshooting and Safety

When switching on the Xenon headlamp using the rocker switch, a lamp short-circuit test is performed.

Current is detected in the lamp circuit before the ignition time and ignition prevented. Connection of the "hot" lamp to the body mass also prevents ignition. In both cases, the system is cut off within < 0.2 s and can only be restarted via the rocker switch.

In general, the maximum ignition time is < 0.2 s, which period is followed by cutoff. This would happen if a lamp was defected.

Lamp missing: system is cut off after < 0.2 s.

If lamp components or cables are damaged by force (accident) so that contact with hazardous parts is possible, the current in these lines is earthed by the vehicle body and - as with a defective household appliance - switched off when 30 mA are reached within < 0.2 s. the cutoff time is shortened by a more powerful defect current.

To protect the ballast, a counter in the electronic safety system ensures that a defective lamp can only be switched off 7 times consecutively after a successful ignition, after which the device is cut off. This prevents flutter and flashing. This counter is put out of action when the lamp cutoff time repetition interval is longer than 1.3 s so that temporary non-defect disturbances that result in immediate invisible re-ignition do not cause lamp cutoff.

A warning notice on the lamp plug makes you aware of the fact that the lamp is operated in this system on a higher voltage (you should therefore switch off the lamp before working on this part).

After taking out the lamp, the contact pins are in a practically idle state (< 34 Volt) after < 0.5 seconds so that there is no immediate danger of electric shock even if the warning is disregarded.

With this safety concept there is no danger to check the ballast with a new bulb. There is a very high probability that the ballast is OK if the ballast can ignite the bulb.

One simple test to check the ballast would be to measure the Nominal current of 1.58 A after one minute for the 24V ballast.

9.2 STOP, TAIL, DIRECTIONAL, BACK-UP, AND HAZARD WARNING LIGHTS

A combination stoplight, taillight, directional signal light and back-up light assembly is mounted at the rear, on each side of the vehicle. Furthermore, when braking, two center stoplights (LED) and a cyclops light (LED) will illuminate simultaneously with the stoplights on the sides for increased safety. The L.H. and R.H. side center stop lights are also used as directional signal and marker lights.

The stop, tail, directional signal and back-up lights consist of individual LED lights mounted on the engine rear door, and each light is serviced individually as a complete unit. The back-up light uses a regular tungsten bulb.

The hazard warning flashing system uses the front, side and rear directional lights simultaneously. This system is energized by a switch on the L.H. dashboard.

9.2.1 Lamp Removal and Replacement

1. Open engine compartment rear door.

Section 6: ELECTRICAL

- Remove the lamp support retaining screws (2), and then from the outside, remove the lamp and its support.
- From the outside, install the new lamp with its support then fasten the retaining screws.

9.2.2 Center Stoplights and Cyclops Light Removal and Replacement

These (LED) lights are sealed unit and should be replaced as an assembly in accordance with the following procedure:

- Unscrew both "Phillips" light screws then remove the light assembly.
- Install new light assembly and secure using screws.

9.3 LICENSE PLATE LIGHT

Two LED units are mounted above the rear license plate(s) of vehicle. In case of burn out, the LED unit must be changed according to the following procedure.

- Pry out the rubber seal with a small screwdriver. Pull on the LED unit and disconnect it.
- Reconnect new LED unit, place rubber seal, and press on it until it is seated in position.

9.4 CLEARANCE, IDENTIFICATION AND MARKER LIGHTS

The vehicle is equipped with marker, identification and clearance lights (LED). The clearance lights are mounted at each corner of the coach near the top and the identification lights are in the upper center of rear and front sections.

The rear clearance and identification lights are red and the front ones are amber.

The amber marker lights are mounted along the sides of vehicle.

9.4.1 Marker Light Removal and Replacement

The side marker light is a sealed unit (LED) and should be replaced as an assembly in accordance with the following procedure:

- Unscrew both "Phillips" light screws, and then remove the light assembly.
- Position the new light assembly and install the "Phillips" screws.

9.4.2 Clearance and Identification Light Removal and Replacement

The clearance and identification light are sealed units (LED) and can be replaced in accordance with the following procedure:

- Unscrew both "Phillips" light screws, and then remove the light assembly.
- Position the new light assembly, and then install the "Phillips" screws.

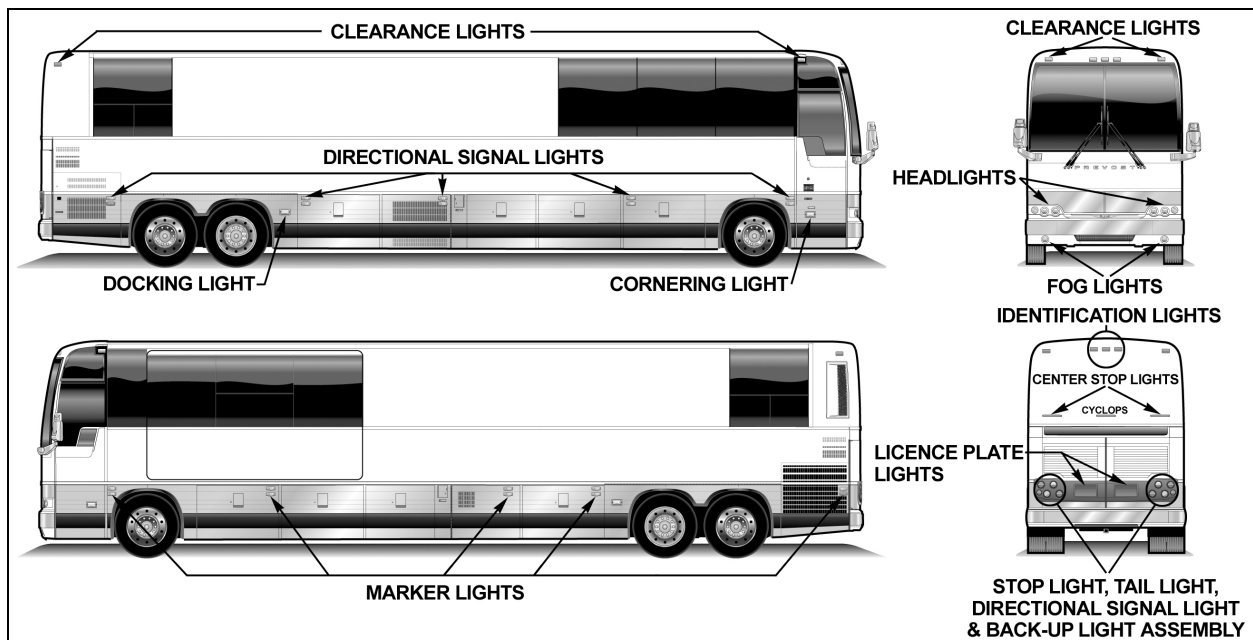


FIGURE 35: VARIOUS LIGHTS LOCATION

06544

9.5 DOCKING AND CORNERING LIGHTS

MTH vehicles are provided with two halogen sealed-beam units that serve as cornering lights. They are mounted on the vehicle as follows: one is mounted on the front L.H. side service compartment door, while the other is located on the entrance door on the R.H. side. The main function of these lights is to increase lateral visibility when turning a corner. These lights are energized simultaneously with the directional lights. A dashboard-mounted rocker switch may be actuated to cancel this system in special situations.

Two additional halogen sealed-beam units may be installed aft of the rear baggage compartment. These lights are used as docking lights and both will illuminate automatically when reverse range is selected to facilitate back-up or docking procedure. The cornering lights do not operate automatically when the reverse range is selected, but by means of a dashboard-mounted rocker switch. When the docking position is selected, the docking as well as the cornering lights illuminate.

9.5.1 Lamp Removal and Replacement

Both docking and cornering sealed-beam units can be changed in accordance with the following procedure:

1. Remove the two "Phillips" screws attaching the retaining ring.
2. Disconnect the light unit connection.
3. Remove the lamp.
4. Position new lamp.
5. Connect and position the light unit.
6. Finally, install the retaining ring.

9.6 FOG LIGHTS

Optional halogen fog lights can be mounted on this vehicle to give the driver better visibility in foggy weather, or to improve the range of vision just ahead of the coach.

9.6.1 Bulb Removal and Replacement

1. Pull on the release handle located in the front service compartment, near the door lower hinge. The bumper will lower gradually.
2. Unscrew the wing nut and pivot assembly upwards.
3. Unscrew the outer ring. Disconnect the light unit connection and remove the bulb.

4. Install the new bulb, reconnect the light unit and replace in its proper position.



CAUTION

During this step, avoid contacting the bulb with your fingers. This could alter the bulb life.

5. Reinstall the outer ring, pivot the assembly downwards.
6. Fasten the wing nut and securely close the bumper.

10. INTERIOR LIGHTING EQUIPMENT

10.1 CONTROL PANEL LIGHTING

The instrument gauges and switches mounted on all control panels are energized whenever the exterior light switch is pushed to the first position. A control dimmer located on the dashboard is used to vary the brightness of the panel gauges, switches and indicator lights.

The gauge lights, panel lights, switch lights and indicator lights have a different bulb arrangement. Thus, the procedure to change a defective bulb can vary according to the application.

10.1.1 Switch Lighting

1. Slightly pull the switch with a defective LED away from the control panel.
2. Disconnect the electric cable from the switch.
3. To install a new switch, reverse the procedure (Fig. 36).

NOTE

Switches are lighted by the use of LED. When lighting on a switch fails, replace defective switch as a unit.

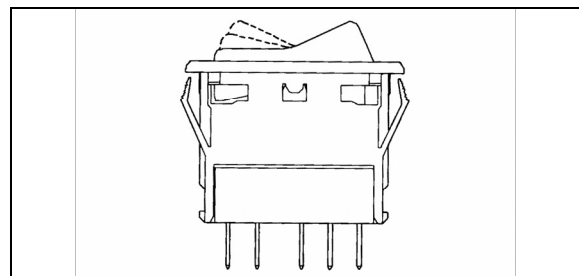


FIGURE 36: SWITCH

06321

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10.1.2 Telltale Light Replacement

Telltale module is non-serviceable and must be replaced as a unit.

1. Unscrew and remove the top dashboard panel.
2. Remove the telltale back wire electric connectors.
3. Unscrew and remove the telltale module.
4. To replace the telltale module, reverse the procedure.

10.1.3 Gauge Light Bulb Replacement

1. For any gauge light bulb replacement, the dashboard panel must be removed in order to have access to the rear of gauges.
2. Remove bulb socket from the gauge, turn the defective bulb counterclockwise and pull it out of the gauge.
3. Push a new bulb and socket ASM and turn clockwise to lock in place.
4. Replace the rear dashboard housing.

10.2 DRIVER'S AREA LIGHTS

Two halogen ceiling lights are installed over the stepwell and the driver's area. These lights are frequently used for night-time operation when passengers board or leave coach.

10.2.1 Bulb Removal and Replacement

1. Unsnap the lamp with a flat head screwdriver and remove it.
2. Pull the defective bulb out of the socket.
3. Install the new bulb by pushing it in position.
4. Replace the lamp by snapping it back in place.



CAUTION

Do not touch halogen bulbs with bare hands as natural oils on skin will shorten bulb life span.

10.2.2 Removal and Replacement of In-Station Fluorescent Tubes

1. Start by pulling out the corner of the lens then delicately peeling it out of its seat.
2. Rotate and pull the fluorescent tube from its sockets.



CAUTION

The lens is fragile. Be very careful when removing and handling.

3. Install a new fluorescent tube, rotating the tube to secure it in the sockets.
4. Replace the screen lens by first inserting one side in the seat, then push the other side in and snap it in place by running it in from one corner to the next.

10.2.3 Removal and Replacement of Reading Lamp Bulb

1. Engage the tool (#830164) over the lamp and turn one quarter turn counterclockwise. Then, remove the tool slowly.
2. Pull the bulb socket off the reading lamp unit.
3. Push and turn bulb counterclockwise, then pull it out of the socket.
4. Install new bulb in the socket, then push and turn clockwise to lock bulb in position.
5. Push the bulb socket in the reading lamp unit.
6. Position the reading lamp with the tool (#830164), turn one quarter turn clockwise.

10.3 ENGINE COMPARTMENT LIGHTING

A switch located in engine compartment on rear start panel, can be used to actuate the two oval engine compartment lights.

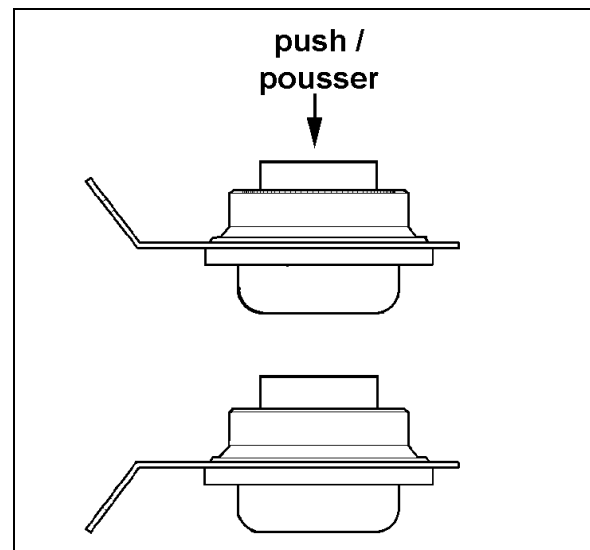


FIGURE 37: ENGINE COMPARTMENT LIGHT

Each light is sealed and can be replaced as follows:

1. Disconnect the light unit connection.
2. Remove the lamp.
3. Position new lamp.
4. Connect the light unit.
5. Make sure the retaining ring is installed properly.

11. LIGHT BULB DATA

When replacing a light bulb, special attention must be paid to the voltage rating (refer to light bulb data hereafter).

LIGHT BULB DATA					
APPLICATION	PREVOST PART NO.	TRADE OR SAE NUMBER	WATTS OR CANDLE POWER	VOLTS	QTY
EXTERIOR LIGHTING					
Hi/Lo-beam	930291	9004	65/45 W	12	2
Lo-Beam Xenon (optional)	930388	D2S	35 W	12	2
Docking & cornering	930319	9415	37.5W	12	4
Fog	930361	H3	55 W	12	2
License plate (sealed)	930266	TL 15206	---	12	2
Marker Light (red)	930340	Grote 47072-3	---	12	2
Marker Light (amber)	930341	Grote 47073	---	12	10
Identification (red)	930334	TL 25420R	---	12	3
Clearance (red)	930334	TL 25420R	---	12	4
Identification (amber)	930337	TL 25450Y	---	12	3
Clearance (amber)	930337	TL 25450Y	---	12	4
Front directional (hazard & marker)	562135	3057	32/3W	12	2
Rear directional	560589	1156	32 W	12	4
Stop	560589	1156	32 W	12	8
Back-up	560589	1156	32 W	12	4
Center stop	930330	HELLA 96208	---	12	2
Cyclops	930330	HELLA 96208	---	12	1
Tail	560123	67	4 W	12	4

Section 6: ELECTRICAL

LIGHT BULB DATA					
APPLICATION	PREVOST PART NO.	TRADE OR SAE NUMBER	WATTS OR CANDLE POWER	VOLTS	QTY
EXTERIOR LIGHTING					
Exterior compartment (except engine)	562278	6429	10 W	24	12
Engine compartment	930383	SEALED	25 W	12	2
INTERIOR LIGHTING					
Instrument cluster lights	562838	2721 MFX (OSRAM)	---	---	---
Telltale panel assy.	562907	---	---	---	1
Step Light	562278	HELLA 78207 (OSRAM 6429)	10 W	24	3

12. SPECIFICATIONS

Battery

Make..... Volvo
 Model..... 20359831
 Prévost Number 563030
 Type Maintenance-free
 Terminal type Top Stud
 Group size..... 31
 Volts 12
 Load test amperage 290
 Reserve capacity (minutes) 195
 Cold cranking (in amps)
 -At 0°F (-18°C).....950 (each battery)
 Maximum dimensions (inches/mm)
 -Length (including flange) 13.0/330,2
 -Width 6.7/169,3
 -Height (including top posts) 9.3/237,0
 -Approximate weight (lbs/kg) 59/26,7
 * *Battery tester cable clamps should be between terminal nuts and lead pads of terminals. If not possible, load value should be 210 amperes.*

Torque specifications

Battery cable to post 10-15 Ft-lbs (13-20 Nm)
 Battery cover 45-50 Ft-lbs (5-6 Nm)

Alternator

Make..... BOSCH
 Model Number..... 0120689552
 Series T1

Hot output

-Amperes..... 140 at 25°C (AMBIENT)
-Volts 28
-Approximate rpm..... 6000
Ground negative
Prevost Number 562752

Battery equalizer

Make..... Vanner
Model..... 60-100D
Amperes 100 amps
Prevost Number 563334

Starter

Make..... Mitsubishi Electric Corporation (MELCO)
Model Number..... M009T82479
Type 105P70
Voltage 24
Prevost Number 510752

No-load test

-Volts 23.5
-Max. current draw 125 amperes
-Min. rpm 3000 rpm

Starter solenoid

Make..... Mitsubishi Electric Corporation (MELCO)
Model Number..... 1115557
Pull In Voltage 16 volts max.