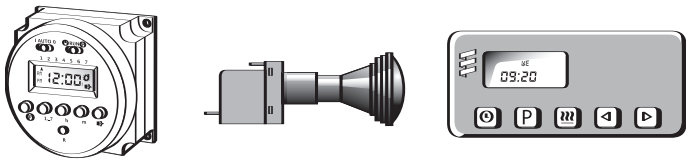
Control Options

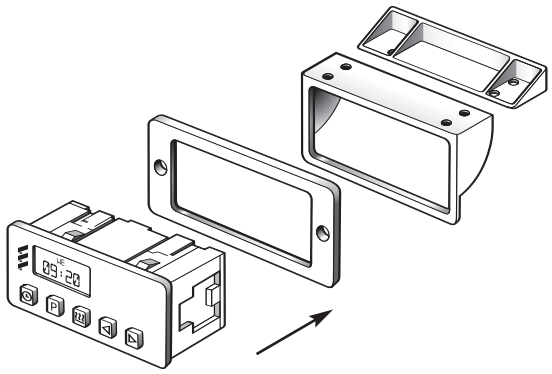
A Programmable Timer, Push/Pull switch or a Multifunction (7 Day Timer) are available.

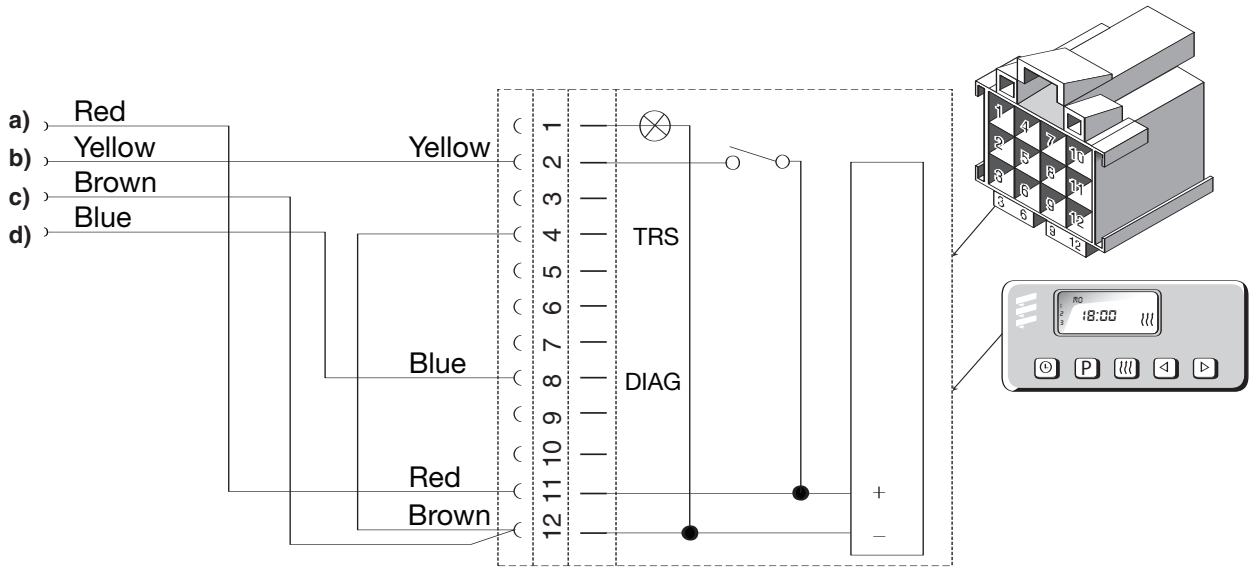


Multifunction

The multifunction is capable of multiple start functions within a 7 day period. Other functions include current time display and AM automatic heater numeric fault code. Display refer to instructions provided with timer for setting options.

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





a) Power from battery "+".

b) Switch control to the heater.

c) Power from battery "-".

d) Diagnostic from heater.

Option #1: Dash lights to timer - connect wire between dash lights circuit and timer at ter minal #1.

Option #2: Operate heater continuously - connect wire from ignition circuit to terminal #10.
See also multifunction (7 day) timer in instructions.

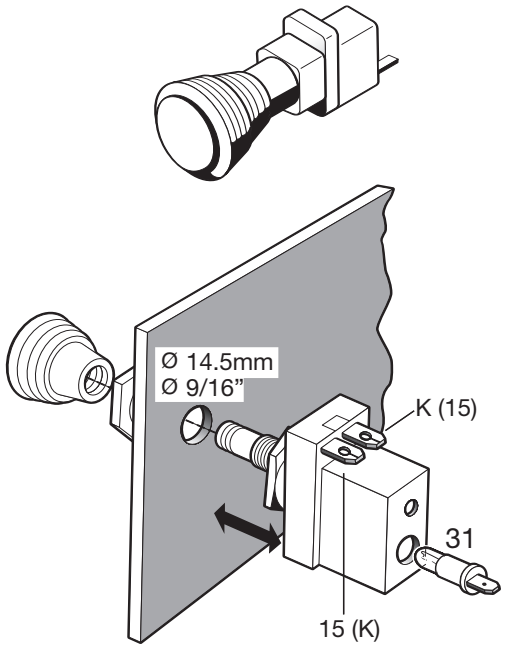
Push/Pull Switch

- Mount switch in a location where it is easily accessible.
- Mount using hardware supplied.
- Connect the 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.

Control Wiring
Push/Pull Switch

Brown- 31	Power from battery "-"
Red- K(15)	Power from battery "+"
Yellow-15(K)	Switch control to the heater
Blue/White	Diagnostic from heater (disregard - tape end and tie off to the side)

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



Heater Operation

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 bleed screw on top of the heater to allow air to escape.
- Loosen rad cap and run engine to allow air to be purged.
- Top up engine coolant.

Start Up

Once switched on the following sequence occurs:

- Control unit does a systems check (flame sensor, glow pin, motors, temperature sensor, safety thermal sensor and various other control unit checks).
- Water pump starts circulating coolant fluid.
- Combustion air blower comes on.
- Glow pin begins to preheat 20-50 secs.
- Metering pump starts and combustion air blower speeds up gradually.
- Once ignition takes place the flame sensor alerts the control unit and the control unit shuts off the glow pin (ignition time: 1.5 - 2 minutes).

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.

Running

Once ignition is successful the following operations take place:

- Heater runs in high heat mode and the temperature is monitotored at the heat exchanger.
- Once coolant reaches 80°C (176°F) the heater automatically switches to low heat mode and continues to run.
- If coolant temperature drops to 75°C (167°F) the heater will automatically switch back to high heat mode.
- If the coolant temperature continues to rise, the heater will automatically switch off once temperature reaches 85°C (185°F).
- 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 reaches 75°C (167°F).
- The heater continues to run as described above until it is switched off, either manually, automatically by a timer or heater malfunction shutdown.

Note: If the heater should shut down due to flame out while in running mode, it will automatically attempt one restart. If successful, it will continue to run. If not, it will shut down completely with a cool-down cycle.

Note: During operation the heater continually senses the input voltage from the batteries. If the input voltage drops to approximately 10.5 volts or rises above 16 volts the heater will automatically shut down with a cool-down cycle, and display a fault code when using a multifunction timer.

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 goes out.
- The combustion air blower and water pump continue to run for 3 minutes to cool down.
- The heater shuts off.

Safety Equipment

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

- The control unit ensures electrical circuits (fuel pump, combustion air blower etc.) are complete prior to starting the heater.

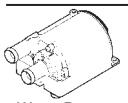
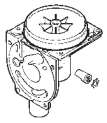
- If the heater fails to ignite within 90 seconds of the fuel pump being started, the starting procedure will be repeated. If the heater again fails to ignite after 90 seconds of fuel being pumped, a “no start safety shutdown” follows. (Fault #52)

- 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, the heater will turn off the fuel pump and complete a cool down and display a F052 code. After troubleshooting the problem the heater can be started again by switching the heater off and then back on again.

- Overheating due to lack of water, a restriction or a poorly bled coolant system results in the overheat shutdown (F012). Fuel delivery will cease and an “overheat shut down” follows. If heater overheats 10 consecutive times, a lockout on the control unit will occur. To unlock the control unit you will need to use the Fault Code Retrieval Device. See following pages for self diagnostics.

- If at any time the voltage drops below 10.5V for 20 seconds, or rises above 16.0V for 20 seconds the heater will shut down and display the associated Fault Code.

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.

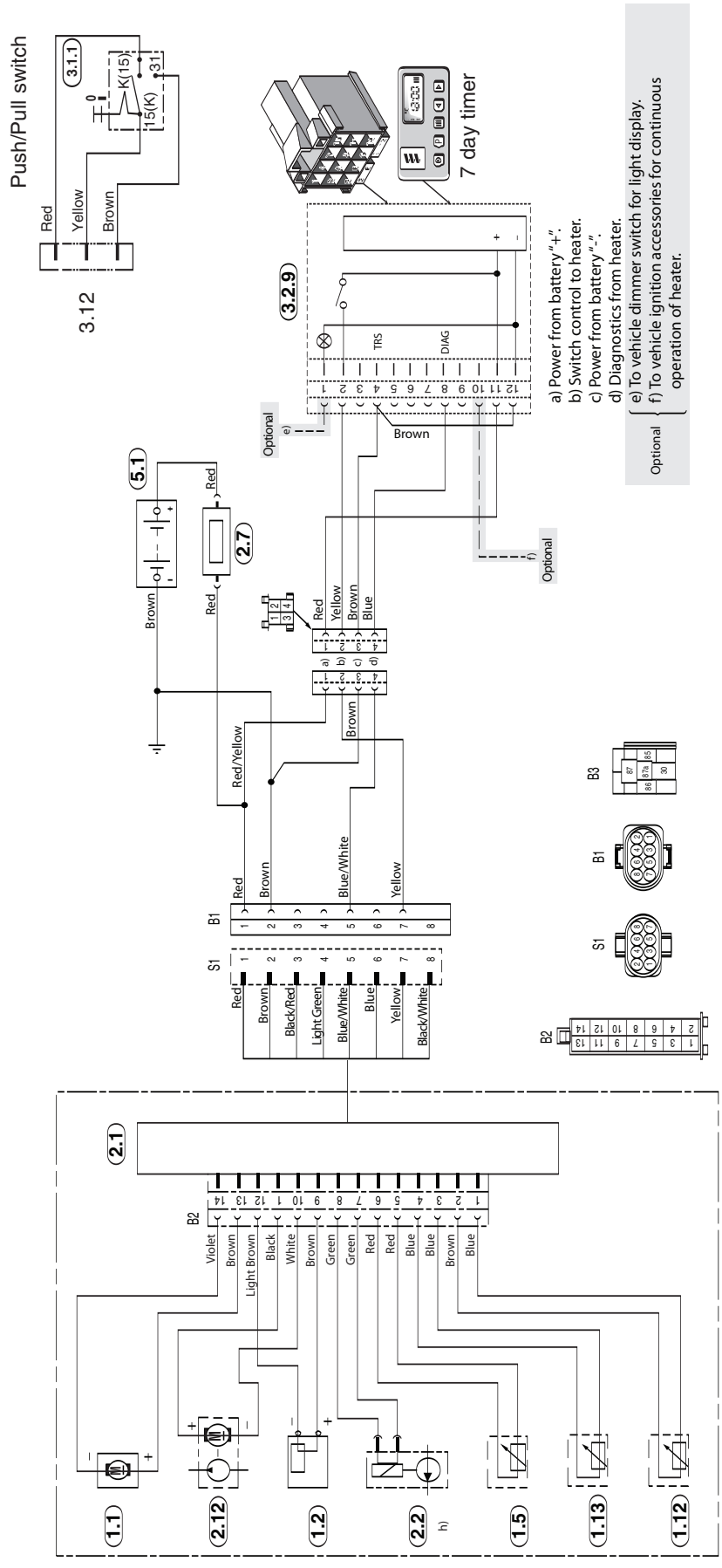
	STARTING PHASE					RUNNING PHASE	SHUT DOWN PHASE		
Operating Mode	System Check	Pre-heat	Ignition Attempt	Pre-heat 2nd. attempt	Ignition Attempt 2nd. attempt	Controlled Heating	After Glow	Cool Down	Off or Stand by
 Water Pump	Off	**On**	**On**	**On**	**On**	**On**	**On**	**On**	Off **On**: if in stand by
 Blower	**On** **Momentarily**	**On**	**On**	Off	**On**	**On**	**On**	**On**	Off
 Glow Pin	Off	**On**	**On**	**On**	**On**	Off	**On**	Off	Off
 Fuel Pump	Off	Off	**On**	Off	**On**	**On**	Off	Off	Off
Time	1- 3 sec.	40 sec.	Up to 80 sec.	40 sec. If Required	Up to 80 sec. If Required	High/Low Operation until switched off manually or automatically	20 sec.	2.5 min.	

Note: During the controlled heating cycle, if the coolant temperature exceeds 86°C(187°F) the heater will cycle off. Heater will automatically restart in high mode once coolant temperature reaches 75°C(167°°F)

Notes:

Hydronic D4 SC 12 Volt
Model 25 2096 05

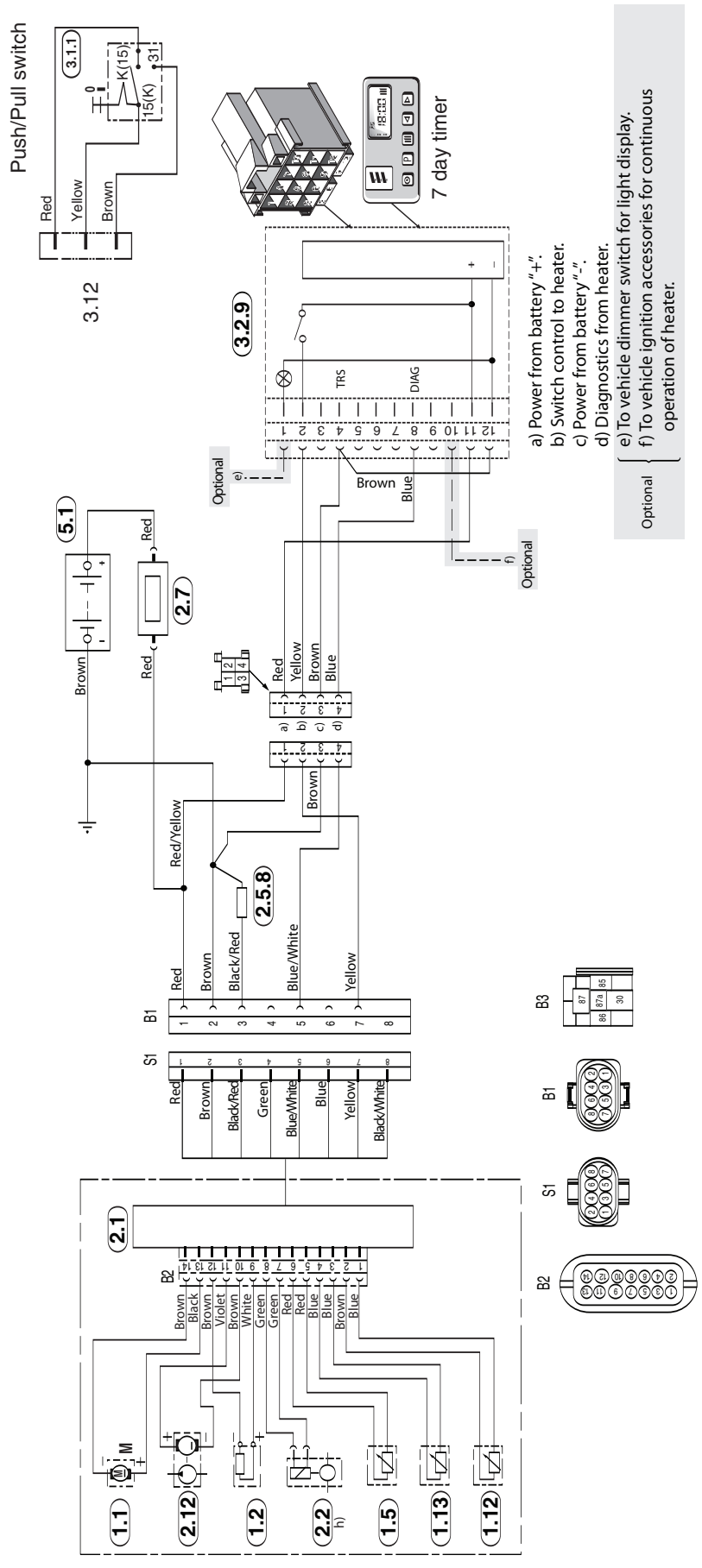
Wiring Harness P/N:
20 2900 70 05 03



1.1	Blower motor
1.2	Glow pin
1.5	Overheat sensor
1.12	Flame sensor
1.13	Temperature sensor
2.1	Control unit
2.12	Water Pump
2.2	Fuel metering pump
2.7	20 amp main fuse
3.12	Push/Pull switch
3.2.9	7 day timer
5.1	Battery

Hydronic D5 SC 12 Volt
Model 25 1920 05

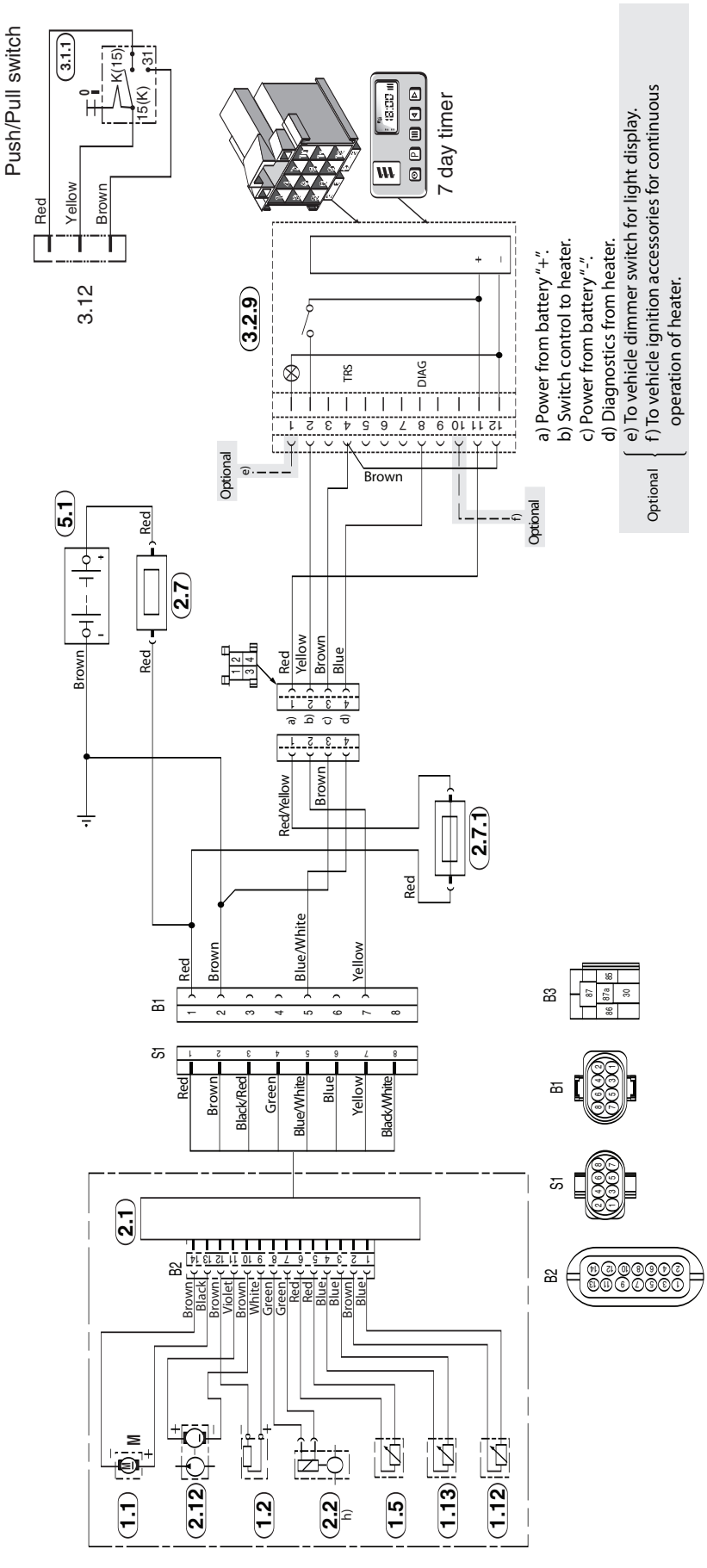
Wiring Harness P/N:
20 2900 70 04 01



1.1	Blower motor
1.2	Glow pin
1.5	Overheat sensor
1.12	Flame sensor
1.13	Temperature sensor
2.1	Control unit
2.12	Water Pump
2.2	Fuel metering pump
2.5.8	Blower lock out resistor
2.7	20 amp main fuse
3.12	Push/Pull switch
3.2.9	7 day timer
5.1	Battery

Hydronic D5 SC 12 Volt
Model 25 2098 05
25 2219 05
25 2257 05

Wiring Harness P/N:
20 2900 70 05 03
Internal FMP
No Blower Relay

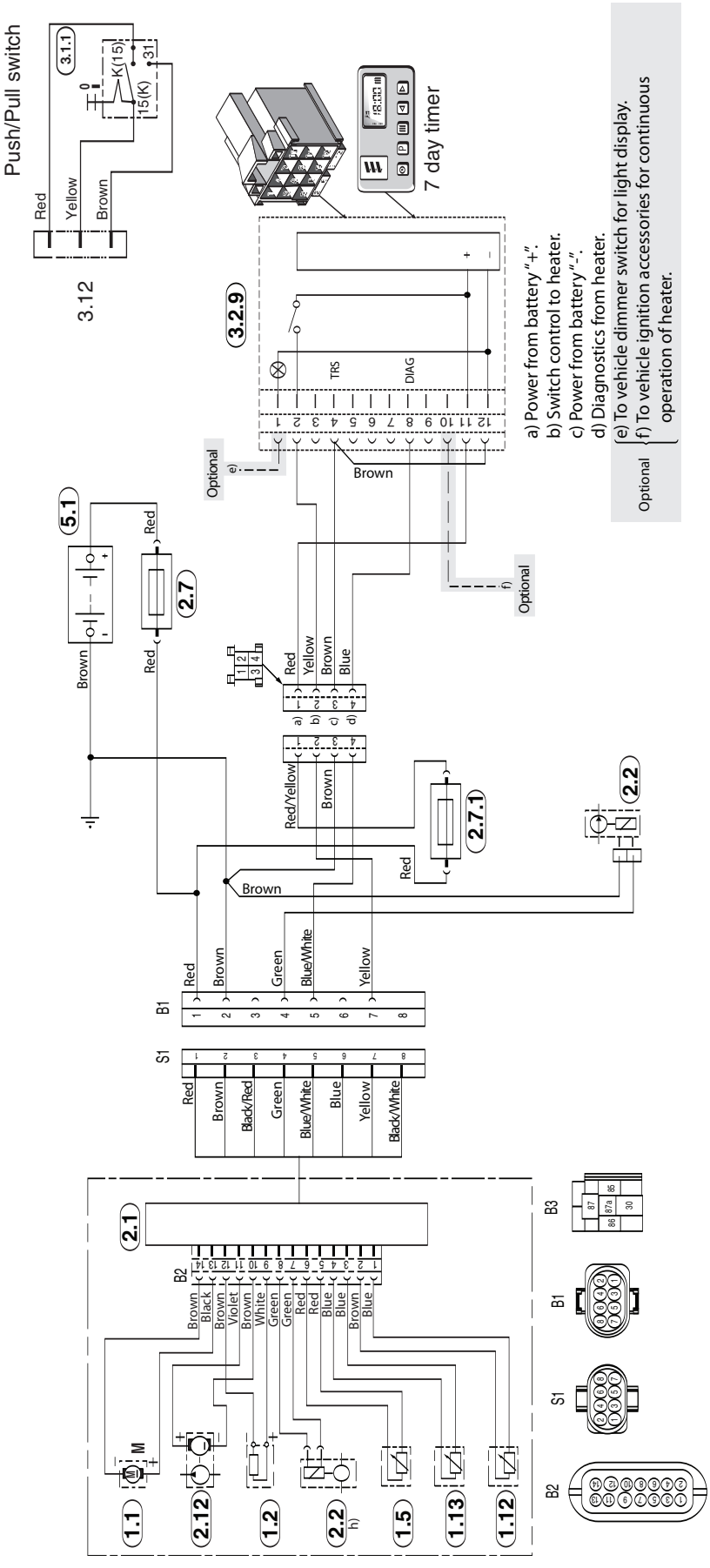


1.1 Blower motor
1.2 Glow pin
1.5 Overheat sensor
1.12 Flame sensor
1.13 Temperature sensor
2.1 Control unit
2.12 Water Pump
2.2 Fuel metering pump
2.7 20 amp/12V main fuse
15 amp/24V main fuse
2.7.1 5 amp fuse
3.12 Push/Pull switch
3.2.9 7 day timer
5.1 Battery

Hydronic D5 SC 24 Volt
Model 25 2147 05

Wiring Harness P/N:
20 2900 70 20 13
External FMP
No Blower Relay

Also applicable to:
Hydronic 4 & 5 SC 12 volt
Gasoline versions
Model 20 1820 05
Model 25 2325 05



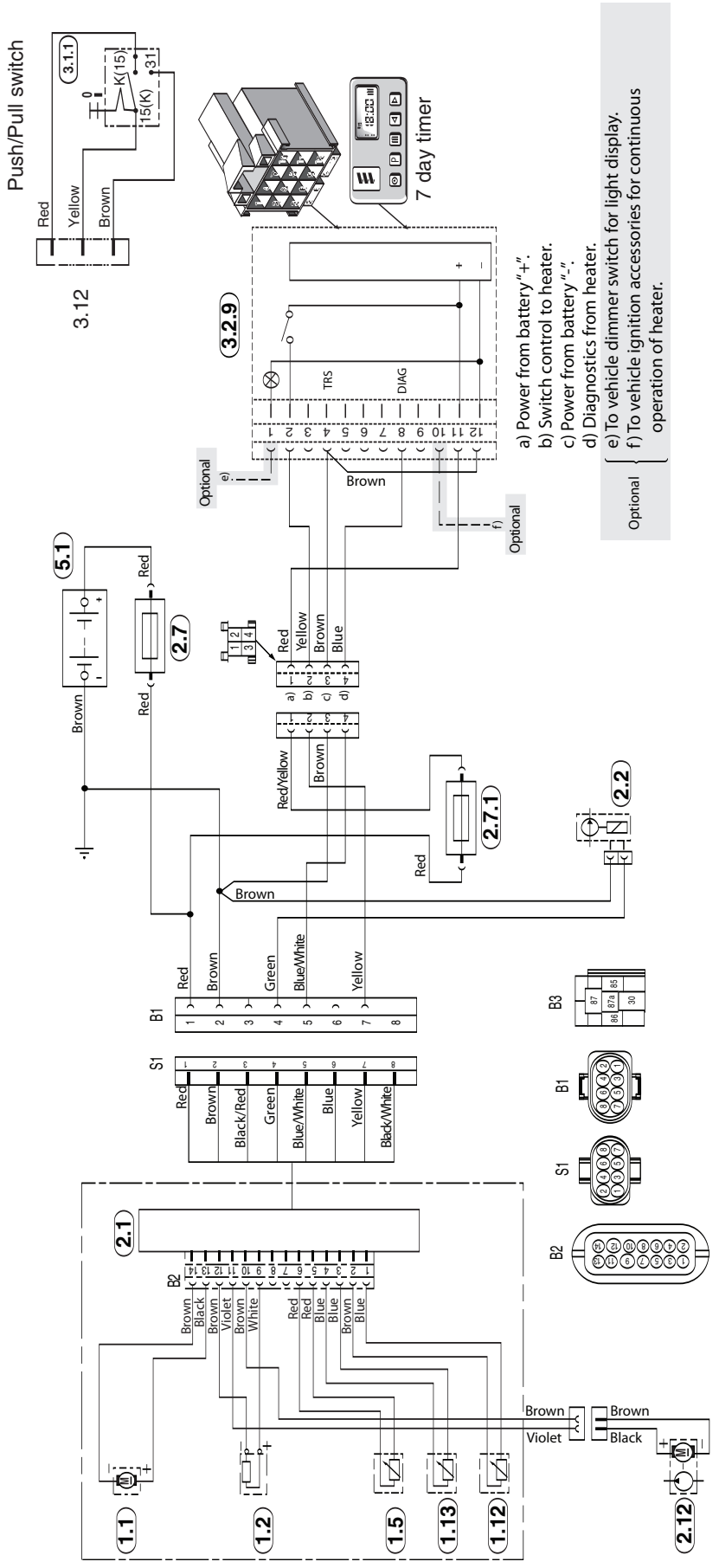
1.1 Blower motor
1.2 Glow pin
1.5 Overheat sensor
1.12 Flame sensor
1.13 Temperature sensor
2.1 Control unit
2.12 Water Pump
2.2 Fuel metering pump
2.7 20 amp/12V main fuse
15 amp/24V main fuse
2.7.1 5 amp fuse
3.12 Push/Pull switch
3.2.9 7 day timer
5.1 Battery

Hydronic 5 S - 12 & 24 volt versions
Diesel & Gasoline versions

Model 20 1793 05	**12 volt**
Model 20 1819 05	**12 volt**
Model 25 2146 05	**24 volt**
Model 25 2217 05	**12 volt**
Model 25 2218 05	**24 volt**
Model 25 2100 05	**12 volt**

Wiring Harness P/N:

12V 20 2900 70 05 07
24V 20 2900 70 05 08



1.1 Blower motor
1.2 Glow pin
1.5 Overheat sensor
1.12 Flame sensor
1.13 Temperature sensor
2.1 Control unit
2.12 Water Pump
2.2 Fuel metering pump
2.7 20 amp/12V main fuse
15 amp/24V main fuse
2.7.1 5 amp fuse
3.12 Push/Pull switch
3.2.9 7 day timer
5.1 Battery

Periodic Maintenance

- 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.
- Visual check of all fuel lines for leaks. Check and if necessary replace fuel filter inserts.
- Visual check of electrical lines and connections for corrosion.
- 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.
- Check the glow pin and replace if necessary.

Troubleshooting

Basic Troubleshooting

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

Check:

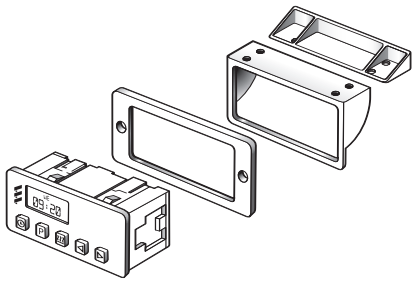
- Circuit breakers and fuses.
- Electrical lines and connections.
- For interference in combustion air and exhaust pipes.
- That there is fuel in the tank.
- Battery voltage.

Self Diagnostics

The heater is equipped with self diagnostic capability. You can retrieve information on the heaters last 5 faults using the Espar multifunction timer or Espar's Fault Code Retrieval Device.

Multifunction

Espar's multifunction timer has a fault code retrieval device built into the unit. This function automatically activates if the heater is experiencing problems.

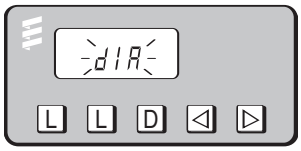


- Fault codes appear on the LCD display screen.
- Codes can then be translated from the charts on the following pages.

Fault Code Retrieval Device

Equipment Face and Controls

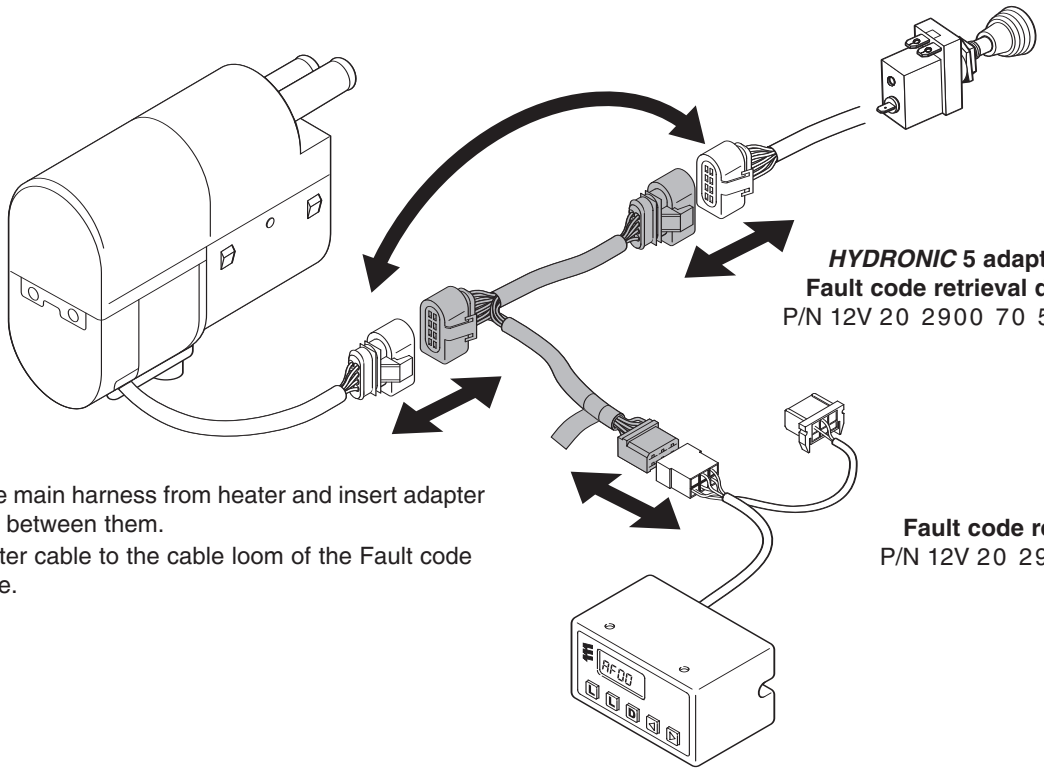
Symbols seen on the display face are as follows:



AF	Actual fault.
F1-F5	Up to five stored faults can be accessed. The AF and F1 are the same number.
	This sign is displayed when the heater is in operation.
DIAG	The word (Diagnostic) will come on when the diag nostic number is requested.
000	Three digit diagnostic fault code number.

Instructions:

- Connect as shown on following page.
- Switch the fault code retrieval device on and wait 10 seconds.
- Press the "D" button.
- Wait 3-5 seconds for the current fault code to appear (AF).
- To review the previous faults use the arrow buttons (F1= Most Recent, F5= Oldest).
- To erase the faults that are in memory press both "L" keys at the same time.
- See the fault code chart on following pages for code number descriptions.



***HYDRONIC* 5 adapter for**
Fault code retrieval device
P/N 12V 20 2900 70 50 28

Fault code retrieval device
P/N 12V 20 2900 70 50 20

Hook Up

- Disconnect the main harness from heater and insert adapter cable harness between them.
- Connect adapter cable to the cable loom of the Fault code retrieval device.

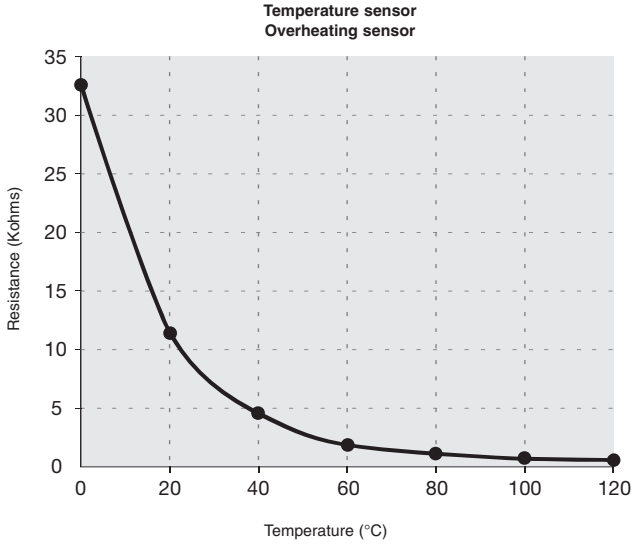
Test Values

Resistance

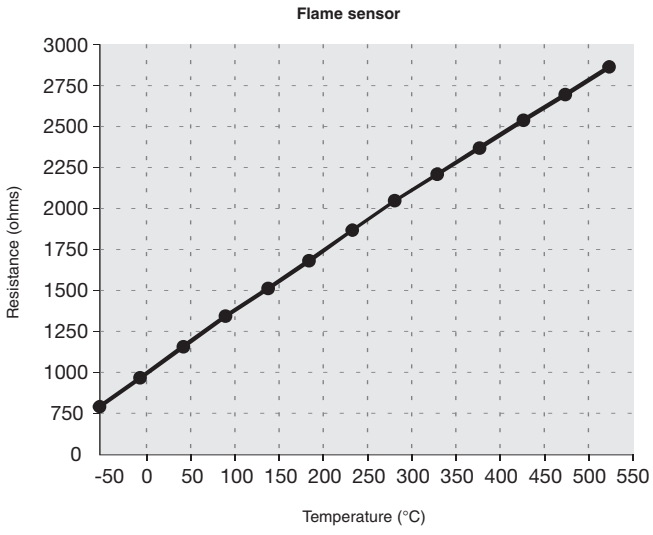
Metering pump	approx. 10 Ω for 12 volt heater; approximately 36 Ω for 24 volt heater
Glow Pin	approx. 0.9 Ω

Checking the sensors

To check the sensors, measure the resistance at current temperature, see following diagrams:



R> 2 Ω = open circuit
R< 50 Ω = short circuit



R> 3400 Ω = open circuit
R< 50 Ω = short circuit

Fault Code	Fault Description	Causes / Repair
000	Normal Operation	
010	Overvoltage	Check voltage between terminals 1(red) and 2(brown) at connector (B1). If voltage is > 15 volts then check battery, electrical leads and vehicle charging system.
011	Under voltage shut down	Check voltage between terminals 1(red) and 2(brown) at connector (B1). If voltage is < 10 volts then check battery, electrical leads and vehicle charging system.
012	Overheating	Check for possible causes of overheat (water circuit), Sensor. Check overheat switch resistance values. Temperature at temperature sensor or overheat sensor is greater than 125°C.
014	Possible overheating detected (difference evaluation)	Difference of measured values at temperature sensor >25°C (min. 80°C water temperature and metering pump in operation); Check temperature sensor and overheating sensor, replace if necessary. Check values from previous page.
015 fault coun-	Too many overheats	Remove cause of over heat. Reset control unit using 7 day timer or code retrieval device to unlock control unit. Permanent overheating ter reading exceeded. Heating enable only possible by means of diagnostics system (press both “LL” keys simultaneously).
017	Overheating detected	Temperature at temperature or overheating sensor > 130 °C, emergency OFF if Fault Code 012 or 014 not applicable; check water circuit, check temperature sensor and overheating sensor; replace if necessary. See graph on previous page.
020	Open circuit - glow pin	Check glow pin and electrical leads for continuity, replace if necessary.
021	Short circuit - glow pin	Check glow pin and electrical leads for continuity, replace if necessary.
030	Combustion air blower motor	Blower impeller or electric motor may be jammed (frozen solid, dirty, etc.) Fix jam, replace electric motor if necessary.
031	Combustion air blower motor	Check lead to combustion air motor for continuity, replace motor if necessary.
032 sary.	Combustion air blower motor short-circuit	Check combustion air blower motor (electric motor); replace if neces- Check power supply (chafed, corroded etc.)
038	Vehicle fan relay control break	Check electric lead to relay, fix break, replace relay if necessary For wiring harness (20 2900 70 04 01) without relay, replace harness.
039	Vehicle fan relay control short circuit	Check electric lead to relay, fix break, replace relay if necessary For wiring harness (20 2900 70 04 01) without relay, replace harness.
041	Water pump break	Check supply lead to water pump for continuity, remedy break, replace water pump if necessary.
042 re-	Water pump short-circuit	Check supply lead to water pump for short circuit, check water pump, place water pump if necessary.
047	Short circuit - fuel metering pump	Check for wires for short to fuel metering pump. Test fuel metering pump. Replace if necessary.

Fault Code	Fault Description	Causes / Repair
048 replace	Open circuit - fuel metering pump	Check supply lead to metering pump for continuity, remedy break, if necessary.
050	Too many no start attempts	Safety time counter reading exceeded. Reset control unit using 7 day Timer or fault code retrieval device to unlock control unit.
051	Faulty flame recognition	At start, if flame sensor is a above 70°C > 240 seconds; check exhaust gas and combustion air supply, check flame sensor, replace if necessary. For flame sensor values see graph on previous page.
052	No start safety time exceeded	No flame detected on start attempt. Check fuel delivery and fuel supply, Check exhaust gas and combustion air ducts.
053	Flame cutout in boost mode	Heater has started successfully the flame has extinguished. Check fuel supply. Check combustion air and exhaust flow. Check flame sensor resistance value. Replace flame sensor if necessary.
054	Flame cutout in high mode	Heater has started successfully the flame has extinguished. Check fuel supply. Check combustion air and exhaust flow.
056	Flame cutout in low mode	Check flame sensor resistance value.
060	Open circuit - temperature sensor	Temperature sensor detects a value beyond it's range. Check connections. Check sensor resistance values between 11 and 12 at connector B2 > 2 M (if open circuit).
061	Short circuit - external temperature sensor	Check connections. Check sensor resistance values between 11 and 12 at connector B2 < 50 Ω (if short circuit). Temperature sensor values on previous pages.
064	Open circuit - flame sensor	Sensor is sensing value outside of range. Check connection leads. Resistance values between 1 and 2 at connector B2 > 3040 Ω (if open circuit).
065	Short circuit - flame sensor	Check connection leads. Resistance values between 1 and 2 at connector B2 > 780 Ω (if short circuit). Flame sensor values on page 17.
071	Open circuit - overheat sensor	Check connection leads. Resistance values between 9 and 10 at connector B2 > 2 M Ω (if open circuit).
072	Short circuit - overheat sensor	Check connection leads. Resistance values between 9 and 10 at connector B2 < 50 M Ω (if short circuit).
091	External interference voltage	Error in controller from interference voltage from vehicle network possible causes: poor batteries, poor battery charges, other interference sources; eliminate interference voltages.
090 092 -103	Controller defect	Control unit malfunction due to interference voltage from vehicle electrical system; possible causes low batteries, charges, other sources of interference, eliminate interference voltages. Internal faults detected in microprocessor/memory. Replace control unit. Internal failure. Replace control unit.
Faults not shown by the diagnosis system *HYDRONIC* won't start		After switching *HYDRONIC* on, the water pump and vehicle fan start immediately. · Remove and check temperature sensor. After switching *HYDRONIC* on, the vehicle fan starts, functioning "preventing" is activated. · Changeover venting to heating at "heating/venting changeover switch.

Fuel Quantity Test

The fuel Quantity should be tested if the heater has difficulty starting or maintaining a flame, using graduated cylinder part # 5520004 10ml.

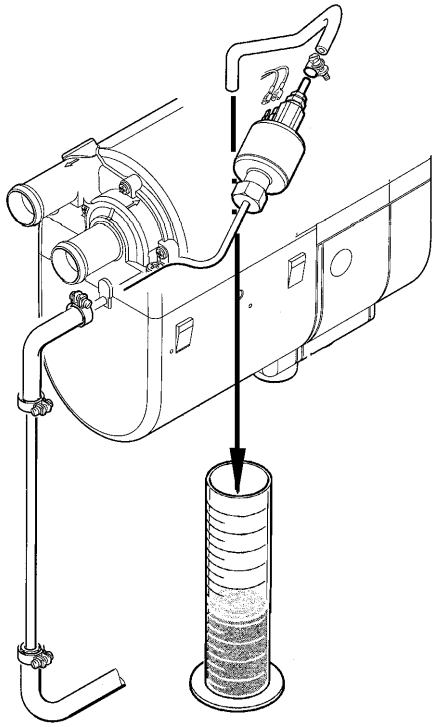
Note: Measure the fuel quantity when the battery is sufficiently charged. At least 11V and at most 13V should be applied at the control unit during measurement.

Preparation

- Remove metering pump cover in the cases of SC versions.
- Pull the fuel line off the combustion chamber and insert into a graduated measuring glass.
- Switch the heater on, when fuel delivery is uniform (approximately 45 seconds after switching on), the fuel line is full and bled.
- Switch heater off.
- Empty measuring glass and replace.

Measurement

- Switch heater on.
- Fuel delivery starts automatically approximately 40 seconds after switching on.
- Hold the graduated measuring glass at the glow pin height during measurement.
- After 90 seconds of fuel delivery, it will shut off automati-cally.
- Switch heater off.
- Read off quantity of fuel delivery in the graduated measuring glass.



Evaluation

← Diesel			Gasoline →		
Hydronic D4W SC	**Hydronic D5W SC**	**Hydronic D5W S**	**Hydronic B4W SC**	**Hydronic B5W SC Hydronic B5W S**	
8.4 cm^3 / 90 seconds	9.5 cm^3 / 90 seconds	9.5 cm^3 / 90 seconds	11.3 cm^3 / 90 seconds	11.9 cm^3 / 90 seconds	**Max**
7.3 cm^3 / 90 seconds	8.5 cm^3 / 90 seconds	8.5 cm^3 / 90 seconds	10.1 cm^3 / 90 seconds	10.7 cm^3 / 90 seconds	**Min**

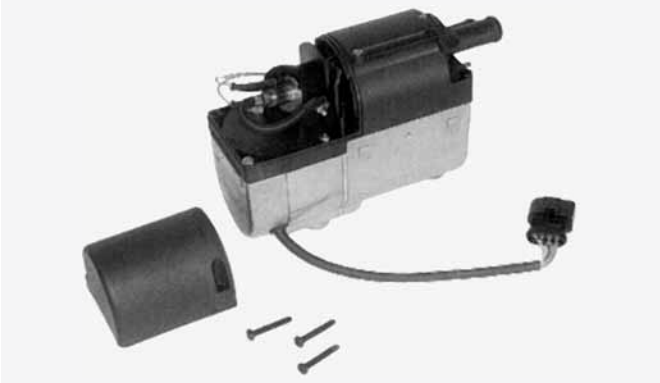
If measured quantity of fuel is over or under the nominal value, the metering pump must be replaced or fuel restriction eliminated.

Repair Steps covered are for the Hydronic 4 & 5 SC versions - other models are similar

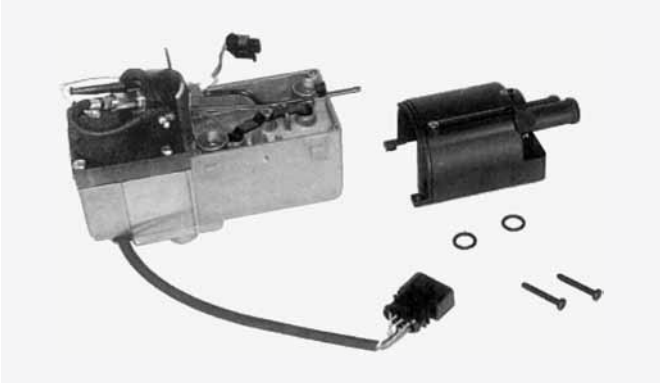
Disassembly / Assembly

1 Cover, metering pump
2 Water pump, assembly
3 Metering pump and bracket
4 Cover, blower
5 Control unit and cover
6 Glow pin
7 Flame sensor
8 Cable harness
9 Electric motor, complete
10 Combustion chamber with flame tube
11 Heat exchanger and jacket

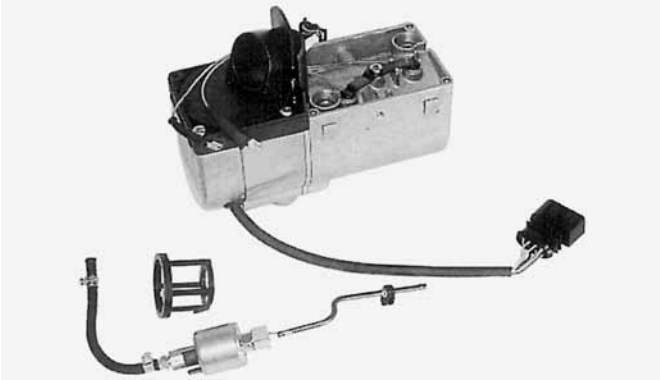
1 Cover, metering pump



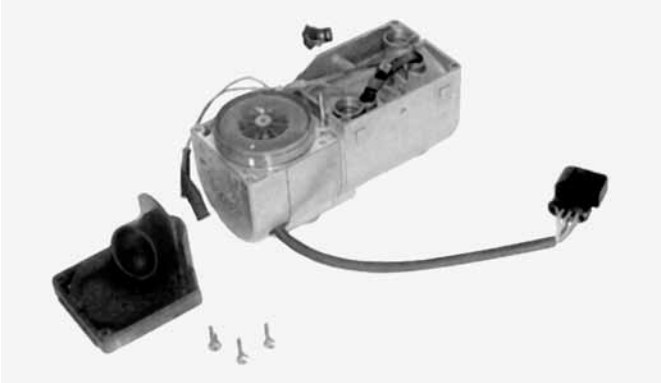
2 Water pump assembly. When mounting, place O-rings on connection on water pump housing



3 Metering pump and bracket



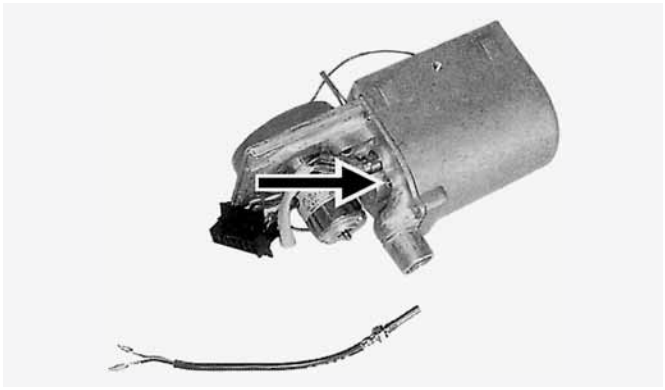
4 Cover, blower



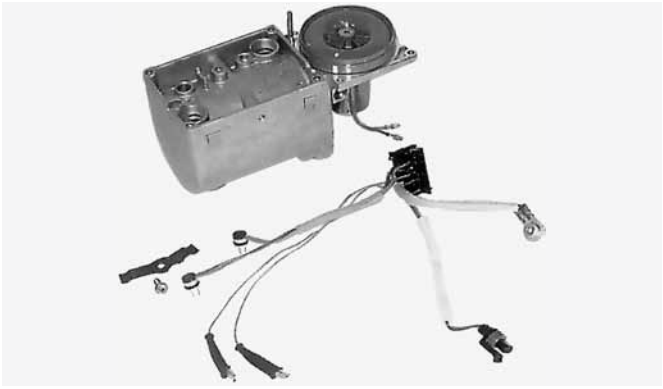
5 Control unit and cover

6 Glow pin

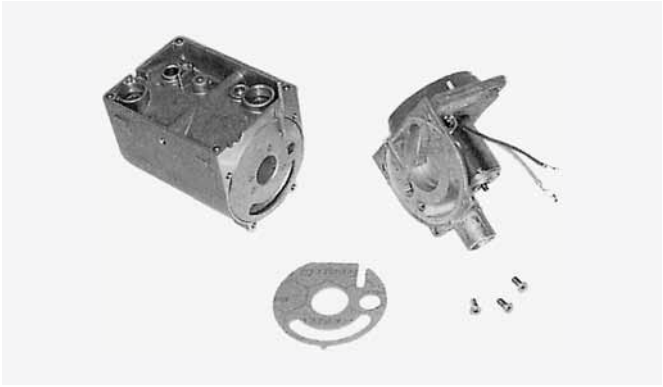
7 Flame sensor, For removal of tab receptacles, use AMP extractor tool



8 Cable Harness

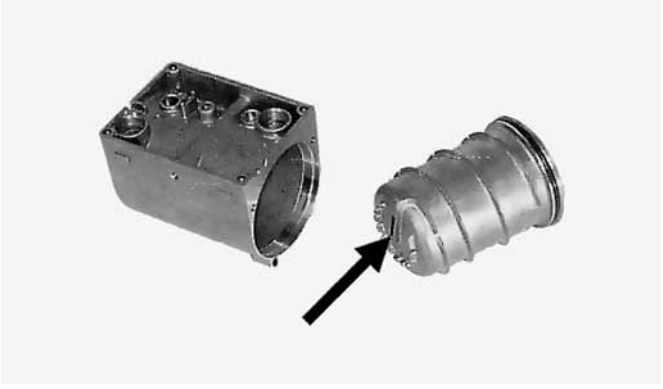


9 Electric motor, complete



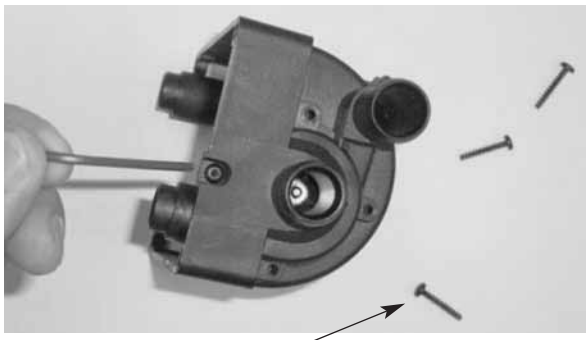
10 Combustion chamber with flame tube

11 Heat exchanger and jacket, Align slot on heat exchanger (arrow) with lug in jacket



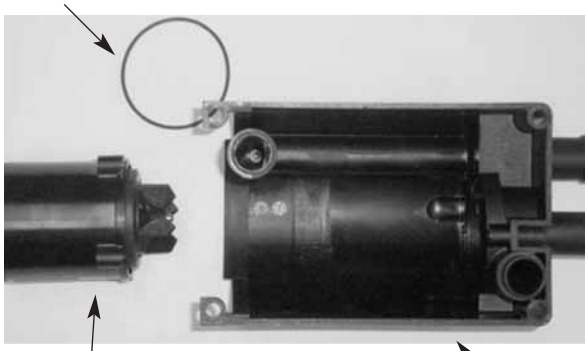
Magnetic Drive Coolant Pump Cleaning

It is advised to make this procedure part of an annual pre-season check up for this heater.

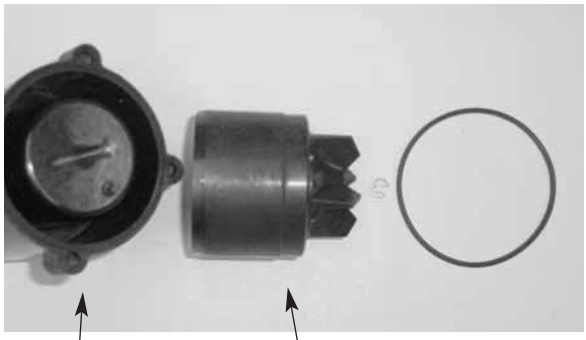


Remove the four screws holding the colant pumps two halves together.

“O” Ring 45mm x 1 1/2 m, Part #: 556 00 06



Motor / Impeller Assembly **Pump Motor**



Motor Assembly **Impeller with Magnet**