

D12W Water Heater

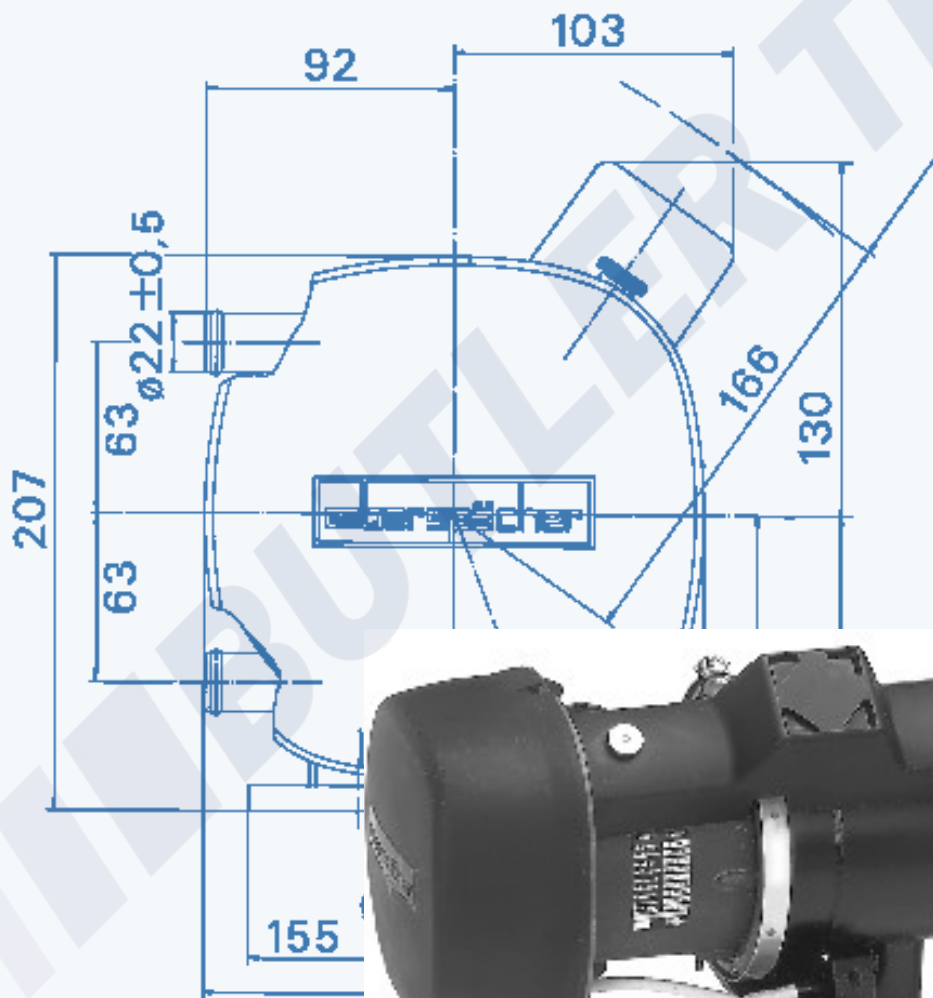
Installation
Troubleshooting and
Repair manual



Espar

Model #'s

- 25 1570/71
- 25 1655/56
- 25 1744/45
- 25 1859/60



15°

October 1998

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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 or fatal injury may result if specific guidelines are not followed.

This publication was correct at the time of print. However, Espar Inc. has a policy of continuous improvement and reserves the right to amend any specifications without prior notice.

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

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

Warning - Fire Hazard

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

Warning - Asphyxiation Hazard

- Route the heater exhaust so that exhaust fumes cannot enter any passenger compartments.
- If running exhaust components through an enclosed compartment, ensure that it is vented to the outside.

Warning - Safety Hazard on Coolant Heaters Used With Improper Antifreeze Mixtures

- The use of ESPAR coolant heaters requires that the coolant in the system to be heated contain a proper mixture of water and antifreeze to prevent coolant from freezing or slushing.
- If the coolant becomes slushy or frozen, the heater's coolant pump cannot move the coolant causing a blockage of the circulating system. Once this occurs, pressure will build up rapidly in the heater and the coolant hose will either burst or blow off at the connection point to the heater.
- This situation could cause engine damage and/or personal injury. Extreme care should be taken to ensure a proper mixture of water and antifreeze is used in the coolant system.
- Refer to the engine manufacturer's or coolant manufacturer's recommendations for your specific requirements.

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

Failure to follow all these instructions could cause serious or fatal injury.



2. Introduction

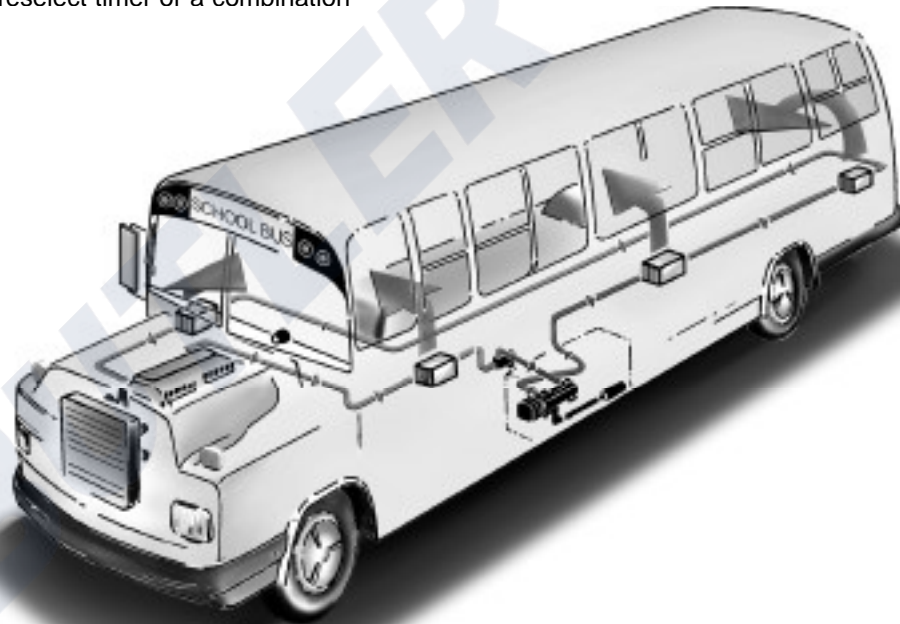
Espar's D12W Coolant Heater

The Espar D12W is a diesel fired 41,000 BTU/hr coolant heater, quality engineered to provide a dependable means of heating. The D12W is available in a universal version or in a weather resistant steel box to protect it and provide for ease of installation.

The heater pumps coolant from the engine, heats it and returns it to the engine. By routing the hot coolant through vehicle heat exchangers it is also possible to heat the interior of the vehicle. Since the heater runs on diesel fuel and 12 or 24 volt power, it is able to perform this completely independently of the vehicle engine. A temperature regulating switch in the unit regulates the coolant temperature between a low of 178°F (81°C) and a high of 194°F (90°C) by automatically cycling the heater through high and low heat levels as required.

The D12W can be operated from the vehicle cab by an on/off switch, a preselect timer or a combination of both.

Temperature regulating switches are available in a safe and dependable system.



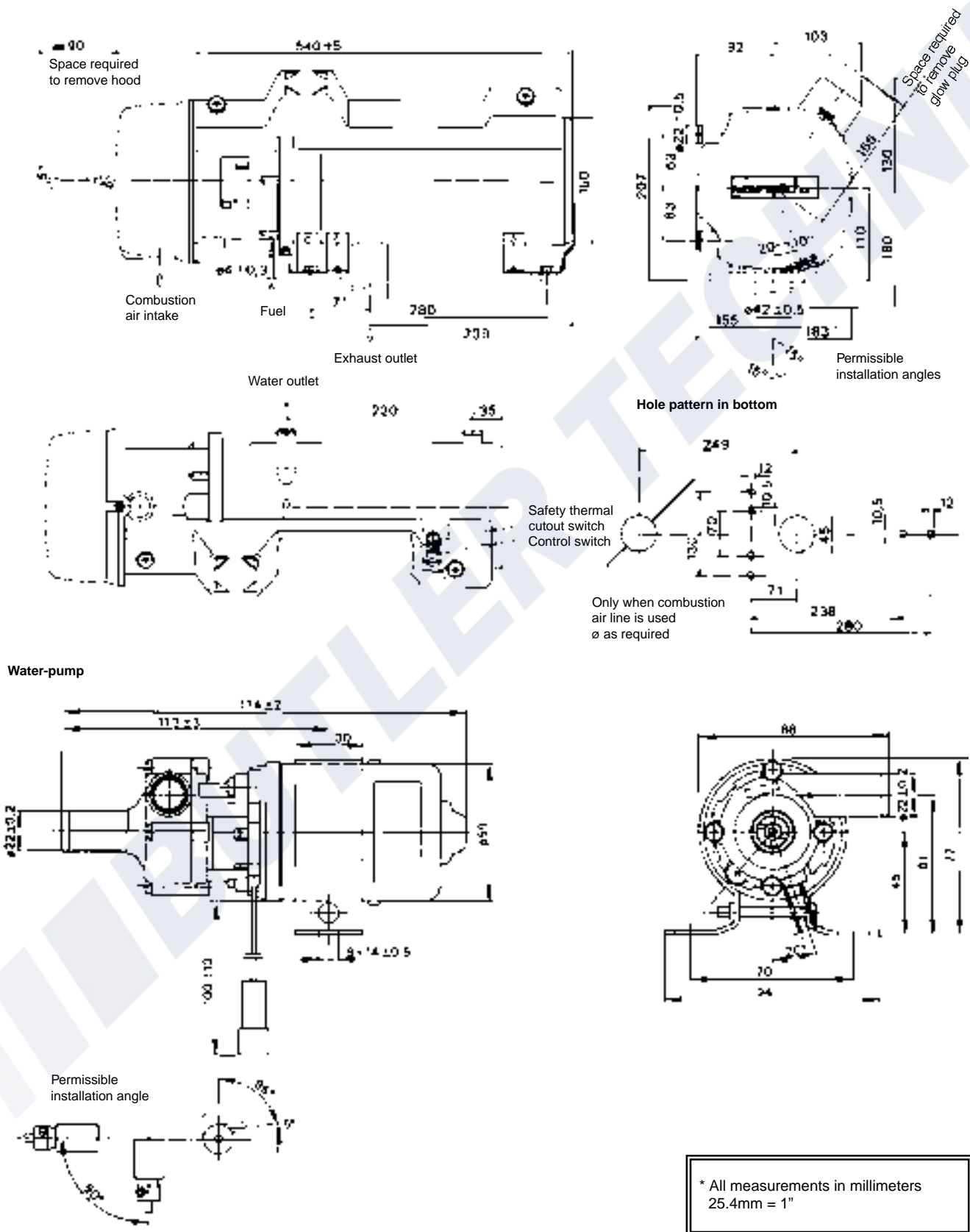
3 General Specifications

Heat Output (±10%)	High - 41,000 BTU (12.0Kw) Low - 24,700 BTU (7.3Kw)		
Current Draw (±10%)	Type	Start	Running
D12W Heater	12V 24V	14.5 amps 12.3 amps	4.5 amps 2.3 amps
Standard Pump	12v 24v		2.5 amps 1.25 amps
High Capacity Pump	12v 24v		8.5 amps 4.58 amps
Fuel Consumption (±10%)	US gal/hr	Litre/hr	
High	0.44	1.65	
Low	0.264	1.0	
Coolant Pump Flow (±5%) at 200 m Bar head pressure	Standard	High Capacity	
	475 US gal/hr 1800 Litre/hr	690 US gal/hr 2600 Litre/hr	
Operating Voltage Range	10.5 to 14.0 vdc at 12 vdc 21.0 to 28.0 vdc at 24 vdc		
Coolant Temperature Range (±5%)			
Standard switch	At 155°F heater switches on (68°) At 176°F heater switches off (80°)		
Hotter Switch	At 178°F heater switches on (81°) At 194°F heater switches off (90°)		
Overheat Temperature Shutdown (±5%)	235°F (115°C)		
Weight	33 lbs.(15Kg.)		
Controls:	On/Off switch or optional timer.		

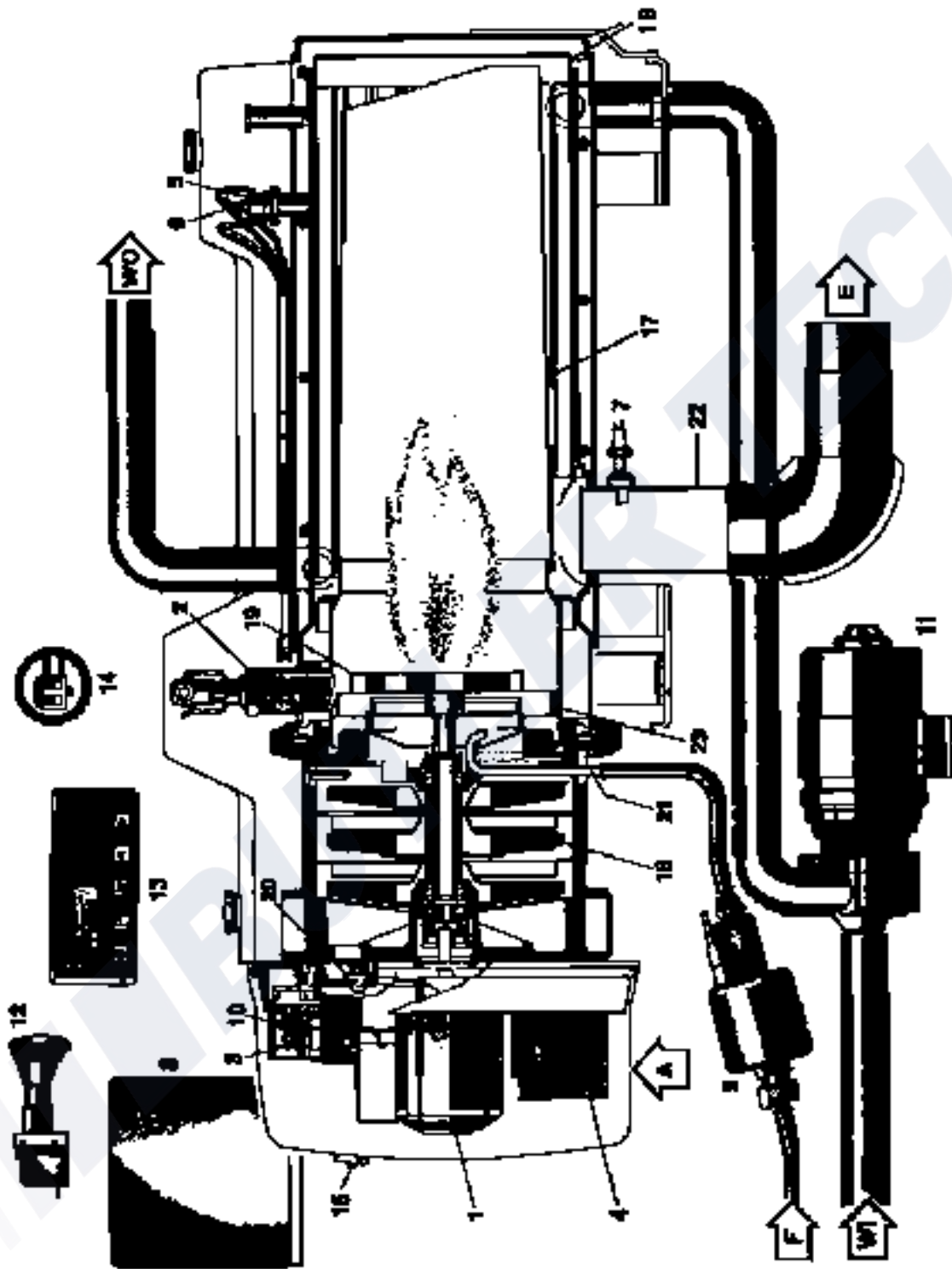
Note: The heater is equipped with a high voltage cutout as well as a low voltage cutout. The coolant pump will not shut down in the event of a low voltage or malfunction cutout.



Principal Dimensions Figure 1A



Heater Components
Figure IB



- | | | | |
|----|-------------------------------|----|-----------------------|
| 1 | Combustion motor | 17 | Flame tube |
| 2 | Glow plug | 18 | Combustion air blower |
| 3 | Series resistor for glow plug | 19 | Atomizer |
| 4 | Ignition spark generator | 20 | Air valve |
| 5 | Temperature Regulating switch | 21 | Fuel pipe |
| 6 | Overheat cutout switch | 22 | Exhaust parts |
| 7 | Flame sensor | 23 | Wick ring |
| 8 | Control unit | | |
| 9 | Fuel metering pump | | |
| 10 | Coolant pump relay | | |
| 11 | Coolant pump | | |
| 12 | Push/Pull switch | | |
| 13 | 7 Day Timer | | |
| 14 | 99 Hour digital timer | | |
| 15 | Diagnostic light | | |
| 16 | Heat exchanger | | |
-
- | | | |
|----|---|----------------|
| WI | = | Water Inlet |
| WO | = | Water Outlet |
| F | = | Fuel |
| A | = | Combustion Air |
| E | = | Exhaust |

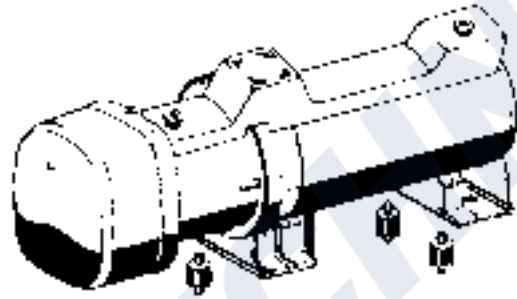


Installation Procedures

Heater Location

Mount the heater in a protected area (eg: storage compartment, engine compartment) If a protected area can't be utilized a boxed version is available. When mounting the heater adhere to the following conditions:

- Situate the heater below the normal coolant level of the engine.
- Guard against excessive road spray.
- Keep coolant hoses, fuel lines and electrical wiring as short as possible



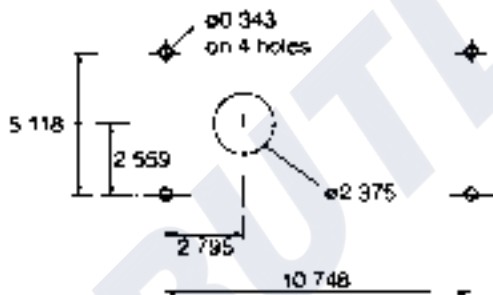
Heater Mounting

Universal mount

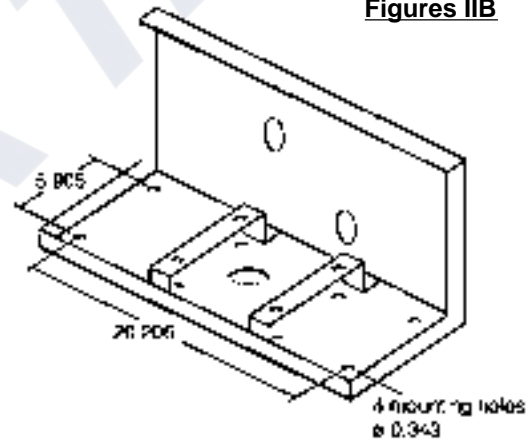
Using the hole pattern shown in Figure IIA, mount the heater using the four(4) shock mounts provided and one of the following mounting methods:

- Use a Side mount bracket to mount the heater on the side of the frame rail.
- Use a storage compartment.

Figure IIA

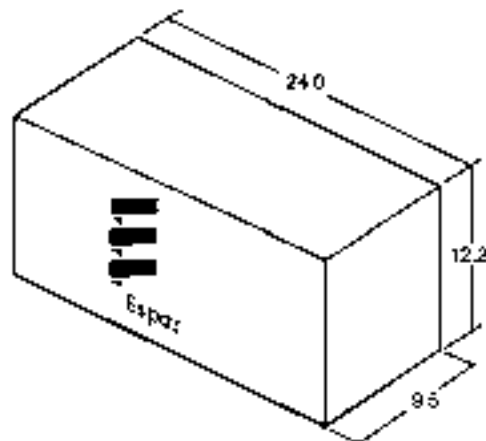


Figures IIB



Box mount

The heater is pre-mounted in a steel box with four(4) rubber shock mounts. These mounts are used between the heater and the box. The overall box dimensions are shown in Figures IIB.



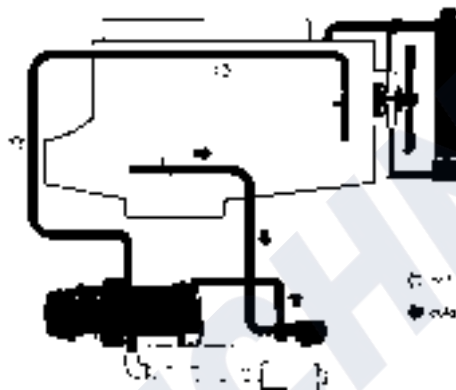
Heater Plumbing

Engine Plumbing

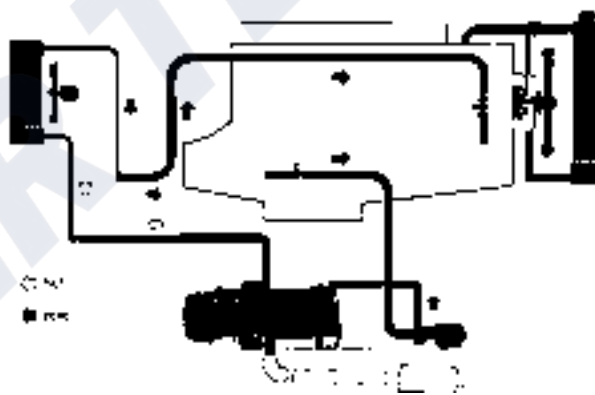
To pre heat engines, follow these guidelines:

- Refer to engine plumbing schematic shown below (Figure IIC).
- Install fittings into the block for pick up and returns.
- Use existing holes in the engine block (ie. remove blanking plugs).
- Use shut off valves to ensure the system can be isolated from the engine when not in use.
- Provide 7/8" or 1" hose barbs for hose connection.
- Use 7/8" or 1" hoses to ensure adequate coolant flow.
- Keep the pick up and return points as far apart as possible to ensure good heat distribution.
- Take the coolant from a low point on the engine to reduce aeration in the system.
- Ensure proper direction of coolant flow by taking coolant from a high pressure point in the engine and returning it to a low pressure point (ie. pickup from back of block and return to the suction side of the engine's water pump).
- Ensure adequate flow rate through the heater by comparing the incoming and outgoing coolant temperatures. If the rise in temperature exceeds 18°F (10°C), coolant flow must be increased by modifying the plumbing methods.
- If the heater is being used to provide supplemental interior heat, refer to the bus plumbing section for alternative plumbing methods.

Figures IIC



D12W plumbed for engine pre-heat



D12W plumbed with heat exchanger

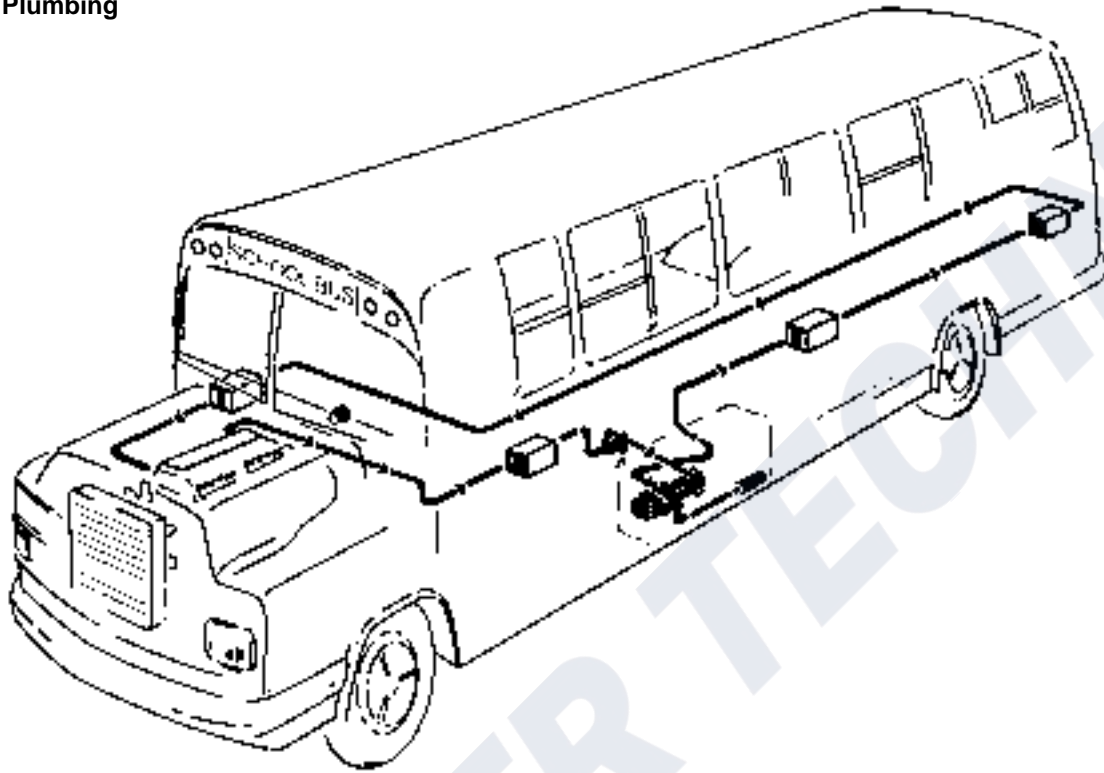
Bus Plumbing

Follow these guidelines to provide supplemental interior heating in addition to engine preheat:

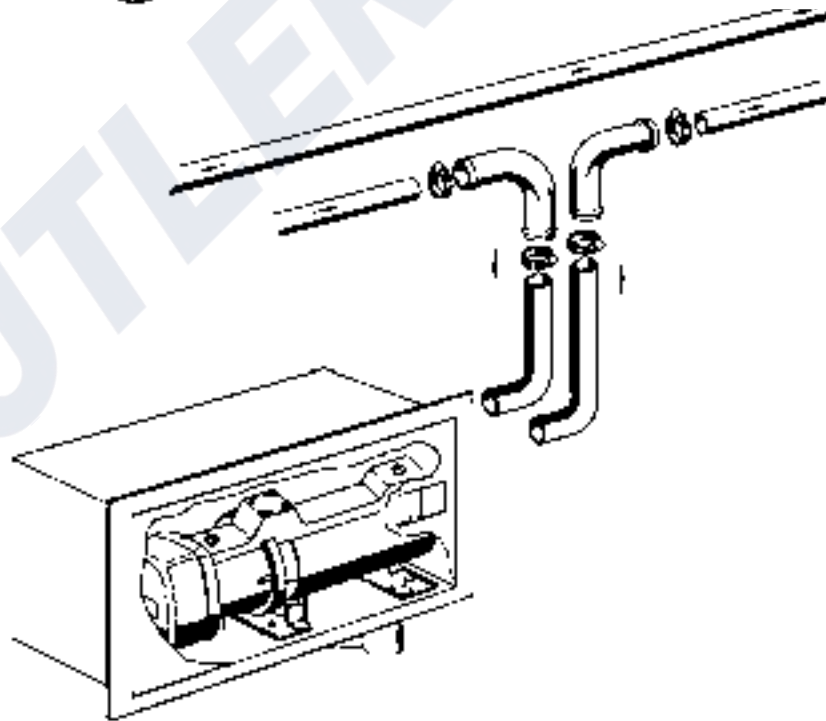
- Plumb the heater in series with existing heating system.
- Use special plumbing accessories to simplify installations (refer to Skirt Mount Illustration on following page, Figure II E).
- follow the engine plumbing guidelines to ensure proper flow through the system.
- Refer to the plumbing schematic on following page for proper plumbing configuration, Figure II D.



School Bus Plumbing
Diagram
Figure II D



Skirt Mount Plumbing
Diagram
Figure II E



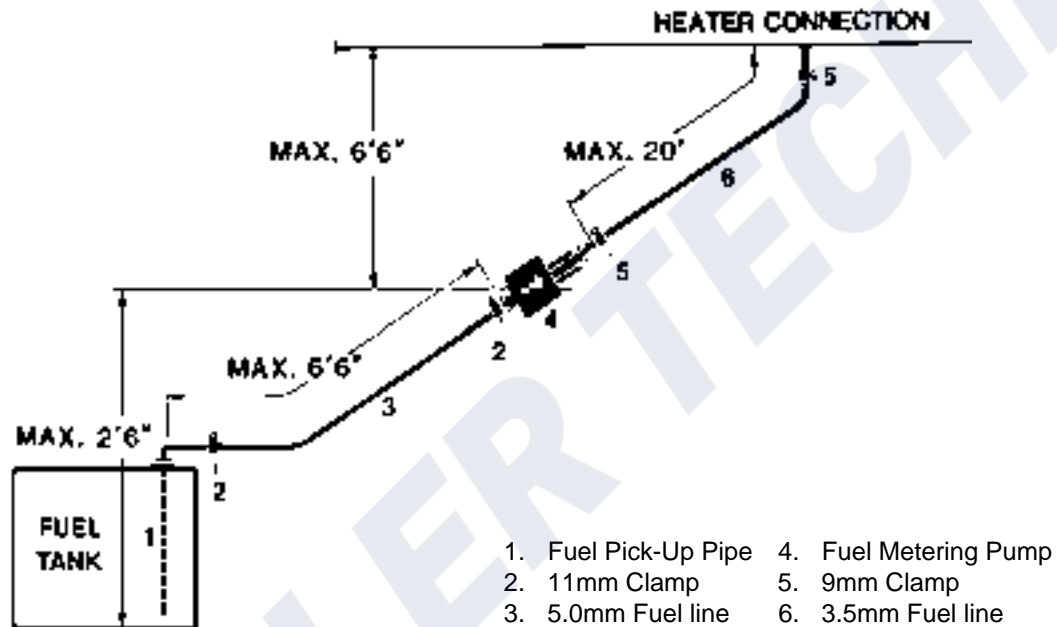
Note: The coolant must contain a minimum of 10% antifreeze at all times as a protection against corrosion. Fresh water will corrode internal heater parts.

Fuel System

The fuel metering pump is the heart of the system and must be installed properly to ensure a successful heater operation. All parts for installation are included with your package. Refer to Figure II F for connections and specifications.

- Note:**
- Fuel line limits must not be exceeded.
 - Ensure that the following conditions are met;
 - Bottom of the fuel metering pump must be within a height of 2'6" of the bottom of the fuel pick-up pipe.
 - Fuel metering pump must be within a total distance of 6'6" from the fuel pick-up pipe.

Figure II F
Fuel System
Tolerances



Fuel Metering Pump

- Choose a protected mounting location close to the fuel pick-up pipe and heater.
- Using the bracket and rubber mount provided, install pump as shown in Figure II G.

Note: Proper mounting angle of 15° is necessary to allow any air or vapor in the fuel lines to pass through the pump rather than cause a blockage.

Fuel Line

- Route fuel lines from the fuel pick-up pipe to the fuel metering pump then to the heater.
- Use fuel lines provided.
- Other sizes or types of fuel lines may inhibit proper fuel flow.

Figure II G





Fuel Pick-Up Pipe Installation (Standard Pick-Up)

- Choose a protected mounting location close to the pump and heater. A spare fuel sender gauge plate provides an ideal mounting location.
- Drill the mounting holes as shown in Figure II I.
- Cut the fuel pick-up pipe to length.
- Mount the fuel pick-up pipe as shown in Figure II J.
- Lower the fuel pick-up pipe (with reinforcing washer) into the tank using the slot created by the two 1/4" holes.
- Lift the assembly into position through the 1" hole.
- Assemble the rubber washer, metal cup washer and nut.

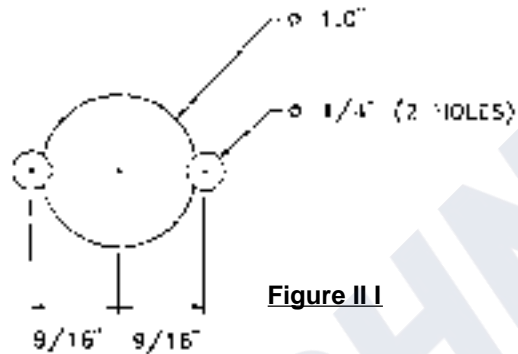
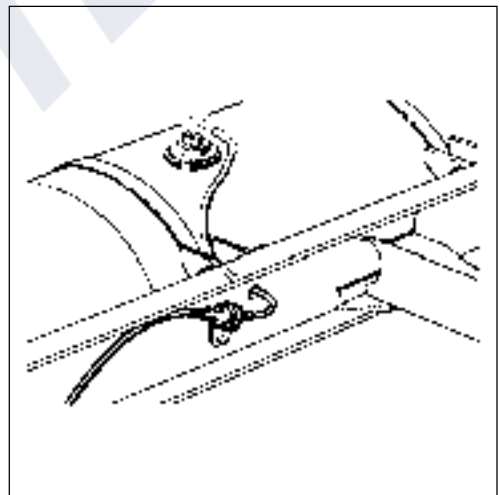
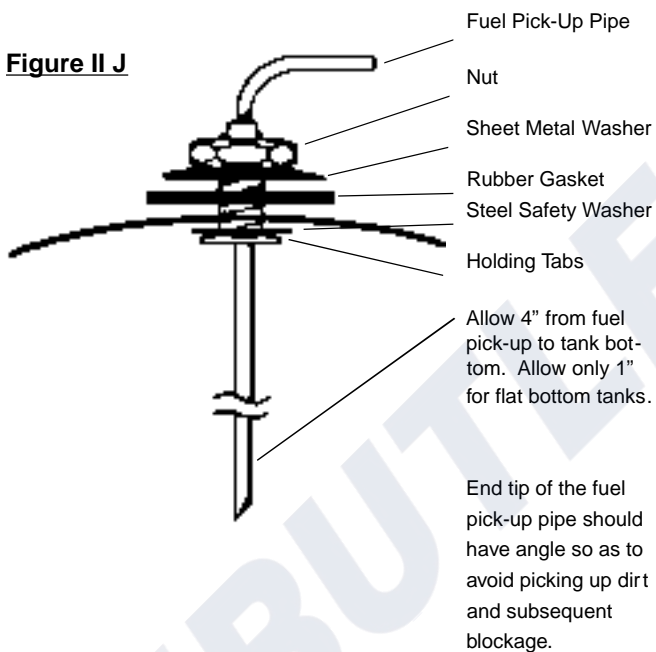


Figure II I

Note: Drill the two 1/4" holes first.

Figure II J

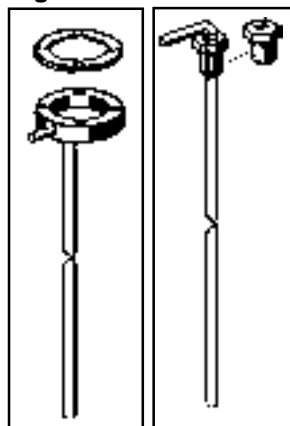


(Optional Pick-Up Pipe with NPT fitting)

- Remove an existing plug from the top of the fuel tank.
- Cut the fuel pick-up pipe to length.
- Secure the fuel pick-up pipe into position using the combined NPT compression fitting as shown in Figure II K.

Note: NPT fittings are available in various sizes (Refer to parts section on pg. 41).

Figure II K

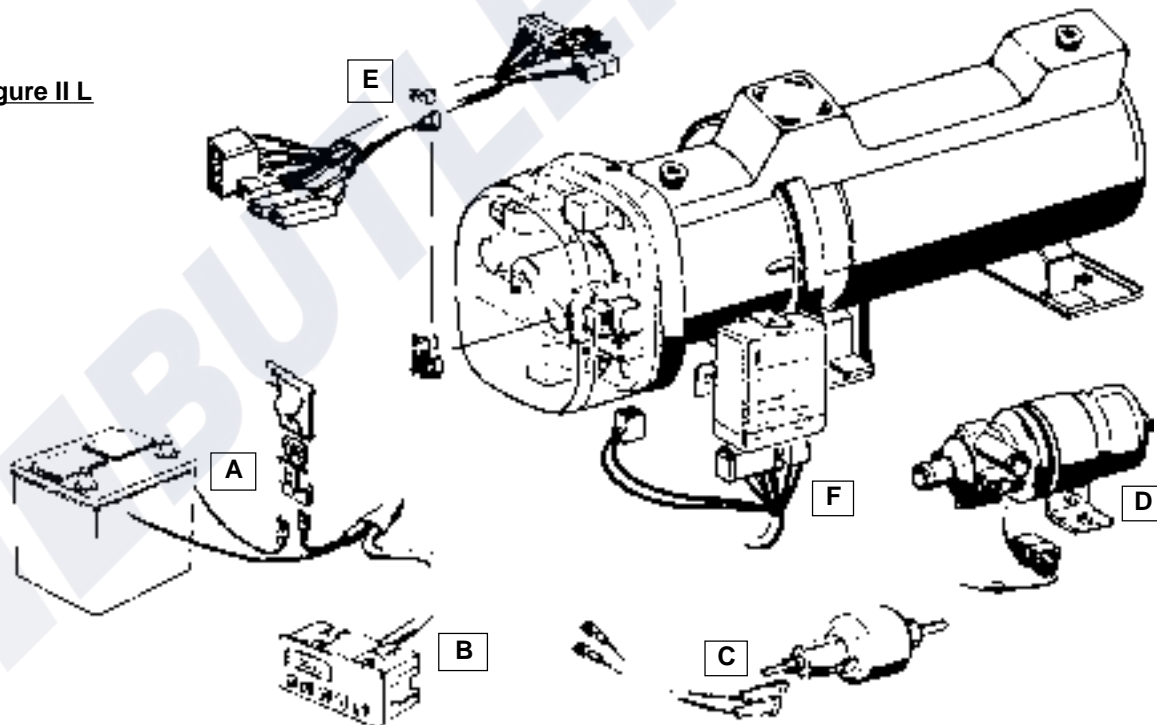


Electrical Connections

Caution: To avoid potential short circuit damage during installation, Make connection to the positive terminal at battery after all electrical connections are complete.

- A) **Power Harness**.....
 - 2 core harness (red and brown).
 - Connect red wire to vehicle battery (+) via fuse link provided, use ring terminal provided.
 - Connect brown wire to vehicle battery (-), use ring terminal provided.
- B) **Switch Harness**.....
 - 3 core harness (red, brown, yellow).
 - Run to location of switch.
- C **Fuel Metering Pump Harness**
 - 2 core harness (green and green).
 - Run to location of fuel pump.
- D) **Water Pump Harness**.....
 - 2 core harness (red and brown).
 - Connect to plug at the water pump (pre-connected in boxed heaters).
- E) **Pig Tail Harness**.....
 - Connects the above harnesses to the heater wiring under the cover.
- F) **Control Unit**.....
 - Connect to mating plugs.

Figure II L



Note: All harnesses should be cut to length.
All exposed electrical connections should be coated with protective grease.



Exhaust Connection

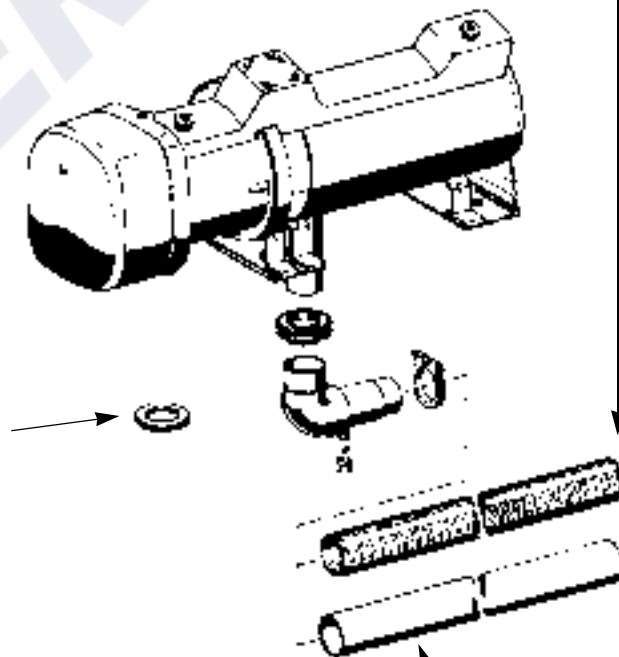
A 42mm flexible stainless steel exhaust pipe (1 meter long), exhaust clamps and holders are provided with the heater kit. Connect the exhaust as follows:

Caution: - Run exhaust so that it cannot be plugged by dirt, water or snow. Ensure the outlet does not face into the vehicle slip stream. Install exhaust pipe with a slight slope or drill a small hole in the lowest point to allow water to run off. Any restriction in exhaust will cause operational problems.

- Connect the exhaust pipe to the exhaust tube on the heater and attach with clamp provided.
- For a boxed heater run the exhaust pipe through the silicone (white) gasket on the bottom of the box.
- Run exhaust to an open area to the rear or side of the vehicle so that fumes can not build up and enter the passenger compartment or the heater combustion air intake.
- Secure the exhaust pipe internally at the heater and externally using clamps and holders provided. Figure II M.

40mm diameter exhaust to be used with 90°elbow. End cap only available for 40mm diameter exhaust.

Figure II M



Boxed units require a white silicone gasket which protects the exhaust from the box.

WARNING: The exhaust is hot, keep a minimum of 2" clearance from any heat sensitive material.

WARNING: Route exhaust so that the exhaust fumes cannot enter the passenger compartment.

42mm diameter exhaust to be used without 90°elbow. No end cap available

Operating Switches

A Push/Pull Switch is supplied with the heater, an optional 99 Hour Digital Timer or a 7 Day Timer are also available. Connect the operating switch as follows.

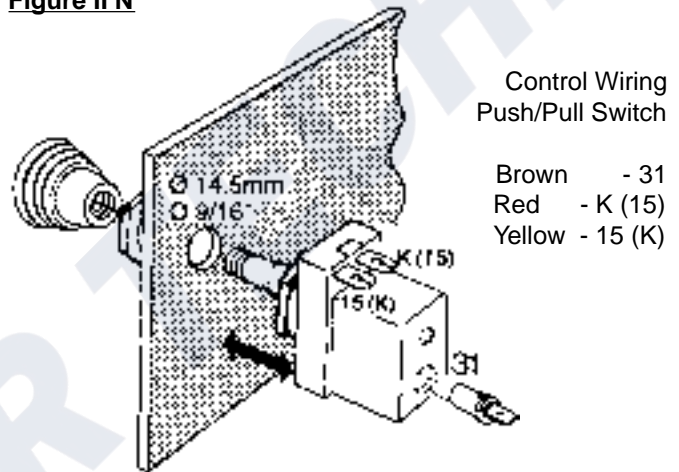
Push/Pull Switch

- Mount switch in a location where it is easily accessible.
- Mount using hardware supplied.
- Connect the 25' switch harness to the connector at the heater and run the harness to the switch location.
- Cut harness to length at the switch and install terminals.
- Connect wiring as shown in Figure II K.

Note: Wired as above the switch light glows when pulled out and is off when pushed in.



Figure II N



Control Wiring
Push/Pull Switch

Brown - 31
Red - K (15)
Yellow - 15 (K)

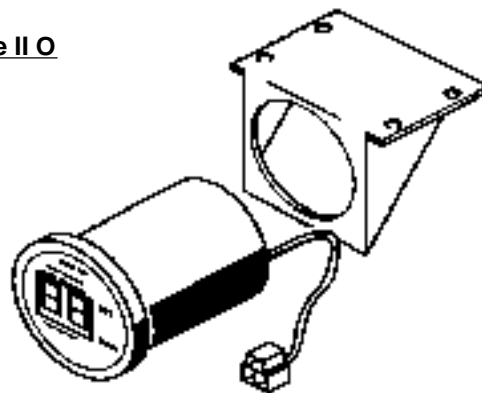
99 Hour Digital Timer

This timer is pre-set by Espar to operate the heater for one (1) hour only. If an alternative run time setting is desired refer to the instructions provided with the timer.

- Mount the timer using a 2" hole in the dash or the optional mounting bracket.
- Mount timer using hardware supplied.
- Connect the 25' switch harness to the connector at the heater and run the harness to the switch location.
- Cut harness to length and terminate wires.
- Attach using connector provided.

Red-Red
Yellow-Yellow
Brown-Brown

Figure II O



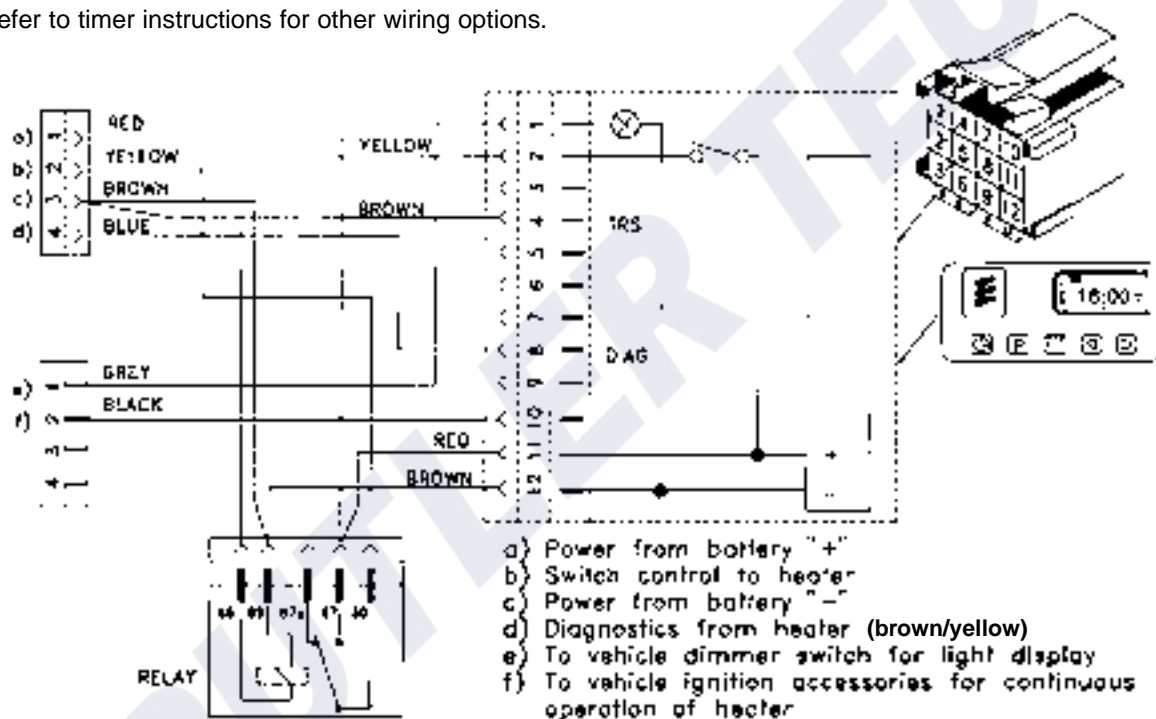
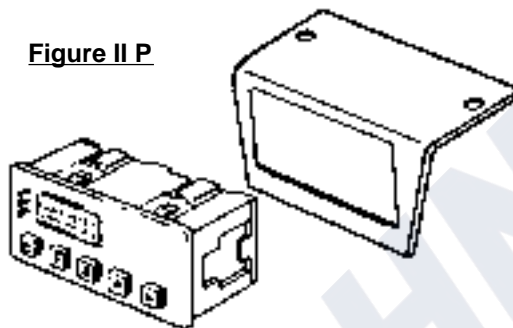


7 Day Timer

The 7 day timer is capable of setting up to 3 preset start times within 24 hrs. or 1 start time within 7 days. It also has other functions such as a current time display. Refer to instructions provided with timer for setting options.

- Mount timer and bracket in a suitable location.
- Connect the 25' switch harness to the connector at the heater and run the harness to the switch location.
- Cut harness to length at the switch and install terminals.
- Connect harness to timer as shown in Figure II P
- Refer to timer instructions for other wiring options.

Figure II P



Note: The timer display is automatically illuminated while the heater is operating.

Connecting the grey wire to the vehicle dimmer switch will allow the timer display to illuminate with the vehicles dash lights.

An alternative to connecting the black wire to the vehicle ignition accessories "On" circuit may also be considered for some applications where extended run times are desired.

Connecting the black wire with the red wire will enable the heater to run continuously whether the heater is switched on manually or through the preset function.

Heater Operation

1. Pre-Start Procedures

Upon completion of installation prepare the heater as follows:

- Check all fuel, electrical and plumbing connections.
- Refill the engine coolant
- Bleed air from the coolant system by loosening the top heater hose to allow air to escape.
- Resecure the heater hose.
- Run engine to further bleed the system.
- Top up engine coolant.

2. Start Up

Once switched on the following sequence occurs:

- Control unit does a systems check (glow plug, flame sensor, temperature, safety thermal cutout switch and various control unit checks).
- Combustion air blower starts.
- Ignition system begins to preheat combustion chamber. (3-20sec. depending on input voltage)
- After sufficient glow pre-heat, the fuel pump will start.
- Once ignition takes place the flame sensor will automatically switch the ignition system off (ignition time: 1-3 minutes maximum).

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.

Note: On initial start up the heater may require several start attempts to self prime the fuel system.

3. Running

Once ignition is successful the following operations take place:

- Heater runs in full heat mode.
- Once coolant reaches 176°F (80°C) the heater automatically switches to low heat mode and continues to run.
- If coolant temperature drops to 167°F (75°C) the heater will automatically switch back to full heat mode.
- If coolant temperature continues to rise, the heater will automatically switch off once coolant temperature reaches 185°F (85°C).
- The water pump will continue to circulate coolant to allow the heater to monitor engine temperature.
- The heater will automatically re-start once coolant temperature drops to 167°F (75°C).
- The heater will continue to run as described above until it is switched OFF, either manually, automatically by a timer or heater malfunction shutdown.

Note: While in running mode if the heater should shut down due to flame out, it will automatically attempt one restart, if successful it will continue to run, if not it shuts down completely.

Note: During operation the heater continually senses the input voltage from the batteries, if the input voltage drops to approximately 10.0 volts (20.0 V for a 24 V system) the heater will automatically shut down.

4. Switching Off

When the heater is switched off, manually or automatically, it starts a controlled cool down cycle.

- The fuel metering pump stops delivering fuel and the flame is extinguished.
- The glow plug is re-energized for a 15 second after glow.
- The combustion air blower and water pump continue to run for a three (3) minute cool down cycle, then switch OFF.



Warning: The heater must be switched OFF while any fuel tank on the vehicle is being filled.



Warning: The heater MUST NOT be operated in garages or enclosed areas for prolonged periods of time.

5. Safety Equipment

The control unit, overheat switch and flame sensor continually monitor heater functions and will shut down the heater in case of a malfunction.

- The control unit ensures electrical circuits (glow plug, fuel metering pump, combustion air blower etc.) are complete prior to starting the heater.
- If the heater fails to ignite within 90 seconds of the fuel pump being started, the starting procedure will be repeated. If the heater again fails to ignite after 90 seconds of fuel being pumped, a “no start safety shutdown” follows.
- If the heater flames out during operation, the heater automatically attempts to restart. If the heater fails to ignite within 90 seconds of fuel delivery, or ignites but flames out again within 3 minutes, “flame out” shutdown follows.
- Overheating due to lack of water, a restriction or a poorly bled coolant system results in the overheat cutout switch tripping. Fuel delivery will cease and an “overheat shut down” follows.
- If at any time the voltage drops below 10.0v or 20.0v (for 24V), or rises above 14.0v or 28.0v (for 24V), “high/low voltage” shutdown follows (after a 20 second delay).

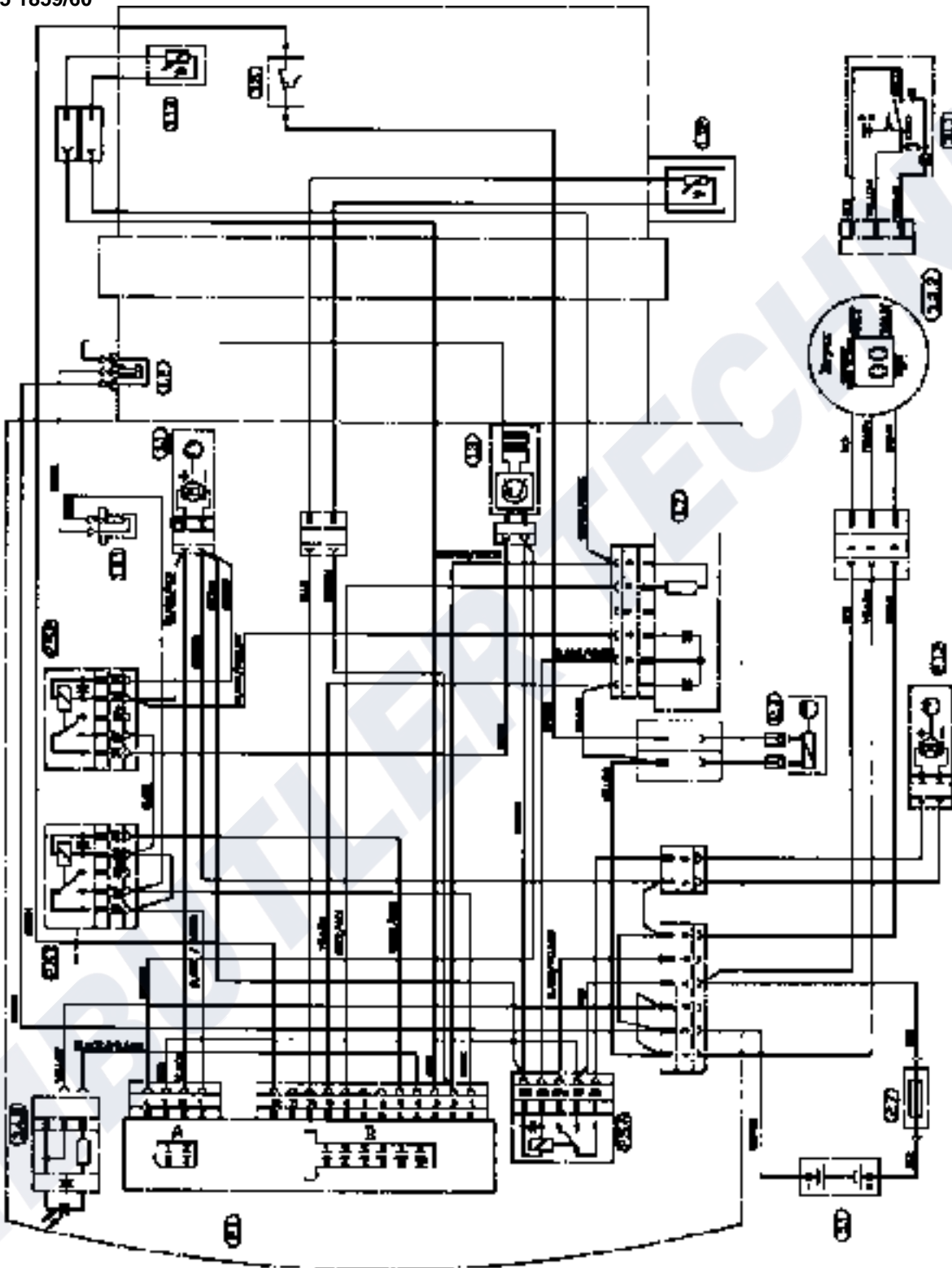
Operational Flow Chart

STARTING PHASE		RUNNING PHASE				SHUT DOWN PHASE	
Pre-heat 2nd. attem pt	On	On	On	On	On		
Ignition Attem pt 2nd. attem pt	On	On	On	On	On		
	50 sec.						
	Up to 90 sec. If Required						



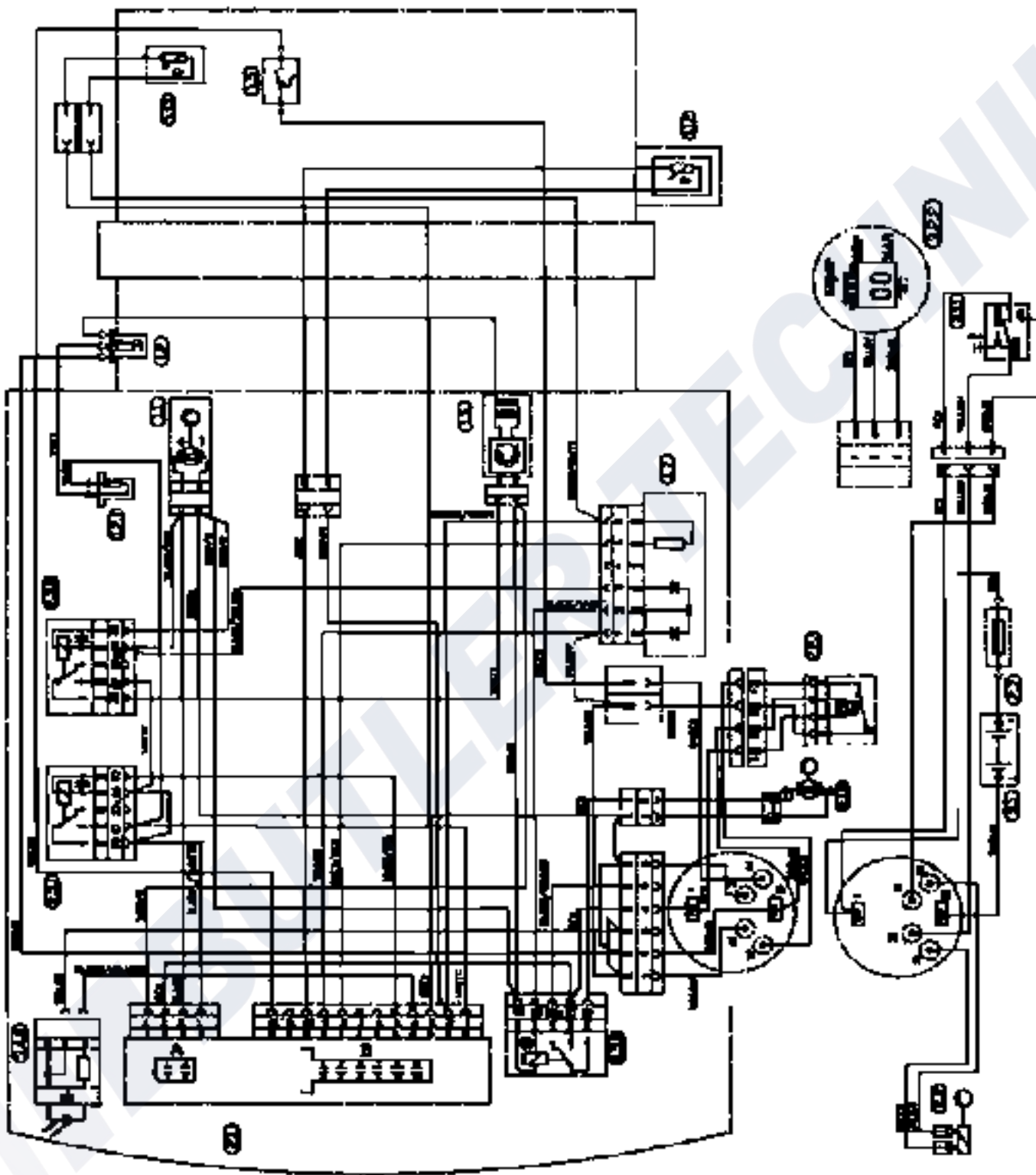
D12W Wiring Diagram

Model 25 1859/60



- | | | | | | |
|-------|----------------------------|-------|-----------------------|-------|-----------------------|
| 1.1 | Combustion air blower | 1.13 | Temperature sensor | 2.12 | Water pump |
| 1.2 | Glow plug/Spark plug | 2.1 | Control unit | 3.1.1 | Push/pull switch |
| 1.2.1 | Series resistor (24V only) | 2.2 | Fuel metering pump | 3.2.2 | Timer (99hr. digital) |
| 1.3 | Ignition spark generator | 2.5.1 | Glow plug relay | 3.4.8 | Diagnostic LED |
| 1.5 | Overheat switch | 2.5.2 | Spark generator relay | 5.1 | Battery |
| 1.7 | Printed circuit board | 2.5.6 | Coolant pump relay | | |
| 1.12 | Flame sensor | 2.7 | Main fuse 30 amp | | |

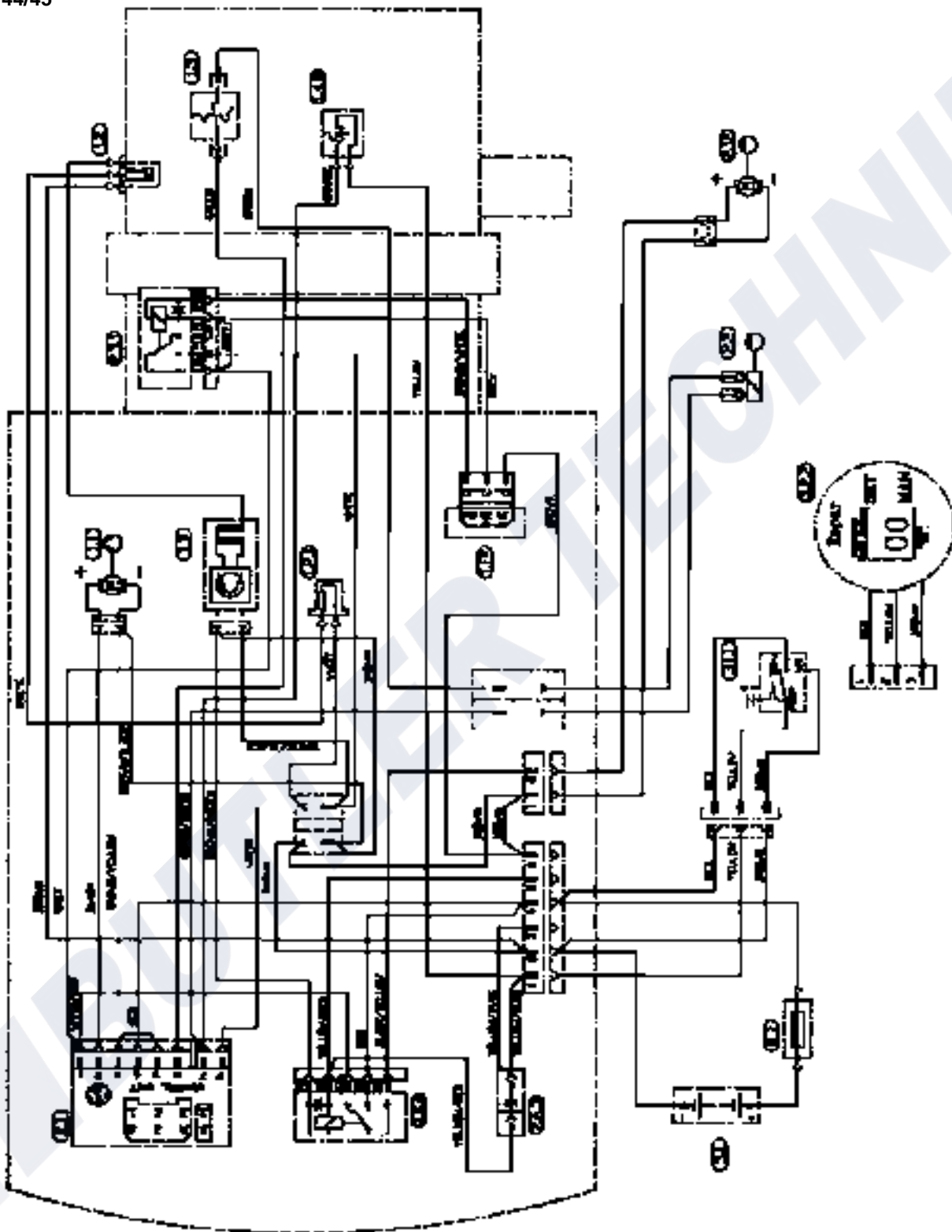
D12W Wiring Diagram
 Model 25 1859/60 with Skirt Mount



- | | | | | | |
|-------|----------------------------|-------|-----------------------|-------|-----------------------|
| 1.1 | Combustion air blower | 1.13 | Temperature sensor | 2.7 | Main fuse 30 amp |
| 1.2 | Glow /Spark plug | 2.1 | Control unit | 2.12 | Water pump |
| 1.2.1 | Series resistor (24V only) | 2.2 | Fuel metering pump | 3.1.1 | Push/pull switch |
| 1.3 | Ignition spark generator | 2.2.1 | Roll over switch | 3.2.2 | Timer (99hr. digital) |
| 1.5 | Overheat switch | 2.5.1 | Glow plug relay | 3.4.8 | Diagnostic LED |
| 1.7 | Printed circuit board | 2.5.2 | Spark generator relay | 5.1 | Battery |
| 1.12 | Flame sensor | 2.5.6 | Coolant pump relay | | |



D12W Wiring Diagram
Model 25 1744/45



- 1.1 Combustion air blower
- 1.2 Glow/Spark plug
- 1.2.1 Series resistor
- 1.3 Ignition spark generator
- 1.4.5 Temperature regulating switch
- 1.5 Overheat switch
- 1.12 Flame sensor
- 2.1 Control unit
- 2.2 Fuel metering pump
- 2.5.1 Fuel plug relay
- 2.5.6 Coolant pump relay
- 2.6.3 Coolant pump diode
- 2.7 Main fuse 30 amp
- 2.12 Water pump
- 3.1.1 Push/pull switch
- 3.2.2 Timer (99hr. digital)
- 5.1 Battery

Maintenance Troubleshooting & Repairs

1. Recommended Periodic Maintenance

- Remove the glow plug and inspect for carbon build up. Clean or replace.
- Espar recommends the use of non detergent 100% volatile carburetor cleaner and an air gun to remove carbon. Remove loose carbon from the glow plug chamber.
- Check coolant hoses, clamps, and make sure all valves are open. Maintain the engine manufacturers recommended coolant level and ensure that the heater is properly bled after service on or involving the coolant system.
- Run your heater at least once a month during the year (for a minimum of 15 minutes).
- Maintain your batteries and all electrical connections in good condition. With insufficient power the heater will not start. Low and high voltage cutouts will shut the heater down automatically.
- Use fuel suitable for the climate (see engine manufacturers recommendations). Blending used engine oil with diesel fuel is not permitted.

2. Troubleshooting

A. Basic Troubleshooting

In the event of failure there are several items which should be checked first before any major troubleshooting is done.

- Check**
- Circuit breakers and Fuses.
 - For breaks on Glow Plug coil.
 - Electrical lines and connections
 - For interference in Combustion air and Exhaust pipes.
 - That there is fuel in the tank.
 - Has the over heat cut-out switch triggered? Figure IV A
If so press the red reset switch

If a fault can't be detected follow one of the other troubleshooting methods outlined in this manual.

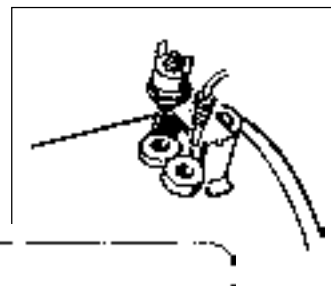
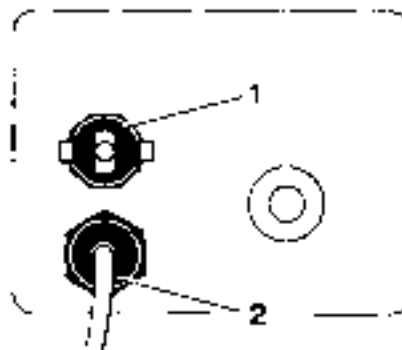


Figure IV A



1. Overheat cutout switch
2. Internal water thermostat



Troubleshooting

Fault →									
Cause ↓									
	No blower noise approx. 5 secs. after switch on	Blower runs for approx. 5 secs. after switch on, then cuts out automatically.	Blower runs for approx. 5 secs. after switch on, pump ticks, automatic cut out after 3 min.	Blower runs for approx. 5 secs. after switch on, pump does not tick, automatic cutout after 3 min.	Heater cuts out permanently during heater operation.	Heater capacity insufficient or heater goes off by itself.	Heater smokes and soots.	Blower continues to run after switch off longer than the usual delayed cutoff time (3-4 min.).	
Main 16A fuse defective	✓								
Glow ignition plug (GZE 201) coked/defective			✓						
Motor current fuse in control unit defective	✓								
Safety thermal cutout switch has responded					✓				
Ignition spark generator defective			✓						
Glow plug series resistor defective			✓						
Under voltage		✓							
Overvoltage		✓			✓				
Control unit not supplying pulses for the fuel metering pump				✓					
Reed relay in control unit has no contact		✓							
On/off switch, timer, control switch defective	✓								
Plug relay sticking in D12W (25 1859/60) with temperature switch			✓						
Electronic delayed shutoff unit defective in D12W (25 1859/60) with flame sensor								✓	

Check	Remedy
Visual/continuity check	Remove short-circuit in the wiring or coke from the heating coil of the glow ignition plug, replace the glow ignition plug if necessary
Visual/continuity check	If necessary, change glow ignition plug
Visual/continuity check	Remove damage in combustion air system motor or blower, change the motor current fuse
Switch off the heater Check water flow (min. 1000 l/h)	Remove air from water circuit, operate the safety thermal cutout switch
Hold high-tension cable approx. 5mm away from earth	If necessary, change the ignition spark generator
Visual/continuity check	If necessary, change the glow plug series resistor
Measure voltage at 6-pin plug, terminals 4 and 2, min. voltage 10.5 or 21v	Charge battery Check wiring for voltage drops
Measure voltage at 6-pin plug, terminals 4 and 2, max. voltage 14.5 or 29v	Check dynamo regulator, change if necessary
Connect pilot light to the contacts of the fuel metering pump or terminal 6 on the control unit, if no pulses are available.	Change the control unit
See fault	Change the control unit
Visual/continuity check	If necessary, change the operating element
Check relay functioning	If necessary, change the plug relay
See fault	Change the optical flame sensor



Troubleshooting

Fault →

↓ Cause

	No blower noise approx. 5 secs. after switch on	Blower runs for approx. 5 secs. after switch on, then cuts out automatically.	Blower runs for approx. 5 secs. after switch on, pump ticks, automatic cut out after 3 min.	Blower runs for approx. 5 secs. after switch on, pump does not tick, automatic cutout after 3 min.	Heater cuts out permanently during heater operation.	Heater capacity insufficient or heater goes off by itself.	Heater smokes and soots.	Blower continues to run after switch off longer than the usual delayed cutoff time (3-4 min.).
Fuel metering pump not pumping				✓				
Fuel metering pump pumping too much							✓	
Fuel metering pump pumping too little			✓			✓		
Fuel line leak Filter Clogged Air in the fuel line			✓			✓		
Combustion and/or exhaust line clogged							✓	
Combustion air blower speed too low							✓	
Electric motor defective	✓							
Blower damage (Combustion air blower damage)	✓							
Temperature switch does not respond in D12W 25 1859/60			✓					
Optical flame sensor defective in D12W 25 1859/60			✓					

Check

Remedy

Connect test lamp to the fuel metering pump when pulses are present

Replace fuel metering pump

Measure fuel quantity; if the quantity is outside the permissible tolerance

Replace fuel metering pump

Measure fuel quantity; if the quantity is outside the permissible tolerance

Replace fuel metering pump

Visual check

Seal and bleed fuel line, change filter

Visual check

Remove blockage

Measure speed at motor shaft 5900 RPM +10% (at rated voltage)

Change electric motor

If the shaft of the electric motor does not turn

Replace burner

If the shaft of the electric motor turns

Change electric motor

Defect is present when there is still minus at terminal 85 (glow plug relay) after max. 120 secs. after switch-on

Change temperature switch

Clean quartz rod on flame sensor with a soft cloth: if no function:

Change the optical flame sensor

Fault Code	Fault description	Indication		Remedy
		Fault signal/flashing code		
000	No fault	████████████████████		
001	Pre-heating, overvoltage	■	■	Check control unit. Charge battery
002	Pre-heating, under voltage	■	■	
010	Overvoltage switch-off	████	■	Check control unit. Check battery charge. Connect heater directly to the battery.
011	Under voltage switch-off	████	■	Charge battery. Check control unit. Check cross sections of power leads.
012	Overheating	■	■	Overheating switch has triggered, vent heater (lack of water), open heating valve, check water flow and switch. Check for continuity through fuel metering circuit. Check electrical leads and contacts to metering pump. Flame sensor has reported a high temperature. Check sensor.
013	Temperature at heat exchanger to high	■	■	
020	Glow plug defect	■	■	Check glow plug. Check connections to glow plug and to glow plug relay. Check connection to control unit.
022	Short circuit in current regulator contacts	■	■	Check glow plug relay (current regulator). Check connection to glow plug, check connection to control unit.
023	Interruption in current regulator	■	████	Check coil connection to glow plug relay. Check connection to control unit.
024	Short circuit in current regulator coil	■	■	Check coil connection at glow plug relay. Check connection to control unit.
025	Short circuit at diagnostic output	No flashing code		No flashing code. Check diagnosis lead. Check connection to control unit.

Fault Code	Fault description	Indication		Remedy
		Fault signal/flashing code		
030				
031	Combustion air fan does not rotate	■		Check combustion air fan. Replace if necessary. Check motor speed relay . Check connection to control unit
032				
033				
037	Water pump does not rotate	■ ■ ■ ■ ■ ■ ■ ■		Check water pump (external triggering). Check connections to control unit
047	Short circuit in metering pump	■ ■ ■ ■ ■ ■ ■ ■		Check metering pump. Check connections to control unit.
051	Flame sensor defect	■		Temperature at flame sensor does not fall below Check flame sensor or combustion, possibly replace.
052	Failure to start/safety time expired	■ ■ ■ ■ ■ ■ ■ ■		No flame was detected during the start up phase . Check the fuel supply & cable harness of metering pump. Check glow plug, exhaust & combustion air piping.
053	Flame out in "high" mode	■ ■ ■ ■ ■ ■ ■ ■		Heater has started (flame detected) and indicates flame loss in power setting. Check fuel flow rate, blower speed, combustion is O.K, necessary.
	check flame sensor, replace if	■ ■ ■ ■ ■ ■ ■ ■		055 Flame out in "low" mode
059	Water temperature rises too quickly	■ ■ ■ ■ ■ ■ ■ ■		Check water circulation and temperature control sensor
060	Interruption in temperature sensor			Measured temperature lies outside measuring range. Check sensor.
061	Short circuit in temperature sensor	■ ■ ■ ■ ■ ■ ■ ■	Indication	Check connection to control unit Remedy



Fault Code	Fault description	Fault signal/flashing code	
064	Interruption in flame sensor		
065	Short circuit in temperature sensor	■ ■ ■ ■ ■ ■ ■ ■	Measured temperature lies outside measuring range. Check sensor. Check connections to control unit
090	Control unit defect (internal reset)		
092	ROM fault		
093	RAM fault		
094	EEPROM fault	■ ■ ■ ■ ■ ■ ■ ■	Replace control unit
095	Control unit defect (general fault)		
096	Control unit defect (general fault)		
097	Control unit defect or cable harness fault	■ ■ ■ ■ ■ ■ ■ ■	Check and if necessary replace control unit. Check cable harness.
091	External interference voltage	■ ■ ■ ■ ■ ■ ■ ■	Check voltage supply. Check connection to control unit



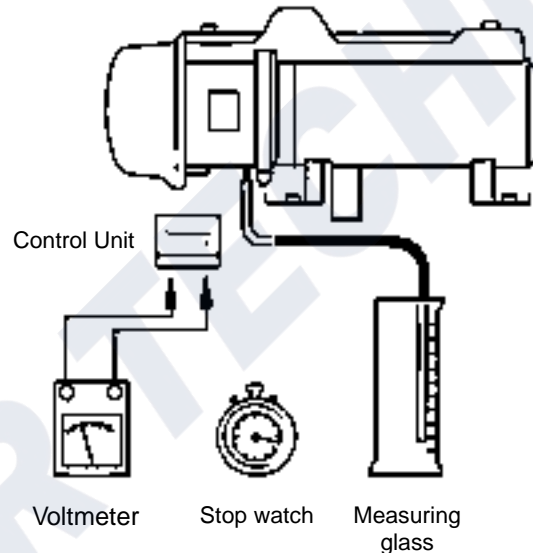
Fuel Quantity Test

The fuel Quantity should be tested if the heater has difficulty starting or maintaining a flame.

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

A). Preparation

- Apparatus:- voltmeter, measuring glass, stop watch.
- Detach the fuel line from the heater.
- Insert the fuel line into a measuring glass.
- Connect the voltmeter to terminals 3(-) and 4(+) of the control unit.
- Switch the heater on and allow the fuel line to bleed.(approx.25-55 seconds)
- Switch off the heater and empty the measuring glass.



B). Measurement

- Switch on the heater.
- Hold the fuel line in the measuring glass while fuel is being delivered.
- Fuel starts being pumped 25 - 55 seconds after switch-on.
- Hold the measuring glass at the level of the plug during measurement.
- Read the voltage at the voltmeter.
- The pump will stop delivering fuel automatically after 90 seconds.
- Switch off the heater.

C). Evaluation

- Read the fuel quantity in the measuring glass.
- Transpose the readings into the appropriate diagram. Figure IV E
- The fuel consumption is OK if the intersection of the two readings are within the limit curves.
- If the intersection is outside the limit curves, inspect the fuel system and replace fuel metering pump if necessary.

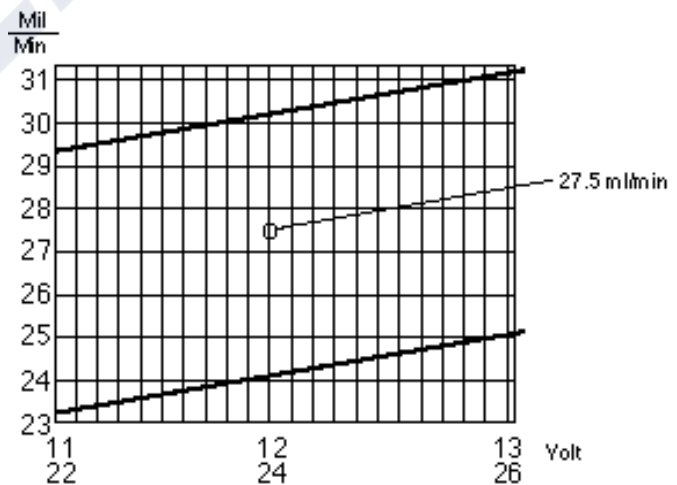


Figure IV E

Note: Do not adjust fuel metering pump. Adjustments will only provide a temporary fix.

Repair Steps

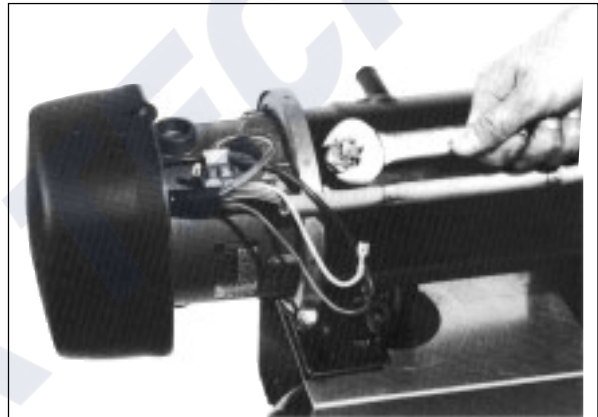
Removal and Replacement of the:

1. Glow Plug
2. Overheat Switch
3. Control Switch (Model # 25 1570/71)
4. Temperature Switch (Model # 25 1570/71)
5. Ignition Spark Generator
6. Control Unit (Model # 25 1570/71
25 1655/56)
7. Series Resistor (24V)
8. Electric Motor
9. Water Pump Diode (Model # 25 1570/71)
10. Glow Ignition and Water Pump Relays
11. Burner Head
12. Flame Sensor (Model # 251655/56)

1. Glow Plug

- Undo the knurled nuts and remove the cable duct
- Detach plug connector and cable plug from the glow plug
- Unscrew the glow plug using a deep 5/8" socket
- Inspect glow plug and coil for carbon build up breaks or metal fatigue
- Clean or replace if necessary
- Re-install in reverse order

Figure IV G



2. Overheat Switch

- Undo the knurled nuts and remove the cable duct
- Detach the cable plug
- Unscrew the overheat switch and replace if necessary

Figure IV H



3. Control Switch (model #s 25 1570/71 25 1655/56)

- Remove the cable duct
- Detach the cable plug
- Unscrew the control switch
- Replace if necessary

Figure IV I

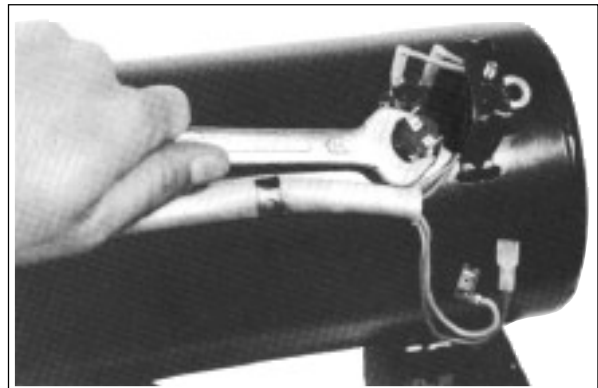




Figure IV J

4. Temperature Switch (model # 25 1570/71)

- Remove protective rubber cap
- Detach the cable plug
- Unscrew the temperature switch
- Replace if necessary and install in reverse order



Figure IV K

5. Ignition Spark Generator

- Remove the hood
- Undo the knurled nuts and remove the cable duct
- Detach plug connector and cable plug from the glow ignition plug
- Unscrew the plug connector from the high-tension cable
- Pull the high-tension cable out through the rubber grommet
- Remove the plug housing from the ignition spark generator
- Undo the screws from the ignition spark generator
- Replace ignition spark generator if necessary
- Re-install in reverse order

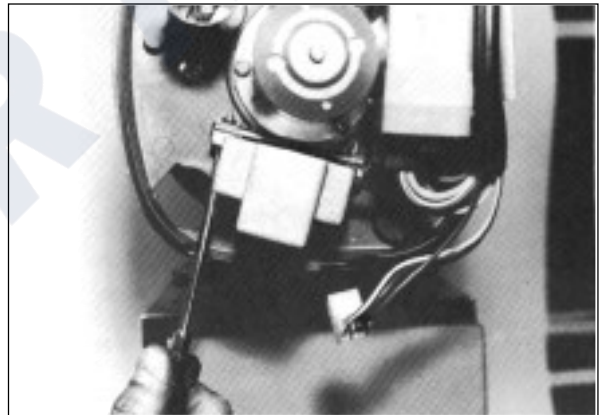
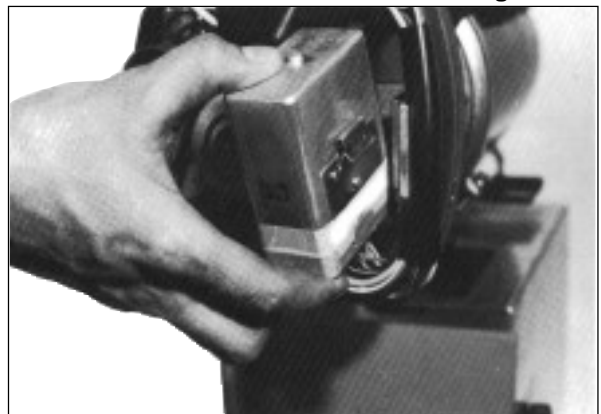


Figure IV I

**6. Control Unit (model #s 25 1570/71
25 1655/56)**

- Remove the cable duct
- Detach the cable plug
- Unscrew the control switch
- Replace if necessary



7. Series Resistor (24V models)

- Remove the hood
- Undo the connecting cable from the series resistor
- Unscrew the series resistor
- After a visual and continuity test, screw the new/ current series resistor back in



Figure IV M

8. Electric Motor

- Check the current fuse in the control unit and replace if necessary (old model heaters only)
- Remove the hood
- Detach the plug housing from the electric motor at the cable harness
- Remove the control unit (see repair step 6)
- Undo the three cross thread screws on the flange of the electric motor
- Remove the electric motor
- Install the new motor in reverse order

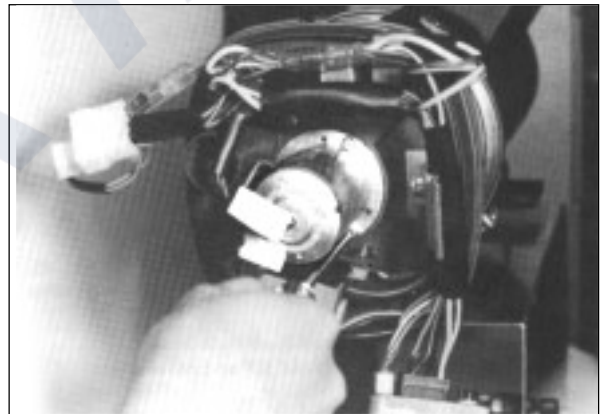


Figure IV N

**9. Water Pump Diode (model #s 25 1570/71)
25 1655/56)**

- Remove the hood
- Detach the diode housing
- Install a new diode (diode connections cannot be mixed up)

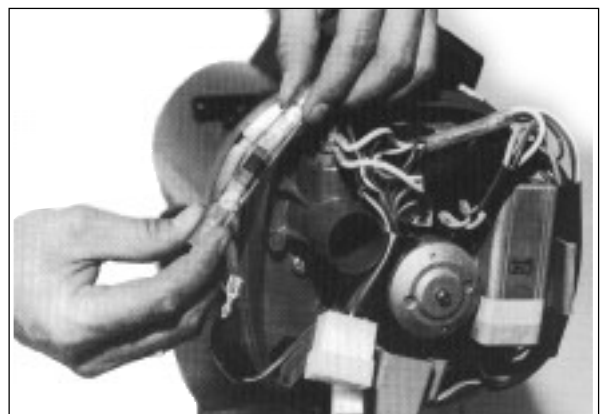


Figure IV O



Figure IV P

10. Glow Ignition Pump and Water Pump Relays

- Detach the relay from the connection base
- Replace the relay

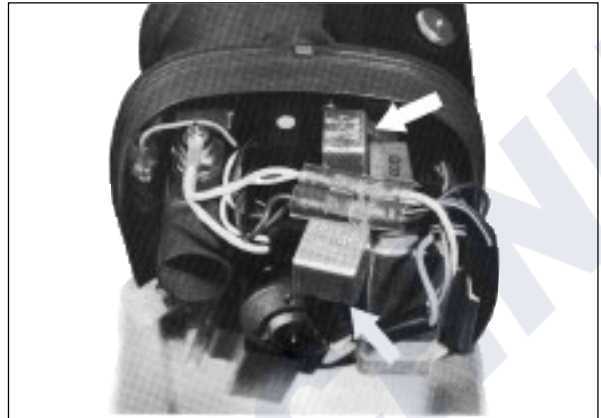


Figure IV Q

11. Burner Head

- Undo the knurled nuts and remove the cable duct
- Remove the hood
- Detach the cable plugs from the safety thermal cutout, control and temperature switches
- Detach plug connector and cable plug from the glow plug
- Undo the fuel connection and detach it
- Detach the plug connections for current supply (6 pin plug), for the water pump (2 pin flat connector housing).
- Pull the cable with plug out of the penetration hole
- open the Vee-profile clamp and remove the burner head
- Re-install in the reverse order

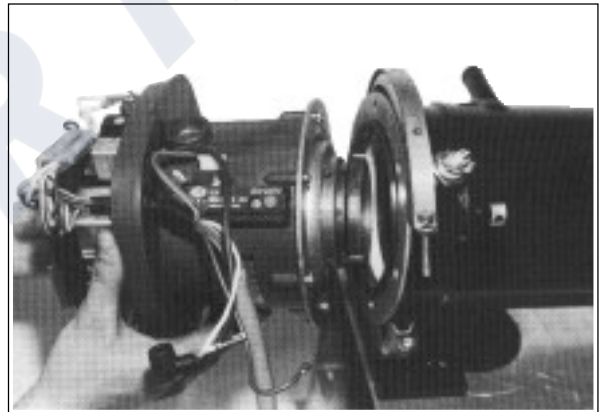
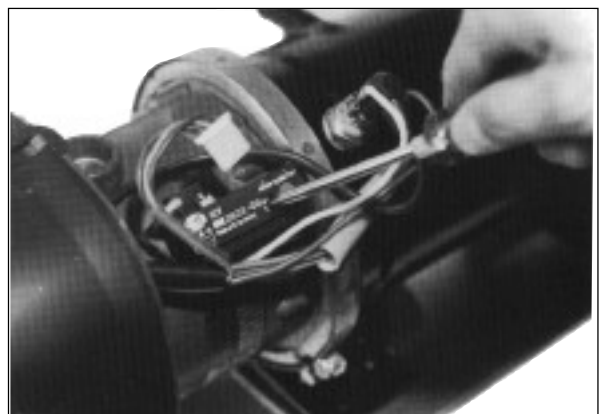


Figure IV R

12. Flame Sensor (model # 25 1655/56)

- Undo the knurled nuts and remove the cable duct
- Detach the plug from the flame sensor
- Undo the cross-head screw in the middle of the flame sensor housing
- Pull the flame sensor out of the hole
- Replace the flame sensor. Make sure that silicone sealing washer is re-used with new sensor



Skirt Mount for School Buses

Heater Location

The best location for mounting the heater is directly beside the battery box(eg. conventional school bus chassis).

- Keep the heater as close to the battery as possible.
- Ensure the fuel system is within specification.
- Tap into the buses heater system in series (Refer to page 7).
- Ensure there is sufficient clearance at the back of box.

Skirt Box Mounting

- Cut hole in skirt of bus as per dimensions in Figure VI A.
- Raise the box into position.
- Drill mounting holes into skirt of bus using 3/8" diameter drill bit.
- Fasten box into position using hardware supplied.
- Connect rear box support (optional).

Coolant hose Connections (see pgs. 8&9).

Fuel System (see pgs. 10 to12).

Electrical Connections

- The D12W school bus uses a Quick connect electrical connection.
- It is also equipped with a roll over fuel cut off switch which will cut the heater off in case of an accidental roll over of the vechile. This is pre connected in the box and complies with section 393.77 of the United States Federal Motor Carrier Saftey Regulations when installed per manufacturers recommendations
- Refer to pg.13 for wiring hook up and other pertinent information.

Exhaust Connections (see pg.14).

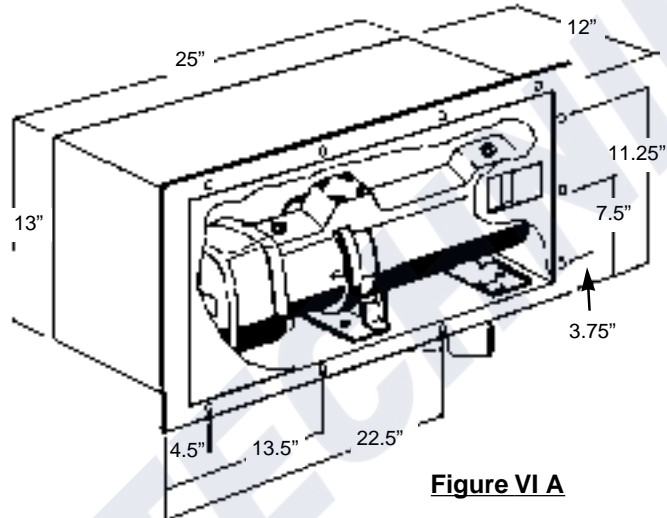
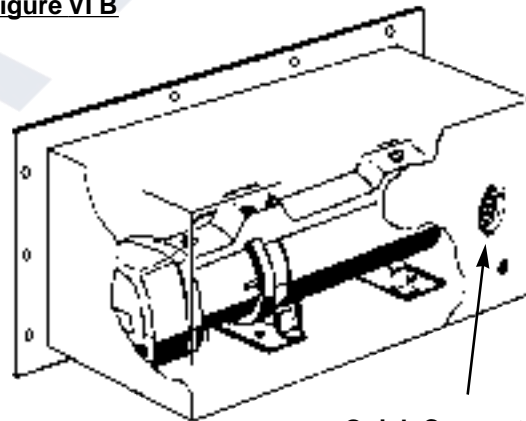


Figure VI A

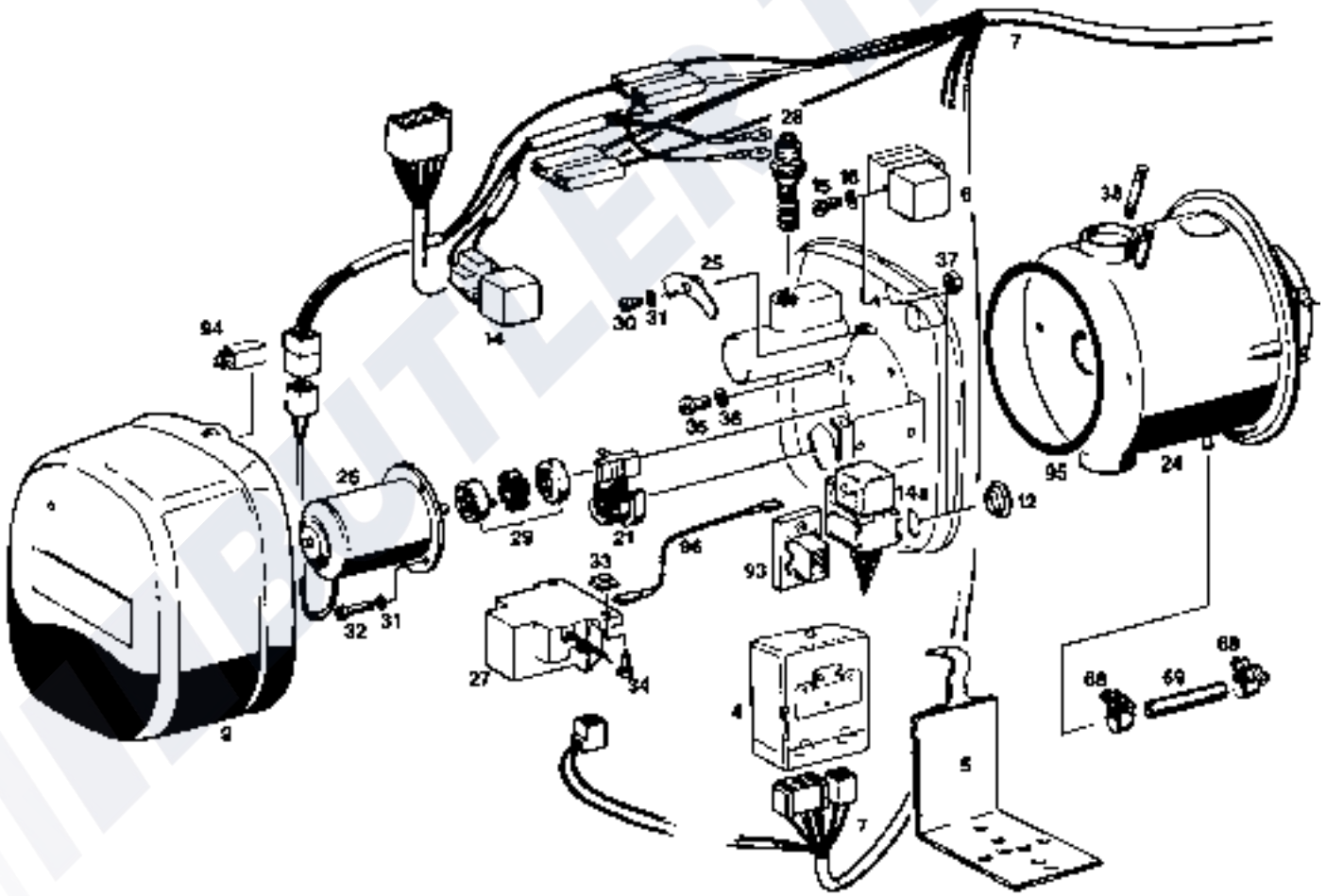
Figure VI B

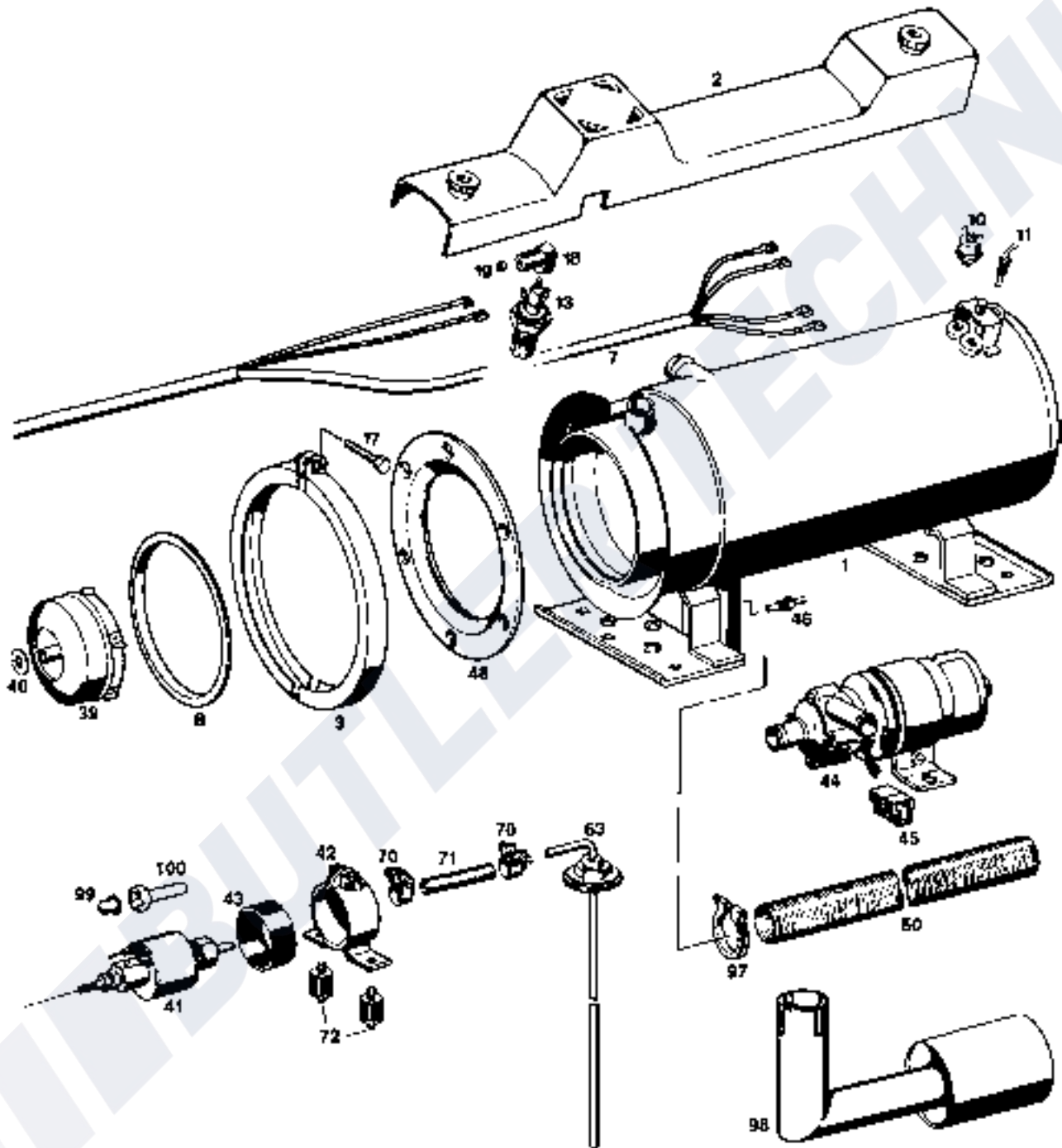


Quick Connect



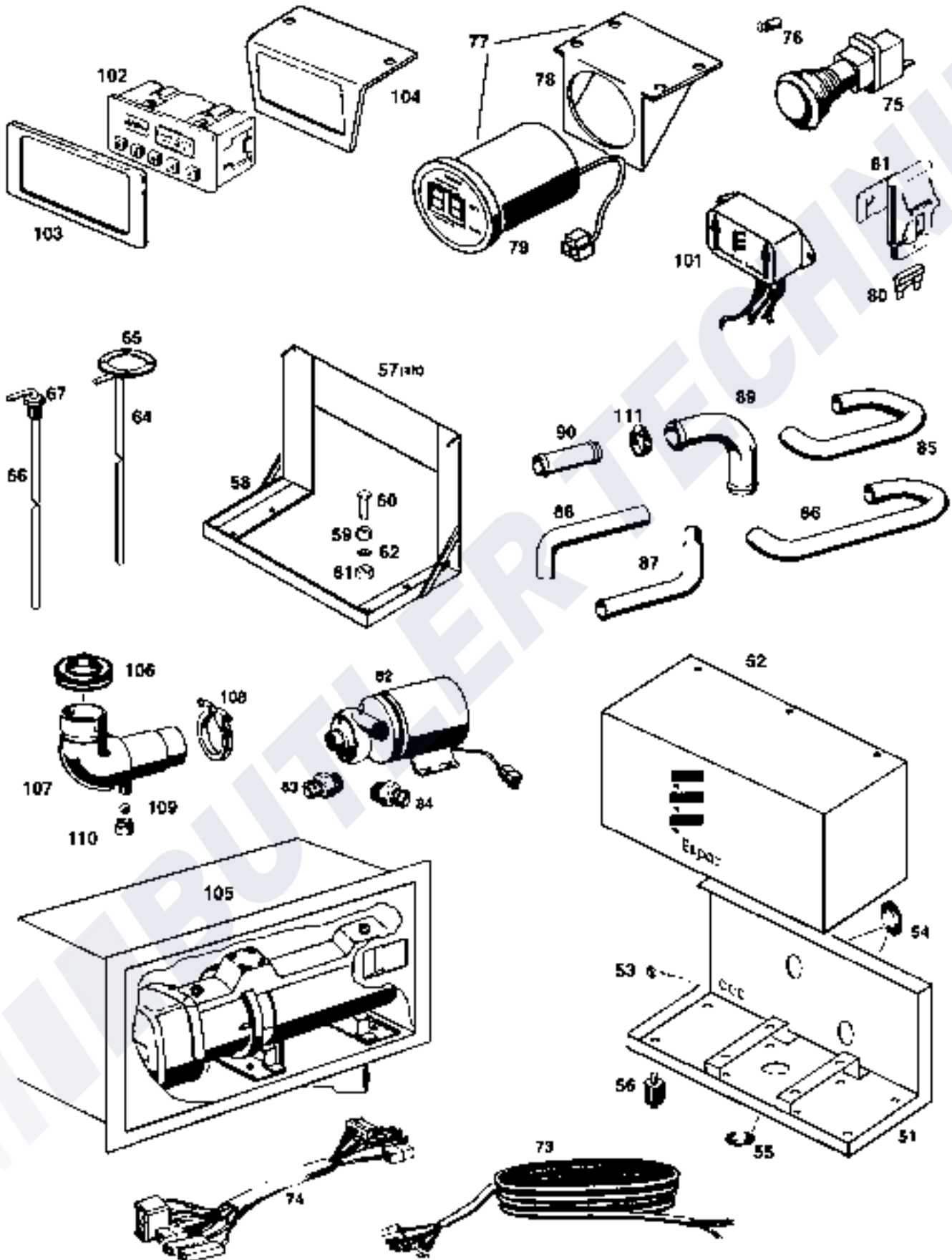
D12W Parts Diagram
Heater Components
Model #'s 25 1859/1860







Parts & Accessories



Description & Part #'s									
Ref. No.	Description	Part Number	Model #	25 1570	25 1571	25 1655/25 1744	25 1656/25 1745	25 1859	25 1860
1	Heat exchanger	25 1859 06 00 00 25 1678 06 00 00				•	•	•	•
2	Glow plug cover	25 1571 01 04 00 25 1859 01 06 00		•	•	•	•	•	•
3	Clamp	25 1571 01 02 00		•	•	•	•	•	•
4	Control unit	12V 25 1688 50 00 43 24V 25 1689 50 00 36 12V 25 1570 52 00 00 24V 25 1571 52 00 00		•		•		•	•
5	Control unit bracket	25 1859 65 01 00						•	•
6	Control unit relay	12V 203 00 065 24V 203 00 066						•	•
7	Main heater harness (internal)	12V 25 1859 01 05 00 24V 25 1860 01 06 00						•	•
8	Seal ring	25 1571 01 00 09		•	•	•	•	•	•
9	Hood	25 1859 01 00 05 25 1571 01 00 05		•	•	•	•	•	•
10	Overheat cutout switch	25 1578 01 00 03		•	•	•	•	•	•
11	Temperature sensor	25 1859 01 04 00						•	•
11a	Temperature sensor (Low) (High)	25 1571 41 01 01 25 1436 01 00 03		•	•	•	•	•	•
12	Grommet	20 1280 09 01 03		•	•	•	•	•	•
13	Glow plug	25 1431 01 00 03		•	•	•	•	•	•
14	Relay	12V 203 00 065 24V 203 00 066		•	•	•	•	•	•
14a	Relay (glow plug)	12V 203 00 082 24V 203 00 084						•	•
15	Fillister head screw M5x12	CA3 00 108		•	•	•	•	•	•
16	Spring washer B5	CA3 00 306		•	•	•	•	•	•
17	Screw M6x40	100 10 053		•	•	•	•	•	•
18	Spark generator cap	20 1671 99 01 04 206 00 150		•	•	•	•	•	•
19	Reduction piece	20 1671 99 01 05 206 31 019		•	•	•	•	•	•
20	Diode	208 00 012		•	•	•	•	•	•
21	Grommet	320 31 061		•	•	•	•	•	•
22	Fuse TT8 Fuse TT4	12V 204 00 080 24V 460 26 016		•	•	•	•	•	•
23	Fuse holder cap	204 00 102		•	•	•	•	•	•
24	Burner	25 1859 15 02 00 25 1656 17 01 00 25 1571 15 01 00		•	•	•	•	•	•



Ref. No.	Description	Part Number	Model #	25 1570	25 1571	25 1655/25 1744	25 1656/25 1745	25 1859	25 1860
25	Combustion air regulator plate	25 1571 15 04 00		•	•	•	•	•	•
26	Electric motor	12V		•	•	•	•	•	•
		24V			•	•	•	•	•
27	Ignition spark generator	20 1643 01 01 00		•	•	•	•	•	•
28	Glow plug series resistor	12V		•	•	•	•	•	•
		24V			•	•	•	•	•
		24V							•
29	Coupling complete	25 1426 99 55 00		•	•	•	•	•	
30	Fillister head screw M4x8	Hardware		•	•	•	•	•	
31	Spring lock washer B4	Hardware		•	•	•	•	•	
32	Fillister head screw M4x20	CA3 00 107		•	•	•	•	•	
33	Sheet metal nut	119 10 031		•	•	•	•	•	
34	Sheet metal screw B4.8x19	Hardware		•	•	•	•	•	
35	Fillister head screw M6x12	CA3 00 103		•	•	•	•	•	
36	Serrated lock washer B6	CA3 00 308		•	•	•	•	•	
37	Hex nut M5	CA3 00 206		•	•	•	•	•	
38	Screw M5x40	106 10 020		•	•	•	•	•	
39	Atomizer	25 1656 16 06 00		•	•	•	•	•	
40	Spacer washer for burner	25 1426 15 03 01		•	•	•	•	•	
41	Fuel metering pump	12V		•	•	•	•	•	•
		24V			•	•	•	•	•
42	Fuel metering pump holder	25 1156 20 00 11		•	•	•	•	•	
43	Rubber ring - fuel metering pump	20 1449 00 10 01		•	•	•	•	•	
44	Coolant circulating pump	12V		•	•	•	•	•	•
		24V			•	•	•	•	•
45	Female 2 hole socket	206 31 004		•	•	•	•	•	
46	Flame sensor	12V/24V						•	
47	Seal ring	25 1656 01 00 02		•	•	•	•	•	
48	Flange	25 1571 01 00 04		•	•	•	•	•	
49	Baffle plate with atomizer (Conversion Kit)	25 1571 99 18 00		•	•	•	•	•	
50	Flexible stainless steel exhaust 42mm	WG4 42 000		•	•	•	•	•	
51	Heater box - base	special order only		•	•	•	•	•	
52	Cover	special order only		•	•	•	•	•	
53	Grommet for harnesses and fuel line	20 1280 09 01 03		•	•	•	•	•	
54	Grommet for coolant hose	CA0 11 009		•	•	•	•	•	
55	Silicone exhaust gasket	20 1282 20 00 02		•	•	•	•	•	
56	Rubber shock mounts 5/16"	CA0 00 040		•	•	•	•	•	

Ref. No.	Description	Part Number	Model #	25 1570	25 1571	25 1655/25 1744	25 1656/25 1745	25 1859	25 1860
57	Side mount mounting bracket kit	CA0 10 056		•	•	•	•	•	•
58	Bracket only	CA0 10 027		•	•	•	•	•	•
59	Mounting spacers	CA0 30 122		•	•	•	•	•	•
60	Bolt M8x50	CA3 00 128		•	•	•	•	•	•
61	Hex nut M8	CA3 00 209		•	•	•	•	•	•
62	Lock washer 8mm	CA3 00 302		•	•	•	•	•	•
63	Standard fuel pick up pipe	CA0 12 058		•	•	•	•	•	•
64	Custom ring type fuel pick up pipe	CA0 12 012		•	•	•	•	•	•
65	Gasket for #63	CA0 12 040		•	•	•	•	•	•
66	Custom straight pick up pipe 16" length 24" length	CA0 00 030		•	•	•	•	•	•
		CA0 12 053		•	•	•	•	•	•
67	Compression fitting 1/4" NPT 3/8" NPT 1/2" NPT	CA0 12 044		•	•	•	•	•	•
		CA0 00 031		•	•	•	•	•	•
		CA0 12 005		•	•	•	•	•	•
68	9mm fuel line clamp (pressure side)	10 2063 00 90 98		•	•	•	•	•	
69	3.5mm rubber fuel hose (pressure side)	360 75 300		•	•	•	•	•	
70	11mm fuel line clamp (suction side)	10 2063 01 10 98		•	•	•	•	•	
71	5mm rubber fuel hose (suction side)	360 75 350		•	•	•	•	•	
72	6mm rubber shock mounts for fuel pump	20 8460 01 00 15		•	•	•	•	•	
73	Installation harness kit (external) Includes: 15' power harness 25' switch harness 20' fuel metering pump harness 10' water pump harness	12V CA1 60 512		•	•	•	•	•	
74	Pigtail harness	CA1 60 527		•	•	•	•	•	
75	Push/pull switch with light	12V CA1 00 003		•	•	•	•	•	
		24V CA1 00 004		•	•	•	•	•	
76	Replacement bulb	12V 207 00 005		•	•	•	•	•	
		24V 207 00 006		•	•	•	•	•	
77	99 hour countdown timer with bracket	12V + 24V CA1 00 050		•	•	•	•	•	
78	Bracket only	CA0 00 032		•	•	•	•	•	
79	Timer only	CA1 00 051		•	•	•	•	•	
80	Main fuse 30A	CA1 07 004		•	•	•	•	•	
81	Main fuse holder	CA1 07 001		•	•	•	•	•	
82	High capacity water pump	12V CA1 00 122		•	•	•	•	•	
		24V CA1 00 124		•	•	•	•	•	
83	1" pump fitting	CA0 11 015		•	•	•	•	•	



Ref. No.	Description	Part Number	Model #					
			25 1570	25 1571	25 1655/25 1744	25 1656/25 1745	25 1859	25 1860
84	5/8" pump fitting	CA0 11 002	•	•	•	•	•	•
85	Preformed hose - standard pump to heater	CA0 11 010	•	•	•	•	•	•
86	Preformed hose - high capacity pump to heater	CA0 11 008	•	•	•	•	•	•
87	Preformed hose - 90 to high capacity pump 1"	CA0 11 012	•	•	•	•	•	•
88	Preformed hose - 90 to heater outlet 7/8"	CA0 11 013	•	•	•	•	•	•
89	1" steel elbow 90	CA0 11 021	•	•	•	•	•	•
90	1" steel in-line connector	CA0 11 022	•	•	•	•	•	•
91	7/8" hose clamp (not shown)	CA1 10 038	•	•	•	•	•	•
92	1" hose clamp (not shown)	CA1 10 039	•	•	•	•	•	•
93	Circuit board, low temperature	12V/24V 25 1859 01 02 00					•	•
	Circuit board, high temperature	12V/24V 25 1859 01 02 00-001					•	•
94	Diagnostic LED red	12V24V 201 00 056					•	•
95	Gasket	25 1656 15 00 02	•	•	•	•	•	•
96	Connector, ground strap	202 00 159	•	•	•	•	•	•
97	Exhaust clamp	152 10 062	•	•	•	•	•	•
98	Bus box exhaust	CA0 10 040	•	•	•	•	•	•
99	Integrated fuel filter	20 1312 00 00 06	•	•	•	•	•	•
100	Fuel connection	20 1621 45 00 00	•	•	•	•	•	•
101	Roll over switch	CA0 00 060	•	•	•	•	•	•
102	7 Day timer with relay	12V CA1 00 135	•	•	•	•	•	•
		24V CA1 00 136		•	•	•	•	•
103	Bezel	25 1482 70 01 00	•	•	•	•	•	•
104	Bracket	CA0 10 061	•	•	•	•	•	•
105	Skirt mount bus box	CA0 1859 60	•	•	•	•	•	•
106	Sealing ring	20 8542 11 00 02	•	•	•	•	•	•
107	Exhaust elbow pipe 90°	25 1226 89 46 00	•	•	•	•	•	•
108	Pipe clip R45	152 10 062	•	•	•	•	•	•
109	Ball	299 00 026	•	•	•	•	•	•
110	Cap nut	116 10 002	•	•	•	•	•	•
111	Clamps 32mm	10 2064 02 00 32	•	•	•	•	•	•
112	Flame sensor	12V 25 1655 99 01 01			•			
		24V 25 1656 99 01 01				•		
113	Sealing ring	25 1656 15 00 02	•	•	•	•	•	•
114	Disc	25 1571 25 0105	•	•	•	•	•	•
115	Axial face seal	329 00 093	•	•	•	•	•	•
116	Ring	329 00 082	•	•	•	•	•	•

