



**Eberspächer**

**EBERSPÄCHER (UK) LTD**  
**Independent Vehicle &**  
**Marine Heating Division**  
Headlands Business Park  
Salisbury Road  
Ringwood  
Hampshire  
BH24 3PB

Our Ref: Telephone: +44 (0) 1425 480151 Fax: +44 (0) 1425 480152 e-mail: enquiries@eberspacher.com Date:

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## **Technical Bulletin No. 281**

### **Inland Waterways Boat Heating Findings**

Please find attached information containing the recently completed 2 year survey carried out by Eberspacher (UK) Ltd on problems experienced with water heating systems as installed into Inland Waterways Boats.

Within this attachment are the Eberspacher (UK) Ltd recommendations. Most of this information is either laid out in the Installation Manual supplied with the Inland Waterways heater installation kit or just common sense.

Your faithfully,

Peter Collard  
**Sales Engineering Manager.**

Paul Christopher.  
**Service / Warranty Manager.**

## **Inland Waterways Boat Findings**

Listed below are the main reasons found for premature failure of diesel heaters on inland waterway boats.

These are listed in order of importance:

1. Poor installation.
2. Operator error.
3. Poor fuel/fuel system.
4. Poor voltage.

### **1. Main problems with installations**

- I. Poor plumbing on the water and fuel systems.
- II. Heater fitted in engine room and running too hot (poor engine room ventilation).
- III. Incorrect heater specification, i.e. fitting a 10Kw when a 5Kw would be sufficient.

### **2. Main problems with operator error**

- I. Shutting all the radiators down at night except the one in the bedroom.
- II. Not servicing the heater on a regular basis.
- III. Using the heater for hot water only without a secondary circuit, i.e. Towel rail etc.
- IV. Using the heater as a frost watch heater.

### **3. Main problems with fuel**

- I. Bad quality red diesel from the pump.
- II. Fuel degrading in the tank over time (Cetane dropping).
- III. Fuel bug.
- IV. Stand pipe fitted lower than the engine pick up in tank.

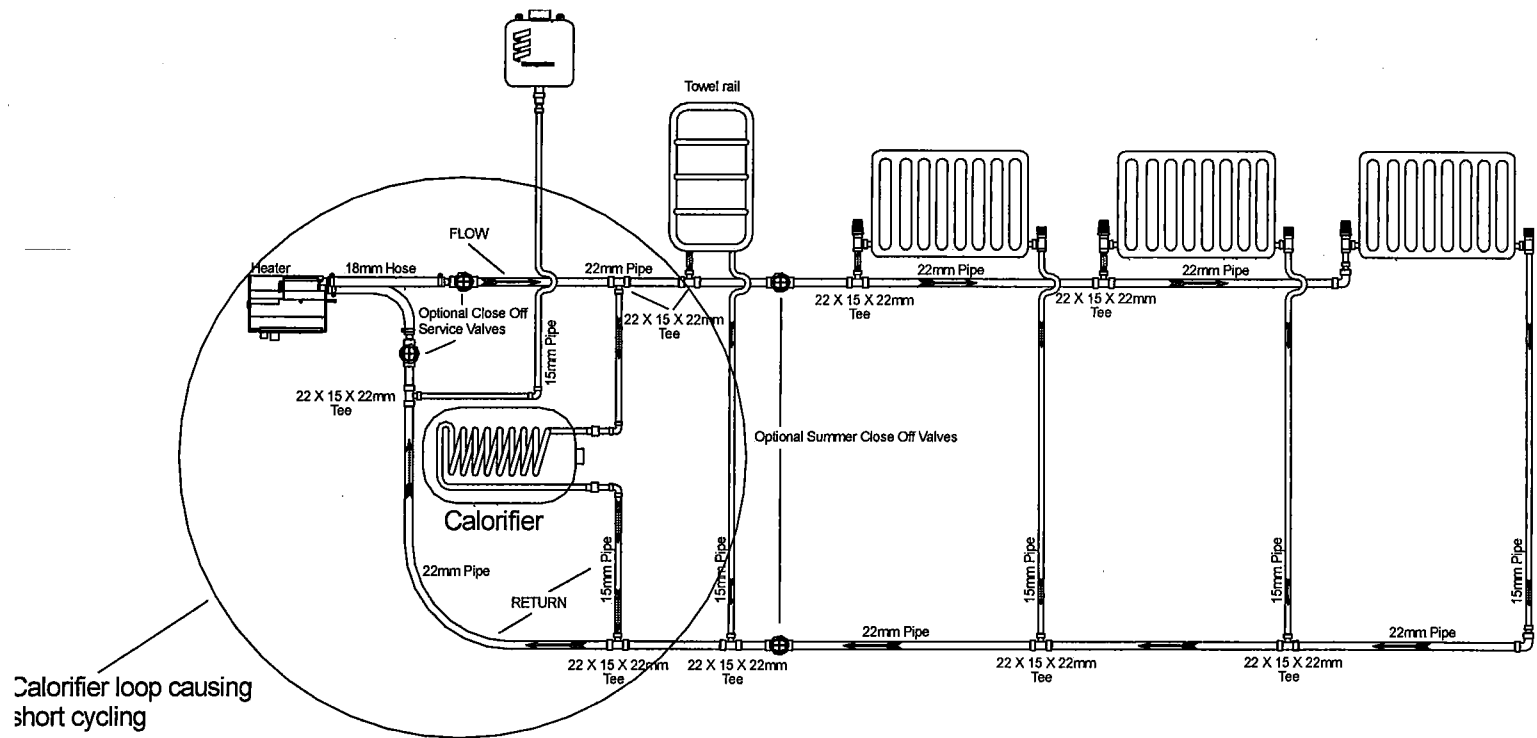
### **4. Main problems with voltage**

- I. Short cycling running the battery down.
- II. Power cable's out of specification (too thin).

## Main problems with installations, operator error, fuel and voltage in more detail

### Water Plumbing

Short cycling around the calorifier loop (see fig1).



**Fig 1**

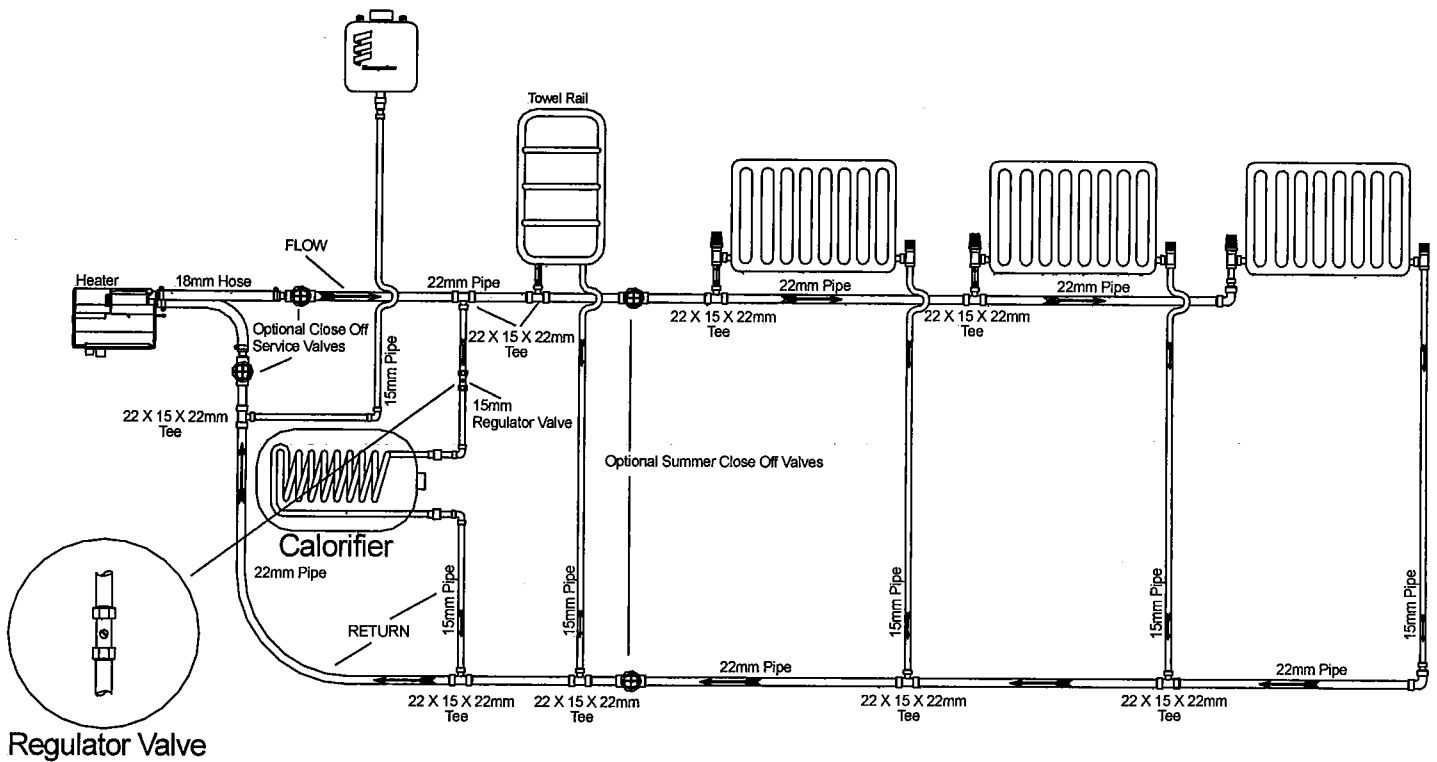
On most inland waterway boats, the first part in the plumbing system is the calorifier. This can make a short circuit between the main flow and return pipes. It is extremely important that this part of the system is balanced properly, if too much water is allowed to flow through this circuit the heater will detect that the system is up to temperature and start to shut down. As the heater shuts down it will detect the cooler water returning from the radiator circuit and start up again.

When this happens on a regular basis the heater will suffer for the following reasons.

- 1, Stopping and starting the heater does not allow the burner chamber to heat up sufficiently to burn out any carbon produced during start up.
- 2, Stopping and starting the heater brings the glow pin in on both occasions using 10Amps each time, this can achieve a low voltage problem within a relatively short period of time.
- 3, If the system is up to temperature and the heater is firing up and shutting down when hot, the cooling effect of the combustion air can be effected. This causes the latent heat build up to travel back from the burner chamber and dry out the front combustion air blower bearing. It may also lead to over heating of the ICU.

### Rectification

A simple, cheap, tamper proof regulating valve fitted into the calorifier loop (see fig 2).



**Fig 2**

Once the valve is fitted the system should be balanced as follows. Ideally this should be done when the system is cold.

Shut the regulating valve in the calorifier feed pipe, start the heater.

When the radiator loop becomes hot slowly open the regulating valve for the calorifier keeping one hand on the return pipe, the pipe should remain warm.

If the return pipe is hot, too much water is flowing through the calorifier and the heater will short cycle.

If the return pipe is cold, not enough water is flowing through the calorifier and the domestic water will take to long to heat up.

If the heater is to be used for hot water only and all the radiators have been shut down a secondary water circuit must be fitted. Note the towel rail circuit in Fig 2 has no valves.

**Note:** If a system is already fitted with a valve in the calorifier circuit DON'T take it for granted that the system is balanced, please check it.

**Attention:** If the system has summer valves fitted with no bypass loop, remove the valves and make sure enough water can still circulate around the system without causing the heater to overheat. The radiators can be shut down instead of using the summer valves.

**Check the main flow and return pipes are 22mm**

### **Fuel Supply Plumbing**

It is extremely common on inland waterway boats to find that the engine fuel line has been tapped into to feed the Eberspacher heater. This is generally the case when the top of the tank is not accessible.

A Narrowboat stand pipe kit (Part No 17785) should be fitted.

A large diameter fuel stand pipe (i.e. 12 – 15mm) or fuel system can cause two problems.

1. It will alter the finely calibrated fuelling being delivered to the heater due to the fuel metering pump having to fight against the weight of fuel in the pipes. This in turn will cause a poor burn and premature carbon build up.
2. In some cases the weight of fuel hanging in the stand pipe can overcome the one way ball valve in the fuel metering pump and over a period of time the fuel will start to siphon back to the tank. This will cause the heater to take one or two attempts to start.

It is also a common problem that a large engine type fuel filter/water trap has been fitted into the heaters fuel line.

The consequence of fitting a filter/water trap is damage to the fuel pumps plunger due to excessively long fuel priming times (it can take over 50 start attempts to prime the average engine fuel filter) during this time the pump is running without sufficient lubrication. This can affect pump calibration.

With both these cases the heater may start and appear to run fine, but usually within 6 to 12 months premature failure will result due to carbon build up caused by incorrect fuelling.

If the fuel metering pumps plunger has been severely damaged by running 'dry' the fuel metering pump may fail totally.

The correct specification fuel system and stand pipe **MUST** be fitted.

### **The Engine Room**

Inland boats (Narrow boats and Widebeams) tend to have very poor ventilation into the engine bay, this can lead to relatively high engine room temperatures in excess of 60° C. The maximum combustion air intake temperature for the heater is 25° C.

It is extremely **IMPORTANT** that this temperature is not exceeded.

The effects of hot combustion air are extremely detrimental to the heater in 2 ways.

1. The air/fuel ratio will change, the burn becomes dirty and will produce excessive carbon.
2. The combustion air helps cool the internal components that are situated directly behind the combustion chamber. This is the blower motor and the ICU.

If these components become excessively hot they will fail prematurely.

### **Rectification**

Draw the combustion air from outside the engine room or at worst directly from the engine room vent. (Combustion air should not be taken from any living area)

### **Wrong heater specified**

This is a fairly common problem, builders and customers will specify a big heater because they think it will work less and heat up quicker. In fact the opposite is true the heater will 'short cycle' or spend most of its time on tick over. The boat will only heat up as quick as the heat being given off by the radiators.

If the heater sits on tick over for prolonged periods of time it will not burn out the carbon produced during this cycle.

**Example:** A 70ft Narrowboat will have a heat loss of approximately 3Kw when the ambient air temperature is 0° C. The average total combined radiator output of this type of boat is 2.5Kw to 3.5Kw

You will see from the figures above that if the maximum heat that can be extracted is 3.5Kw plus for example 1.5Kw for a cold calorifier, fitting a 10kw heater will have no benefit to the boat and a detrimental effect on the heater.

### **Operator error**

This is very common as people expect to use a diesel fired heater in exactly the same way as they use their gas boiler at home. This is not the case, however with a little education it can be run efficiently in a similar way.

Using the heater for hot water only will again cause the heater to 'short cycle' if the heater is left on once the water is up to temperature. Each time a small amount of water is removed from the tank the heater will try and replace that lost heat. With 10, 5 or even 4Kw's again the heater will start up and shut down almost immediately 'short cycle'.

If the owner switches the heater on until the tank is hot, then switches the heater off until the hot water has been used, next time the heater is run it will run for longer thus burning more carbon from the burner chamber.

If a flow and return plumbing system has been used, there must be at least one pipe circuit that cannot be closed. Ideally this will be a towel rail or small radiator in the bathroom. This will act as a bypass if all the radiators are shut down or closed off for summertime use. See Fig 2.

Using the heater as a frost watch heater is not advisable. If it must be done, keep the radiators turned up so the heater runs in its high heat mode, rather than starting up and running in low heat, i.e. ticking over.

Switch operation. This is a common problem on hire fleets, people will switch the heater on, because they can not hear anything they switch the heater back off before it has started, then switch back on as the heater is trying to go into cool down cycle, so of course it will not start again.

We have produced a label that can be fitted by the switch if you suspect this scenario is happening. Label Part number 17946

## **Fuel**

“Red diesel” on the inland waterways, has now been generally replaced by ‘gas oil’ a fuel normally used for industrial and domestic heating boilers. This fuel does not reach the basic fuel standard EN590. It also has a poor cetane rating and a high sulphur content.

Although this fuel is generally poor quality and not specified for Eberspacher heaters, the heaters will run on it when it is relatively fresh (see below). They will not run on poor fuel and another problem.

Example: If a heater is suffering from one of the problems we have just covered, the carbon build up can be extremely quick, what may take 4 or 5 years with white ‘road’ diesel can happen in 6 – 12 months with gas oil. This is why the installation is critical on an inland boat.

Gas oil will start to degrade after approximately 6 months this is where the heavy molecules start to separate in the fuel and begin to sink to the bottom of the tank to form ‘sludge’, water will also start to separate from the fuel and collect with the water generated by condensation. The cetane value of the fuel will begin dropping. This is starting to happen before it leaves the refinery, then it sits in the depots tank until it is transferred to the boats tank. That is normally the last time that the fuel will get mixed or shaken because unlike sea boats or road vehicles the inland waterways tend to be calm the fuel is allowed to sit and separate.

Eventually there will come a point when the cetane value of the fuel falls so low the fuel will no longer ignite in the heater. DO NOT take fuel for granted or over look it when fault finding the heater. If a fuel additive has been added make sure it is mixed in and not just tipped into a tank and allowed to sit there.

**Diesel bug** will cause problems with a heater. It will normally be found as a black sludge in the pump filter. This will alter the fuelling at the heater by restricting the fuel filter, ultimately to the point where the heater will no longer run. If additives have been added check the fuel has been agitated regularly. Some fuel additives will separate out if the fuel is not stirred or shaken up regularly.

**Tip:** If the heaters stand pipe is kept at least 25mm shorter than the engines pick up it will stand a better chance of pulling slightly cleaner fuel. Also if the heater has used the last of the fuel it can reach, there should still be enough left in the tank to run the engine.

If it is winter time check that fuel has been winterised to stop waxing at low temperatures. Gas oil will not be automatically winterised at the pumps and will start waxing from 0°C

## **Rectification**

Good house keeping is one of the main points, keep fuel tanks clean and keep fuel in good condition.

Use all the diesel in the tank and replace with fresh as often as possible.

## **Voltage**

Voltage problems are common on inland boats for several reasons.

1. Each time the heater starts the glow pin or glow plug depending on the heater comes into circuit. Between 10Amps and 22Amps are taken from the battery, this also happens when the heater shuts down as the glow pin/plug comes back into circuit for self cleaning.

If this is happening on a regular basis, i.e. Short cycling of the heater, the battery can be drained in a relatively short period of time.

2. Power cables are too thin. These should be kept within the manuals specification.
3. Flat batteries, owners can easily underestimate the amount of time it takes to re charge a large bank of batteries.
4. Loose connections or fuses.
5. Corrosion or verdigris build up on connections or fuses.

## **Rectification**

Again good house keeping, looking after the batteries, checking terminals etc.

**Tip:** Voltage should be checked at the batteries AND at the heater as the heater is starting up and the glow pin/plug is in circuit. With the system under load any faults will be easier to spot.