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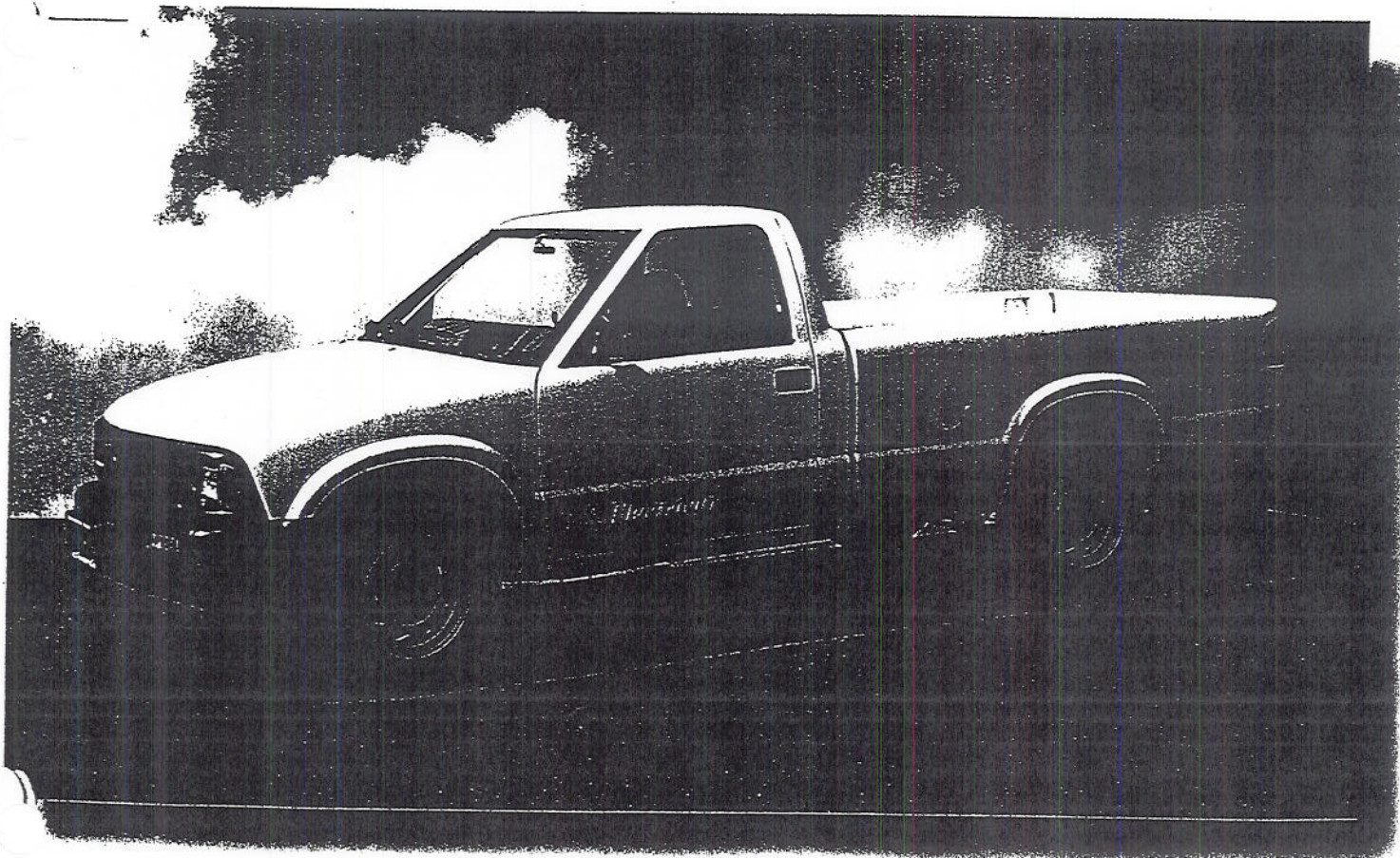
U.S. ELECTRICAR AIR CONDITIONING INSTALLATION.

1. MECHANICAL INSTALLATION (UNDER HOOD)
2. BATTERY BOX ELECTRICAL MODIFICATIONS
3. IN DASH MODIFICATIONS
4. WIRING LOOM CONNECTIONS(UNDER HOOD)

CAUTION

WHEN WORKING IN THE BATTERY BOX; HIGH VOLTAGE IS PRESENT EVEN WITH THE BATTERY SWITCH IN THE OFF POSITION . IT IS RECOMMENDED THAT ONLY QUALIFIED PERSONS ATTEMPT THIS INSTALLATION.

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MECHANICAL INSTALLATION

U.S. Electricar

Installation Instructions

ES-10 Sanden Air Conditioning Package for Vehicles WITHOUT Inductive Charge Ports



Caution

Do not attempt to install this system if you have not received prior training from U.S. Electricar. You will come in direct contact with 300+ volts. Improper installation procedures or equipment could result in serious personal injury and result in vehicle damage.

Overview

This system design is intended to allow for installation of air conditioning without requiring the replacement of the vehicles main wiring harness AND for vehicles that have no other options installed, including inductive charge ports. Modification of the vehicle's wiring system is required to provide power and control for the air conditioning system.

The Electricar ES-10 base vehicle was ordered from General Motors with GM factory air conditioning. The Electrical air conditioning package integrates into the GM system. The dash controls and ducting, the evaporator, condenser, and accumulator are retained. The engine driven compressor is replaced by an electrically driven compressor with a controller and automatic temperature control (ATC). The compressor and controller mount below the drive system Power Control Unit (PCU). The ATC is secured to the firewall inside the motor compartment. New suction and discharge lines connect the electric compressor to the original GM condenser and accumulator.

Power for the 3-phase high voltage electric compressor motor is supplied from the main battery pack. An additional relay is installed in the pack to turn the power on and off. High voltage from the vehicles main battery pack is wired to a 4-pin connector on the bottom of the heater assembly. This pin was originally wired for a different purpose. During the installation process, modification to the existing vehicle wiring will enable the air conditioning system to receive power from this connector.

The original OEM air conditioning rotary control in the dashboard is replaced with a new rotary potentiometer that will control the Electricar system. Driver operation of the system will be similar to the operation of the standard General Motors S-10 air conditioning system.

Mechanical Installation Procedure



Caution

Switch the main battery pack disconnect switch to **OFF**.
Turn the key switch on the steering column to the **OFF** position.
Disconnect the 12-volt negative cable to the auxiliary battery.
Disconnect the 12-volt positive cable at the auxiliary battery.

1. Remove the cargo bed from the chassis
 - A. Remove (6) bolts holding cargo bed to chassis
 - B. Remove charging inlet connector from the bed (located behind fuel door) by removing (3) mounting bolts holding face plate to cargo bed.
 - C. Utilizing 4 people, lift the cargo bed off the vehicle chassis
2. Remove the Dolphin PCU (See figure 6-1)
 - A. Disconnect the 12-volt auxiliary ground [1] and positive [3] cables at the PCU.

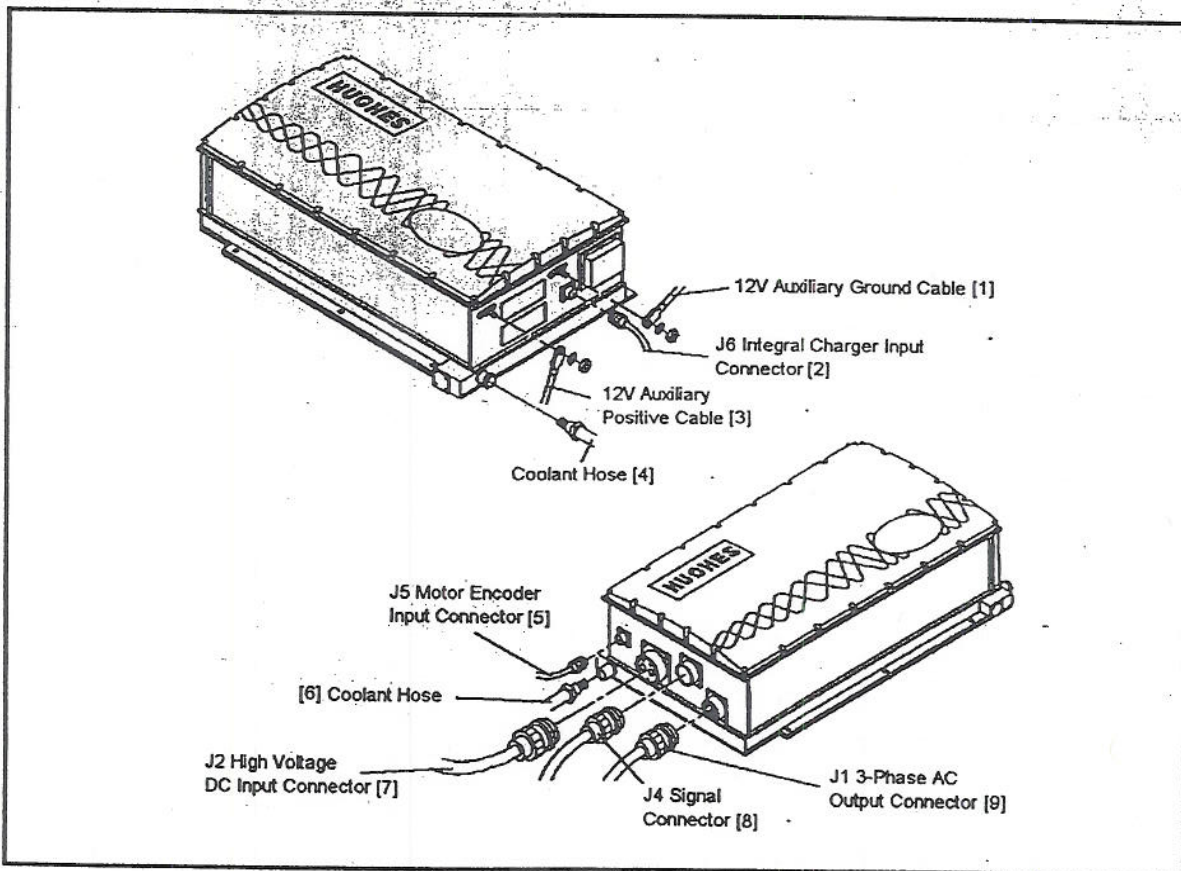


Figure 6-1 - PCU Connections

- B. Disconnect the following pin connectors:

- J6 [2]
- J2 [7]
- J1 [9]
- J5 [5]
- J4 [8]

- C. Disconnect coolant hoses [4] and [6].
- D. Install coolant caps to hoses.
- E. Install coolant caps to inlet/outlet of the PCU.
- F. Remove six bolts from the mounting bracket (3 in front, 3 at rear).
- G. Remove the PCU (due to the PCU weight, this is a 2-person operation).

3. Install the compressor and controller (See figure 6-2).

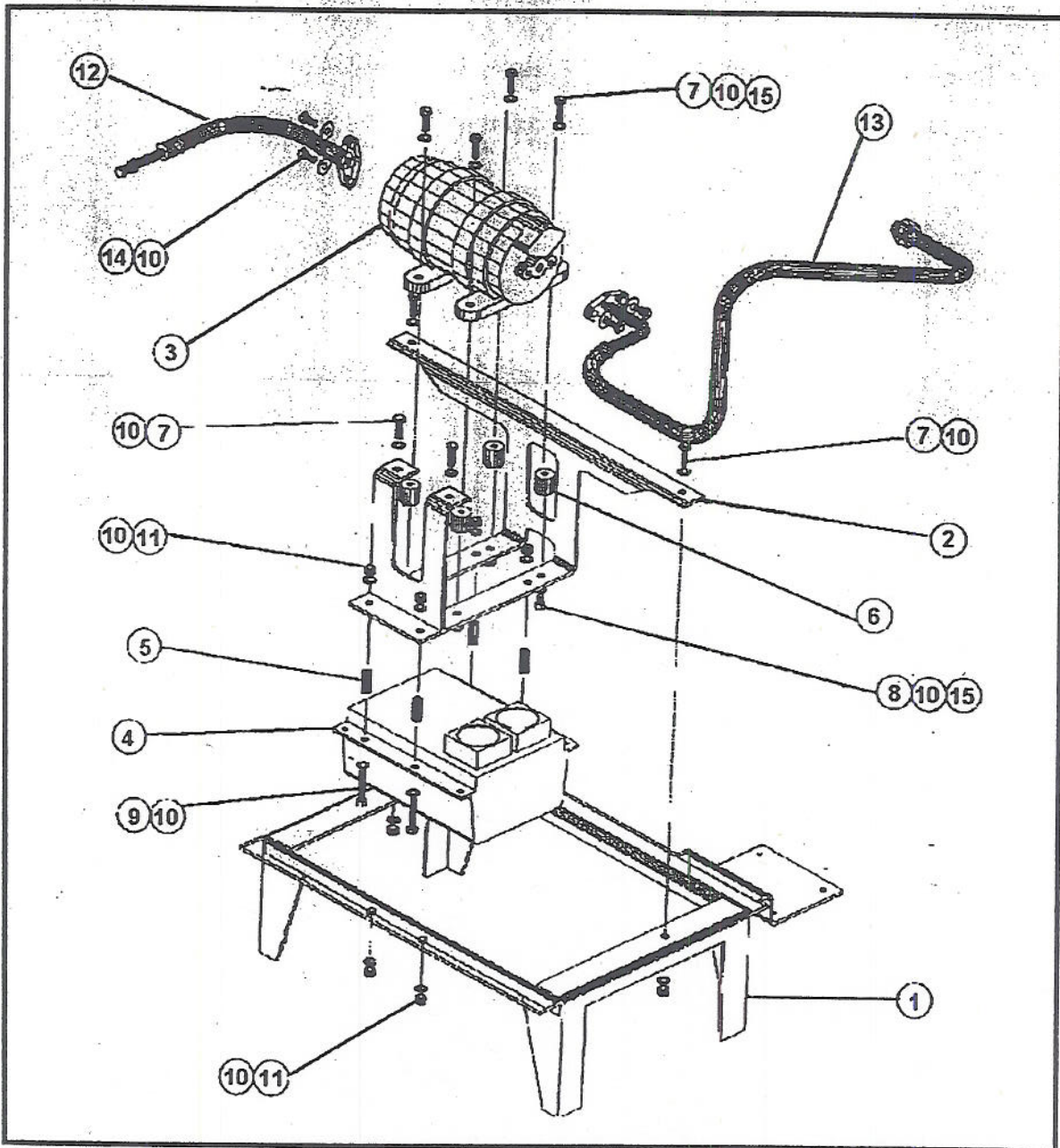


Figure 6-2 - Air Conditioning Mounting

- A. Bolt the rubber isolator mounts [6] to the compressor mounting bracket [2] using 5/16" -18 x 1/2" bolts, 5/16" flat washers and 5/16" lock washers. Tighten to 10 ft-lbs.

- B. Align the compressor mounting bracket [2] with the PCU mount [1] as shown in figure 6-2. Clamp in place and line drill the mounting holes with a 3/8" drill bit.
 - C. Bolt the compressor mounting bracket to the PCU mount using 5/16" - 18 x 1" bolts [7], 5/16" flat washers, and 5/16" ny-lock nuts. Tighten to 35 ft-lbs.
 - D. Mount the controller [4] to the compressor mounting bracket using the standoffs [5] and 5/16" - 18 x 2" bolts, 5/16" flat washers, and 5/16" ny-lock nuts. Tighten to 35 ft-lbs.
 - E. Check that the compressor is filled with 2-ounces of SE-10Y refrigerant oil.
 - F. Mount the compressor [3] to the rubber isolator mounts [6] using 5/16" - 18 x 1" bolts [7], 5/16" flat washers, and 5/16" lock washers. Tighten to 10 ft-lbs.
 - G. Attach the suction line [13] to the accumulator at the discharge port. Tighten to 30 ft-lbs.
 - H. Attach the suction line to the compressor at the suction port using the M8 x 1" bolts and 5/16" flat washers. Tighten to 30 ft-lbs.
 - I. Attach the discharge line [12] to the condenser at the suction port. Tighten to 18 ft-lbs.
 - J. Attach the discharge line to the compressor at the discharge port using the M8 x 1" bolts and 5/16" flat washers. Tighten to 30 ft-lbs.
4. Remove the accelerator potentiometer box (pot box) from it's mounting.
 5. Remount the pot box as shown in figure 6-3 using a longer 5/16" - 18 x 3" and a 5/16" - 18 x 4-1/2" bolt, new longer standoffs, and the original nuts. Tighten to 18 ft-lbs.

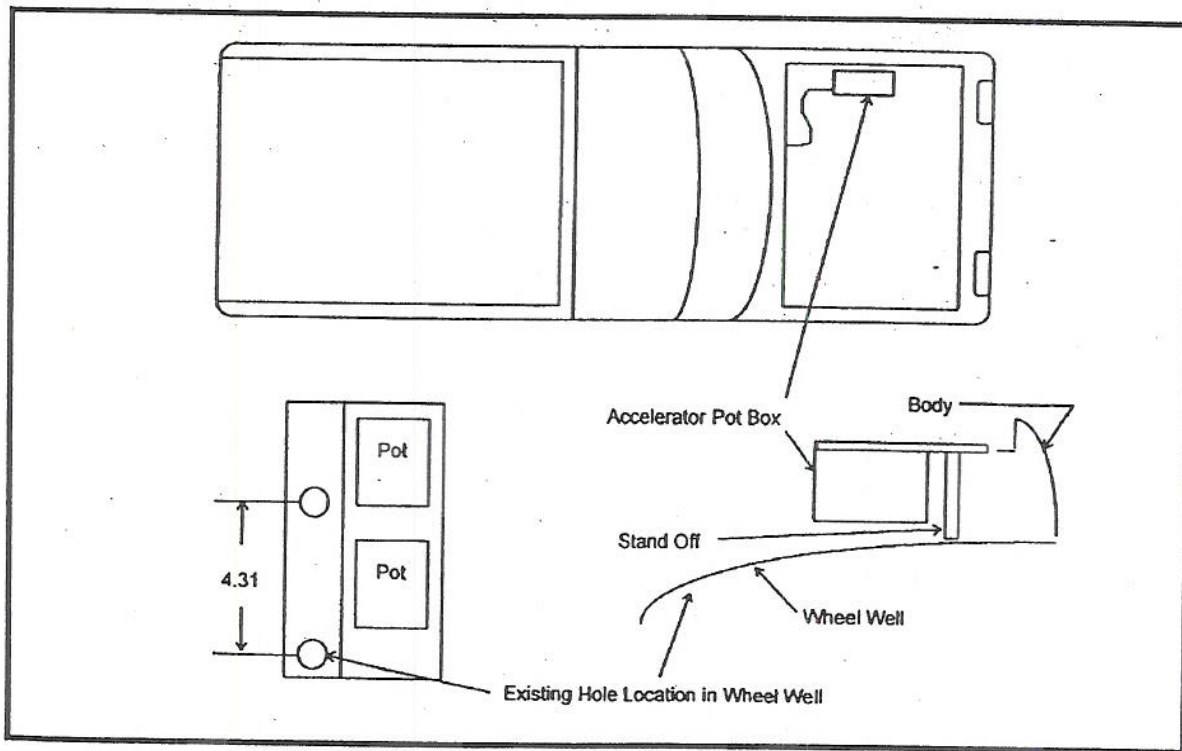


Figure 6-3 - Accelerator Potentiometer Box Mounting

6. Mount the Automatic Temperature Control (ATC) to the firewall in the location shown in figure 6-4. Drill two 1/8" holes in the fire wall and mount using #10-11 self tapping screws.

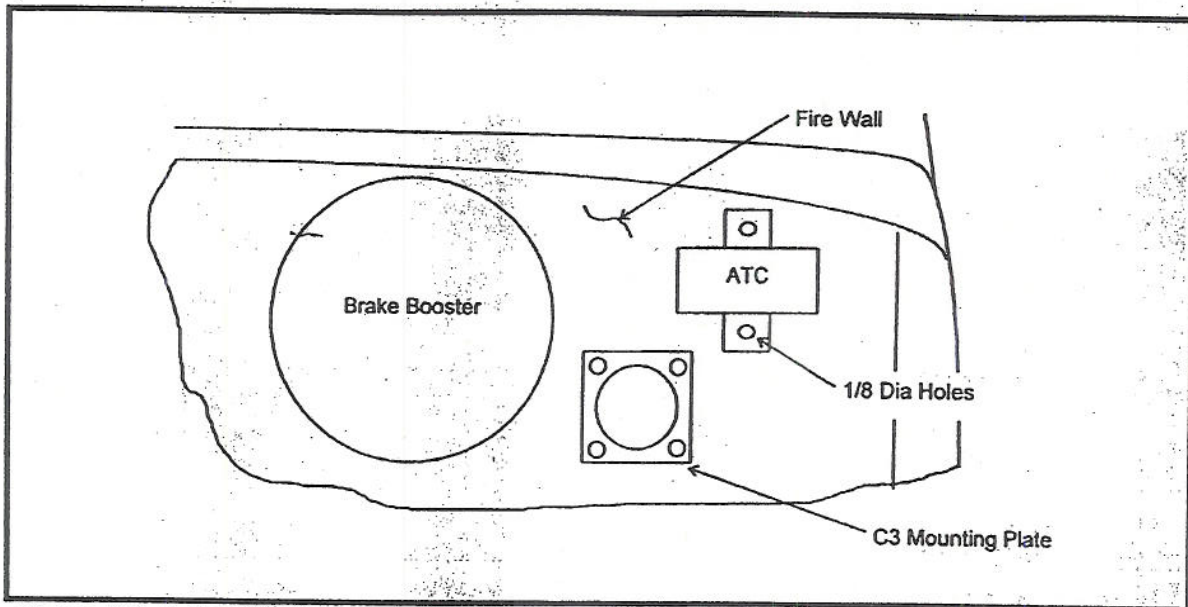


Figure 6-4- Automatic Temperature Control mounting

Electrical Installation Procedure

Main Battery Pack Modifications

1. Remove the lid from the battery box.
2. Cover the batteries with a clear plastic sheet or Plexiglas to protect against accidental contact with high voltage.

NOTE: Even when the battery pack master switch is turned OFF, leaning on the wrong portion of the battery pack or accidental touching of terminals with tools can create a high voltage danger situation.

(Refer to Electrical Diagram *****)

Instruction numbers correspond with numbers within boxes on the electrical diagram.

Some of the existing wiring may need to be extended.

1. Mount a midget fuse block for Littelfuse KLK20 in the battery pack center section (contactor tray). Drill mounting hole in aluminum battery box and tap with an 8-32 tap. Mount fuse holder with 8-32 x 1/2" screw. Mounting screws must not protrude into the drive shaft tunnel.
2. Disconnect the #10 BLU/RED [2] wire from the main fuse and connect to load side of the KLK20 fuse [1]. You may need to extend this wire.

3. Add new #10 BLU/RED from "B(-)load" post of the main fuse to the supply side of the KLK20 fuse [1].
4. Mount [K5] Aromat relay (20A, 300V) in contactor tray. Drill mounting hole in aluminum battery box and tap with an 8-32 tap. Mount fuse holder with 8-32 x 1/2" screw. Mounting screws must not protrude into drive shaft tunnel.
5. Add new #10 ORN/BLK wire from main contactor buss bar (load) to supply side of K5 relay.
6. Disconnect the #18 ORN/BLU wire from the main contactor buss bar and connect to coil "+" of K5 relay. You may need to extend this wire.
7. Add new #18 BLK wire from coil(-) of K5 to coil(-)of main contactors.
8. Disconnect the #10 ORN/BLK wire from the main contactor bussbar and connect to load side of K5. You may need to extend this wire.
- 8a. *Disconnect # BLU wire that runs from 4-pin Amphenol connector to main fuse at the main fuse. Cut and tape off with electrical tape and abandon.*
Under Hood Modifications and Wiring
9. Connect #14 RED/WHT wire from A/C controller to the 4-pin Amphenol connector located on the bottom of the heater. **High voltage wires in harness should be clearly designated using a wire loom of a color OTHER THAN black.**
10. Connect #14 BLK wire from A/C controller to 4-pin Amphenol connector located on the bottom of the heater. **High voltage wires in harness should be clearly designated using a wire loom of a color OTHER THAN black.**
11. Cut the connector off the bundle of 4-wires on the controller. Attach a 4-pin Deutche connector in it's place. Connect the controller ground (black wire) to chassis ground through the 4-pin Deutche connector.
12. Mount two 12V, 20 Amp (HELLA) relays [K6 & K7] near 12V hot buss on left fender. Use a 3A and 20A inline 12V fuse holder.
- 12a. Run a #16 BLU wire from relay K7 load side (pin 87) to the cooling fan motor high side (other wire on fan is grounded to chassis). Splice into wire using a Scotch Lock connector.
- 12b. Run a #16 ORN wire from relay K7 common (pin 30) to the 12V hot buss via the 12V, 20 inline fuse.
- 12c. Install a single terminal post near the K6 and K7 relays. Connect the relay K6 load side (pin 87) using a #18 RED/BLU wire to the relay K7 coil(+) (pin 86) via the single terminal post.
- 12d. Run a #18 BLK wire from relay K7 coil(-) (pin 85) to chassis ground.
- 12e. Run a #18 OR/BLU wire from AC contactor control (12V coil(+) signal) on 4-pin Amphenol connector to the single terminal post connecting to relay K6 load side (pin 87).
13. Connect #18 PUR wire on A/C controller to #18 WHT/RED (pin 7) on the ATC connector through the 4-pin Deutche connector.
- 13a. Connect #18 YEL wire on A/C controller to #18 YEL/RED (pin 8) on the ATC connector through the 4-pin Deutche connector.

14. Run a #18 BLU wire from one pole (pigtail on motor) of the thermal switch on the compressor motor to the single terminal post connecting to relay K6 load side (pin 87).
Note: You can connect to either pole on the motor.
15. Connect the #18 BLUE (sometimes this wire is RED on some controllers) wire on the controller (through the 4-pin Deutche connector) to the other pole of the temperature switch on the A/C compressor motor.
16. Connect #18 RED wire (pin 1) from ATC to the single terminal post connecting to relay K6 load side (pin 87).
17. Connect #18 BLK/RED wire (pin 9) from ATC to chassis ground.
18. Install thermistor into evaporator shroud. Locate probe on outlet side of heat exchanger. Connect thermistor leads to ATC (pins 10 & 12) with #18 WHT/BLK/RED wire. *RRURABLE O.K.*
19. Install a 4-pin Deutche connector on the 3 wires connecting the AC compressor motor and the controller (#14 RED/WHT/GRN) and connect the motor and controller. Shield the wiring between the A/C compressor motor and controller with plated copper braid. Ground shield to chassis by soldering a wire to the shield.
20. Run a #18 BLK wire from coil (-) of relay K6 (pin 85) to vehicle chassis ground.
21. Run a #18 LT GRN wire from coil (+) of relay K6 (pin 86) to the A/C-HTR switch inside the cab (A/C side, pin C).
22. Connect #18 BLU/YEL/RED (pin 11) and #18 BLU/RED (pin 4) on ATC to positions 4 and 5 of a 5-pin Deutche connector, *located under dash near A/C potentiometer switch.*
23. Run a #18 ORN wire from relay K6 common (pin 30) to 12V hot buss at left fender via inline 3A fuse.

Inside CAB Modifications and Wiring

24. Remove existing A/C HTR select switch from dash board. **NOTE: When removing the three (3) yellow wires connected to the Tines at the bottom of the switch, note their location.** They must be installed on the new switch in the same locations.

Install the wiring and Deutche connector to the new rotary potentiometer switch (POT SWITCH) on a table and install the completed assembly into the vehicle after completed.

Connections to the pins on the POT SWITCH should be soldered.

- [22] Connect pin D of the POT SWITCH to position 4 on the 5-pin Deutche connector with #18 BLU/YEL/RED wire. Connect pin E of the POT SWITCH to position 5 on the 5-pin Deutche connector with #18 BLU/RED wire.
25. Connect pin B on the POT SWITCH to position 2 on the 5-pin Deutche connector with #18 YEL/BLK wire.
26. Connect pin A on the POT SWITCH to position 1 on the 5-pin Deutche connector with #18 YEL/BLK wire.

27. Connect pin C on the POT SWITCH to position 3 on the 5-pin Deutche connector with #18 BLU wire.

Install the POT SWITCH in the dashboard. Orient switch the same as the original switch removed.

Replace the three (3) yellow wires attached to the Tines at the bottom of the switch in the same location as removed from the original switch.

The wires running from the other side of the 5-pin Deutche connector to the motor compartment **will pass through the firewall.** A hole with a rubber grommet exists in the firewall that can be used for this purpose.

- [25] The existing wires to the Heater Control and Lockout are both YEL/BLK. It is important that the correct wire is connected to the proper position on the POT SWITCH or the air conditioning will not work. Measure the resistance of both YEL/BLK wires. The Aux System Enable (Lockout) wire will measure the highest resistance (approximately 500 ohms). This wire should be connected to position 2 on the 5-pin Deutche connector so as to connect to pin B on the POT SWITCH.

- [26] The YEL/BLK wire from the Heater Control will measure the least resistance (approximately 50 ohms). This wire should be connected to position 1 on the 5-pin Deutche connector so as to connect to pin A on the POT SWITCH.

- [27] Run a #18 BLU wire from position 3 on the Deutche connector (so as to connect to pin C on the POT SWITCH) to relay K6 coil(+) (pin 86).

Reinstall Drive System PCU (See figures 6-1 and 6-5)

1. Place the controller on the mounting bracket and install 6 mounting bolts. Torque to 32 N-m.

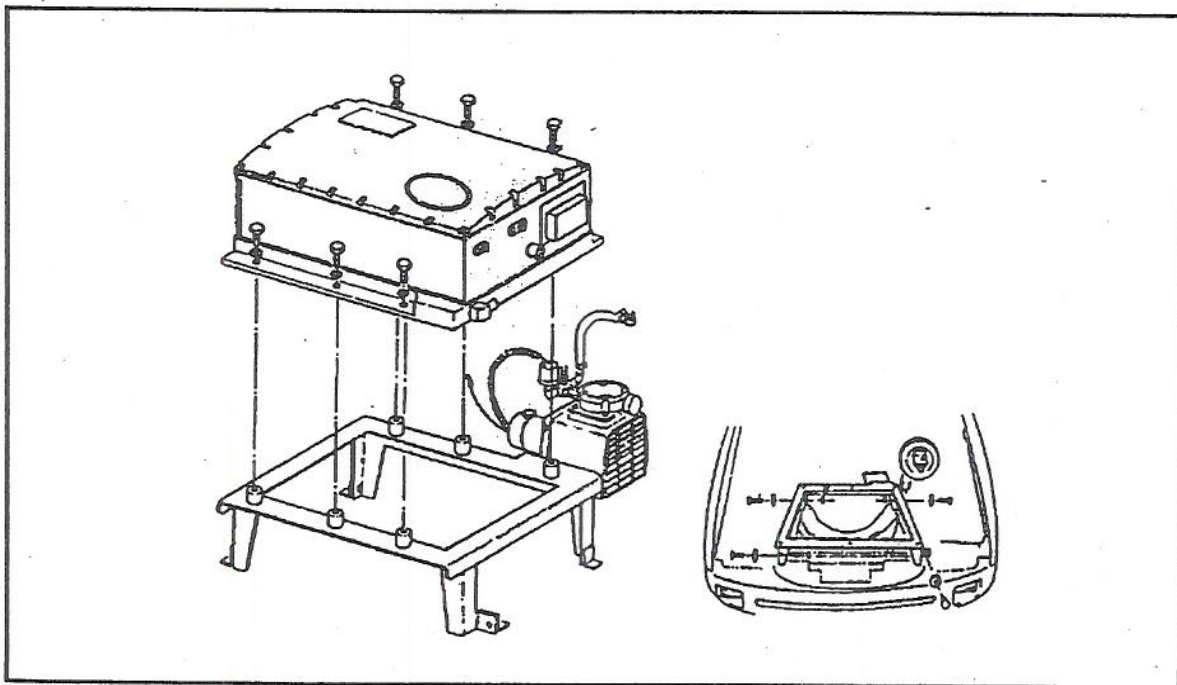


Figure 6-5 - PCU installation

2. Connect the cooling hoses [4] and [6].
3. Connect high voltage DC input connector to J2 connector [7].
4. Connect signal cable to J4 connector [8].
5. Connect 3-phase AC output to J1 connector [9].
6. Connect motor encoder input to J5 connector [5].
7. Connect integral charger input to J6 connector [2].
8. Connect 12-volt auxiliary battery positive cable to PCU [3].
9. Connect 12-volt auxiliary battery ground cable to PCU [1].
10. Connect 12-volt auxiliary battery cables to auxiliary battery.
11. Add coolant to radiator until cooling system is filled to 1-1/2 inch below the fill hole.
12. Open cover of Inverter Interface Junction Box
13. Contact connection 14 to ground using a jumper wire. This will run the coolant pump.
14. Run coolant pump for a few seconds.
15. Top off coolant in radiator.
16. Repeat steps 13 and 14 until coolant level remains constant at 1-1/2 inches below radiator fill neck.

Air Conditioning Charging Instructions

Note: Do not operate the compressor without refrigerant in the system. Permanent damage will result.

1. The system must be completely installed electrically and mechanically prior to charging.
2. Connect a R-134A refrigerant gauge set to the vehicle according to the manufacturers instructions.
3. Connect the vacuum unit to the gauge set.
4. Open the low pressure side of the gauge set.
5. Evacuate the A/C system until 30 in. Of Mercury is obtained and held for 5-minutes.
6. Close the low pressure side of the gauge set.
7. Disconnect the vacuum unit and connect the R-134A refrigerant tank.
8. Fill the system with 2 lbs of R-134A refrigerant.

DO NOT OVERFILL the air conditioning system. Overfilling will blow the precharge resistor in the main drive system PCU.

Test The System

1. Cover the main battery pack with clear plastic or Plexiglas to protect against accidental contact with the high voltage system.
2. Turn the main battery pack master switch ON.
3. Turn the key on the steering column ON.
4. Turn on the air conditioning system utilizing the dash controls.

Close Up Battery Box and Replace Cargo Bed

1. Turn the main battery pack master switch OFF.
2. Install the battery pack enclosure cover and torque mounting bolts to ** lbs.
3. Remount the cargo bed with (6) mounting bolts.
4. Remount the charge receptacle in the fuel access door.