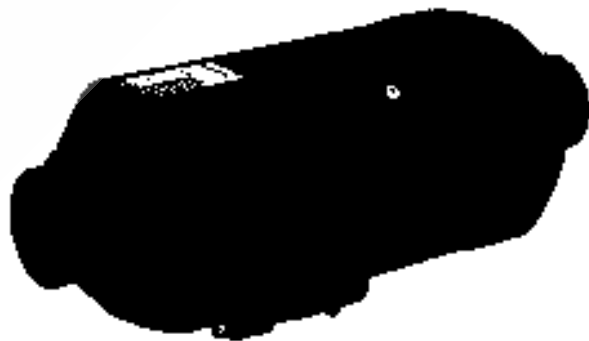




Espar

# D1L-C

## INSTALLATION TROUBLESHOOTING & PARTS MANUAL



For D1LC Model:

25 1688 05 12V  
25 1767 05 12V  
25 1774 05 12V  
25 1830 05 12V

25 1689 05 24V  
25 1768 05 24V  
25 1775 05 24V  
25 1831 05 24V

**MARCH 1995**

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### SPECIAL NOTES

**Note:** Highlight areas requiring special attention or clarification.

**Caution:** Indicates that personal injury or damage to equipment may occur unless specific guidelines are followed.

**Warning:** Indicates that serious personal injury or death may result if specific guidelines are not followed.

## 1. HEATER WARNINGS

**Warning To Installer:** Correct installation of this heater is necessary to ensure safe and proper operation. Read and understand this manual before attempting to install a heater.

- Warning - Explosion Hazard**
  - 1. Heater must be turned off while re-fueling.
  - 2. Do not install heater in enclosed areas where combustible fumes may be present.
  - 3. Do not install heaters in engine compartments of gasoline powered boats.

- Warning - Fire Hazard**
  - 1. Install heater so it will maintain a minimum distance of 2" from any flammable or heat sensitive material.
  - 2. Install the exhaust system so it will maintain a minimum distance of 2" from any flammable or heat sensitive material.
  - 3. Ensure that the fuel system is intact and there are no leaks.

Failure to follow these instructions could cause fire resulting in personal injury or death.

- Warning - Asphyxiation Hazard**
  - 1. Route the heater exhaust so that exhaust fumes cannot enter any passenger compartments.
  - 2. Ensure an air tight seal will be maintained between the heater and mounting surface and at any exhaust connection points.
  - 3. Ensure that heating air supply is taken from an area where poisonous gases will not be present.
  - 4. If running exhaust components through an enclosed compartment, ensure that it is vented to the outside.

Failure to follow these instructions could cause oxygen depletion resulting in personal injury or death.

Direct questions to Espar Heater Systems - USA 1-800-387-4800  
CDA 1-800-668-5676

# ESPAR-D1LC AIR HEATER

## 2. INTRODUCTION

### 1. Espar D1LC Air Heater - Heater Introduction

The ESPAR D1LC is a diesel-fired 6,150 BTU/HR air heater, quality engineered to provide a dependable means of space heating. This heater is uniquely designed for inside mounting and ease of installation.

The heater provides hot air to the interior of vehicles for passenger comfort. Since the heater runs on diesel fuel and 12 or 24 volt power, it is able to perform this completely independent of the vehicle engine.

The heater is operated by a rheostat switch for heating capacity. The heater will cycle through three temperature settings (high-medium-low) in order to maintain the desired temperature. If, in special cases, even less heating capacity is required than the heater supplies in the "Low" setting, it switches to the "Off" setting. Temperature and overheat limit switches, and a specially designed heat exchanger are among the safety features which make this heater a safe and dependable unit.

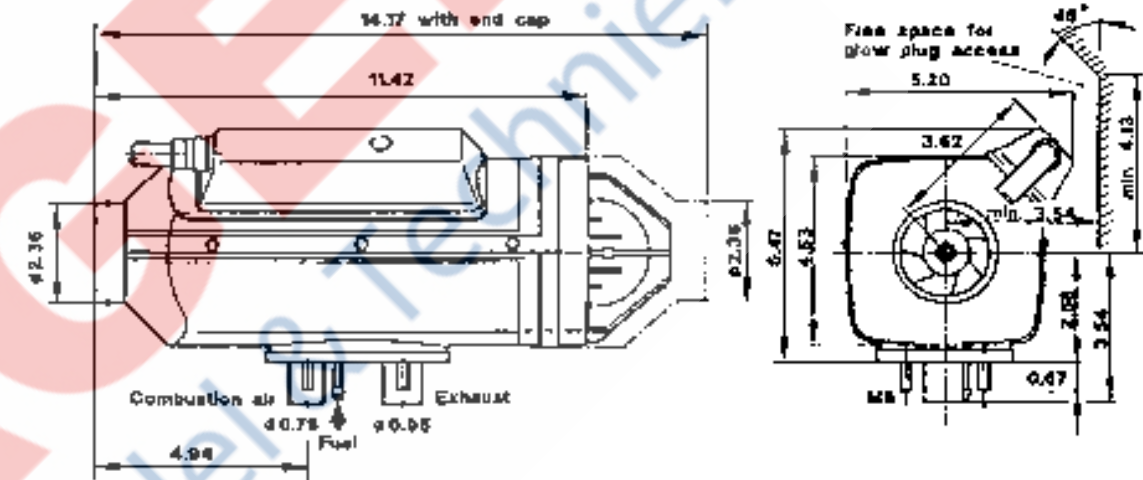
## 3. GENERAL SPECIFICATIONS

Model 25 1830 05 12V  
25 1831 05 24V

|   |   |               |          |
|---|---|---------------|----------|
| <b>Heat Output (±10%)</b>                   | 6,150 btu/hr High<br>4,100 btu/hr Med<br>2,900 btu/hr Low             |               |          |
| <b>Current at 12v (+10%)</b>                | 20.8 amps/hr - Start<br>2.1 amps/hr - High<br>1.25 amps/hr - Med/Low  |               |          |
| <b>Current at 24v (±10%)</b>                | 11.25 amps/hr - Start<br>1.04 amps/hr - High<br>.83 amps/hr - Med/Low |               |          |
| <b>Fuel Consumption (±5%)</b>               | U.S.<br>Gal/hr  | Imp<br>Gal/hr | Litre/hr |
| High  | .06   | .04           | .21      |
| Med.  | .04   | .03           | .14      |
| Low   | .03   | .02           | .10      |
| <b>Air Flow (±10%)</b>                      | 54 cfm High<br>34 cfm Med/Low   |               |          |
| <b>Operating Voltage Range</b>              | 10.5 to 15.0 vdc at 12 vdc<br>21.0 to 30.0 vdc at 24 vdc              |               |          |
| <b>Overheat Temperature Shutdown (+10%)</b> | 240°F (116°C)   |               |          |

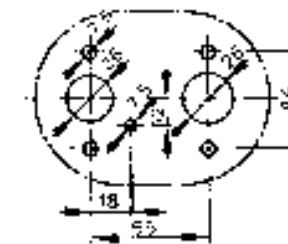
**Note:** The heater control unit is equipped with a low voltage cutout to prevent vehicle battery drain and a high voltage cutout to protect heater electrical parts.

## 4. D1LC PRINCIPAL DIMENSIONS

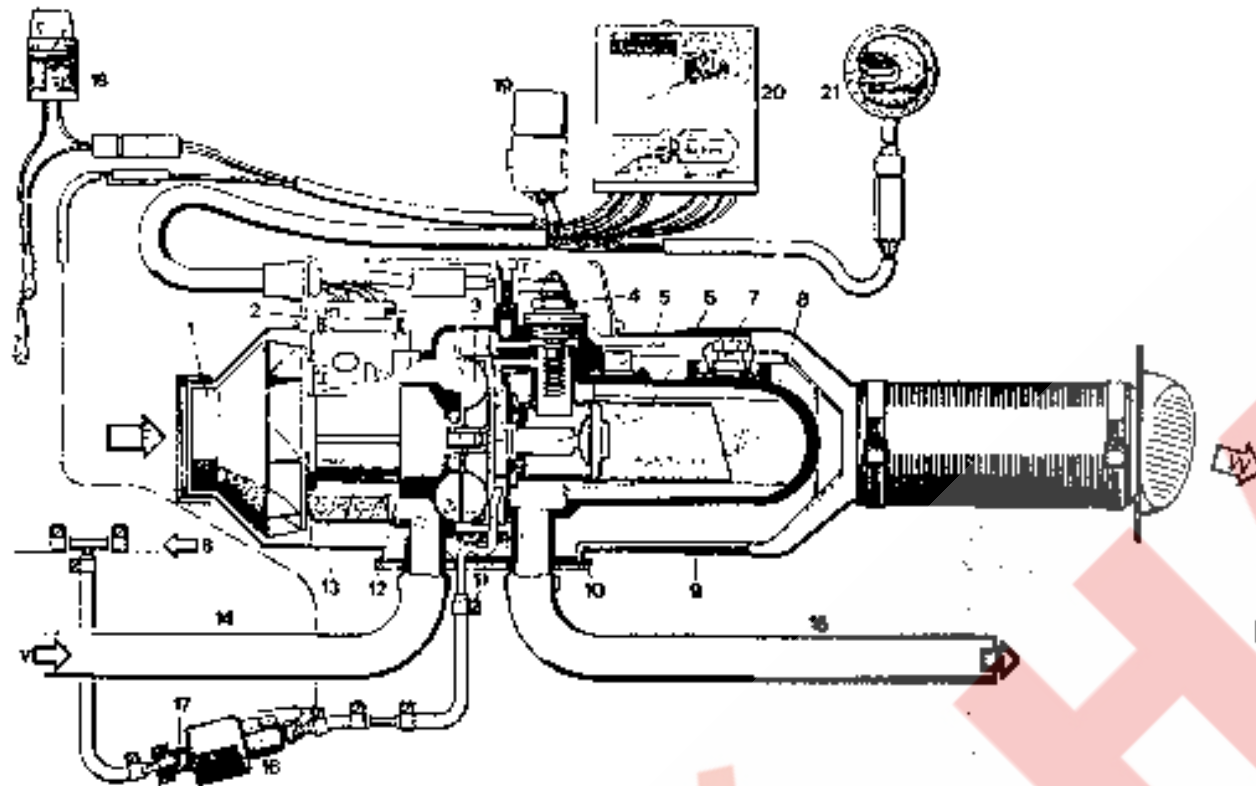


## 5. MOUNTING PATTERN

Fastening to the vehicle wall/floor make penetrations in accordance with the hole pattern.



## 6. HEATER COMPONENTS



1. Hot air blower wheel
2. PCB with controller temperature sensor
3. Combustion air blower wheel
4. Glow plug
5. Safety thermal cutout switch
6. Combustion chamber
7. Flame monitor
8. Heat exchanger
9. Outer casing

10. Flange seal
11. Fuel line
12. Series resistor for glow plug (for 24V only)
13. Blower motor
14. Combustion air intake line
15. Exhaust line
16. Fuel metering pump
17. Fuel strainer

18. Main fuse, 25A
  19. Relay, glow plug
  20. Control unit
  21. Operating unit
- F = fresh air  
V = Combustion air  
B = fuel  
W = hot air  
A = exhaust

## II. INSTALLATION PROCEDURES

### 1. Heater Location

Depending on the type of vehicle, the best location for mounting the heater will vary. Basically, the heater may be mounted anywhere inside the vehicle provided you adhere to the following conditions:

- A) Combustion air intake, exhaust and fuel inlet must be located outside of vehicle.
- B) Heater must be mounted on flat horizontal surface providing an air tight seal between heater and vehicle.
- C) Do not mount the heater outside the vehicle, unless care is taken to protect the heater from the weather.

When selecting the location, consider the following:

- A) Combustion air and exhaust connections
- B) Ducting
- C) Fuel line connections
- D) Electrical connections

### 2. Heater Mounting

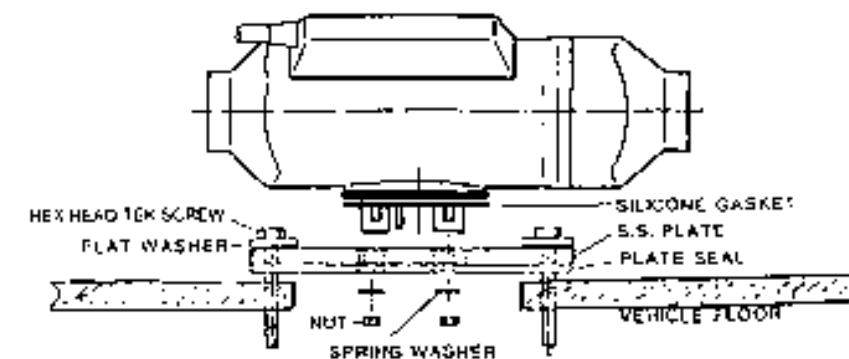
A mounting plate and hardware are provided with the heater kit.

#### A) Heater

- Choose heater location.
- Using template provided, drill and cut center hole (depending if you choose one circular hole or one rectangular hole) and four plate mounting holes.
- Cut one (1) four and one half inch (4½") diameter hole or one rectangular hole four (4") by five (5") inches.
- Mount heater on mounting plate with nuts and spring washers provided.
- For ease of installation make the exhaust, combustion air intake and fuel connections at base of heater before mounting the heater into the vehicle.
- Position heater in vehicle and bolt down with hardware provided.

**Note:** Tighten bolts sufficiently to ensure positive seal between mounting plate and mounting surface. **Do not** over tighten bolts.

### HEATER MOUNTING PLATE INSTALLATION



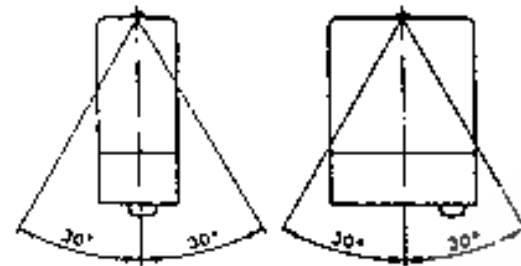
**B) Control Unit and Voltage Regulator**

- Mount control unit using bracket provided in a convenient location near heater.
- Mount voltage regulator beside control unit.

**Note:** Always mount control unit with pins pointing downwards to ensure that no moisture or water can enter the unit.

- It is possible to mount control unit at slight angles if a vertical mounting surface is available. The following diagram illustrates allowable installation angles.

**Control unit allowable installation angles:**



**3. HEATING AIR DUCTING**

**A) Installation**

A two inch (2") flexible duct (40 inches long), hot air outlet and clamps are provided with the heater kit.

In routing and installing the ducting the following criteria must be observed:

- Do not use existing vehicle ducting or outlets. They may not be rated at Espar operating temperature standards. Ducts and outlets must be capable of withstanding a minimum of 300°F operating temperatures. Beware of vehicle systems, especially plastic ones.
- Run ducting with smooth bends. Avoid crushing duct.
- Position hot air outlet so that it cannot be obstructed.
- Use protective air intake grille on air inlet side of heater to prevent objects from being sucked in.
- Do not overtighten duct clamps.
- Do not position outlet so that it will blow hot air directly at operator or room thermostat.

**Caution:** Do not connect too many components in your ducting system. The sum of component ratings may not exceed the value of ten (10).

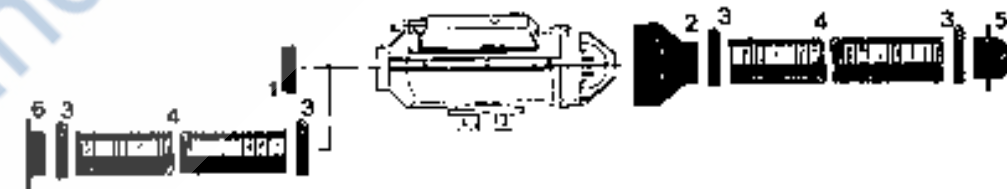
\*See the following ducting component rating for details.

**Warning:** Heating air inlet must be installed in an area where exhaust from the vehicle's engine or from the heater cannot enter under normal operating conditions.

**B.) Ducting Component Rating**

To make sure your ducting installation does not exceed allowable rating simply add component ratings of all components used including all bends made in the flexible duct. This sum should not exceed ten (Use table below).

**COMPONENT RATING DIAGRAM AND TABLE**



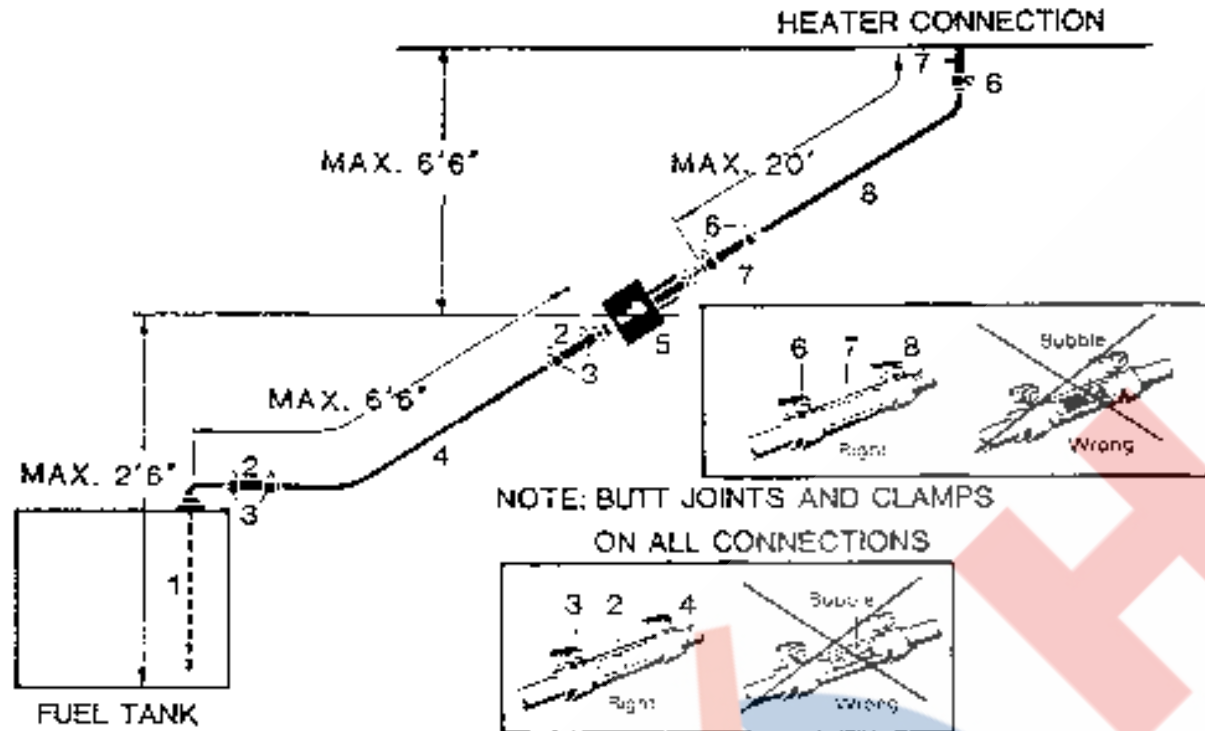
| ITEM DESCRIPTION                 | COMPONENT RATING | PART NUMBER      |
|----------------------------------|------------------|------------------|
| 1 Protective Grille              | 2.0              | 25 1688 80 06 00 |
| 2 Air Outlet Hood                | 1.0              | 25 1688 80 03 00 |
| 3 Hose Clamp 2"-2 3/4" (50-70mm) | —                | CA1 10 047       |
| 4 Flex Duct 2 3/8" (60mm)        | 0.35/ft          | 10 2114 31 00 00 |
| 5 Air Outlet - Rotatable         | 1.0              | 20 1577 89 06 00 |
| 6 Connection Piece               | 0.4              | 20 1577 89 06 01 |
| 90° Bend of Duct - 2 3/8" (60mm) | 1.0              | - -              |

#### 4. FUEL SYSTEM

The fuel metering pump is the heart of the system and must be installed properly to insure a successful heater operation.

All parts necessary to do the installation are included in the kit as shown in Fig. 3.

Fig. 1: Fuel System Overview

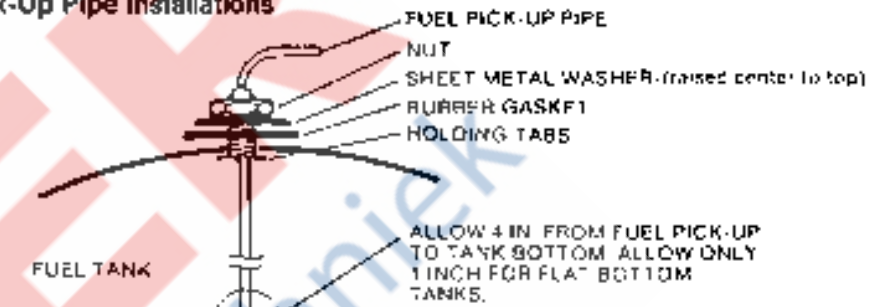


- |                                  |                                  |
|----------------------------------|----------------------------------|
| 1. Fuel Pick-Up Pipe             | 5. Fuel Metering Pump            |
| 2. 5.0 Rubber Connector          | 6. 7mm Clamp                     |
| 3. 10mm Clamp                    | 7. 3.5mm Rubber Connector        |
| 4. 2.0mm Black Plastic Fuel Line | 8. 1.5mm White Plastic Fuel Line |

##### A) Fuel Pick-Up Pipe

- Decide on location point for pipe in tank (in a protected area).
- Drill a one inch (1") hole in tank or blanking plate.
- Install a pick-up pipe as shown in Fig. 3A.

Fig. 1A: Fuel Pick-Up Pipe Installations



##### B) Fuel Metering Pump

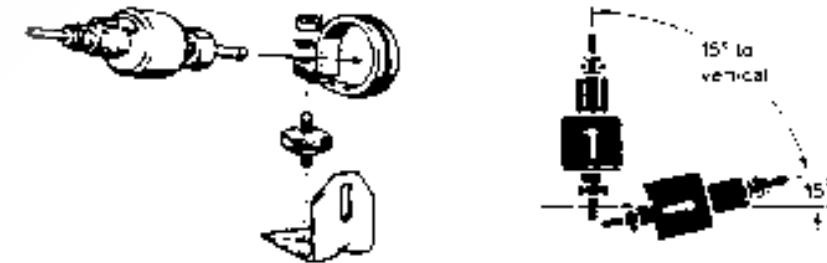
- Decide on location for fuel pump.
- Must be in a protected area.
- Near fuel tank.

**Note:** - The fuel metering pump maximum lengths are shown in Fig. 3 - do not exceed these limits.

- Using the bracket and rubber mount provided install fuel pump as shown in Fig. 1B.

**Note:** - The mounting angle of the fuel pump, it is necessary to adhere to this angle to allow any air or vapour in the fuel lines to pass through the pump rather than cause a blockage.

Fig. 1B: Fuel Pump Installation



**Note:** - Always cut plastic fuel line to length.

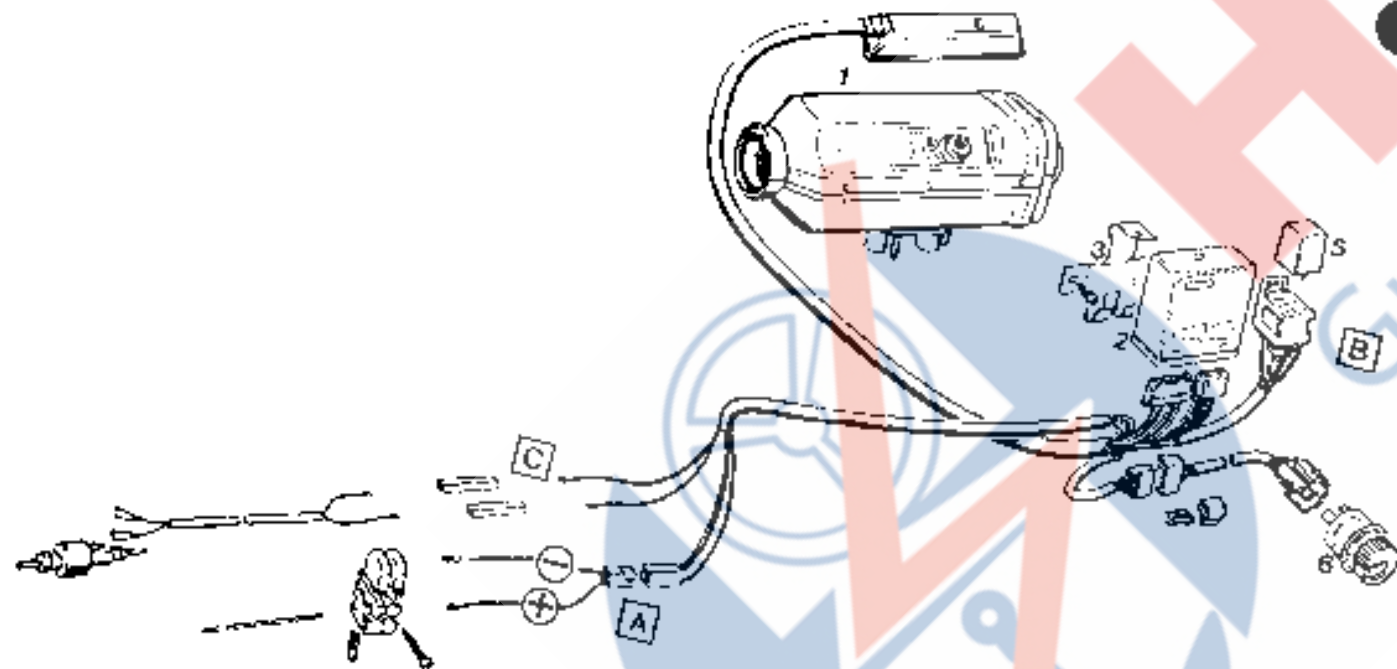
- To ensure clean unburred cuts always use a sharp utility knife to cut plastic fuel line.
- Always use butt joints and clamps on all connections.
- Always use fuel line provided with heater - other sizes of fuel line will reduce fuel pump efficiency resulting in heater operating problems.

### 5. ELECTRICAL CONNECTIONS

- A) Power Harness**
  - 2 core harness (red & brown)
  - Red wire with fuse direct to vehicle battery (positive)
  - Brown wire to battery (Ground)
- B) Switch Harness**
  - 6 core harness (red, brown, yellow, black, blue and grey)
  - Run to location of heater control (ie. rotary knob or thermostat)
  - Connects to 2 pin connector block at heater harness
- C) Fuel Pump Harness**
  - 2 core harness (green and green)
  - Run to location of fuel pump
  - Connects using two (2) single connector blocks at heater harness
- D) Wiring Harness Hood to Heater**
  - 14 pin connector and 2 pin connector
  - Gently press the 12 pin connector onto the printed circuit board on the top of the heater.
  - Join the 2 pin connector on harness to the 2 pin connector leading to the glow plug.
  - Install ring connectors onto glow plug - model 25 1830 and 25 1831
  - Carefully place the hood into position over the glow plug and printed circuit board area and secure using a 6mm hex wrench.

All harnesses should enter vehicle through sealing grommets.

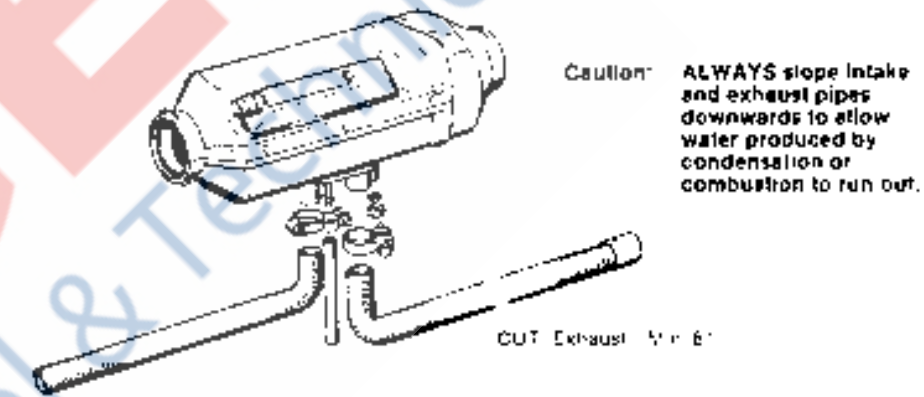
#### Electrical Connections



**Note:** - All exposed electrical connections should be coated with protective grease, (petroleum gel, vaseline, etc.).

### 6. EXHAUST CONNECTION

A 24mm flexible stainless steel exhaust pipe (39" long), exhaust clamp and holder are provided with the heater kit. The exhaust pipe can be shortened to a minimum of 6". Attach the exhaust pipe to the exhaust outlet of the heat exchanger (as shown below). Once secured to the heater exhaust outlet, the exhaust pipe must run to an open area to the rear or side of the vehicle so that fumes cannot build up and enter the cab or the combustion air inlet to the heater. Install protective end cap.



**Caution:** ALWAYS slope intake and exhaust pipes downwards to allow water produced by condensation or combustion to run out.

OUT Mix & Combustion Air

- WARNING:** The exhaust is **HOT** keep a minimum of 2" clearance from any heat sensitive material.
- WARNING:** Route exhaust so that exhaust fumes cannot enter the passenger compartment or combustion air intake.

**Note:** - Run exhaust so that it cannot be plugged by dirt, snow or water and allows water produced by combustion to run out.

- Install exhaust pipe with a slight slope and drill a 1/8" hole in the lowest point to allow water to drain off.
- Any restriction in exhaust will cause operational problems.

### 7. COMBUSTION AIR INTAKE CONNECTION

A 20mm flexible plastic tube (39" long) for combustion air intake, clamp and holder are provided with the kit.

Attach the combustion air intake tube to the combustion air inlet of the heater. Be careful to keep intake pipe away from exhaust. Once secured to the heater inlet, the intake pipe must run to the underside of the vehicle where it will pick up clean, fresh, moisture free air.

**Note:** - Please attempt to balance the exhaust pipe length with combustion air tube lengths.

- The above **MUST** be adhered to ensure proper operation of the heater.

### 8. AIR TEMPERATURE SENSORS

#### A) Internal Temperature Sensor (Universal Models Only)

A temperature sensor is provided in the heater on the heating air intake side. This arrangement of the temperature sensor is only suitable in return ducted operation with heaters that have blower circulation capability.

**Note:** - For D1L-C 12V 25 1767 05, 25 1774 05, 24V 25 1768 05 and 25 1775 05 when less heating capacity is required than the heater supplies in the "Low" setting, it cycles to the "Off" setting similar to previous models. Normal continued operation follows, and then a constant continued circulation at extremely low blower speed, until restart takes place. This allows the internal temperature sensor to accurately sense the average bunk temperature.

### 9. OPERATING SWITCH

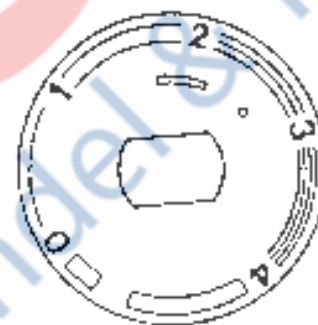
**Note:** The D1LC truck kit is supplied with an electronic thermostat and a fifteen foot (15') switch harness.

The heater may be operated using one of the following switch options:

- Rotary control switch with on/off control
- Rotary control switch with timer for on/off control
- Thermostat with built in on/off switch

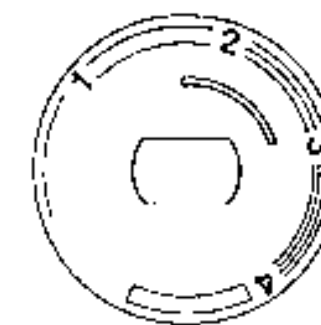
#### A) Rotary Control Switch and Optional Heater Timer

Two scales are supplied as follows:



1

Scale disc 1 is fitted if operation is exclusively with the operating unit. The rotary control switch then serves as an "ON/OFF" switch and temperature controller.



2

Scale disc 2 is fitted if a timer is used for actuation. Switch "ON" is then exclusively with the heater timer, and the temperature is selected with the rotary control switch. See wiring diagram for connection

Connect the six pin plug of the switch harness to the corresponding plug on the heater harness.

Connect the six core switch loom to socket housing using the terminals supplied in the kit, as follows:

- Brown/White** wire to terminal No. 1
- Grey/Red** wire to terminal No. 2
- Blue/White** wire to terminal No. 3

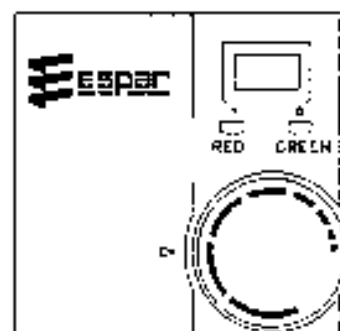
- Black/White** wire to terminal No. 4
- Red** wire to terminal No. 5
- Yellow** wire to terminal No. 6

In cases where the optional timer is used, disconnect the red wire from No. 5 on the rotary control switch and insure that the bare wire is not exposed.

**Note:** If constant illumination of the switch is required, connect a wire from the vehicles lighting circuit to terminal No. 9 of the rotary switch.



### B) Optional Thermostat with Built-In-Remote Sensor



This operating device serves as an "ON/OFF" switch, thermostat and external temperature sensor. This thermostat option requires a special switch harness. Please refer to parts section for specific part numbers.

Connect the six pin plug and the two pin plug of the switch harness to the corresponding plugs on the main heater harness. It should be noted that the two pin plug with the single black/white wire activates the external temperature sensor, already built into the thermostat. Simultaneously, it disengages the internal temperature sensor built into the heaters PCB.

Connect the six core switch harness to the thermostats terminal strip as follows:

- Brown wire to terminal No. 1
- Grey wire to terminal No. 2
- Blue wire to terminal No. 3

- Red wire to terminal No. 5
- Yellow wire to terminal No. 6
- Black wire to terminal No. T

### III. HEATER OPERATION

#### 1. SWITCH ON / START UP

Heater always starts in **HIGH** mode.

Once switched on the following sequence of events takes place:

- A) Green pilot light on rotary switch is on. Red and green lights on thermostat are "on" (Control unit does a systems check. Blower motor starts).
- B) Glow plug begins to preheat the combustion chamber (25-65 seconds depending on the input voltage).
- C) Fuel pump starts.
- D) Once ignition takes place the flame sensor will signal the control unit to turn the glow plug off (motor speed will increase slightly).
- E) Heater begins heating interior.

**Note:** - If the heater fails to start the first time it will automatically attempt a second start if unsuccessful the heater will shut down completely. If input voltage to the control unit is below 10.5 (21v) or above 15.0 (30v) volts the unit will shut down after a 20 second delay.

#### 2. RUNNING

- A) Heater runs in heat mode.
- B) Once the air intake (or room) temperature set on the rheostat has been reached (between 10°C and 30°C), the heater switches to "Low" heating capacity (reduced blower noise). If the 850W heating capacity is insufficient to maintain desired temperature, the heater switches to "Medium" (1200W) with "Low" blower speed. In most cases the Low-Medium-Low control sequence with low blower speed will supply the heat requirement. If however the "Medium" stage is not sufficient, the heater switches back to "High". This again entails full blower speed.

**Note:** - While in running mode if the heater flames out it will automatically attempt a restart.  
 - During operation the heater continually senses input voltage from the batteries  
 - if the input voltage drops to approx. 10.5v or rises above 15.0v (21.0v or 30v on 24 volts) the heater will automatically shut down after a three (3) minute cool down cycle.

**3. SWITCHING OFF**

After switch-off the green pilot light goes out. The blower continues to run for a three (3) minute cool down cycle then switches off completely.

**4. SAFETY EQUIPMENT**

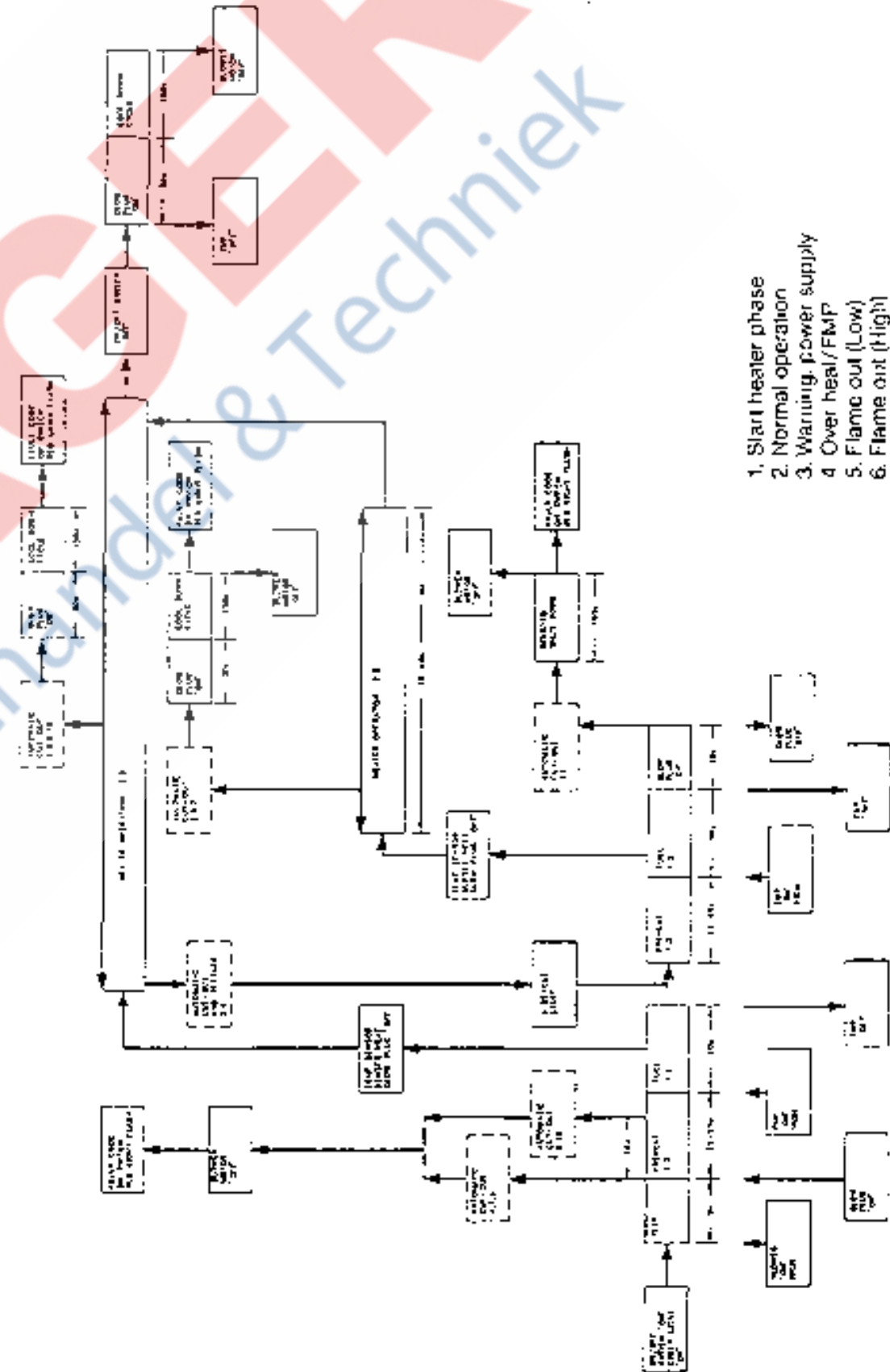
The flame is monitored by the flame sensor. The overheat temperature is monitored by the safety thermal cutout switch. Both influence the control unit which switches off the heater in the event of malfunction (See the following diagram on heater components).

- A) If the heater fails to ignite within three (3) minutes, malfunction shutdown follows.
- B) Overheating (due to restriction of heating air flow by blocking inlet or outlet with blanket, rags, etc.) results in the safety thermal cutout switch popping, with stoppage of fuel supply followed by a cool down cycle and a malfunction shutdown. Green light on operating switch will begin a steady flashing code.
- C) If at any time the voltage drops below 10.5v or 21.0v (as the case may be), or rises above 15.0v or 30.0v automatic malfunction shutdown follows (after a 20 second delay).
- D) The heater does not start if the blower motor is defective or the electrical cable to the metering pump is broken.

**Note:** During electrical welding work on the vehicle, disconnect the power to the heater, in order to protect the control unit.

**▲ WARNING:** - The heater must be switched off while any fuel tank on the vehicle is being filled. The heater must not be operated in garages or enclosed areas.

**5. OPERATIONAL FLOW CHART**



1. Start heater phase
2. Normal operation
3. Warning: power supply
4. Over heat/FMFP
5. Flame out (Low)
6. Flame out (High)
7. Glow plug defective
8. Burner motor defective
9. Cut-out due to under voltage
10. Cut-out due to over voltage
11. Non start safety time

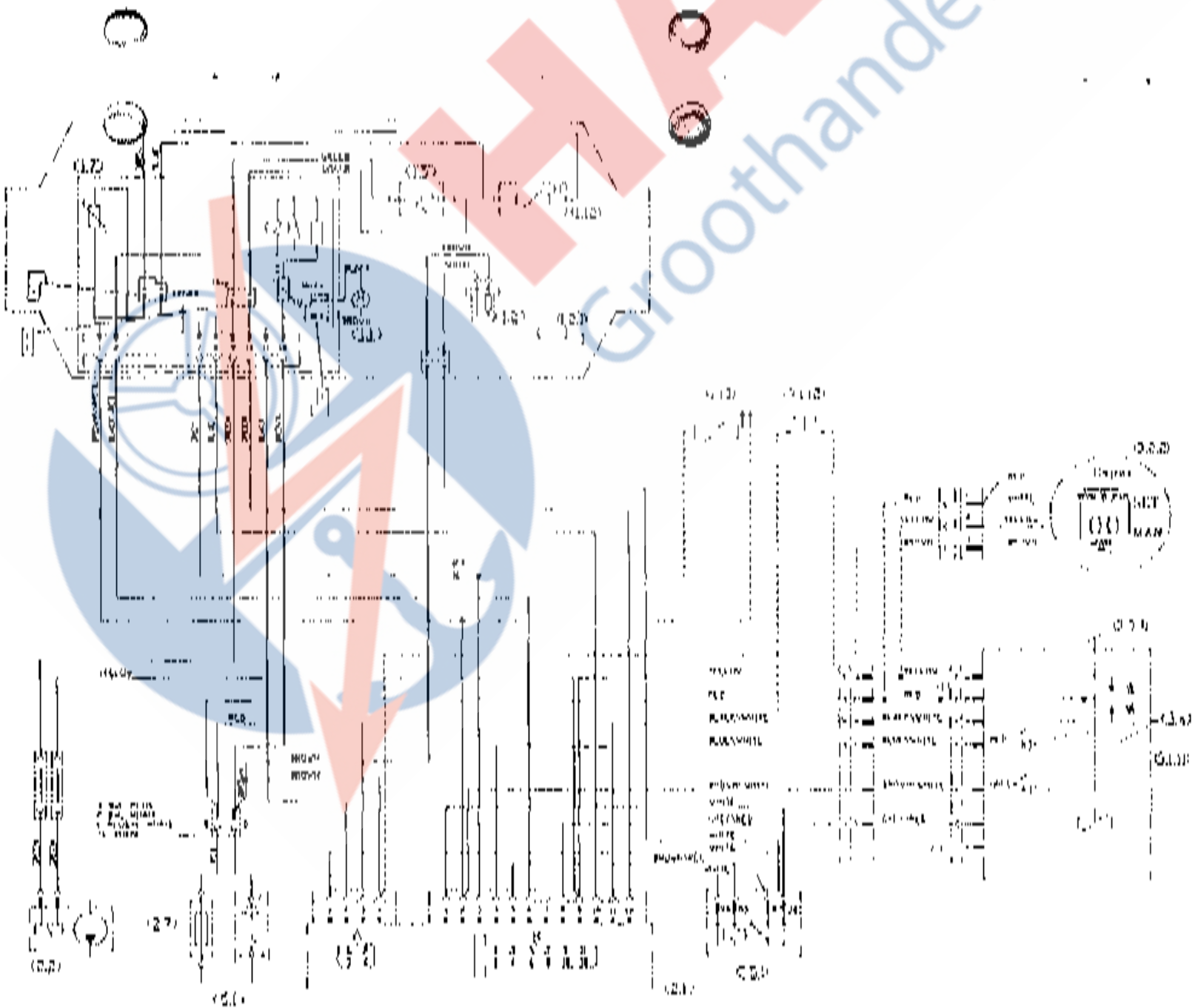
**IV. MAINTENANCE AND TROUBLESHOOTING**

**1. RECOMMENDED PERIODIC MAINTENANCE**

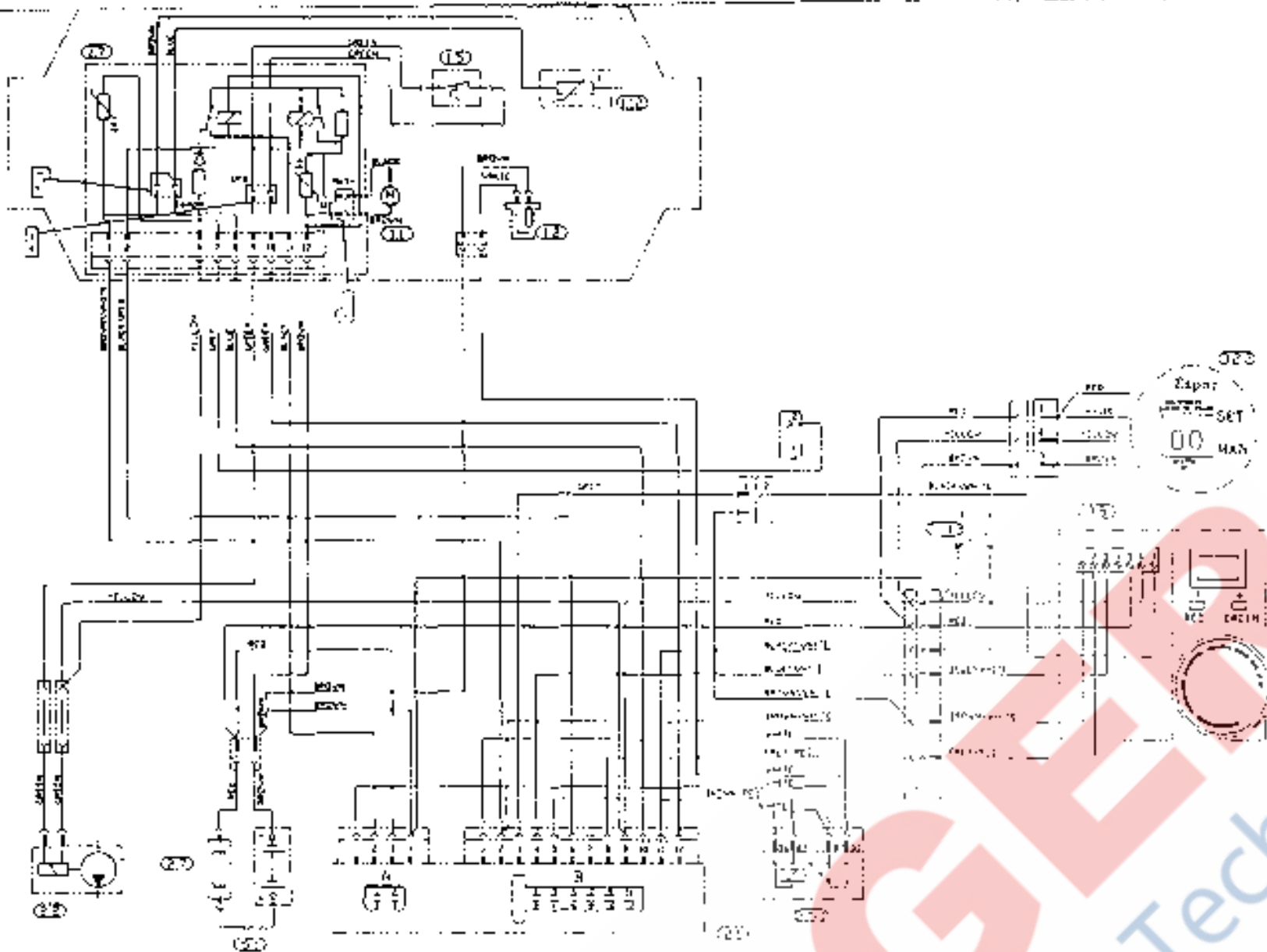
- A) Remove the glow plug and inspect for carbon build up. Clean or replace.
- B) Remove the glow plug screen and inspect for carbon build up. Clean or replace. - cleaning is required, use brass brush (Escaar part number CA2 35 006).
- C) Make sure vent hole is open. Escaar recommends the use of non-damaging 100% valeric carburetor cleaner and an air gun with 150 psi. Remove loose carbon from the glow plug chamber.
- D) Inspect the ducting, the air intake screen and air outlet for restriction or blockage.
- E) Inspect combustion air intake and exhaust for blockage.
- F) Run your heater and check for proper operation during regular Preventative Maintenance throughout the year.
- G) Maintain your batteries and all electrical connections in good condition. When insufficient power the heater will not start. Low and high voltage circuits will shut the heater down automatically.
- H) Use fuel suitable for the climate (see engine manufacturers recommendations). Blending used engine oil with diesel fuel is not permitted.

**2. D11C WIRING DIAGRAM**

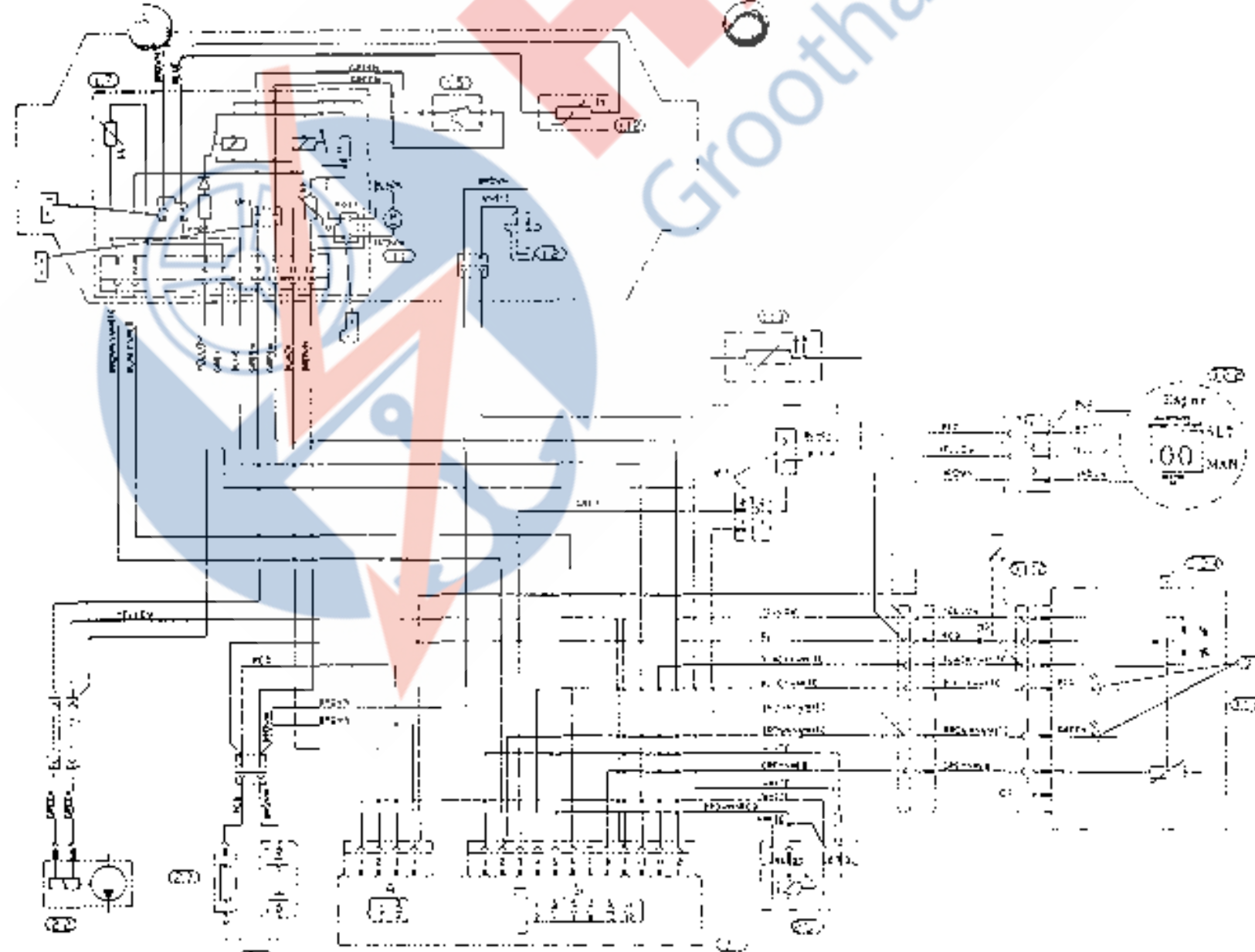
D11C - UNIVERSAL (12V/24V) 2S 1688 05/25 1689 05



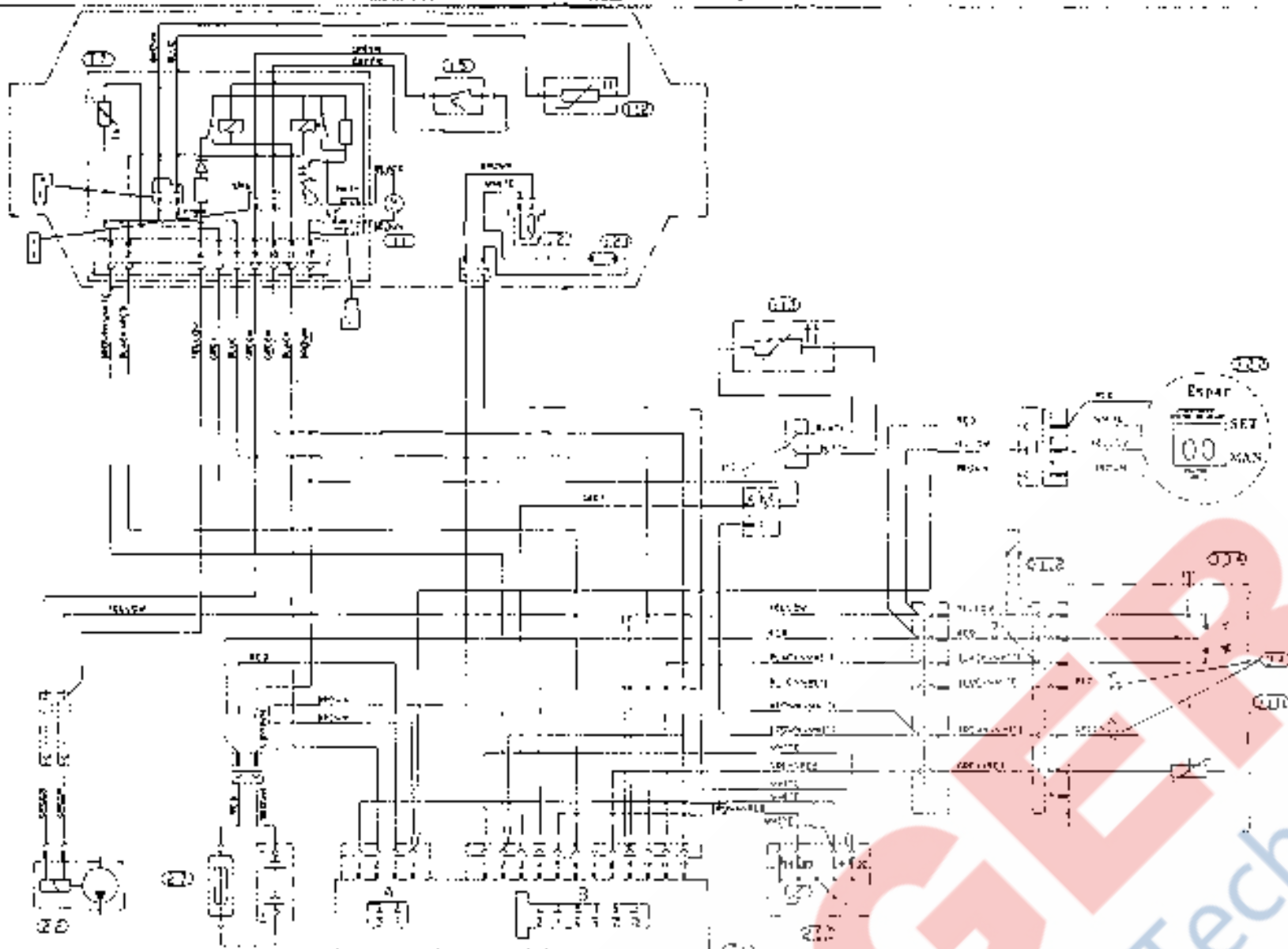
- |       |  |        |                                   |       |   |
|-------|--|--------|-----------------------------------|-------|---|
| 1.1   | Glow plug  | 2.1    | Control unit                      | 3.3.4 | Pilot lamp with switch                    |
| 1.2   | Glow plug relay  | 2.2    | Fuel metering pump                | 3.4   | Switch on pilot light                     |
| 1.2.1 | Resistor for glow plug (24V only)                                      | 2.5.1  | Glow plug relay                   |       | Lighting                                  |
| 1.5   | Safety thermal cut-off switch  | 2.7    | Main fuse, 25A                    |       | Diagnostic light                          |
| 1.7   | ECU with coolant temperature sensor, speed change and plug distributor | 3.1.11 | Operating unit                    | 4.1   | Battery                                   |
| 1.12  | Temperature sensor, external   | 3.1.12 | Pushbutton for diagnostic display | 4.2   | Diode for high to connect fuse            |
| 1.13  | Temperature sensor, external   | 3.2.2  | Time OFF countdown                | 4.3   | Connection of external temperature sensor |



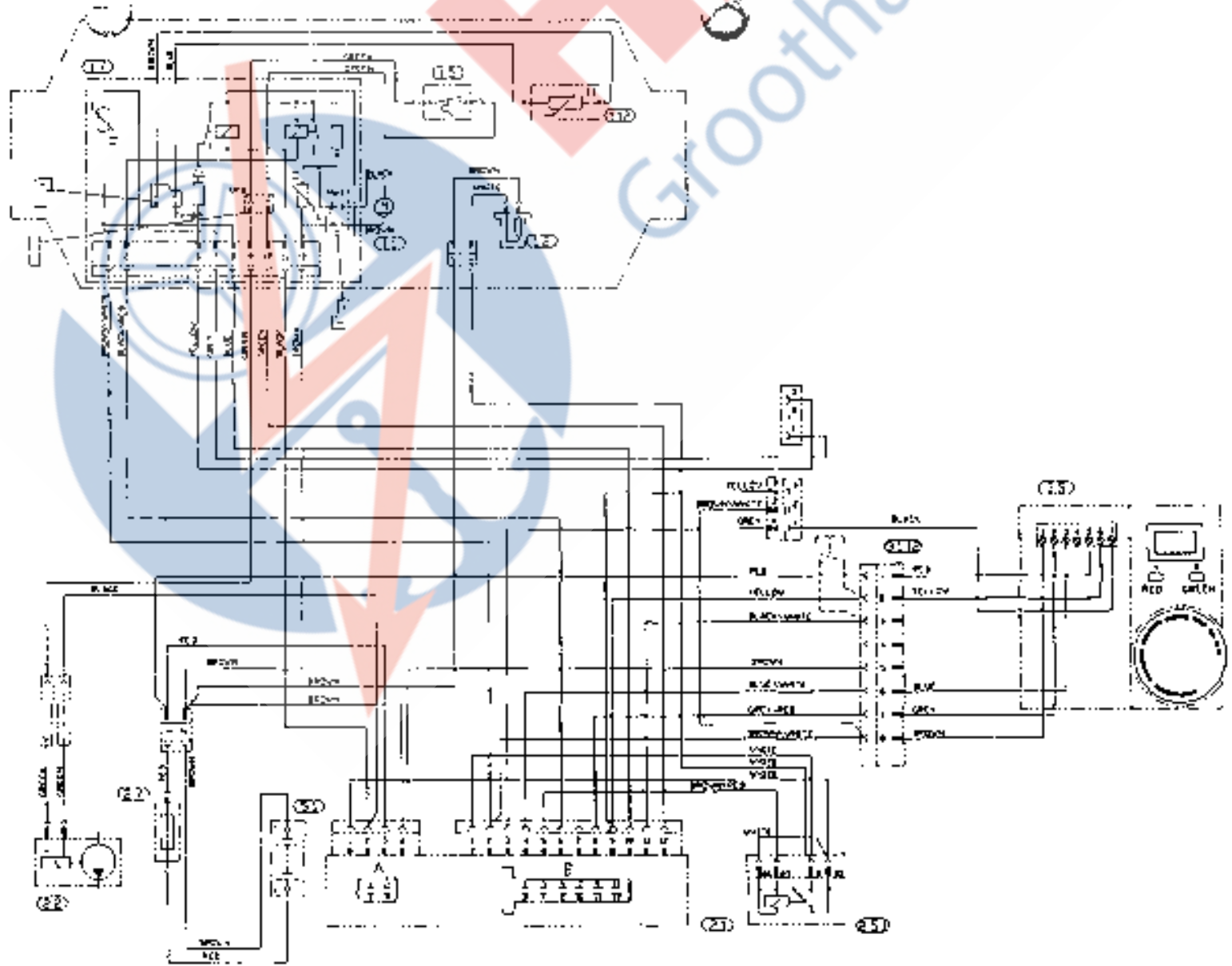
- |     |  |       |                    |        |   |
|-----|--|-------|--------------------|--------|---|
| 1.1 | Blower motor   | 1.12  | Flame monitor      | 3.1.12 | Pushbutton for diagnostic display         |
| 1.2 | Glow plug  | 2.1   | Control unit       | 3.2.2  | Timer, 99hr countdown                     |
| 1.5 | Safety thermal cutout switch   | 2.2   | Fuel metering pump | 3.5    | Thermostat                                |
| 1.7 | PCB with controller temperature sensor speed change and plug distributor | 2.5.1 | Glow plug relay    | 5.1    | Battery                                   |
|     |  | 2.7   | Main fuse, 25A     | e)     | Connection of external temperature sensor |



- |      |  |        |                                   |       |   |
|------|--|--------|-----------------------------------|-------|---|
| 1.1  | Blower motor   | 2.1    | Control unit                      | 3.3.a | Potentiometer with switch                 |
| 1.2  | Glow plug  | 2.2    | Fuel metering pump                | 3.4   | Switch-on pilot light                     |
| 1.5  | Safety thermal cutout switch   | 2.5.1  | Glow plug relay                   |       | Lighting                                  |
| 1.7  | PCB with controller temperature sensor speed change and plug distributor | 2.7    | Main fuse, 25A                    |       | Diagnostic light                          |
| 1.12 | Flame monitor  | 3.1.11 | Operating unit                    | 5.1   | Battery                                   |
| 1.13 | Temperature sensor, external   | 3.1.12 | Pushbutton for diagnostic display | d)    | Break line: here to connect timer         |
|      |  | 3.2.2  | Timer, 99hr countdown             | e)    | Connection of external temperature sensor |



- |  |   |  |
|--|---|--|
| 1.1 Blower motor   | 1.13 Temperature sensor, external       | 3.3.4 Potentiometer with switch              |
| 1.2 Glow plug  | 2.1 Control unit                        | 3.4 Switch-on pilot light                    |
| 1.2.1 Resistor for glow plug (24V only)                                      | 2.2 Fuel metering pump                  | Lighting                                     |
| 1.5 Safety thermal cutout switch   | 2.5* Glow plug relay                    | Diagnosis light                              |
| 1.7 PCB with controller temperature sensor speed change and plug distributor | 2.7 Main fuse, 25A                      | Battery                                      |
| 1.12 Flame monitor   | 3.1.1 Operating unit                    | d) Break line here to connect timer          |
|  | 3.1.2 Pushbutton for diagnostic display | e) Connection of external temperature sensor |
|  | 3.2.2 Timer, 99hr countdown             |  |



- |  |  |
|--|--|
| 1.1 Blower motor   | 2.2 Fuel metering pump                   |
| 1.2 Glow plug  | 1.13 Temperature sensor                  |
| 1.5 Safety thermal cutout switch   | 2.5.1 Current regulator                  |
| 1.7 PCB with controller temperature sensor speed change and plug distributor | 2.7 Main fuse, 25A                       |
| 1.12 Flame monitor   | 3.1.12 Pushbutton for diagnostic display |
| 2.1 Control unit   | 3.5 Thermostat                           |
|  | 5.1 Battery                              |

### 3. TROUBLESHOOTING

#### BASIC CHECK LIST:

#### What happens when the heater is switched on?

##### A) The heater does not ignite

###### 1) Blower motor does not run

- Check:**
- Fuse in power harness.
  - Power to control unit.
  - Power to switch.
  - Electrical connections.

###### 2) Blower motor runs approximately 20 seconds and then shuts off

- Check:**
- Ensure voltage at control unit remains above 10.5 volts during start up with glow plug circuit on.

###### 3) Blower motor runs/fuel metering pump starts and then shuts down after two 90 second start up cycles

- Check:**
- Fuel lines and fuel filter.
  - Fuel quantity.
  - Combustion air or exhaust tube blockage.

###### 4) Blower motor runs/no fuel metering pump

- Check:**
- For electrical pulses at fuel metering pump.
  - If pump is frozen.
  - Blocked fuel line.

##### B) Heater ignites

###### 1) Shuts down at random

- Check:**
- Fuel metering pump quantity.
  - Possible overheat.
  - Control unit input voltage.

###### 2) Heater smokes and carbons up

- Check:**
- Exhaust pipe blocked.
  - Combustion air intake blocked.
  - Exhaust entering combustion air intake pipe.
  - Short cycling, rapid on/off operation.
  - Fuel system.
  - Fuel metering pump quantity.
  - Motor rpm.

##### C) SELF DIAGNOSTIC

The D1LC is equipped with a self diagnoses light in the center of the rotary control knob. The green light on the thermostat face will produce fault codes.

In the event of the component failure or a systems failure during operation the heater will shut down. A failure code can be produced at the green light by jumping pins #9 and #11 at the control box for one (1) to three (3) seconds. The code will be in the form of a flashing green light. Refer to wiring diagrams.

To assist the service technician to obtain heater fault code the diagnostic box as illustrated in figure 1) is available. Espar part number 12V CA1 05 003 and 24V CA1 05 004.

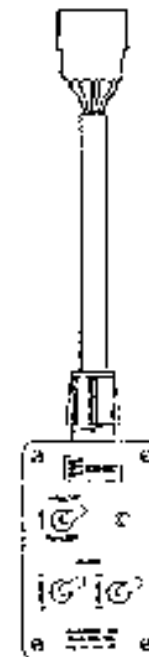
##### Set Up:

- Unplug six pin switch harness connector at the heater.
- Ensure diagnostic box switches are in the following positions:
  - on/off switch in "off" position.
  - high/low switch in "high" position.
- Plug female six pin diagnostic box connector to the male connector from the heater switch harness.
- Green indicator light should now light up indicating that there is power.

##### Operation:

- Switch on/off switch to "on" position to start the heater.
- High/low heat switch can be switched to "low" position after heater start. When the heater reaches operating temperature, switching to low heat mode will cause the heater to switch itself to run at low heat or to cool down and start in circulation mode.
- If the heater does not operate when the on/off switch is switched to the "on" position, the fault code can be obtained by pressing the momentary switch (labeled "activate fault code") for approximately 3 seconds. The green indicator light will then flash a code.

Fig. 1 :



The codes, their meaning and the remedies are listed on the "Function and Fault" Chart.

Before proceeding to any main troubleshooting the following should be checked first.

- Fuel in tank?
- Fuel connections - OK
- Electrical lines and connections - OK
- Glow plug - OK
- Combustion air and exhaust - (proper lengths, no obstructions) - OK
- Fuse - OK
- Ground - to battery, no corrosion - OK

If the above checks fail to reveal the problem proceed to further troubleshooting the heater as outlined on the following pages.

**TROUBLESHOOTING USING THE LED'S IN THE CONTROL KNOB OR THERMOSTAT AS A GUIDE**

During operation the light displayed in the control knob is green. In the thermostat the green light is on.

If a malfunction occurs and the proper jumping procedure at the control box has been carried out, the green led in the control knob or on the thermostat starts to flash a code in the form of a flashing green light. In the case of the diagnostic box the green indicator light will flash a code.

The codes and their meanings are shown on the "Function and Fault" Chart.

**Note:** Light Code - Green = Black Line Field

The codes are repeated every 8 seconds. Read two or three sets of codes to ensure you are reading the proper code.

Once the code is understood refer to the fault and then the remedy column on the chart. Follow the outlined repair. All component replacement procedures are outlined in this manual after the troubleshooting section.

**Note:** Short code — is 0.33 seconds in length  
Long code — is 1.33 seconds in length

**4. DIAGNOSTIC CODES**

| Operation  | Light Code | Meaning   | Remedy                            |
|--|------------|---|-----------------------------------|
| Warning of over temperature  | — — — — —  | Over temperature  | Check ventilation, change battery |
| Overvoltage output   | — — — — —  | Check controller, if necessary check battery. Heater must be disconnected from the battery  |                                   |
| Under voltage output   | — — — — —  | Change battery, check controller  |                                   |
| Glow plug fault  | — — — — —  | Check glow plug, glow plug capacitor (for 24 V), replace if necessary. Check voltage lines and control box. Check main line to glow plug relay  |                                   |
| Heater motor does not turn, without downstream relay alarm and indicator | — — — — —  | Check heater motor (not stopped), if necessary replace it. Check over (not adequate), if necessary replace it. Check heater motor relay, motor/relay - 3000V 1.0/0.5 amp  | Replace glow plug relay           |
| Short circuit of glow plug relay control                                 | — — — — —  | Check main supply line glow plug (interrupted coil, not wired correctly), replace if necessary  |                                   |
| Control box (diagnostic) no glow   | — — — — —  | Check battery air lines, inlet and outlet for clogging, if necessary remove clogging. Check the inlet block, vent duct to outside (change). Check battery thermostat switch and indicator   |                                   |
| Overheat   | — — — — —  | Check thermostat pump and supply lines, replace if necessary  |                                   |
| Short circuit of heat exchanger pump                                     | — — — — —  | Plug ventilation to temperature neither too high nor too low, make thermostat automatically check PCB, thermostat battery (not adjust). If necessary limit the external temperature sensor directly. Check connection to operating mode, and check the filter (not important for operation (day/night)) |                                   |
| Temperature sensor defective   | — — — — —  | Check filter battery or connection, and also PCB (not adjust)   |                                   |
| Flame goes out at start of "preheat" stage. Heater goes out by itself    | — — — — —  | Check fuel quantity. Check blower speed   |                                   |
| Flame goes out at "high" stage. Heater goes out by itself                | — — — — —  | Check fuel quantity. Check blower speed   |                                   |
| Control unit malfunctions  | — — — — —  | Replace control unit  |                                   |
| External display (by voltage)  | — — — — —  | Replace cable   |                                   |

**MANUAL COMPONENT TESTING:**

- To check the:
- Room temperature sensor (on the P.C. Board)
  - Glow plug
  - Overheat Switch
  - Flame Sensor

an OHM Meter is required.

The glow plug cover must be removed by first removing the hood hold down screw.

Disconnect the glow plug connector and remove the 12 pin connector by:  
**Gently spreading the locking ears on the connector and pulling up.**

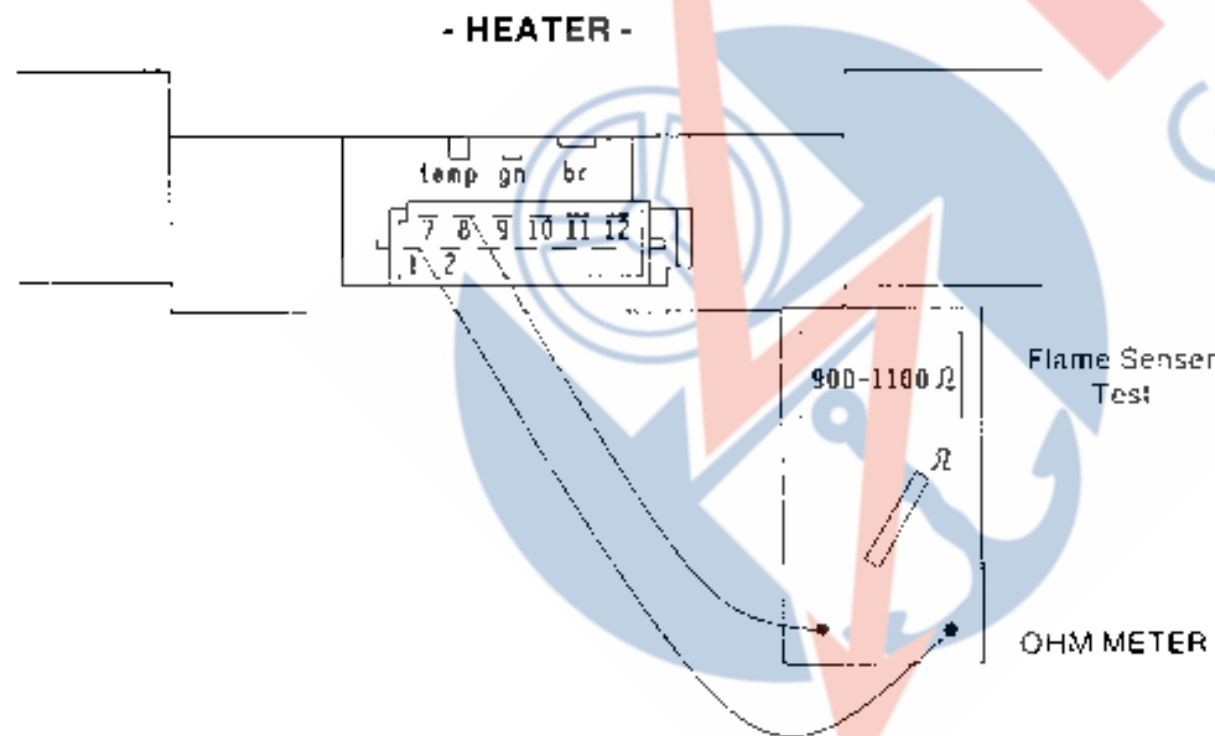
Refer to the diagram showing the P.C. Board before using the OHM Meter to check the:

- Flame sensor
- Overheat switch

**FLAME SENSOR:** Place OHM Meter leads on pin #1 and pin #8 being careful NOT to touch other pins. A stable reading of 900 - 1100 OHMs (0.9K - 1.1K) should be seen for a cool heat exchanger.

If the flame sensor does not meet the specification it must be replaced.

CONTROL KNOB CODE: | - - - - - |



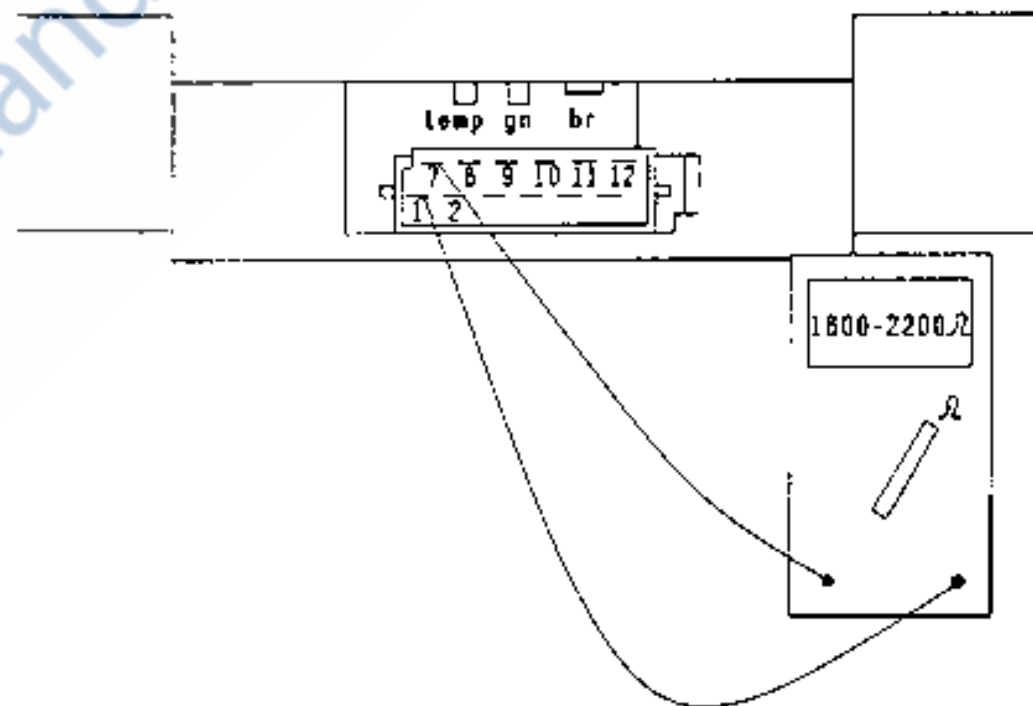
**INTERNAL TEMPERATURE SENSOR: (on P.C. Board)**

Place OHM Meter leads on pin #7 and pin #1.

A steady reading of 1800 - 2200 OHMs (1.8K - 2.2K) is required. If these values are not produced then the P.C. board must be replaced.

CONTROL KNOB CODE: | - - - - - |

**- HEATER -**





**OVERHEAT SWITCH:**

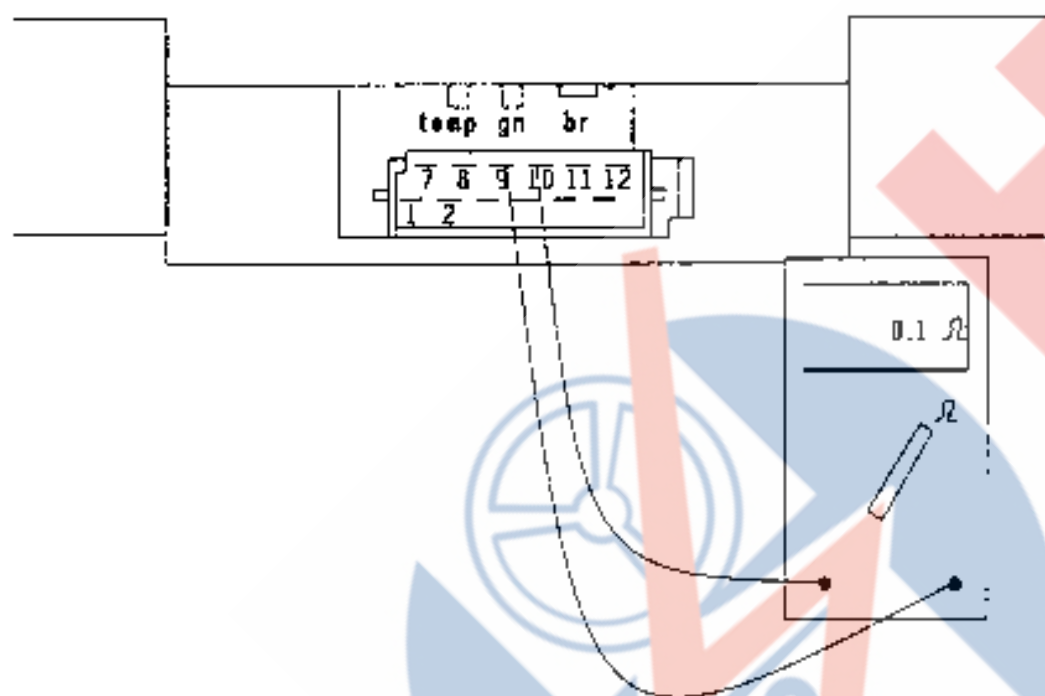
Place OHM Meter leads on pin #9 and pin #10.

A steady reading of 0.1 OHMs should be seen

If this is not produced the overheat switch should be replaced.

CONTROL KNOB CODE: | - - - - - |

**- HEATER -**



**GLOW PLUG:**

The glow plug should produce a resistance of 0.7 - 0.9 OHMs.

CONTROL KNOB CODE: | - - - - - |

If all the above checks are OK the glow plug and the 12 pin connectors can be replaced and the hood replaced and secured.

**MOTOR TEST:**

The heater is a two speed motor with speeds switched and controlled by a relay and a resistor on the P.C. board.

The blower motor can be checked for proper high and low speeds by using an optical or strobe tachometer.

High Speed            4500 = 10% RPM  
 Low Speed            3000 = 10% RPM

If low speed cannot be obtained it can be checked using a second method.

The second method requires that the P.C. board be removed from the heater. Once removed a OHM Meter is used to check the low speed resistor.

Refer to the following diagram for the proper test points.

Values required for the resistor are:

3.71 - 4.1 ohms for 12 Volt OR 17.1 - 18.9 ohms for 24 Volt

If the resistor is not within specification, replace the P.C. board.

If the blower motor does not turn to specification in high or low speed, replace the blower motor.

CONTROL KNOB CODE: | - - - - - |

**COMPONENT SPECIFICATION CHART:**

| PCB COMPONENT   | PINS            | RESPONSE                                  |
|-----------------|-----------------|---|
| Flame Sensor    | 1, 8            | 900-1100                                  |
| Temp Sensor     | 1, 7            | 1800-2200                                 |
| Overheat Switch | 9, 10           | 0, 1                                      |
| Motor           | See Text        | 4500 + 10% RPM High<br>3000 + 10% RPM Low |
| Glow Plug       | 2 Pin Connector | 0, 7 - 0, 9                               |

## 5. FUEL QUANTITY TEST

### Measuring Fuel Quantity

#### A) Preparation

- Disconnect the electrical connection under the cover cap on the heater.
- Connect a test lamp.
- Detach the fuel line from the heater and introduce it into a measuring glass (size 10cc).
- Connect a voltmeter to terminals 3 (+) and 4 (-) of the control unit with the 4-pin plug.
- Switch on the heater. When the fuel is being pumped evenly (approx. 25-55 secs. after switching on), the fuel line is now filled and bled.
- Switch off the heater, and empty the measuring glass.

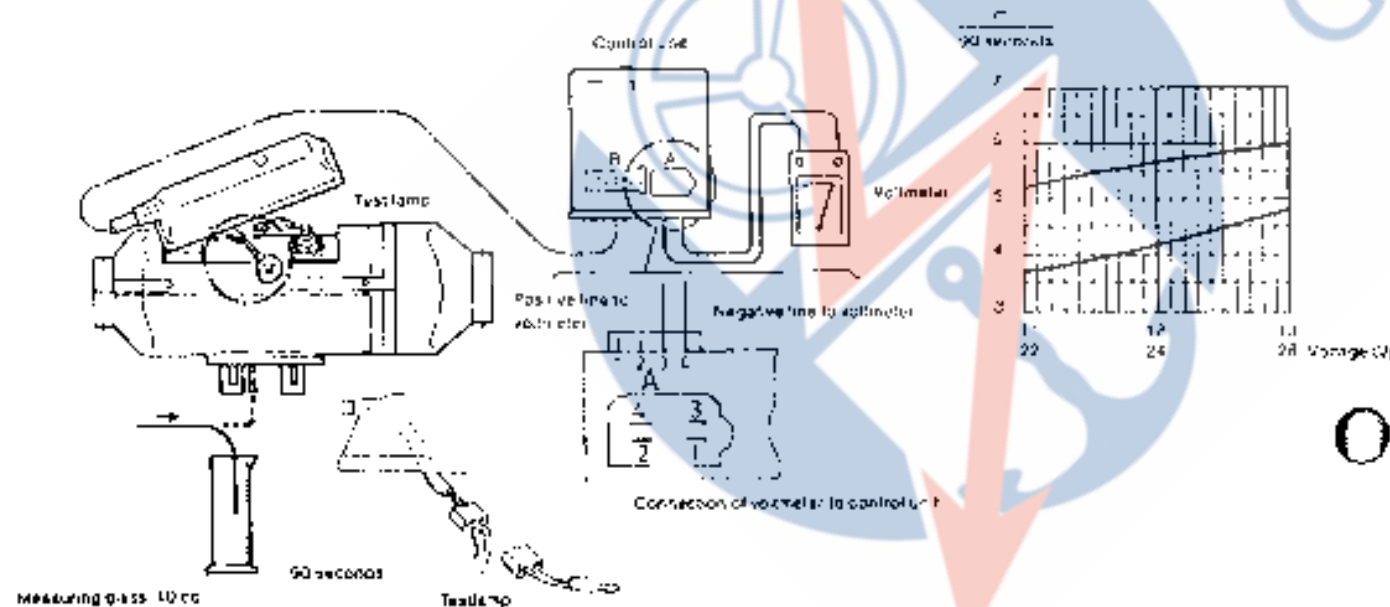
#### B) Measurement

- Switch on the heater.
- Fuel is being pumped approx. 25-55 secs. after switching on.
- Hold the measuring glass at the plug level during measurement. Read off the electrical voltage at the voltmeter. Fuel pumping stops automatically after 90 seconds.
- Switch the heater back off.
- Read off the fuel quantity in the measuring glass.

#### C) Evaluation

- Transpose the values obtained to the graph.
- The fuel consumption is okay when the intersection of the two lines is within the limit curves.
- If the intersection is outside the limit curves, the metering pump must be replaced.

**Note:** Only measure the fuel quantity when the battery is sufficiently charged. At least 11/22 V and at most 13/26 V should be applied at the control unit during measurement.



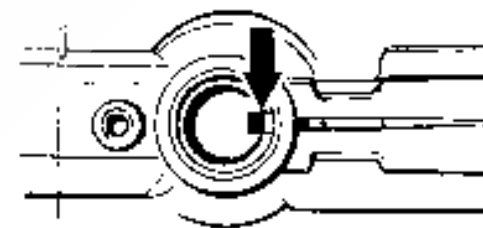
## 6. HEATER REPAIR STEPS

1. Removing/lifting the glow plug
  2. Removing/lifting the plug filter
- Removing the cap

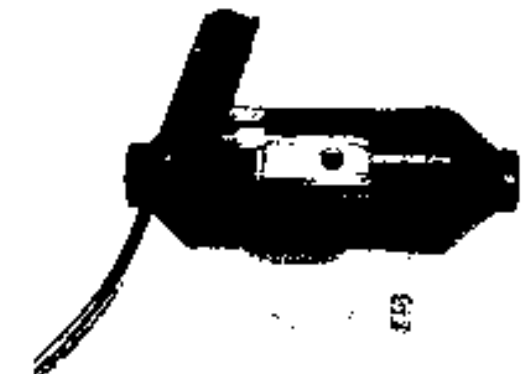


Remove the glow plug connector.  
Unscrew the glow plug.  
Remove the plug filter.

When refitting the plug filter note the position of the nose.

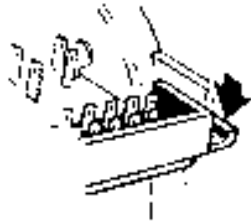


Carefully slide in the plug filter.



**3. Removing/fitting the PCB.**

Removing the plug from the PCB.  
Press down the nose.



Pull out the PCB.

PCB with changeover relay for blower speed  
and temperature sensor (internal).



Temperature sensor for heating air (internal).

**4. Removing the air outlet section**



**5. Removing/fitting the upper casing half.**

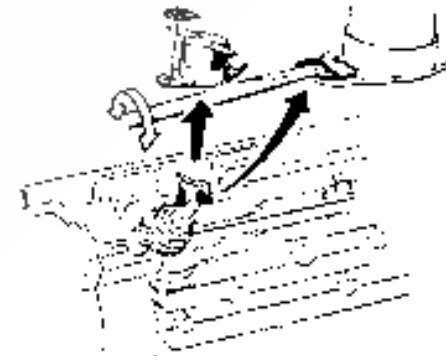
Remove split rivet: knock pin through using a  
small drive, lever out rivet using a knife.

When assembling, use a new split rivet.

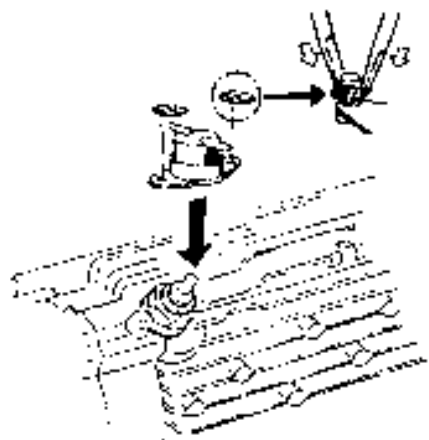


Removing the upper casing half.

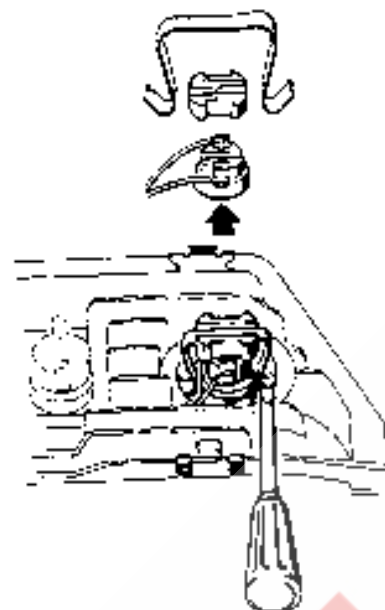
**6. Removing the safety thermal cutout switch.**



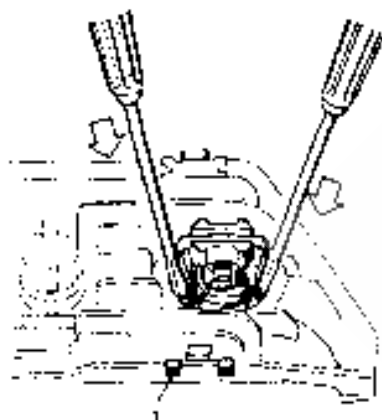
Fit the safety thermal cutout switch, using new clamping springs.



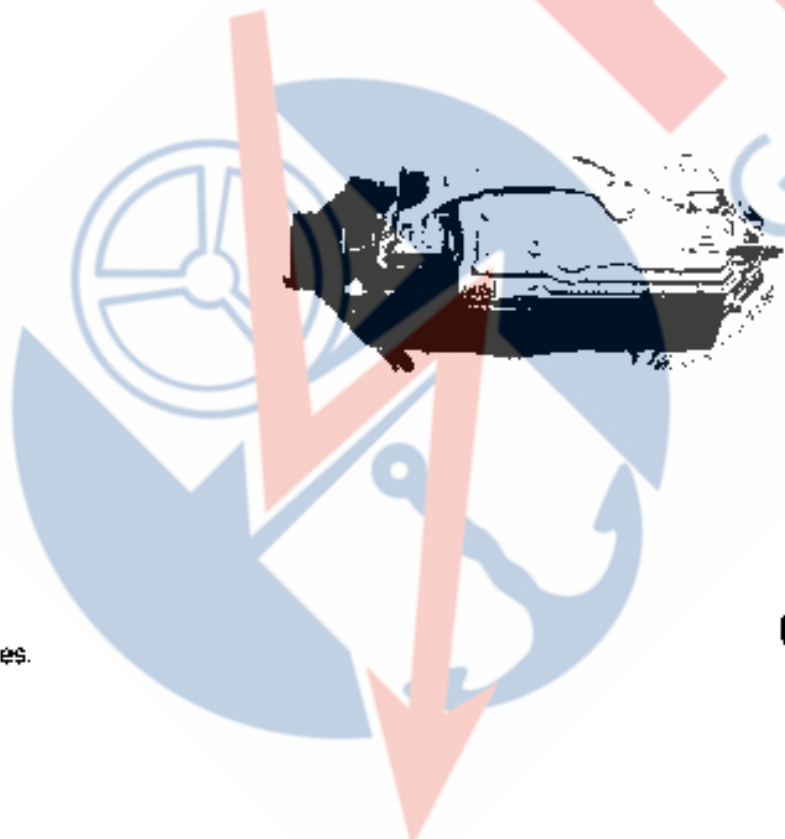
7. Removing the flame sensor.



Fitting the flame sensor



1 - spacer clamps for the casing halves.



Removed parts

- 1 - PCB
- 2 - safety thermal cutout switch
- 3 - glow plug
- 4 - plug filter
- 5 - flame sensor
- 6 - spacer clamps for casing halves

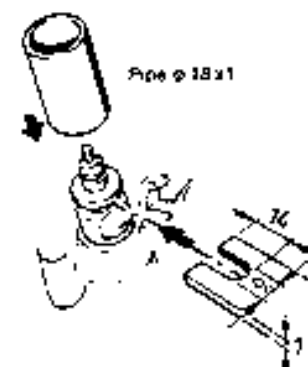
8. Changing the series resistor for glow plugs in the 24 V heaters

Note on removal: The series resistor has been fitted with a clamping ring, there is no thread!



Please note when fitting:

Place fork-shaped section in slot of resistor. Fit the pipe over this section and drive the series resistor into its mounting by light hammer blows. Do not knock against the insulator or screw connection.



Note: When fitting the combustion air blower/heat exchanger into the lower casing half, care must be taken that the fastening hooks of the blower engage in the slots of the casing half, otherwise the blower wheel might catch.



Removing the series resistor



9. Unscrewing the blower from the heat exchanger



Change the seals on the heat exchanger.  
 Unscrew the flange (1) from the heat exchanger.  
 Fit new seals (2) and (3) as illustrated.

Removing the blower



Fig. 20



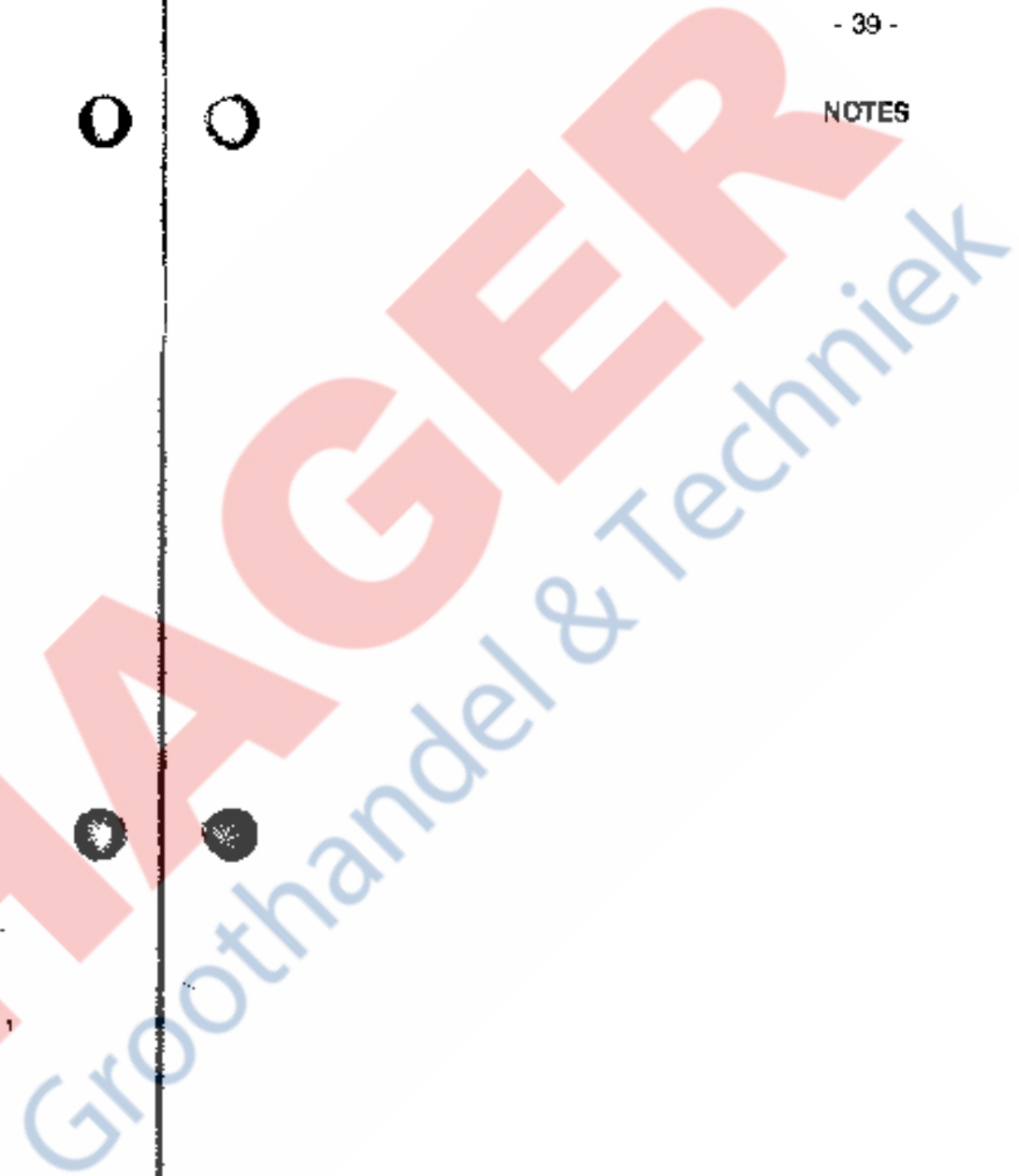
10. Replace the seals on the blower.

Remove/scrape the old seal from the blower flange. Affix new seal (self-adhesive).

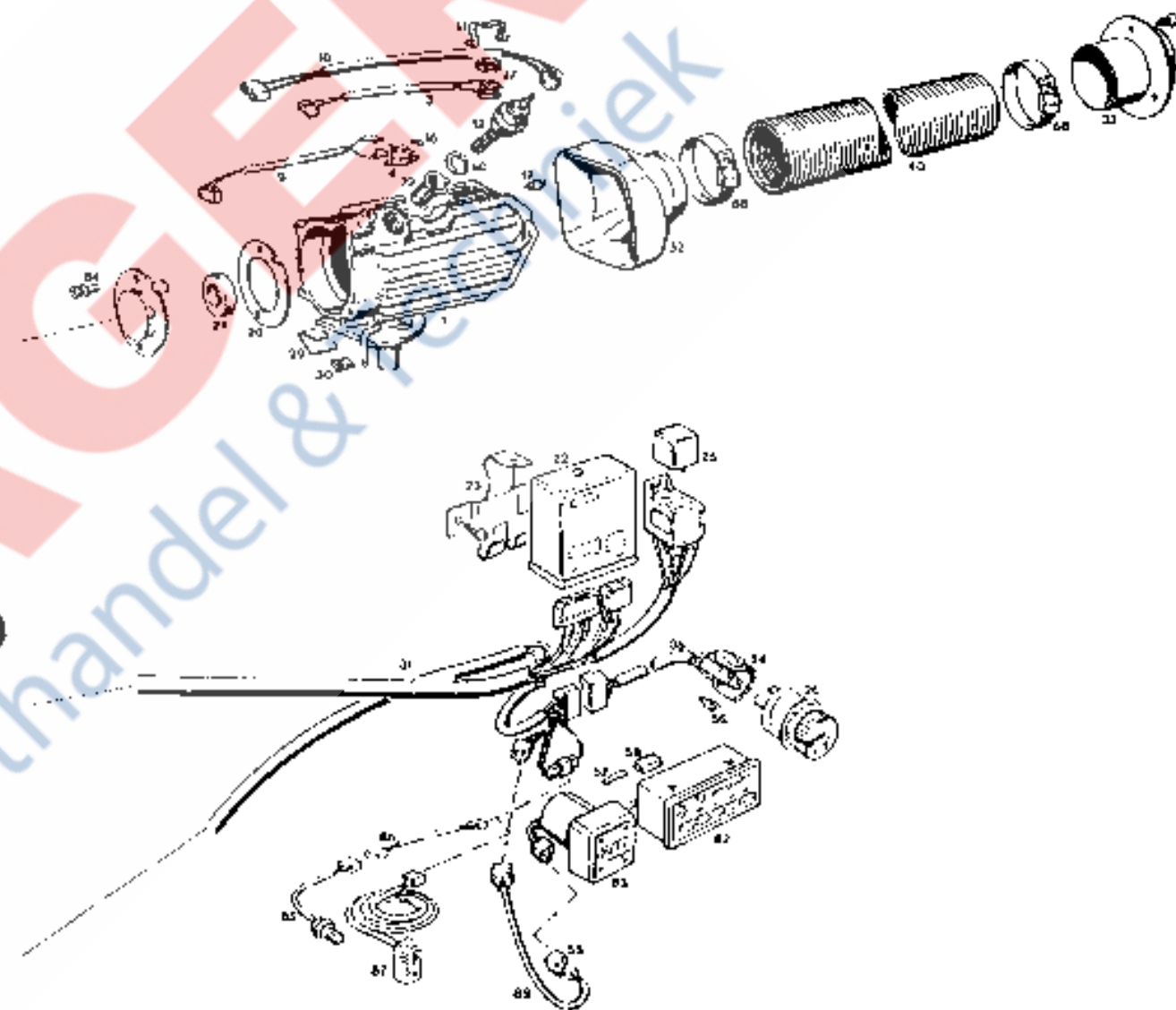
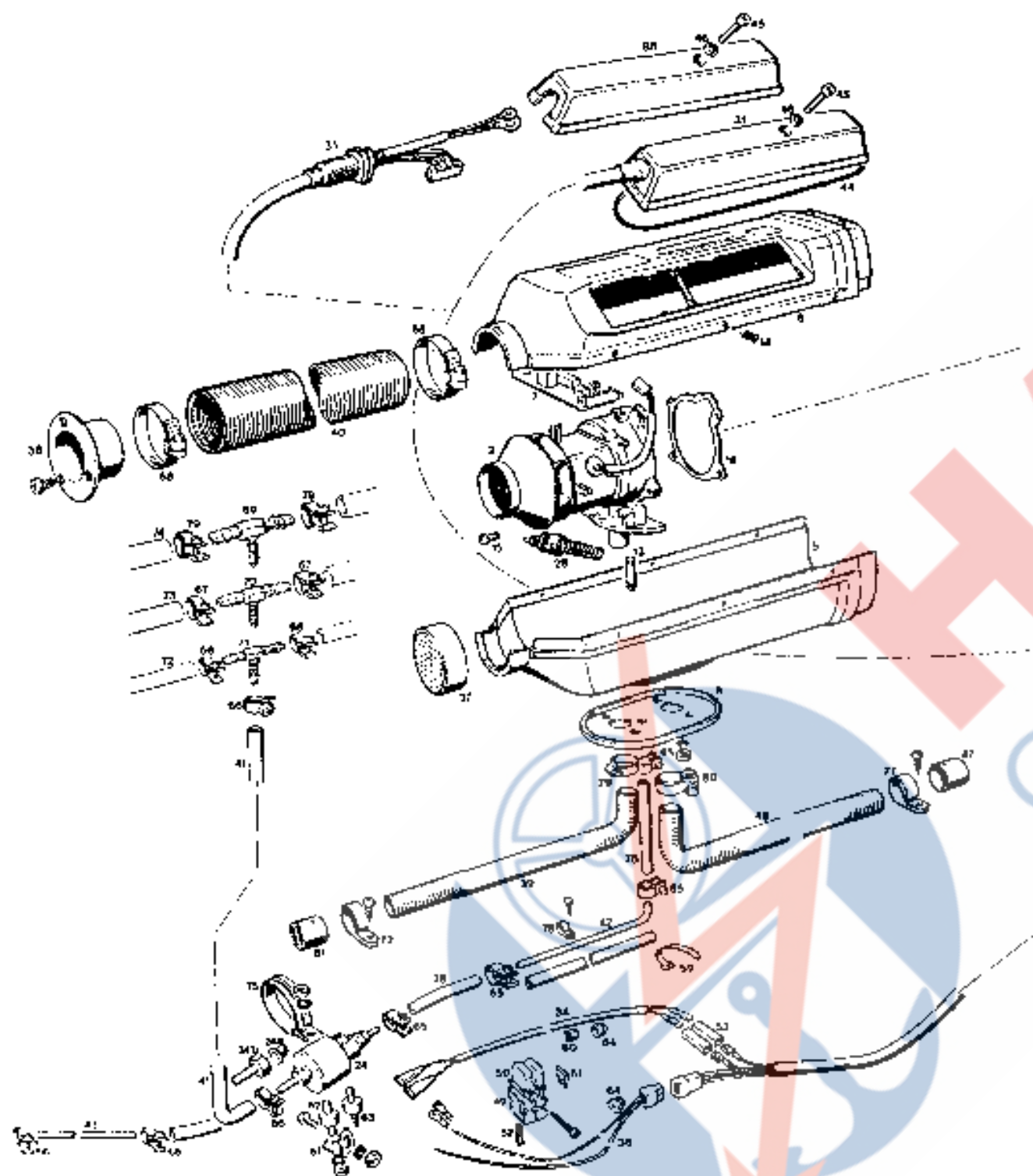


**Note:**  
 When fitting the combustion air blower/heat exchanger into the lower casing half, care must be taken that the fastening hooks of the blower engage in the slots of the casing half, otherwise the blower wheel might catch.

NOTES



V. HEATER PARTS SECTION  
1. D1LC - SERVICE PARTS DIAGRAM



2. D1L-C PARTS LIST

\* Normally not available, Manufactured to order

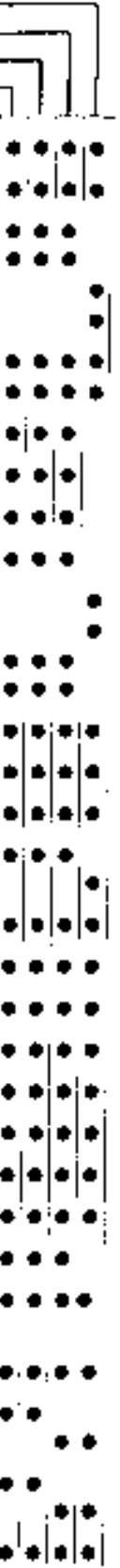
| Ref. No. | Description                  | Part Number  |
|----------|------------------------------|--|
| 1        | Heat exchanger               | 25 1688 99 06 00<br>25 1774 99 06 00   |
| 2        | Combustion air blower        | 12V 25 1688 99 20 00<br>24V 25 1689 99 20 00   |
| 3        | Flame sensor                 | 25 1774 99 36 00   |
| 4        | Safety thermal cutout switch | 25 1729 40 00 00   |
| 5        | Lower half of casing         | 25 1688 01 01 00   |
| 6        | Upper half of casing         | 25 1688 01 06 00   |
| 7        | Printed circuit board        | 12V 25 1688 01 09 00<br>24V 25 1689 01 03 00<br>12V 25 1767 01 01 00<br>24V 25 1768 01 01 00 |
| 8        | Silicone Mounting Seal       | 25 1688 01 00 02<br>25 1774 01 00 02   |
| 9*       | Cable section                | 25 1688 01 07 00   |
| 10*      | Cable section                | 12V 25 1688 01 04 00<br>24V 25 1689 01 02 00   |
| 11       | Retaining spring             | 25 1388 01 00 04<br>25 1774 01 00 03   |
| 12       | Glow plug                    | 12V 25 1830 01 01 00<br>24V 25 1831 01 01 00   |
| 13       | Grub Screw                   | 106 10 022   |
| 14       | Rivet                        | 131 31 051   |
| 15       | Fillister head bolt M 5x20   | 103 10 461   |
| 16       | Fuse                         | 171 42 080   |
| 17       | U-Clip                       | 25 1688 01 00 03   |
| 18       | Gasket                       | 25 1688 01 00 06   |
| 19       | Removable glow plug screen   | 25 1688 06 04 00   |
| 20       | Sealing washer               | 25 1688 06 00 03   |
| 21       | Sealing ring                 | 25 1688 06 00 06   |
| 22       | Control Unit                 | 12V 25 1688 50 00 06<br>24V 25 1689 50 00 08   |
| 23       | Mounting Bracket             | 25 1688 65 00 01   |
| 24       | Fuel metering pump           | 12V 25 1688 45 00 00<br>24V 25 1689 45 00 00<br>12V 25 1830 45 00 00<br>24V 25 1831 45 00 00 |

25 1830 / 25 1831  
25 1774 / 25 1775  
25 1767 / 25 1768  
25 1688 / 25 1689



| No. | Description                                 | Part Number  |
|-----|---|--|
| 24A | Pot-shaped strainer                         | 20 1312 00 00 06   |
| 24B | Hose connection                             | 20 1621 45 00 02   |
| 25  | Relay                                       | 12V 203 00 082<br>24V 203 00 084   |
|     | Current regulator                           | 12V 25 1830 30 01 00<br>24V 25 1769 80 06 00   |
| 26  | Temperature control switch complete         | 12V 25 1767 71 00 00<br>24V 25 1768 71 00 00   |
| 27  | Ceramic holder                              | 206 00 160   |
| 28  | Resistor                                    | 24V 25 1689 30 00 00   |
| 29  | Protective plate                            | 24V 25 1689 01 00 02   |
| 30  | Double u-clip                               | 24V 151 22 052   |
| 31  | Cable harness                               | 0.6m long 25 1830 80 03 00<br>2.0m long 22 1000 30 24 00<br>0.6m long 25 1767 80 03 00<br>2.0m long 25 1767 81 03 00 |
| 32  | Air outlet hood                             | 60mm 25 1688 80 03 00  |
| 33  | Adjustable air outlet deflector             | 60 mm 20 1577 89 06 00   |
| 34  | Cable section (Fuel metering pump)          | 20 1579 80 04 00   |
| 35  | Temperature control switch harness          | 25 1688 80 04 00<br>22 1000 30 02 00   |
| 36  | Power Cable (unfused)                       | 20 1575 80 03 00   |
| 37  | Safety screen                               | 25 1688 80 06 00   |
| 38  | Hose connector                              | 60mm 20 1577 89 06 01  |
| 39  | Combustion air intake hose                  | 20mm x 1mtr 360 00 099   |
| 40  | Flexible air hose                           | 60mm 10 2114 31 00 00  |
| 41  | Fuel hose                                   | 5mm I.D. 360 75 350 (360 75 130)   |
| 42  | Plastic fuel line                           | 1.5mm I.D. 090 31 118  |
| 43  | Plastic fuel line                           | 2mm I.D. 090 31 125  |
| 44  | Seal ring                                   | 25 1688 80 01 02   |
| 45  | Cable harness head screw M 5x25 with washer | 100 10 005   |
| 46  | Washer                                      | N/A  |
| 47  | End sleeve                                  | 22mm 20 1645 80 04 01<br>24mm 25 1482 80 00 01   |
| 48  | Flexible Exhaust                            | 22mm 360 61 100<br>24mm 360 61 299   |
| 49  | Bottom section, Fuse holder                 | 204 31 004   |

25 1830 / 25 1831  
25 1774 / 25 1775  
25 1767 / 25 1768  
25 1688 / 25 1689



| Ref. No. | Description               | Part Number                                    |
|----------|---------------------------|--|
| 50       | Cover, Fuse holder        | 204 31 005                                     |
| 51       | Fuse                      | 25A 204 00 089                                 |
| 52       | Terminal for fuse holder  | 206 73 058                                     |
| 53       | Plug and socket connector | 206 00 040                                     |
| 54       | Housing                   | 206 31 282                                     |
| 55       | Socket Housing            | 206 31 303                                     |
| 56       | Socket connections        | 206 36 151                                     |
| 57       | Flat-pin terminal         | 206 73 016                                     |
| 58       | Flat-pin guide            | 206 31 014                                     |
| 59       | Cable band                | CA1 00 005                                     |
| 60       | Holder                    | 156 22 010                                     |
| 61       | Angle piece               | 20 1348 03 00 02                               |
| 62       | Metal-rubber mount        | 20 1185 00 00 01                               |
| 63       | Metal-rubber mount        | 20 1673 60 01 01                               |
| 64       | Grommet                   | 20 1280 09 01 03                               |
| 65       | Fuel hose clamp           | 9mm 10 2063 00 90 98                           |
| 66       | Fuel hose clamp           | 11mm 10 2063 01 10 98<br>10mm 10 2063 01 00 98 |
| 67       | Fuel hose clamp           | 12mm 10 2063 01 20 98                          |
| 68       | Hose clamp                | CA1 10 047                                     |
| 69       | T-pipe section            | 262 31 153                                     |
| 70       | T-pipe section            | 262 31 152                                     |
| 71       | T-pipe section            | 262 31 151                                     |
| 72       | Fuel hose                 | 7.5mm 360 31 070                               |
| 73       | Fuel hose                 | 9mm 360 31 095                                 |
| 74       | Fuel hose                 | 11mm 360 31 096                                |
| 75       | Fuel pump clamp           | 152 00 144                                     |
| 76       | Pipe clip                 | 152 00 139                                     |
| 77       | Pipe clip                 | 25mm 152 10 048<br>28mm 152 10 051             |
| 78       | Fuel hose                 | 3.5mm I.D. 360 75 300                          |
| 79       | Hose clamp                | 10 2064 10 60 25                               |
| 80       | Exhaust clamp             | 22mm 25 1688 80 12 00<br>24mm 152 61 102       |

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| No. | Description                      | Part Number                                  |
|-----|----------------------------------|--|
| 81  | End sleeve with crossbar         | 25 1688 80 12 01                             |
| 82  | Heater timer<br>Timer/thermostat | 12V 22 1000 30 08 00<br>24V 22 1000 30 09 00 |
|     | 7 day timer                      | 12V 22 1000 30 12 00<br>24V 22 1000 30 13 00 |
| 83  | 99 Hr. timer                     | CA1 00 050                                   |
| 84  | Screw taptite M 5x10             | 109 00 043                                   |
| 85  | Temperature sensor, external     | 25 1482 89 45 00                             |
| 86  | Cable section                    | 25 1688 89 09 00<br>25 1482 89 40 00         |
| 87  | Temperature sensor, external     | 25 1774 89 03 00                             |
| 88  | Cable cover                      | 25 1776 01 04 00                             |
| 89  | Switch harness                   | 20 1575 80 02 00                             |
| 90  | Sealing ring                     | 25 0999 00 01 22<br>25 1830 01 01 01         |

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